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PROCEEDINGS

...OF THE...

First Annual Convention

...OF THE...

INTERNATIONAL DEEP WATERWAYS ASSOCIATION.

CLEVELAND, SEPTEMBER 24, 25, 26,

1895.

With an Appendix; Including a Report of the Proceedings of the Toronto Convention, 1894.

Prepared by

FRANK ABIAL FLOWER,

Executive Secretary.

Printed and Bound by
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Subjects of Papers and Proceedings.

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INTRODUCTORY.

The Deep-Water Movement.

BY FRANK A. FLOWER,

Secretary and Editor.

The topic assigned to the executive secretary of the I. D. W. A. for the Cleveland Convention—"An Historical and Critical Statement of the Deep-Water Movement"—was intended to give a view of what has been accomplished He had been unable to make an opportunity for its preparation; besides, the program was so full of better things that it was thought inadvisable to take up any time of the gathering with mere history. Hence the appearance of the executive secretary in the space usually assigned to an introduction or preface.

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The Deep-Water Movement.*

The central idea of our association is not new any more than the idea of civil liberty is new, although successful republics and popular self-governments are comparatively recent institutions. Even in early times no man of comprehension looked upon a map of North America without realizing that the advancement of civiliz**on and the growth of commerce would make an adequate outlet ..m the great lakes to the ocean inevitable.

EARLY DEEP-WATER DISCUSSIONS—Cadwallader Colden, a surveyor of the colony of New York, agitated the military and commercial necessity of a canal from Lake Erie or Lake Ontario to the port of New York almost 175 years ago. But he was ridiculed and silenced as effectually as if his utterances had been treason.

Pehr Kalm, the Swedish traveler, in 1750 pointed out the inevitable construction of a navigable watercourse from the Atlantic to the great lakes.

Robert Fulton, inventor of the steamboat, made a similar prophecy 110 years ago, but he at first thought the more feasible route was by way of Philadelphia, and urged his views upon the governor of Pennsylvania strenuously, but without avail.

These ideas were regalvanized, not originated, a little later in the Erie canal discussion. In 1811, Mr. Fulton, with a modified notion as to route, became a member of the first Erie canal board as a partial reward for the ridicule that before had been heaped upon him. A descendant of Cadwallader Colden was chosen to prepare the large and costly volume containing the official history of the inception, construction and opening of that pioneer channel, which unquestionably is responsible for more than one-half of the size, wealth and importance of the port of New York. It was a tremendous engineering achievement in its day, but was not accomplished without prolonged opposition.

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*NOTE—The topic assigned to the executive secretary of the I. D. W. A. for the Cleveland convention—"An Historical and Critical Statement of the Deep Water Movement"—was intended to give a view of what has been accomplished. He had been unable to make an opportunity for its preparation; besides, the program was so full of better things that it was thought inadvisable to take up any time of the gathering with mere history. Hence the appearance of the executive secretary in the space usually assigned to an introduction or preface.

CANADIAN IMPROVEMENTS—In Canada the first comprehensive idea of an outlet to the ocean came from William Hamilton Merritt. In 1818 his flouring mill at St. Catherines was without a sufficient supply of water. The floods of Lake Erie towered several hundred feet above him. He conceived the notion of drawing power for his mill from that source. Out of that conception grew the plan for a ship-canal. English and American engineers told him the project was possible, but to carry it out would bankrupt a nation. He was caricutured as a fool or lunatic, and when he issued his prospectus the public was cautioned to wait for greater things, as "Merritt's next project would be a canal to the planet Mars."

But he was undaunted, and, forming a private company, raised a considerable portion of his first fund in New York City and turned the first sod on November 30, 1824. After eleven years of ceaseless labor, he completed at once a waterpower and a canal, the first actual opening of navigation between the great lakes toward the Atlantic ocean, locking down 326 feet.

INEVITABILITY OF OPPOSITION—There has been equal opposition to all other considerable transportation projects. When the subject of a land-grant by the United States to the state of Michigan to aid in constructing locks around the Falls of St. Mary was being discussed in congress, Henry Clay summoned the forces of his unlimited dramatic ability to ridicule the project. He said it was like "squandering the public money on chimeras beyond the domain of civilization or the moon." Nevertheless the grant was made, the canal constructed and subsequently several times enlarged until now it presents the most massive locks and accommodates the greatest gateway commerce of the world.

De Lesseps was tantalized and harried for years after he began to advocate the feasibility of the Suez canal,* yet he cut a continent in twain, made India an exporter of breadstuffs to compete with America and created forever a new route for the commerce of more than half the globe.

SOURCES OF OPPOSITION—Hostility to the present enterprise has been less violent, but more wide-spread, than that toward

*NOTE—History discloses that, 3200 years before there had been projected an artificial waterway connecting the Mediterranean and Red Seas, the construction of which was abandoned by Sesostris after sacrificing 120,000 lives; continued by the great Persian monarch Darius and completed by Ptolemy II, founder of the Alexandrian library—a channel 40 feet in depth, with gates and sluices, which was in use during many centuries.

almost any other of national or international importance. But I think it has been more rapidly overcome and changed to positive friendship and active support than in any other instance. Sources:

First. Vague ideas as to what our association expected to accomplish;

Second. Supposition that the project could not be completed within a lifetime, perhaps a century;

Third. Belief founded on inimical allegations that the cost would be enormous—almost beyond computation;

Fourth. Active or covert hostility of many powerful railway interests under the curious notion that developing the country meant destruction to railroad property;

Fifth. Sectional jealousy.

Sixth. Indefinable and yet discernible undercurrents of opposition in both countries to any friendly arrangement of a co-operative nature between Canada and the United States, no matter how beneficial might be the probable results.

Circulating about each of these main though by no means universal sources of opposition were satelites of lesser unfriendliness, the most serious of which was the primary attitude of the vessel interests. The situation in this respect at the beginning of the agitation was complicated as well as comical. Small and old craft looked with jealousy upon any improvement tending towards deeper draught and greater hulls. They felt that every enlargement of capacity relegated their lesser draughts further into inactivity and nearer to final disuse. The owner of sailing craft saw no reason for canals to the ocean, because he himself could not use them without resorting to towing, which is costly. The greater steamship man, without giving the matter full consideration, concluded he did not wish to reach the ocean because his vessels were not provided with surface condensers—which are necessities in making steam from salt water—and his crews would be seasick.

Sea-masters gravely asserted that an outlet from the lakes was absolutely useless because sea-craft would never care to enter those waters and the owners of shallow lake-craft declared that such an outlet was positively dangerous to the country because at the moment of its opening sea-going vessels would rush in and drive the lake carriers out of business and into bankruptcy.

But after the Cleveland convention vessel interests which had been hostile became tolerant and those which had been indifferent became friendly, having seen that the aims and plans of the I. D. W. A. were in the direction of promoting the general welfare.

Other unfriendly influences in the United States did not consider any item of freight except that destined to foreign ports as belonging in the problem of a channel to tidewater. They refused to assign a place or value, in the freight movement, to the enormous amount of western products required and consumed by Atlantic ports from Halifax to Savannah and in comparison to which the export trade is small indeed. They professed to believe that breaking bulk at Buffalo, Tonawanda, Oswego and Ogdensburgh was good enough for the west so long as it did not so completely devour the western product before reaching New York that there was nothing left to pay tolls, charges and commissions.

They did not care to admit that if there were a channel 100 miles in width from the Atlantic to the great lakes it could not possibly open to foreign competition the coasting trade of either country, which covers, perhaps, 95% of all our inland commerce.

DEEP-WATER CAMPAIGN IDIOSYNCRACIES—To successfully deal with the several elements of opposition to the present undertaking, without the power of the state, was difficult and delicate. They must all be broken down without doing violence or giving offense. To again and again project the great enterprise before the people as a naked proposition had little effect. The scheme was too large—the public mind had not grown to it.

The first progress, therefore, it seemed, was coming more from the attacks made upon the project than from the aggressions of its projectors. It thus was necessary to so draw the fire of the enemy that it would prove self-destructive; to invite attack in ways planned to bring us out of the contest enlarged and strengthened rather than defeated. This idea came from the Mohawk valley, where a diplomatic Dutchman constructed his stone wall four feet wide and three feet high, because he said, "If der wint blows him over, she was higher as before."

The foundation of our campaign, for the reasons stated, had to be laid on broad grounds and with high claims to patriotism.

It was found that the tinge of barbarism—the idea of preying upon neighbors—had not wholly disappeared from our civilization. McRae said that "a rale Scoachmon was a mon who küpt the Sobbath day and uvvery thing else he coold lay his honds on." Our campaign developed that certain communities and localities verged upon this description, being quite as eager to injure or cripple competitors as to help themselves. Because the cry for cheaper transport came chiefly from the west, they jumped to the false conclusion that resulting benefits would accrue only to the west.

CHANGING AND ENLARGING FORMS OF COMPETITION—Therefore, little progress could be made unless all writings and arguments ignored localities and were so conceived as to embrace views of the entire world of commerce; for only the blind, it was believed, could not see, or be made to see, that a burdensome era of lower prices was upon all sections alike. Competition was limited only by the confines of the world. Every country, every people, and every seaport was now a direct or indirect competitor. The conditions and methods of that competition were changing and the change was not in our favor. For a generation America led the world in invention, high wages, labor-saving machinery and quick fortunes.

Almost every element of competition had been favorable. In the older countries a single ox, or a horse and a cow yoked together, feebly tilled the soil, while in America the husbandman rode upon a wheeled plow driven by steam or drawn by a phalanx of horses and turning several broad furrows at once; there, women and children wrought from sun to sun to gather the wheat, here whole counties of golden grain were swept together like magic by the self-binder and the six-horse header; there the crop was laboriously pounded out by flail, here the steam thresher and elevator rushed it through in a few hours; there the grain was cleaned by the slow process of the winnowing-board, here by powerful machinery at the rate of thousands of bushels per hour; there the crop was borne to rafts and boats in aprons, or baskets and sacks on the backs of men or horses and cattle, here it was whisked across the country in long trains of grain cars running 25 miles per hour, gathering the product of a year and an empire into immense elevators as though it were the pastime of a holiday. But it is unnecessary to further particularize. It was the aggressive stride of American progress and success outstripping like the wind the slow and primitive methods of other days.

RIVALS ADOPT AMERICAN TOOLS AND METHODS—But now everything is changing. The high-class, labor-saving machinery which was not only invented and used, but manufactured in America, is being sold and used liberally in the countries which are now pressing us with their competition. As before they did not meet us, so now we cannot meet them upon an equal footing. Their labor is patient and accustomed to long hours and moderate compensation; capital is represented by the accumulations of generations; interest is low, and the avenues to political and social position are not open to the ordinary people, so that the entire family, from the toddling infant to tottering age, grasping the instruments which hitherto made us omnipotent, join patiently together in the work of production and competition.

AMERICAN AND FOREIGN CONDITIONS CONTRASTED—Nearly every country that competes with the principal products of America lies close upon a seaboard open all the year or is pierced by ocean-connecting channels. The floods of the Volga, the La Platte, the Ganges, the Nile, the Danube and the Obi carry grains direct from the fields to tide-water.

Nor does this end the contrast. The total wheat product of all countries is now about 2,500,000,000 bushels. The available land in Argentina alone, put to wheat and raising 10 bushels per acre, could in one season fill elevators of 3,000,000,000 bushels capacity—500,000,000 more than the entire world is now producing. The new wheat districts of Siberia more than equal in extent all the grain fields of the American continent, and in depth and productiveness of soil are matched nowhere on this footstool. The Russian state railways tap them in one direction, and the enormous rivers of that country, deep enough to accommodate ocean ships, drain them to the sea in the other direction.

What was to be done to meet these new conditions? It could not be admitted that the plane of wages, domestic economy, public instruction, style of living and general tone of civilization should be brought down to that of our foreign competitors. There remained, then, but a single solution, namely, cheaper transportation.

TRIBUTE TO WATERWAYS—What should that cheaper transport be? Water. But that was not an attractive or popular proposition. Canals were considered too slow; rivers ran dry; the lakes were inflexible—incapable of extensions, side-tracks, spurs or branches—in short, could not like railroads be bonused into each new town or bonded into every fresh platting of government land.

Water, like air, is so common that its possibilities were unappreciated. They had to be explained and popularized. "An editor can direct and animate a healthy public sentiment but not create a soul beneath the ribs of death." It was necessary to show over and over that water was the original method of transportation; the free gift of nature—unaffected by leases, pools or strikes; unlimited in value, capacity, cheapness and duration; without capital stock to be watered, right of way to be condemned, culverts to wash out, bridges to break, trestles to burn, lobby at Washington or Ottawa; that its endless tracks could never wear out and never fall into the hands of the receiver or E. V. Debbs and that it was the author of all the substantial additions to the map and the father of all the greater epochs in history.

Had there been as little water as there is land and as much land as there is water, the nations of the earth would have been to day comparatively barbaric. Yet how derelict governments have been, especially that of the United States, in developing the capabilities of this most cheap, ample and enduring of all mediums of transportation.

ACHIEVEMENTS OF WATERWAYS—It was also necessary to dwell at length upon the achievements of artificial waterways, pointing out that in China, India and Egypt canals are more ancient than written history; that China, having the greatest population, the smallest debt, and the oldest written records of the world has more canals twice over than all other countries combined; that she has had public waterways for 4,000 years, with whole districts in which there is not a wheel for transportation but canals instead reaching to every village, farm, and productive area, carrying freight for less than the cost of transferring in this country, used without tolls, as common as wagon-roads in New England, and cleanly, pleasant and cheap; that canals saved Russia from starvation; have been in use and perfection for centuries in France, and were the authors of the early marine prowess of the Netherlands; that in England, which has nearly 8,000 miles of canals—in proportion to area a greater mileage than any other country—artificial waterways were an inheritance from the Romans, and had been in uninterrupted use in some instances more than a thousand years; that they had been so successful that in 1840 the railways secured 3,000 miles of the system; that the railways in Pennsylvania acquired about 800 miles of canals, and that several powerful and prosperous railway corporations like the Great Northern, the Canadian Pacific, the Erie and the New York Central owned steamships and transferred their freight business to water wherever opportunity offered because of its cheapness.

We were compelled to demonstrate by the great number of insolvent and non-paying railways that on bulk products, destined for remote markets, no further relief was possible from all-rail transportation, and that for the present the development of railways, owing to the non-dividend paying character of their securities, had reached its limit.

All of these considerations the officers of our association presented in and out of season through newspapers, magazines, public lectures, arguments before legislatures, at political meetings, in college courses and elsewhere until the deep-water tune was familiar to all ears from Manitoba to Mexico, Quebec to Montana, and New York to Texas.

THE SLEEPING SEABOARD—During this campaign many peculiar facts and conditions were developed. It seemed remarkable that, instead of many of them offering opposition, all eastern manufacturing and commercial districts had not with irresistible force united, generations ago, to pierce the great west with an ample water route and thus secure cheaper access to the bread-basket of the continent for their own benefit regardless of any resulting advantage that might accrue to the bread-basket itself.

It seemed incomprehensible, while searchers for wealth had penetrated the interior of the dark continent for diamonds; waded the Yukon snows and Alaska ice-fields for gold; endured mountain hardships and dangers for silver, and risked their lives in poisonous jungles for precious woods, that the seaboard traders, scrimping along on hardpan that in places comes up to the third rail on the fence, idle unless they can handle the goods and products of others, were doing so little to unite themselves adequately with the sources of the necessities of life and manufacture.

Having a sterile soil, no consumers to the eastward, little food or fuel for her homes and factories except from the west, the Atlantic seaboard can not escape a long and unequal struggle except through large reductions in transportation. Therefore the logic of business principles and the instincts of self-preservation should have driven its people years ago to break down the barrier between themselves and the great lakes in order to gain the easiest and cheapest access to the base of supplies, instead of being as we found them, sleeping and frequently hostile.

PITTSBURGH AND NEW YORK—Pittsburgh is in a partial sense in the same situation as the seaboard, but she is active and alert. She will save herself by water-routes of her own making to the great lakes, and in saving herself will strengthen neighbors and competitors. She will cheapen coke to the great lakes furnaces and of fuel to New York and the Atlantic coast.

For a generation the iron heart of the continent has been at Pittsburgh. None but giants could maintain its ponderous pulsations. They know that their mills were busiest and most profitable when the country at large was prospering. They can be relied upon, therefore, to grasp and promote any transportation project, no matter how great, at home or in the east, west or south, that will advance the general welfare.

Pittsburgh is planning to secure a water connection with the great lakes. Certain localities shortsightedly hope she will not succeed. Such a hope is not the foundation of success.

Destruction by overcharges for transport weakens the owner of the thing destroyed the same as destruction by fire, flood, tornado, drought or plague. The drought and grasshopper plague which laid waste Dakota and Nebraska in part did not enrich rival corn and wheat fields, but ruined railways, paralyzed wholesaling and pinched manufacturing in sections outside of the plague-stricken states and laid a burden of charity upon the remainder of the country.

New York, Detroit, Superior, Duluth, Cleveland, Chicago and other cities must have the splendid coke that Pittsburgh sends out, and therefore for their own benefit want that district to have the cheapest possible transportation. If that helps Pittsburgh, so much the better, for it enlarges the consuming power, strengthens the energy and so benefits the the people of the whole country.

In his paper in this volume, John E. Shaw of Pittsburgh, forcibly illustrates the great benefits to the seaboard of deep waterways; Mr. Pattison, the Vermilion iron king, says they would divide the cost of Bessemer ores at tidewater; Mr. Hurd, the great flour manufacturer and exporter, says they would divide the cost of landing bread at New York; Mr. Dutton and Mr.

Thorpe show that they would divide the cost of transporting meats to eastern consumers. A reduction in the cost of transporting other bulk articles would of course follow.

Is not this the substance of the chief problem of municipal commercial and manufacturing life—of existence itself?

Distinguished New Yorkers wrote that their state would oppose sending delegates to the Cleveland convention and opposed the International Deep Waterways association itself, because their people did not wish to commit the government to canal building, not even to enlarging the Erie canal, fearing that it would be a precedent which might give other sections government aid for improving waterways. They thought New York was able to build her own canals and other states were not, and, therefore, that the policy indicated would continue to give life and strength to the hand of monopoly and oppression.

Suppose England should suddenly choke Gibralter, leaving the Mediterranean blocked and embargoed? All mankind would denounce it as an outrage; yet it would be a puny calamity compared to leaving our great lakes—bordered by new empires that are bounding forward in population, wealth, production, civilization and christianity—closed by a few miles of shallows.

Suppose the Atlantic ocean should suddenly recede and leave New York perched high and dry upon the former seashore. It would be a less grievous calamity to the country than continuing the lock upon the great lakes in front of the storehouses of the west, but it would not be nice for New York any more than the policy of those New Yorkers who wish to continue to choke products through a shallow canal is nice for the west.

But the eastern views developed by our convention must not be regarded as the final and substantial stand or the unanimous sentiment of the Atlantic seaboard. The cause has had friends in that section, and in the state of New York especially able and liberal supporters.

New York is a great and powerful port and must and will have an equally great commercial highway leading to the west. Before the deep-water campaign shall have progressed much farther the seaboard, seeing its error, will be our most united and powerful ally.

Canadian Understanding and Achievement—In Canada there is a far better general understanding of the problems of transportation, competition and foreign trade and commerce—learned and inherited from the mother country.

In the way of providing an unbroken water outlet to the sea, 2,400 miles from Port Arthur to Belle Isle and the only real transcontinental railway line in America, the whole costing above $275,000,000, the efforts and achievements of this handful of 4,800,000 people have been wonderful.*

*Note—See pp. 303-4.

If the United States had been equally effective in proportion to strength and opportunity there would have been no need of a Cleveland convention and the industrial map of North America would have been far more emphatic than it now is.

WORK OF THE I. D. W. A.—Deep water conventions are common in the history of American transportation. Through them improving the Mississippi, cutting the Hay Lake channel, deepening and broadening the St. Clair Flats passage, enlarging the Soo locks and inaugurating a general 20-foot channel policy on the part of the United States government, were brought about. Gatherings of this sort have been held at Burlington, Vt., (as far back as 1849), Saratoga Springs, St. Paul, Washington, Detroit, Sault Ste. Marie, West Superior, Des Moines, St. Louis, Chicago, New Orleans, Toronto, Vicksburg and elsewhere. All, however, were local and special—devoted exclusively to neighborhood improvements. The one at Toronto was the germ of the present, powerful international movement. While called for the purpose of hastening government action in completing the agreed enlargements of the St. Lawrence canals, many delegates were invited and present from the United States. They could not join in a movement looking toward an enlarged outlet to the ocean through the St. Lawrence without some effort in the direction of an equal channel to the Atlantic through an American port. These diverging views resulted in the abandonment of the idea of indorsing a specific route and recommending the formation of a permanent international association. An executive board was created to perfect the organization, formulate a constitution and proceed with the work of drawing mutual interests in both nations into the association.

It was decided at the same time to invite the two countries to join in a commission to make a preliminary investigation of the entire deep-water project between the lakes and the ocean from an international standpoint. This work was also given to the executive board. The original plan was embraced in a resolution* appointing a committee chosen from the two countries to proceed to Washington and Ottawa and ask the appointment of a commission who should serve without pay and not be in reality officials of either government, but capable, nevertheless, of gathering and digesting information and reporting it to the proper authorities as a basis for future action. This committee was composed of United States Senator Wm. F. Vilas, Frank A. Flower and James J. Hill for the United States, and O. A. Howland, James Fisher and George R. R. Cockburn for the Dominion of Canada.

SENATOR VILAS' DECISIVE SUGGESTION—Believing the initial step must be taken by the United States I went to consult

*NOTE—By Frank A. Flower.

Senator Vilas of Wisconsin. After examining carefully the entire plan as it had been formulated he suggested that the project was too great and too important to the people of each country for a further sacrifice of individual means and effort and stated a belief in his ability to have enacted a law creating a commission on behalf of the United States with provision at least for expenses if not personal compensation, and that he would take pleasure in putting forth his best effort in that direction at the next session of congress, then close at hand.

I believed that that meant success, for he is a man who never promises what he does not expect to perform, and never enters upon a project that he does not intend, if within his power, to carry through.

Of course it was now unnecessary to proceed further in the direction originally conceived. At the next meeting of the executive board—in November, 1894, at Chicago—a very elaborate bill was formulated, providing for the commission and defining its duties. Later, in Washington, it became the judgement of Sen. Vilas that the draft covered too much ground and involved too great an expenditure. He suggested a briefer and simpler measure, general in scope and moderate in resulting expenditures. I immediately acquiesced, the result being, in 65 days, the enactment of the law* quoted in the appendix of this volume, page 330, and published in the United States sundry civil statute of 1895.

SUCCESS IN CANADA—In Canada the success of our deep-water movement was equally marked. The United States having enacted a law which was considered a friendly invitation to the Dominion for co-operation, public sentiment unanimously endorsed the cabinet in making reciprocal appointments to complete the fabric of an international commission. This action was secured through President Howland and his associates who presented a petition by a delegation headed by Lieut. Col. F. C. Denison. The reply was an announcement in the senate by the premier, Sir McKenzie Bowell, and in the house of commons by the minister of railways and canals, Hon. John Haggart, that appointments made by the United States under the Vilas law would be met by similar appointments on the part of the Dominion of Canada.

STATE AND PROVINCIAL LEGISLATION—In the several states and provinces deep-water advocates have not been idle. A law providing for a deep-water commissioner was passed by the Wisconsin legislature with only twenty-four dissenting votes out of 133 in both houses, notwithstanding the opposition of Gov. Upham. Under this law an appointment was made several months later though not in the interest of the deep-water project.

In Iowa President A. P. McGuirk succeded in having the Democratic state convention incorporate a deep-water plank in its

*NOTE—Appointments under this law made Nov. 4, 1895. See p. 450.

platform which for weeks and months stood at the head of nearly one-half of the leading papers of that state.

In Illinois the most far-reaching and statesmanlike of all the bills brought to notice in the several states and provinces was drafted by Vice-President Cooley and through his efforts passed both branches of the legislature with only 5 dissenting votes. Notwithstanding this unanimity of the legislative vote, Gov. Altgeld waited until after the adjournment of the enacting body, so that the bill could not be passed over his head or re-enacted, then filed a veto.

In Ontario, through the efforts of International President Howland, who is a member of parliament, a sum of money was voted which proved sufficient for all the preliminary printing required in the Dominion with a balance large enough to pay for the beautiful Cleveland convention badges.

THE CLEVELAND CONVENTION—The plan of arrranging for the Cleveland convention was rather autocratic. It was not intended so much to secure a great as a representative gathering and to provide such material as would make the official report of its proceedings a standard deep-water text book.

A programme covering practically the entire range of subjects relating to the project of opening the great lakes to the sea was formulated and indorsed by the executive board at its Chicago meeting, June 25, 1895. Persons of well-known reputation and ability in their particular fields were invited to treat the topics thus selected, all papers to be complete and in the executive secretary's hands two weeks previous to the meeting of the convention for final arrangement upon the program and to be printed in advance to facilitate discussion and expedite business.

The convention as planned was a success. Over 6,000 invitations were issued to prominent individuals in the two countries and municipalities and commercial, trade and business bodies in the states and provinces tributary to the great lakes basin were invited to send delegates. The result was between 4,000 and 5,000 letters of regret, nearly 1,000 acceptances and duly appointed delegates and 331 individuals present entitled to seats and participation in the convention, all devoting time, money and talent to the general welfare without reimbursement or hope of reward.

CHARACTER OF THE PRESENT VOLUME—It is not inappropriate to call attention to the character of the contents of this volume. Letters found on pages 31 to 42, like those by Senators Hoar, Hansbrough, Burrows, Proctor and Blanchard; ex-Senator George F. Edmunds; Receiver J. G. McCullough, of the Erie railway; Dr. W. Seward Webb of the Vanderbilt system of railways; D. H. Bacon, W. F. Dalrymple, Smith M. Weed, R. S. Taylor, Samuel Hill and others of a similar character, must certainly cause people to think and have a wholesome influence upon public sentiment.

The formal papers herein establish that an adequate outlet from the great lakes to the sea would give cheaper ores, flour, lumber, minerals and meat to the seaboard and the Ohio valley; cheaper coke to great lakes furnaces and Atlantic seaports; cheaper coal in the west and on the eastern seacoast; cheaper materials for railway and ship building and a far stronger position to America for competition with the world.

They also establish that waterways create business for themselves as well as railroads; that interchangeable fresh and salt water navigation is practicable; that on bulk articles railway transportation rates have been brought down to the verge of insolvency; that American wheat and flour can only compete with foreign products through swifter and cheaper methods of transportation; that it is practicable to control the general levels of all the lakes in the interest of navigation; that there is a growing spirit of harmony and friendliness between Canada and the United States and that increasing the prosperity of a community does not destroy the profits of railway and other interests in that community.

The authors of these papers and discussions are representative men and from actual knowledge covered the field—waterways, railways, marine architecture, ship building, iron and steel making, manufacturing, mining, political economy, engineering, lake level control, marine and railway construction, international law and co-operation and the broader ethics of diplomacy and statesmanship.

When the Duke of Wellington, after the battle of Waterloo, entered the house of lords in England, the noble earls arose and uncovered their heads. A proceeding so unusual caused remark and they replied, "He is the man who did the thing"—swept Napoleon from the field and saved the map of Europe. So we must treat most of the writers represented in this volume because—like O. A. Thorpe of Chicago, who is actually sailing steamships between that city and Europe—"they have done the thing."

There is true eloquence in this volume. But whence does it come? Not from cold obstructionists, toll-takers and little canalers, but from the heated movers and creators of commerce and civilization—from the Pattisons, who own the Bessemer iron mines; from the Thorpes, who have steamed in one ship the breadth of the ocean and the length of the lakes; from the Moxhams, whose great steel mills are the true measure of their genius; from the Hurds who, to the extent of thousands of barrels daily, gather wheat from the heart of the western hemisphere and land gilt-edged flour on the dinner tables of the eastern hemisphere. Truth is eloquence, and this volume is full of truth.

PERSONAL NOTES—In this connection one or two personal notes may be interesting: J. Enoch Thompson, of Toronto, may be considered the father of the practical form of the present deep-water movement, because he is the author of the Toronto convention which resulted in the formation of the International Deep Waterways association.

O. A. Howland, M. P. P., of Toronto, is the author of the scheme for an international court—and it is the most practical one yet laid before the public. As may be seen from his annual address herein, it a splendid apostrophe to the great supreme courts of the United States and Great Britain and to the influence of the English speaking peoples. He is to a marked degree broad-guaged, high-minded and patriotic, and a fair and thorough student of the public weal who diffuses everywhere a wholesome influence. Nothing could be more generous and beautiful than his tribute to the genius of the time and the progress of the American people embraced in a description of what is being accomplished for commerce and civilization by primary instruments of bloodshed and destruction—the war and navy departments of the United States.* It was certainly good fortune that made him the head of our international organization.

The idea of constructing our deeper channels along natural and indestructable lines and upon cheaper bases of treatment that indicate ampler probable results, belongs to Lyman E. Cooley of Chicago, the originator and promotor of the great Chicago sanitary and ship canal. He is one of the noted engineering projectors of the age, daunted by no problem, discouraged by no obstacle or reverse. His capacity for mental digestion suggests Milton's description—"beyond the deepest deep there is still another deep." When his plans for enlarging and improving our internal waterways shall become known the public will have a clear understanding of the enormous commercial and industrial possibilities of this continent—multiple channels, impounded waters, deeper navigation with less excavation, greater economy in water-course construction and maintenance, and abundant capacity for cheaper transportation.

It is probably unnecessary to say that the pneumatic steel lock was invented by Chauncey N. Dutton, and that the first practical steps to secure international co-operation for the improvement of the great lakes were taken through Sen. Vilas.

RESULTS OF THE CLEVELAND CONVENTION—Putting everything else aside, our first annual convention was worth many times its cost in rendering public opinion homogenous, wiping out misconception and more perfectly aligning the efforts of those interested in securing broader, deeper and cheaper channels of commerce. Pittsburgh demonstrated that her interests are insep-

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*NOTE—See pages 313-314.

arably connected with the development of the great lakes system, and Cleveland that she has nothing to fear from promoting the welfare of the Pittsburgh and Shenango valley; the Atlantic seaboard discovered that her prosperity can not be enduring without the continued advancement of the west; New York was shown that her tradesmen will thrive most when the country back of her is most thriving: the Canadians frankly declared that they found the people of the United States friends, not enemies; the delegates from the United States defined their policy as not one looking to the annexation of territory or the destruction of flags and national life, but the simple unification of interests and effort for mutual advantage; the lesser lake ports were taught that Chicago is a powerful instrument of development, not of destruction; Chicago declared that she required and asked for nothing not more than equalled by the compensatory projects which she wishes to help secure.

The interest awakened by the convention is spreading and growing. Its fruits are useful and valuable. Inventors of locks, dredges, excavators, lock-gates, barge-hulls, wharf appliances and freight handling machinery, and the promotors of new marine and transportation enterprises, are now alive and active everywhere, doubling the executive secretary's correspondence. A general revival of activity in these directions can not be otherwise than beneficial—may result in revolutionizing many branches of business and greatly promoting the general welfare.

Our influence has reached good soil in Washington. The United States engineers have received orders to report upon works to control the levels of the great lakes.

THE DAY OF GREATER THINGS—The day of greater things than even the discovery of America is upon us. Man himself must expand and project in accordance with the time. He can no longer be a pigmy. The forces and resources of nature are just commencing to respond to his magic touch. He must be as great as the great things he is doing. His instruments of civilization, must not be better than that civilization itself.

Looking backward, a century is but a speck upon the stream of time. Yet the closing century has produced nearly everything desirable in modern life. The coming century however, will bring more numerous and more marvellous changes. In 1995 these two nations, Canada and the United States, will teem with more than 400,000,000 of people. Production, transportation and distribution, even with reference to this vast population, will be carried on in relatively greater perfection than they are to-day.

We shall need three or four locks on either side of the Falls of St. Mary—and nature wisely left room for them. All of the numerous channels of the St. Mary's river—apparently provided by the Creator with a full knowledge of what would be required of them—will be widened and deepened to free ship-courses. The St. Clair flats and its connections will be 30 feet in depth and 2,000 feet in width. There will be not less than four locks around Niagara Falls and not less than four channels 30 feet in depth from Lake Ontario to tidewater.

The great lakes will be under control; all harbors will have been deepened by raising the general level of the lake surfaces and ships will ply as freely—lockages excepted—between seaboard and lakeboard cities as between Liverpool and New York.

Man will finish the incomplete continent and perfect it as a habitation for the human family and the seat of culminating civilization. For the full play of the genius of projection no other situation offers equal opportunities. The Creator stretched these great lakes, one rising above the other, 2,000 miles into the heart of the continent to diversify the products of the soil, hold in check the cold waves of the north, modify the hot blasts of the south and afford the cheapest known means of interchanging the productions of unlike soils and unlike natural resources.

By this peculiar disposal of our prodigious chain of waters, overshadowing all the lacustrine systems of the earth, engineering skill can easily and cheaply add a quarter to the length of Lake Ontario; several feet to the depth of all the harbors of Lake Erie; permanency to a higher level of Lakes Michigan and Huron; equalized volume to the enormous floods of Superior; broad and ample channels to the sea and prosperity to two nations.

These extravagent gifts of nature were intended to help work out the perfection of civilization in America. The Mediterranean can not be impounded or manipulated for the benefit of surrounding nations; the waters of the Suez canal can not be raised; the seas of Europe can not be drawn upon to transform the character of a continent, or create a new commerce, or lay the benediction of prosperity upon an empire of production. These transformations are all to take place in America.

Probable Results of a Deep Channel—The earliest move, therefore, should have been toward an ample connection between the seaboard and the great lakes. Had that been made a century ago, or fifty years ago, New York would be a far greater community than she now is; Chicago would have 5,000,000 and Superior and Duluth 2,000,000 of inhabitants; Cleveland, Milwaukee, Detroit and sister lake cities would be many times their present size; the Dominion of Canada would have 10,000,000 instead of less than 5,000,000 of inhabitants; Manitoba would be teeming with wealth and population, and the war of the rebellion would have been closed in eighteen months instead of four years —indeed, it might have been closed before it was begun.

Not a moment should be lost in correcting the errors and supplying the deficiencies of the past.

ASTONISHING RAILWAY AND WATERWAY FIGURES—The small man will begin by casting up, not the benefits, but the cost of these apparently vast but relatively puny improvements. The cost is nothing. Suppose the two countries were to begin immediately, as they should, to improve the great lakes and their connections to the greatest feasible extent commensurate with the probable growth of the future and the commerce they must ultimately accommodate, with double and quadruple locks and 30 feet of water, and that it would cost $500,000,000! That sum is more than $300,000,000 less in proportion to population and commerce than little Canada has already spent in her effort to construct a waterway from the great lakes to the ocean!

This aggregate may seem great, but it can seem great to only those who will not compare it with other transportation expenditures, private and public. For instance, the Dominion of Canada has given in cash for railway building $187,000,000 and the several provinces $16,000,000, making a total cash railway bonus of $203,000,000, besides grants of land amounting to 33,000,000 acres and a number of annuities which will certainly bring the aggregate up to $300,000,000, or more than $60 per capita. On her channel from Lake Superior to the the sea, not counting other waterway expenditures, she has disbursed more than $61,000,000, or over $12 per capita.*

Here we have four times as great an expenditure as would be required to give the great lakes an ample outlet to the ocean.

Certainly the Canadians are a proud, far-seeing and heroic handful of people, making the utmost while the United States has made the least of really magnificent opportunities.

In the United States, which has 95 per cent. of the commerce and business of the great lakes basin, the wretched sum of $10,000,000† only has been expended in making a ship channel toward the seaboard, and for all purposes for all time on all the great lakes and their harbors and connections, the sum of $40,000,000 only!

While thus so derelict at the point where there was an opportunity for the most splendid and useful improvement in the world, what has the United States done in other directions? Granted 200,000,000 acres of the public domain worth not less than $500,000,000; $163,000,000 in bonds and over $51,000,000 in interest to railways nearly every one of which is, or has been within two years, in the hands of the receiver.

Thus we have in the United States more than $700,000,000 of the people's money tied up in railroad lines and only $10,000,000 in the grandest water line upon the foot stool; in Canada nearly $250,000,000 tied up in railroad lines and about $62,000,-

*NOTE—See page 303.
†NOTE—See page 302.

000 in a water line to the ocean—almost a round billion of the people's money in both countries locked in private railways to a paltry bagatelle invested in the people's international waterway!

Should it require even $500,000,000 to make our water transportation equal to what the governments have made rail transportation, the sum would be small compared with resulting benefits, and small compared to the vastly expanded resources of the nations since the railway grants were made.

But we have another comparison to show that what is wanted for internal waterway development is nominal: In the United States the total railway mileage is about 180,000 miles. The total capital stock of all railroads in the United States is $4,700,000,000; bonds $5.500,000,000; other obligations $1,000,000,000; total $11,200,000,000. This is an average per mile of $62,222*.

As one-third of this railway mileage is in the great lakes basin, directly upon or tributary to their waters, the total amount of capital represented in railway property along the competing water-route from Lake Superior to the sea is $3,733,000,000. Is not the sum required to make the great lakes facilities equal to neighboring railway facilities a bagatelle?

In these hard times about 75 per cent. of railway capital stocks pay no dividend, and probably for 1895 20 per cent. of railway bonds defaulted their interest. But the railroads in the great lakes basin are not the ones whose bonds are in default, or whose capital stock pays no dividends. Therefore, taking a low average rate of interest and a low percentage for dividends, the railways directly tributary to the great lakes basin produce an annual income of about $125,000,000 besides immense salary lists and enormous charges for renewals and betterments which are unknown to the eternal highways of the water.

About one-fifth of this annual income would cut a 30-foot channel around Niagara Falls which would last for all time. Less than one-half of this annual income would make a ship-channel from Lake Ontario to the sea. Considerably less than four-fifths of this annual income would construct the largest ship-channel under consideration from the great lakes to the port of New York.

All of this is without considering the railway capitalization and income tributary to the great lakes in the Dominion of Canada. Yet gadflies in statesmanship and economy declare that our waterways can not be improved because the cost would be too great!

But it is possible to be still more specific: Taking such a portion of the mileage of eighteen larger railways in the country directly tributary to the great lakes as actually exists in that basin, we find the total capitalization is $1,200,000,000. With one or two exceptions, all are prosperous and paying interest on their securities and dividends on their capital stock. If the combined

*NOTE—The report of the United States interstate commerce commission gives the average railway capitalization at about $63,500 per mile.

interest and dividend payment is assumed to be 4 per cent., the income from the great lakes portions of these eighteen railway systems is $48,000,000 a year, or almost enough to give us 26 feet of water from the head of Lake Superior to the Atlantic ocean!

Private individuals having permanently invested nearly $4,-000,000,000 in railways in the great lakes basin, the yearly income from which is sufficient to dig a ship-outlet to the sea that would serve the people without cost for all time, the argument that the expense of providing a marine highway for more than 20,000,000 of people is too heavy for the resources of two nations, is simply disgusting.

CITIES OUTSTRIP NATIONS—Several cities have far outdone the utmost that is demanded of these two countries. A generation ago an Erie canalboat could not reach Glasgow at low water, the shoals in the Clyde affording scarcely 18 inches of navigation. The Scotch tradesmen saw that they could not compete with the world and transfer their goods twenty miles on the backs of mules to and from a little wharf called Port Glasgow. The city, therefore, by a new and heroic effort, acquired thousands of acres of wharfage and miles of water frontage, and, spending $60,000,-000 thereon, turned Glasgow from a struggling town of 100,000 or less into the foremost ship-building and the fourth largest shipping port in the world, and the second richest city in the British empire.

To act as a Clyde trustee is one of the high honors of Scotland, and well it may be.

At Hamburg the government has monopolized the Elbe, transforming the river into an arm of the sea, and erected thereon the most modern and pretentious warehouses and dock structures on the oceans. No expense was considered too heavy for the creation of the strongest maritime city on the continent. Actual results more than justify the original outlay.

At the mouth of the Mersey the tide rises and falls 30 feet. Liverpool merchants, therefore, were obliged to engage largely in the African slave and other foreign trade which did not require their ships to land at the home port. After the war of 1812 and the downfall of Napoleon slave trading was interdicted and privateering became unprofitable. Thereupon the city, then only a small town, created a dock board, wrested the water frontage from private ownership, executed an unparalleled system of tidal locks, stone quays, hydraulic wharf machinery and transfer works. The enterprise cost $110,000,000, but it now produces an income of $8,000,000 per year and makes Liverpool the most powerful and famous shipping center on the globe.

Manchester invested nearly $80,000,000 for a ship-outlet through dry land to the Irish sea; the New York dock commission has expended nearly $30,000,000 in improvements and enlargements during the last few years and Chicago is putting $40,000,000 into her channel toward the Mississippi.

A comparison of what has been done by these several cities, with what has been accomplishad by the United States on her great lakes system—population, resources, opportunity and resulting benefits considered—is humilating.

And yet there are those who argue, as if it were true, that what the single city of Liverpool spent in creating her marine prowess is too much for the American republic, too much for these two adjoining nations, to invest in projecting an outlet from the greatest water system and the most prodigious area of production in the world.

Such individuals could not have been intended for statesmen, or to sit in parliament or congress, or to be the creators of wealth, power and civilization. They are fit only to run errands and peddle peanuts.

This continent is a great farm. If one individual owned it, inevitably his first improvement would be an unbroken channel from the great lakes to tidewater. The opening effort of the possessor of a mine, or a forest, or a quarry, or a farm, is to "break a road" to it in order to let his products out and his necessities in at the lowest possible cost. But if he should construct or leave that road so that products, after having been hauled a part of the way in wagons, had to be transferred over a log to wheel-barrows and further on transferred back from wheel-barrows to wagons, he certainly would be regarded as a mudhead.

With respect to a waterway from the great lakes to tidewater, this continent is at present in the condition of the mudhead's farm.

It is as much the duty of governments to improve, expand and conserve the public resources as it is that of a father to protect and educate his children. Governments can no more neglect a national water highway because they have already granted large sums to railways and other expenses are heavy, than a father can starve his last and perhaps most promising child because he has been over-indulgent with previous children or with himself.

Nothing could give the closing century a more creditable ending or more enduring fame than a beginning at once by the two governments to impound waters and construct locks and channels for not less than 30 feet of water by every feasible route from the great lakes to the sea in channels so broad and lake-like that crowding and delay would be impossible, and the enlarged prosperity of the people never-ending. F. A. F.

November 6, 1895.

PROCEEDINGS

OF THE

FIRST ANNUAL CONVENTION

OF THE

International Deep Waterways Association.

Tuesday, September 24—Afternoon Session.

The first annual convention of he Inte national Deep Waterways Association was called to order in A my and Navy hall, Cleveland, Ohio, at 3 P. M., Tuesday, September 24, 1895, by President Oliver A. Howland, M. P. P., of Toronto, in the following words:

Gentlemen: This is not the formal opening of the International Deep Waterways Association. It is a complimentary reception by our kind friends, the honorable mayor and the corporation and the people of this beautiful city of Cleveland. They are receiving on this occasion not merely the association itself, with its formal membership, but the numerous delegates and guests and other attendants upon this convention who have come together to assist in its deliberations and to manifest their interest in the great question which we have humbly taken in charge, and who are not now enrolled in our organization. Therefore, we regard this as a reception by the honorable mayor and corporation to the whole convention—the members of the association, delegates and guests. From that point of view we think it is more expedient, and more suitable, I am sure, to his honor, and to our hosts, that the principal part in the proceedings this afternoon be taken by a representative appointed to this convention by the greatest of the states of the union. I therefore have great plea ure in calling upon Gen. Edward C. O'Brien of New York, president of the New York Dock commission, and ex-commissioner of navigation of the United S ates, to take the chair on behalf of the first convention of the International Deep Waterways association.

On taking the chair, greeted by applause, Gen. O'Brien said:

GEN. O'BRIEN'S ADDRESS.

Mr. President and Gentlemen of the Convention: I thank you most heartily for the great honor you have done me in making me temporary chairman of such a convention as this, and I congratulate you on its auspicious opening and bright promise of results great and far-reaching for good for all our fellow men. I consider this to be one of the most important public gatherings ever assembled in this country—certainly the most important of the past twenty-five years. Firstly, because of the nature of the questions we are here to consider; and secondly, because of its cosmopolitan character, and the presence of so many men representative of the great forces engaged in the commercial and legislative history of North America —men eminent for learning, professional and executive ability, and the trust and esteem of the communities of which they are accredited representatives.

I am here because I believe, as you do, that an adequate waterway uniting these great lakes with the sea will, more than any other one thing, bring increased prosperity to our people, and because you, who have given so much study to this question, by your deliberations will bring into bold relief its transcendant influence for good and dissipate any clouds of doubt as to its feasibility.

Your commerce and transportation on these great lakes and in their tributary basins have reached that stage in their development when it becomes absolutely necessary for you to have relief from the congestion, and bring your surplus products to the seaboard cheaper than can be done by existing means.

What is so necessary to the people in the heart of the continent will prove to be scarcely less important to us on the seaboard, and I have no hesitancy in saying that when you have carefully sifted the matter and formulated your desires in a fully matured plan which can meet and in its own completeness and sufficiency refute the criticisms of those who do not believe in its feasibility, an adequate waterway to the seaboard will be built. (Applause.)

I now have the great pleasure of presenting to you his honor, the mayor of the city of Cleveland, Robert E. McKisson.

MAYOR M'KISSON'S ADDRESS OF WELCOME.

Mayor McKisson: It is a pleasure to welcome the members of the International Deep Waterways association to Cleveland.

It is very appropriate, indeed, that your convention should be held in this city. No interior center of population in this country has so large an interest in this movement. Deep waterways and deep harbors are questions which concern us, and are of vital importance. The economy of water transportation, and the benefits to be derived from it, are not matters of local importance, but they are matters of general and national importance, not only to this city but to the whole country.

It has been said by a mathematician that in this country to-day $150,-000,000 are saved to the people by water transportation. This sum is equal to one-half the aggregate wealth of the city of Cleveland; and when we consider that it is brought about by reason of the fact that water transportation gives cheaper rates and quicker movement than transportation by rail; when we take into consideration these questions, and enter into these matters of public concern, we are not slow to come to the conclusion that if $150,000,000 can be saved to the country in the present condition of the great lakes, what may we expect in the future when the practical ideas which you gentlemen are laboring for, are accomplished in the near future?

It is simply this: it proves to the entire community of our land that every ton of coal that is carried to the west, every barrel of flour that is carried to the east, and the iron and steel which are brought to the different ports on the great lakes, are to be carried cheaper than it has been done in the past, and which to-day is carried for one-half the cost upon water. It simply says to the producer that in a short space of time you shall not only receive the benefits you are to-day receiving, but you shall see a like benefit of the same practical importance given to every individual in this land.

This economy of water transportation is one of general and national importance. It is one that every individual who has the prosperity of our lake and land commerce at heart should be deeply concerned in, because it places at his door more advantages than anything else that can be arranged for in the way of transportation in this country. Therefore, I say, as a matter of logical deduction, every one of us should be interested in these propositions.

I am glad, indeed, to know that this matter has progressed thus far so rapidly under your management. I am not here for the purpose of discussing the project, or your plan, or to direct in what manner it may be accomplished. I would prefer to be a listener; but I do want to say to all of you that the people of Cleveland are interested in your undertaking, and they will watch your deliberations with deep concern. We have as much interest in this matter as any community in the land. We know that the aims and objects of your association are noble and worthy of success; and it is of the utmost importance, so far as we are concerned, that every effort on your part and all the deliberations of this convention may meet your fondest expectations.

In behalf of the citizens of Cleveland, I now extend to you all the courtesies which the city affords. We trust that your convention here will be harmonious and will meet your wishes. I thank you most heartily for the privilege of extending to you the hospitality of the city of Cleveland. (Applause.)

PRESIDENT HOWLAND'S RESPONSE.

Chairman O'Brien called on President Howland to respond on behalf of the association to the mayor's welcome. Mr. Howland said that besides the cordiality with which the invitation had been extended by the Cleveland delegates in the Toronto convention—Messrs. Goulder, Wheeler and Benham—and the attractiveness and the well known hospitality of the city, Cleveland, as a striking exemplification of the value of deep water navigation, would be sure to appreciate the purposes of the association and no doubt heartily enlist in their promotion. For that reason it was an appropriate place for the first annual convention of the International Deep Waterways association and it was with great pleasure and great warmth of feeling that he acknowledged the very kind reception which the mayor had extended on his own behalf, and on behalf of the council and the citizens.

Chairman O'Brien then asked E. V. Smalley, of St. Paul, to respond on behalf of the United States to the mayor's address.

MR. SMALLEY'S RESPONSE.

Mr. Smalley said that eighteen years ago he lived in Cleveland, which then had about 80,000 people. It had hardly begun to recover from the panic of 1873, and it was the general sentiment among prominent business men that the place had about got its growth. It was argued that the country was about as thickly settled around it as it was likely to be, and that very little could be looked for in the way of further development. To-day Cleveland had more than a third of a million of people—more than four times as large as it was nineteen years ago. What had occasioned this phenomenal development? Cheap iron ore was possible in Cleveland only through the improvements in the channels of the great lakes, which have produced the big propellers, whalebacks and barges. If iron ore were still coming down from Lake Superior in the little schooner of former days there would be no city of 350,000 people at the mouth of the Cuyahoga river. "Cleveland," he said, "is the sturdy product of deep water navigation. It has outstripped all other Ohio cities because of its position near the lower end of the thousand miles of deep waterway which now reaches from Duluth and Superior to the Niagara river. Its prosperity will be increased when that waterway no longer terminates at Buffalo, but is extended eastward to meet the tidal flow of the Atlantic. I remember when a banquet was held in this city to celebrate the beginning of work by the government on your new harbor. Colonel R. C. Parsons, who is here to-day, prophesied that some day the flags of all nations would float in the Cleveland harbor. That prediction will some day be realized, and the patient advocates of the deep waterways movement count constantly upon the help of Cleveland in the work they are carrying on."

Chairman O'Brien stated that the next response would be by

James Fisher, Q. C., M. P. P., from the province of Manitoba, on behalf of the Canadian delegation.

MR. FISHER'S RESPONSE.

Mr. Chairman, Your Worship, and Gentlemen: I arise very gladly at the call to add a word to what has been so aptly said in acknowledgment of the kindly greeting and reception extended to the delegates to this convention. I want to say that we do very gratefully appreciate the very hearty welcome that has been extended to us by the municipal authorities of this city; and more than that, we feel indebted to his worship, the mayor, for the kindly words of sympathy and encouragement with which he has spoken in reference to the objects of this association. (Applause.) I echo with all my heart everything that has been said by my friend Howland and my friend Smalley as to the pleasure with which we visit Cleveland.

When we look upon the aims of our meeting here to-day, I regard Cleveland as an object lesson for us all—an object lesson to those who are studying the effect of water transportation upon commerce. I therefore feel that it was eminently proper that the very first convention of the International Deep Waterways association should be called in this city.

I have come, perhaps, the farthest of any delegate to attend this convention—by rail nearly fourteen hundred miles. I have come all that way to tell you of our interest in the movement which has been taken hold of by this association since we met in Toronto a year ago. I come from a province in the northwest of which, perhaps, the people here know very little; but it is unsurpassed in this wide world for richness of soil, for the luxuriance of its grasses, for the beef it produces and for its wheat. We produce the sweetest, purest and most toothsome cheese that is exported from any country. We have the land of the brightest sunshine and the most delightful climate. It is invigorating, (laughter), I grant you, but delightful nevertheless. It is cold up there, but we don't feel it. The only trouble with us is, we are a long distance away from the markets of the world, and we are hampered by the cost of transportation. Our coal costs us from $12 to $14 a ton. Last year it came down as low as $8 75 for the coal I burn in my furnace. This year we hope to get it for $8.50. We would have to pay $20 if it were not for the lake route. We get our coal brought from Buffalo and Cleveland to Port Arthur for 25 cents to 30 cents a ton. One season it was brought for 10 cents a ton. But when it gets there we have to carry it 400 miles by rail, hence the high cost.

Now I said I was from the far northwest, but let me qualify. The far northwest extends a thousand miles beyond, not Winnipeg, but the farthest boundary of our province of Manitoba. Our wheat fields extend a thousand miles beyond our province, and 1,200 miles beyond the city of Winnipeg. The greatest part of that country would be tributary to the great water route extending through the lakes to the Atlantic seaboard. The prosperity of that country is dependant upon that water route. It is for this reason I have come here to represent that great northwestern province which is seeking deliverance from the misfortune we are suffering from, namely, high rates of transportation. I will say by way of encouragement to the members of this convention that we have to a large extent made up our minds, and the feeling grows stronger and stronger, that that deliverance must come in the shape of a deep water channel through to the ocean. It is reasonable that these two great nations should unite together and form a scheme whereby this great project, which we are here to discuss, can be carried out by a common purse. We are not here to press any particular scheme. We are here to discuss the scheme in its general bearing; to say that we do want a deep water channel to the sea; and I am not going to say that I insist upon having it on Canadian soil, or that I object to having it on American soil. These are common waters given us for the building up of commerce, and it is reasonable that we should use them jointly, and improve them jointly.

I have no fear that Great Britain and the United States will ever clash arms again. May God forbid that they should The most potent factor in establishing peace between two nations is to create common interests. And if Great Britain and the United States jointly spent $100,000,000 in the construction of a waterway between the great lakes and the ocean, surely, Mr. Chairman, that will be such an interest as will forever keep them in peace and harmony. (Applause.) I feel that we are going to succeed in this great enterprise, and I am not going to trouble myself very much as to how it is coming.

Chairman O'Brien announced that next in the order of exercises was the report of the executive secretary of the International Deep Waterways association, Hon. Frank A. Flower, of Wisconsin, who postponed the formal paper in the following words:

SECRETARY FLOWER'S BRIEF REPORT.

Gentlemen of the Convention: The topic set opposite my name on this program—"An Historical and Critical Statement of the Deep Water Movement"—would seem to require an elaborate report. In a body of men like this such a report would be fully appreciated; but I have, in this great enterprise, been so long on the front seat—principally because there was no room on the back seats—that I feel that I may now be permitted to retire to the rear where there is more elbow room and where I can restfully watch the strong onward movement of our organization.

Besides, I am in exactly the position of the little negro boy who found himself on the inside of a large sugar hogshead which was plastered to the depth of several inches with a soft, yellow, pulpy mixture of sugar and molasses. Kneeling down he clasped his hands and fervently exclaimed: "Oh, Lord, give me a thousand tongues that I may do justice to this subject." If I had a thousand tongues as eloquent as those before me, I would try to do justice to this grand subject, fraught with greater beneficence—as I look at it—to future generations than any other within the range of my knowledge. But, if you please, let this splendid convention be my report; and for my reward and my glory I will accept the enhanced prosperity of my country and my people, which, I am sure, will grow out of this great movement. (Applause.) However, those who are unable to be present to-day, but who, nevertheless, take with us an equal interest in promoting the objects of our association, are entitled to something of a picture of our progress, and that I will try to prepare for the published volume of our official proceedings.

Mr. Flower then said he had 4,000 letters of regret, "beginning with our only president and ending with our only ex-president," and including congressmen, members of parliament, United States senators, and leaders in transportation, mining, railway and agricultural interests. He would read to the convention the vital paragraphs from a few of them, which he did as follows:

LETTERS AND REGRETS.

C. H. Grosvenor, M. C., Athens, O.: While compelled to be absent in person, I am heartily with you in interest.

D. W. Bole, Wholesaler, Winnipeg: I am in hearty sympathy with the objects of your association and hope to witness your success.

J. Lute Christie, Superior, Wis.: I gladly gave my services during the rebellion and if the wolf were not now so close to the door, should be happy to make a contribution toward this not less stupendous victory of peace.

Wm. B. Dean, Wholesale Iron and Steel, St. Paul: I desire to contribute in every way I possibly can to the advancement of a cause so important to the interests of the whole country, but regret that I can not be at the Cleveland convention.

Frank D. Jackson, Governor of Iowa: You will find Iowa in line with the other states in promoting the great cause of more ample transportation facilities. I regret that I can not attend your convention, but I have selected very able delegates to represent our state and they will no doubt work in harmony with you for the common good.

Geo. W. Benzenberg, City Engineer of Milwaukee: I can not be with you except in spirit. Your great object deserves and will win success.

D. Ferguson, Charlottetown, P. E. I.: I should esteem it a great pleasure to be able to participate in a meeting to advance objects of such vital import to the continent of North America, but am prevented from doing so. May success be with you.

Ex-Superintendent J. G. McMynn, Madison, Wis.: While unable to be at Cleveland, I feel no less interest in the success of your great undertaking and fully realize the sacrifice made by the very few who comprehend the magnitude of its future benefits and are willing, without material reward, to carry its manifold burdens.

E. Rosewater, Editor Omaha Bee: I am glad there is a full attendance at your convention. The real work, however, which you have to perform for the association must be done at Washington and Ottawa. Resolutions adopted by conventions do not necessarily impel the passage of appropriations. You will have to make an effort to reach and enlighten with solid facts the individual members. When the time comes, I shall endeavor to assist you.

T. A. Bernier, St. Boniface, Canada: The object of the convention is one in which I take a deep interest. Let me hope that the results of your deliberations will be such as to promote good feelings between the two countries and increased facilities for the transportation of the immense trade which is developing itself on both sides of the lines.

United States Senator Julius C. Burrows, Kalamazoo: I believe your association is destined to be of great benefit to the commercial interests of our great natural waterways, and it will always be my pleasure to co-operate in bettering and sustaining these interests.

Irving Beman, Meadville, Pa.: A breakwater extending from the Canada shore about opposite Fort Porter, Buffalo, across the shoal and unnavigable part of the river a mile or so to the deeper current, would throw a considerable part of the outflow of Niagara toward the Buffalo side and thus so tend to deepen not only the water at Buffalo docks, but the whole lake and the Detroit channel and even above that point, as to counteract whatever the Chicago outflow may be. By narrowing the Niagara channel at its upper end the same level would be maintained notwithstanding any diminished amount of water. Sorry I can't attend your convention.

E. L. Corthell, C. E., New York: I have been for several years greatly interested in the subject of the convention, and wish it entire success and the moving forward of its very worthy object.

Levi P. Morton, Governor of New York, by his Secretary A. W. Cole: Gov. Morton recognizes the vast importance of the purpose for which your association has been organized, and of the work in which it is engaged, especially to the great state of New York, and he trusts that in the coming convention your labors will be productive of beneficial results to the commercial interests of the whole country.

Robert H. Cook, President New York & Lake Champlain Transportation Company, Whitehall, N. Y.: We recognize the importance of improvement to our deep waterways, and will do all in our power to assist in that direction.

Ex-Attorney General C. E. Estabrook, Milwaukee: As your association and its convention are working in the right direction, ultimate success is inevitable.

Walter Evans, M. C., Louisville: I am sorry I am so tied as to be unable to attend the Cleveland convention, especially as I fully sympathize with the objects of all such associations.

B. B. Dovener, M. C., Wheeling: Our people are taking great interest in the deep waterways movement, especially that looking to connecting the Ohio with the great lakes and the Atlantic. I can not be at Cleveland but wish to express my friendly interest in the objects of your organization.

Rufus G. Flagg, D. D., President Ripon College: The matter your convention will discuss is one that ought to inspire every loyal American. I hope to live to see the day when steamers from Liverpool will touch at Superior and Milwaukee, Chicago and Cleveland, as well as at New York and Boston.

Hon. Thos. J. Henderson, Princeton, Ill.: I beg to assure you, that I most heartily sympathise with your association and with the objects and purposes for which this convention has been called; and I sincerely trust that much good may result from it, called as it has been to consider matters of the highest national and international importance.

John Kennedy, Chief Engineer, Harbor of Montreal: I am much in sympathy with the objects of your association, as I understand them, and will be at your convention if official duties permit.

L. B. Walker, Chicago: I am physically unable to attend your convention, much to my regret. I am sorry that the proposition to raise the lake levels is a government matter involving, I fear, years of disgusting red tape. Our lakes are three to four feet lower than usual. These fluctuations could easily be remedied by a dam at the head of Niagara river. At Holyoke, Mass., a dam is building 1,000 feet in length, 32 feet high and costing nearly $2,000,000, yet how puny the utility when compared to a dam at Niagara that would deepen all our harbors. God-speed you.

Charles King, Mayor of Little Falls, N. Y.: I regret that I can not be present at Cleveland. I believe the real sentiment of the people of the state of New York is in favor of the government controlling a canal of sufficient capacity so that lake vessels can carry their cargoes unbroken to New York city. The tonnage handled this year by the Erie canal has been the smallest for years, and I believe that when the New York Central railroad is able to move freight by electricity generated at Niagara Falls that it will be able to make the rate so low, that the ordinary canals can not compete. A line is now being built by this company, so I am informed, and personally I have no doubt as to its success, thus realizing the sentiment as expressed by Commodore Vanderbilt, that railroads would be able to carry freight so cheap across the state that the Erie canal would have to be abandoned.

*Samuel Hill, President Minneapolis Trust Company, Minneapolis:** I thank you for your invitation. I believe this to be the most important matter now before the people, affecting most directly the interests of the western states. The reasons which I might urge have undoubtedly been so often urged that I forbear to express them at this time. My best wishes are yours. Your ultimate success is, I believe, assured.

United States Senator H. C. Hansbrough, Devil's Lake, N. D.: I believe that adequate canals and deep waterway facilities in the great lakes and their connections would result in a very great reduction in the cost of moving the enormous wheat crops of North Dakota. For that reason I am decidedly in favor of any plan looking to this end, and will in the future, as I have in the past, leave nothing undone in an official capacity at Washington to secure desired results.

Ex-Congressman Ralph Plumb, Streator, Ill.: Being in my 80th year I cannot be depended upon to participate in the proceedings of the first annual convention of the international association at Cleveland, O., and I regret it, for nothing of a public nature interests me more. Whatever needs to be done to better and cheapen transportation by great canals and deepening the channels that connect our inland seas, can be done, and in doing it both capital and labor will be profitably employed and the completed improvements will surely recompense producers a thousand fold, and make us a stronger nation than otherwise is possible.

Thomas M. Rogers, for S. W. Cobb, M. C., St. Louis, Mo.: Mr. Cobb will not return to this country until the first week in November, consequently will be unable to attend the Cleveland convention. If he were at home, however, I am satisfied he would be present, for as chairman of the committee on railways and canals of the house of representatives, during the second and third sessions of the fifty-third congress, he gave the subject to be discussed deep study and consideration, and was heartily in favor of deep waterways.

General O. M. Poe, U. S. A., Detroit, Mich.: I regret that the pressure of my public duties at the time named will probably be so great as to prevent me from attendance upon the sessions of the association. I have no doubt that the proceedings will be highly interesting, and I trust they will be of such character as to forward the general objects of the association, with which I am in full sympathy.

John H. Sinclair, New Glasgow, Nova Scotia: Owing to professional engagements at the time fixed for the meeting, I fear it will be impossible for me to be present. I write, however, to express my hearty sympathy with the movement. Great good must come from discussion and interchange of views on the important matters embraced in the program. * * * It is time to cease waging war against geography and nature, which always must end in failure.

*NOTE—Highest officer, next to James J. Hill, of the Great Northern railway.

S. Martindale, jr., La Crosse, Wis.: It is with the keenest regret that I find myself unable to attend as a delegate for the state of Wisconsin at Cleveland. The object of your association appeals to me strongly, as it seems to me it must to every citizen of the great west and our common country. I can see no enterprise, in which business men can engage, fraught with so much good to themselves and to their fellow men, as I believe will ultimately grow out of this deep-water navigation.

Geo. S. Morison, President A. S. C. E., New York: The subject which your association is to consider are of the highest importance and there are no matters of greater professional interest. I sincerely hope that this first annual convention will prove all that its best friends have hoped for and will result in the advancement of some of the most important interests with which our profession have to deal.

D. H. Bacon, President Minnesota Iron Company, Soudan, Minn.: Upon my return from Chicago I find my appointment as delegate to the first annual convention of the Deep Waterways association to be held in Cleveland on the 24th, 25th and 26th days of this month. I esteem it an honor and regret very deeply that it is impossible for me to be present, as matters of importance require my attention here. Let me assure you of my support in any undertaking which will stand the close examination of business men and will promise the delivery of our product at the Atlantic, or abroad, or the product of other countries or of our seaboard cities, at our lake cities, at a saving to the whole.

R. S. Taylor, Mackinac Island, Mich.: I have the honor to acknowledge the receipt of your kind invitation to be present at the first annual convention of the International Deep Waterways association, to be held at Cleveland, Ohio, September 24, 25 and 26, and beg to apologize for this tardy response to the same. I would esteem it a great pleasure to be present on that occasion. A considerable part of my time for a number of years past has been given to a work falling within the general field of the objects of your association.

Among all the economies which have transformed the conditions of life in modern days no one is more far-reaching and beneficent in its influence than economy in transportation. It reaches producer and consumer alike with its blessing. It lightens the load of the whole human race and augments human happiness like a lengthening of the day. And in the close study of all the economies which modern competition enforces, no fact more clearly appears, in my opinion, than that the highest economy in transportation is to be found in deep waterways and large units.

The good your association may have it within its power to do by awakening and improving public opinion on this subject and bringing it to the attention of legislatures and governments is beyond measure.

When I received your invitation, my thought was to try to find some way to be present, and I deferred an immediate answer in the hope that I might do so. But various causes, one only of which is the pressure of other engagements which I can not postpone, combine to defeat my wish; so that I can only send you my regrets with my earnest hope that the session of your convention my prove agreeable to those present and useful to us all.

J. G. McCullough, Receiver, New York, Lake Erie & Western Railroad Co., North Bennington, Vermont: I am very sorry that my engagements in the east are such as to deny me the privilege of accepting the invitation of the International Deep Waterways association; otherwise I should consider it both a pleasure and a duty to be with you in your discussions. I regret this the more because I believe that the work contemplated by your association is one of the most important of the day and one that calls for and should receive the most earnest public attention. I can not conceive of any work fraught with more momentous consequences to the material interests of that great region that stretches from the mouth of the St. Lawrence to the far west, and which lies upon both sides of those magnificent inland seas that empty into the Atlantic through the St. Lawrence.

The work is one that should receive not only public attention, but, in my judgment, favorable governmental action upon the part of the United States and Canada. If this work should be carried out upon a grand and comprehensive scale then sea-going vessels loading at all the ports of the upper lakes would be enabled to deliver their cargoes, not only at Cleveland and Buffalo, but at all the points on the St. Lawrence to its mouth, as well as at any port on Lake Champlain, and, through the deep water connection with the Hudson, at Troy and Albany, and at New York city itself without breaking bulk.

No man can foretell the material blessings that would be conferred upon the people inhabiting the great lake region by deepening the waterways so that the ocean-carrying and Atlantic coast trade might ride safely upon these inland waters. The agricultural, mining and manufacturing interests of this great region would grow and multiply into an empire that would of itself furnish the world with the necessaries and luxuries of life. The scheme is so grand and comprehensive, and withal, so pregnant with future development, as to be worthy of our DeWitt Clintons.

G. W. Balch, Chairman Committee on Canals, New York Produce Exchange: In acknowledging the receipt of your courteous telegram, which by its terms removes all doubt regarding the propriety of this exchange appearing by representation at the meeting of the Deep Waterways association, whose sessions begin on the 24th inst. I have the honor to state that, since seeing Mr. Clarke, whose letter to you undoubtedly prompted the sending of the generous telegram referred to, it has been ascertained that the executive canal committee of this state will be there represented and will, by its declarations, cover the entire ground so far as any assertion pertaining to the canal systems of New York in their relation to the avowed purposes of your association is proper.

It may not, however, be improper for us to refer here to certain matters pertinent to the occasion in explanation, if you please, of the attitude we have been impelled to assume towards the project of a ship canal in contradistinction to the present improvement of the state canals, which, as is well known, this exchange has much at heart.

Those who have been in touch with the export trade of the country, particularly in food products, for the past few years, have been made aware not only of the narrowing conditions of trade, which by its operations has eliminated factors hitherto potential in fixing values at home, but have also encountered conditions in the marketing of our productions which show that, where before we have dominated, in future we must enter objective markets abroad as simple competitors, and that too, not at all times under equal conditions.

Nor is there any indication of betterment, but rather that as food producers in other countries are enabled to avail themselves of increased transportation facilities, these narrowing influences are likely to increase.

It is mainly from convictions forced on this exchange by the seemingly inevitable trend of events as noted, that has prompted renewed attention to the canal waterways of this state, which, by their close alliance with natural laws, are alone able to meet the imperative requirements of the cheapest possible inland transportation for our cheapening productions, and thereby assist in working out the simple problem, which, as a commercial nation, lies upon us, of retaining within ourselves as large returns as may be possible for that which we have to sell, and at the same time hold our proper position in the markets of the world.

The crisis being fully upon us, the imperative demand of the hour is manifestly for the immediate rehabilitation of existing canal waterways of this state to a degree of logical improvement, not only with respect to their physical competency, but also in their business control and management, so far as is possible, to the end that as intermediaries between the great lakes and the ocean they may fully supplement the former in both the ability to transport if necessary the entire output of freight now landed at Buffalo or other tributary ports, and be able also to carry the same at equal rates per ton per mile.

And we hazard nothing in saying, as the result of the most painstaking investigation, that should the legislative enactment, which in the form of a referendum, goes to the people of this state at the ensuing election, be approved, that the Erie and Oswego canals, when improved in accord with present designs, will be able to encompass both results.

Minute calculations evolved from entirely practical sources prove conclusively that canal transport can, with the use of approved steamers alone (ignoring entirely the further possibilities of electricity) render transportation at a lower cost than by any other known means, but as looking to the substitution of a ship canal for them, which is strongly urged by some, mainly on the ground of the supposed physical incapacity of the ordinary canal, we are enabled, as the result also of practical investigation, to state that the main canals of this state, the Erie and the Oswego, will, when properly outfitted, be able to carry forward the entire tonnage of the lakes, which has heretofore in any one season of navigation been landed at either the ports of Buffalo, Tonawanda or Oswego.*

W. Seward Webb, President Wagner Palace Car Co.: As I shall be unable to be present at the International Deep Waterways convention, I take this opportunity of expressing the fullest sympathy with the objects of the convention, and the hope that its labors may be productive of much good.

As a citizen of Vermont, I have long felt the need of adequate communication by water between Lake Champlain and the St. Lawrence river, and I believe the time has now come when this can be accomplished. I also believe that the time is not far distant when a passageway for sea-going vessels between Lake Champlain and the Hudson river will be demanded by the business of the country. There can be no doubt that such a system of communication would be of great benefit to the United States, as it would provide a new outlet through the port of New York for a great deal of commerce.

Hon. Smith M. Weed, Plattsburgh, N. Y.: For many years I have taken a great interest in a deep waterway from the great lakes to the seaboard, and I have patiently waited for the millions of people living upon the great lakes and in the territory contributory to them to become aroused to the importance of such a waterway to them. With a territory capable of supporting from 100,000,000 to 200,000,000 of people, to give them practically the advantages of the sea coasts would require but a comparatively small amount of money, and I have been astonished that they have not ere this risen in their might and determined that such a waterway should be

*NOTE.—Mr. Flower, when reading Mr. Balch's letter, called particular attention to its omissions, saying: "This polite note, written in response to my telegram saying champions of the Erie canal would be accorded every opportunity to be heard in our convention, omits, in reckoning the cost of transportation, the great loss in wastage, elevator and other charges at Buffalo and other points of transfer between the west and the seaboard. This loss almost equals the cost of carriage 1,000 miles from Superior to Buffalo. Mr. Balch's letter by these omissions unfortunately raises the presumption that New Yorkers do not care whether the western producer can make a living provided they can control the handling of his crop and deduct tolls at Buffalo and elsewhere as it passes along to its ultimate market. That the Erie canal is 'physically' able to transport the products of the west is nothing to the husbandman. The railways, for that matter, are 'physically' able to handle all the freight of the continent. But they can not do it cheap enough so the farmer can live. It is cheaper carriage that he must have or go out of the business of competing with other countries; and when he shall do that New York will be in need of neither canals nor warehouses, deep or shallow. The effort to simply secure control of products without an exertion to send a reasonable return in money back to the producer is not one that will very long maintain the supremacy of any city. That the incompleteness of Mr. Balch's statement raises this presumption is undeniable, but I am convinced it is unintentional, for there is abundant evidence that such is not and can not be substantially the New York view."

constructed. It is of almost equal consequence to the great cities of the east, and I have been surprised at their lack of interest in this great enterprise. I trust that in your deliberations you will see to it that all permanent works, like locks, approaches, etc., upon such a waterway, should be ample for the transit of sea-going ships, and ultimately the depth of such watercourse should not be less than 28 to 30 feet upon the mitre sill. With such a canal, the farmer or the manufacturer upon any of the great lakes would be practically as well off as the farmer or manufacturer in the east; and if such a work can be accomplished, the growth and prosperity of the great west and northwest of our entire country cannot be foretold. And everything that I can do in my humble way to aid in this great undertaking I shall be most happy to do.

Alexander Johnson, McGill College, Montreal: I am sorry indeed that I can not be present at your annual convention. My efforts in connection with the Royal Society of Canada, and the British Association for Advancement of Science to lessen the dangers due to tides and currents, make me greatly interested in the general subject, and I hope your meeting will be successful.

J. F. Steeves, New York: The subjects under discussion by your association have always been of great interest to me personally, and are of the first importance to the association of which I have the honor of being an officer (N. Y. Lumber Exchange). I therefore desire that the best possible results may be the outcome of your meeting in convention.

Archbishop John Ireland, St. Paul, by his Secretary, A. McNulty: I was delighted with your invitation to attend the convention of the International Deep Waterways association, and the theme you suggest, "Effect of Cheaper Transportation on Civilization and Christianity", is so large and attractive that it is with the greatest reluctance I find myself obliged, at the last moment, to remain at home. Were it not for the advice of physicians and the counsel of prudence, I should be present and respond to the theme proposed with great pleasure. I hope that the annual convention of the Deep Waterways association, beginning successfully this year, may become a powerful factor in the life of our country and, in fact, of the whole world.

Hon. Eugene T. Chamberlain, United States Commissioner of Navigation, Washington, D. C.: I greatly regret that the pressure of official duties renders it impossible for me to accept the invitation of the president and executive board to be present and participate in the first annual convention of the International Deep Waterways association.

The purposes for which your association is formed, I understand, contemplate one of the grandest material improvements to the country, and if attained will lead to a development of trade which even the most sanguine cannot now foresee.

I trust that your deliberations, which I shall watch with great interest, will awaken general attention to the important aims before you.

Col. F. C. Denison, M. P., Toronto: I regret that in consequence of other engagements I can not be present. I have shown the great interest I take in the object of your convention by urging on more than one occasion in our house of commons that the St. Lawrence river should be deepened by our own people to twenty or twenty-one feet. I hope you will take this fact as an evidence of my good wishes and interest in the proceedings of the convention.

Dr. Josephus Hooper, Louisville, Ky.: Nothing would give me more pleasure than to be with you during your convention. I certainly indorse your efforts, and I think it will be one of the greatest benefits to this country, if you can carry out your intentions. I am glad to see you succeeding so well. You talked this ocean watercourse scheme to us years ago, and you can see by present success that where there is a will there is a way.

W. McAdoo, Acting Secretary of the Navy: Sir—Replying to your letter of the 6th instant, I have much pleasure in informing you that orders have been issued to Lieutenant George P. Blow, United States navy, which will enable him to attend the convention of the International Deep Waterways association, to be held at Cleveland, Ohio, from September 24th to the 26th inclusive. While the department cannot order Lieutenant Blow to prepare a paper on "High Sea and Great Lakes Marine Laws and Regulations," to be read before the convention, there will be no objection to your inviting him to do so.

Ex-Governor John W. Stewart, Middlebury, Vt.: I received to-day your invitation to the deep waterways convention to be held at Cleveland 24th-26th inst. and later a letter from Governor Woodbury, requesting my attendance as a representative of Vermont. I have withheld answering in the hope to see my way clear to a favorable reply, and now greatly regret that it must be negative. Some years ago, at a time when I bore an official relation to the state, I attended a meeting in Burlington called in the interest of a ship canal connecting the waters of Lake Champlain and the St. Lawrence. The late Sir John Young, of Montreal, was present, and presented with great clearness the importance and probable cost of construction of the work. The twenty or more years which have intervened have only confirmed the conviction I was then led to entertain of the vast benefit the construction of a ship waterway from the lakes to the sea would confer upon the country.

The rapid and enormous development of the west, with its constantly increasing product, has fairly outrun and over-matched the wonderful movement of methods of transportation.

The recent trend in the direction of combination, and consolidation of competing corporate interests, point unerringly to the wisdom and necessity on behalf of both producer and consumer of the enlargement of waterways on the line by the St. Lawrence, Lake Champlain and the Hudson, which nature has provided so nearly complete that the artificial complement required, at a cost considerable indeed, yet trifling in view of the inestimable material advantages which would immediately accrue to the vast interests concerned. That this great work is needed and needed now is certain, but not more certain than it will be undertaken and done; and the wonder of all who shall witness this consummation will be that it had been delayed so long. I sincerely hope that this great gathering will prove a long step in the progress to final success.

James M. Swank, General Manager of the American Iron and Steel Association, Philadelphia: It will be impossible for me to attend the Cleveland convention, but I have no doubt that many of the western members of our association will be with you. Pittsburgh and the Shenango and Mahoning valleys take a deep interest in the question of canal transportation to the great lakes, and these districts, as you are aware, owe their prosperity and importance mainly to the enterprise of their iron and steel manufactures, which require cheap transportation.

United States Senator Geo. F. Hoar, Worcester, Mass.: It will be out of my power to attend the annual convention of the Deep Waterways association at Cleveland, but I have hearty sympathy with its object and shall be glad in every way to promote the improvement of our waterways, which are so essential to interstate and international commerce.

W. A. Calderhead, M. C., Marysville, Kas.: I thank you for your kind invitation to the first annual convention of the International Deep Waterways association, and regret that my engagements will prevent my attendance. Every assembly of that kind which discusses the great resources of our still greater country, and lays before the people the facts of our national commerce, is doing a valuable service. And I can only suggest that, if possible, provision should be made for the publication and distribution as widely as practicable in our country, of the papers and addresses presented at the convention. The result will be to interest the people in the progress of the nation, instead of an interest in her distress, which is more frequently proclaimed.

W. Michaelis, Secretary Maritime Association of the Port of New York: We fully appreciate the importance of water communication between the interior and seaboard as tending not only to the development of sources of production and means of transportation, but cementing the common interests of the sections thus connected.

Hon. Urban A. Woodbury, Governor of Vermont: I much regret that absence in the south at that time will prevent my attendance. The people of Vermont are deeply interested in the furtherance of the project to be considered, and I hope that our state will be properly represented in the convention. The great west is yet but comparatively sparsely settled and soon the demand for increased and cheaper facilities for moving her productions to the seaboard will be urgent. What is needed is a canal of sufficient size to admit ocean vessels and avoid storage and lighterage charges on the way to the seaboard. The east is quite largely dependent upon the west for agricultural productions and is consequently more interested than in a general way for the prosperity of the whole country. Any assistance that I can be to your board please command me.

Hon. Edward P. North, New York: I am very sorry to say that my present duties will prevent my either attending your convention or writing, as I would like, a paper to be read before it. There are few subjects which I think are of more importance to the country than the one you will consider at Cleveland.

C. J. Boatner, M. C., Monroe, Ala.: I wish to express my very great regret that I shall be unable to accept your invitation. The country has been very greatly benefited by such associations as yours, and I have no doubt that your deliberations will be of great assistance in forming public sentiment favorable to the works of the kind you contemplate.

United States Senator Redfield Proctor, Proctor, Vt.: I have the honor to acknowledge the receipt of your invitation to be present and participate in the first annual convention of the International Deep Waterways association. I regret that a previous engagement prevents my acceptance. I am especially sorry to forego the pleasure of meeting with your association because I have always felt much interest in the subject of a proper ship canal between the great lakes and the ocean. Until we have such a canal we shall never enjoy the full measure of the advantages which the great lakes are capable of affording the interior section of the country. The lake cities ought to be seaports; nature has almost made them such, and it only remains for man to do a little. The foundation of any plan considered by the association should be, like the canal itself when built, both broad and deep. What we want is a ship canal through which the commerce of the high seas may pass. Such a canal, as I understand it, must have a safe depth of at least 26 feet. I have had some opportunity to see the great variety of productions and the inexhaustible resources of field, forest and mine of the great northwest. Though the development of these has hardly commenced, yet the immense business through the "Soo" canal is some indication of the grand results sure to come when that country on both sides of the border is thickly settled, as it must be, and its wonderful resources developed. The productions of this vast region find their natural outlet though the great lakes and a ship canal from the great lakes to the sea. The project has peculiar advantages for the wide northwest, but also large possibilities for the common good of the whole people. I am glad that the association is endeavoring to awaken the interest of the public in so great and wide-reaching an undertaking, and hope it may devise some feasible plan for carrying it out. If purely local results are disregarded, and the project discussed only in larger proportions, such must be the result. Please accept my most hearty wishes for the success of the convention.

John Carling, London, Canada: I fully realize the importance to both countries of the subjects which you are to discuss, and will follow your deliberations with much interest, although prevented by circumstances from being present in person. You have my best wishes for the success of the convention.

W. F. Dalrymple, North Dakota Wheat King: I much regret my inability to be present and participate in the proceedings, and contribute to the advancement of the object proposed, namely, a deep waterway to the sea.

To accomplish this object every available influence should be brought into operation, and we should not hesitate to make it international if Canada is willing to lend her co-operation and power in its accomplishment.

The United States has too long delayed aid to this project, and the action of the several states of the Union should be brought to bear to hasten the consummation of an enterprise of such vast importance to their material interests.

It matters little to the vast interests seeking this outlet to the sea what particular through route is selected, only that it is the most practical, and accomplished with the least delay and expense.

If the great cities of Buffalo and New York desire this route, let them exert themselves to secure it. If the cities of Montreal and Quebec, and the Dominion of Canada, desire it, let them move with material aid to make the great natural outlet of the St. Lawrence the real outlet of the western continent to Europe and the seaboard.

What matters it to the shipper what route he takes if cheapness and dispatch be secured?

It appears to me, however, that the interests of both the United States and Canada are in the direction of the natural outlet of the lakes and St. Lawrence to the sea; yet I do not hesitate to express my belief in the desirability of an outlet through the territory of the United States to the great city of New York, and hope that the deliberations of your large representative body, assembled to consider these questions, may reach practical results in the way of furthering the object sought.

Lucien J. Fenton, M. C., Winchester, O.: While it will not be possible for me to be present, I desire to return my thanks through you for the invitation and also to express myself as fully indorsing the enterprise.

United States Senator N. C. Blanchard, Shreveport, La.: I beg to acknowledge receipt of the invitation to attend the first annual convention of the International Deep Waterways association to be held at Cleveland, Ohio, September 24, 25, and 26. My engagements in Louisiana will not permit my presence at the aforesaid convention, which I regret, for I have taken, for many years past, a deep interest in the improvement of the channels and harbors of the great lakes. While a member of the river and harbor committee of the house, I made a tour of the lakes for the purpose of acquainting myself personally with the localities needing improvement. And, subsequently, as chairman of the committee referred to, I took great pleasure in aiding in securing appropriations for the works on the lakes. I look upon the great lakes as the greatest inland waterway on the earth—the Mississippi river system being the second largest.

In this matter of river and harbor improvement, there is a reciprocity of interest between the lake states and those bordering on the Mississippi river. The senators and representatives in congress from these states, combined, dominate the river and harbor sentiment in congress. They should stand united and work in harmony to the end of securing appropriations for the improvement and control of these waterways adequate to their importance and for the equal benefit of our common country. I trust the convention will be a success.

Hon. Geo. F. Edmunds, Burlington, Vt.: I have received your courteous invitation "to be present and participate in the first annual convention of the International Deep Waterways association," to be held at Cleveland this September. I much regret that circumstances quite beyond my control will deprive me of the pleasure of attending the convention.

The union of the great lakes with the Atlantic has long been a subject of much interest to me, as I think it must be to every one interested in physical and political geography, as well as in the prosperity of those great and growing communities which inhabit both the northern and southern shores of the St. Lawrence and the chain of the great lakes. These fresh-water seas occupy no less than six degrees of latitude and sixteen degrees of longitude, and are bordered by eight of the United States and by perhaps the most fertile and salubrious portion of the Dominion of Canada. The situation is unique; nowhere on the globe does there exist naturally anything comparable to these great means of commercial and social intercourse and progress, and nowhere are there peoples of different nations having such resources of intercourse, whose habits and customs and social systems are really so much alike.

Surely, it must be a matter of common and friendly solicitude with the people of both countries that the comparatively short link that nature has left to man to forge in the chain that will make these magnificent sheets of water in every practical sense—for the welfare of the millions of the people of the vast region which embraces the lakes—great bays and harbors of the ocean to which every ship that moves on the great highway of all nations may resort. I think that to such ends the association should devote itself. The canal to be of much use, (even in the near future), to the vast commerce of the region affected, must be a *real ship canal*, capable of the easy transit of the ships engaged in ocean commerce. Anything short of this would produce, I fear, a "lame and impotent conclusion."

If there be any present canal or railway interests that might be felt to be adversely affected by such a canal as I have described, I beg to say that, in my humble opinion, any such feeling is a mistaken one, for the larger the development of the vast region of country around the great lakes, the greater will be the increase of the use of the ordinary canals and of the railways. This, it seems to me, is too obvious to intelligent men to be enlarged upon. The most complete neutrality of the canal (in possible time of war with other powers) compatible with the just rights of her majesty's government and of the United States, should, I think, be provided for by arrangements between the two governments; although a war between our two countries may, I gladly hope and believe, be laid out of the question.

At this point Chairman O'Brien stated that the convention was honored by the presence of one of the very best types of American citizenship, a distinguished gentleman, who had been making a few blades of grass grow where none grew before. "It will be a pleasure to you, I know, to see an original promoter of the ship canal and of the deep waterways idea, who called and organized the first ship canal convention at Burlington, Vermont, in 1850, and who built the first 150 miles of the Northwestern railroad out of Chicago before there was a railroad into Chicago from the east." So saying he presented "Mr. Thomas H. Canfield, a citizen of the United States."

MR. CANFIELD'S REMARKS.

Mr. Chairman and Gentlemen of the Convention: I am certainly very much surprised that the chairman of this convention should call upon me to speak. It is the most remote thing I could have expected.

I have been for many years identified with the transportation interests from the east to the west, which commenced way back in 1849. My partner and myself were at that time in Burlington, Vermont, engaged in the construction of railroads, trying to connect our state with Boston and the east. At that time the only mode of transportation for products between Vermont and western New Hampshire was by way of Lake Champlain and the Champlain canal from Whitehall to the Hudson river. Everything that was raised in Vermont came to Burlington for shipment to New York, Philadelphia and Boston. In return, the goods which supplied our country, as well as the opposite side of Lake Champlain, came upon boats from New York and Troy. The flour which we got from the west came through the Erie canal and the salt from Syracuse.

In the course of time two roads came, one through the capital of New Hampshire to Burlington, and the other by way of Bellows Falls to Burlington. Both were completed in December, 1849 That event interfered seriously with the business of Burlington. Burlington had received her commerce from the products of the country, being like Buffalo to-day, a place of exchange. But the progress of business did not stop at Burlington. We proposed to go on.

Our firm was deeply interested in the transportation business between New York and Montreal. We soon saw that railroads would, to a certain extent, do the business so far as connecting the east with Boston was concerned. We began to look around to see what would take the place of it. At that time one of the members of our firm, who was a gentleman of this city, Mr. Selah Chamberlain, built the Ogdensburgh railroad. In the meantime my firm, seeing the effect this was to have, decided that I should make a trip to the "far west" on a voyage of discovery. I went to Montreal and there conferred with Harrison, Stevens & Holmes, and McPherson & Co. I proposed to these gentlemen whether we could make a road by that route to Burlington and Lake Champlain without having to come by way of Ogdensburgh, to reach the products of the west. They did not give me much encouragement. Finally I got on one of those propellers and went through the canal, which then went along the Cascade rapids to the St. Lawrence river, and stopped at Oswego. There I sold 1,000 kegs of nails. I went to Rochester and to Buffalo, and Cleveland and Detroit. The result of that trip was I came back to this city (Cleveland) and here I purchased flour and chartered a vessel of A. H. Varney and D. H. Varney, two brothers doing business on the lakes, who afterwards went to New York.

I took that flour to Montreal and got it across the ferry. There wasn't any hoops on it when I got there, but it was the same identical flour.

In the meantime we were building the Ogdensburgh road. The question came up of water connection as well as rail connection between Lake Champlain and the St. Lawrence river. We called a deep waterways convention at Burlington in 1850. At that convention Sir John Wood, of Canada, who knew more of this business than any man I ever met, with some other gentlemen, came on to Burlington. We discussed the subject of connecting the borders of Lake Champlain with the waters of the St. Lawrence, so that such vessels as went into that water could pass into Lake Champlain. We adjourned that convention to meet at Saratoga. Eminent men came to Saratoga, and the same question was brought up.

Another convention was held at Troy at which Sir John Wood was again present. We required a charter from the Canadian government, but when it was taken up it was hampered by so many conditions that, although the charter was granted, we were not able to build under it. The result was that it was considered impracticable to go on.

Meanwhile this road had been constructed to Ogdensburgh, and we were determined not to be defeated. I made another trip, and decided to put on a line of propellers from Ogdensburgh to connect with Cleveland. The next year a stranger came along and introduced himself. It was Mr. Crawford from Cleveland. He said that he had consigned a cargo of flour, and had come to see what kind of a country it was. I soon found that he was engaged in propellers. The result was—to make a long story short—we entered into a relation with Chamberlain, Crawford & Co., and put on a line of propellers from Ogdensburgh to Detroit. Unfortunately we lost one or two of them, but the line was kept up, and that line runs to-day as the Vermont Central line between Ogdensburgh and Chicago.

Such, gentlemen, is a part of the progress that has been made in transportation in the last 50 years. At that time there was no railroad into Chicago. We took a contract in Chicago in 1852 to build what was then called the Chicago & Rock River Union railroad, now called the Chicago & Northwestern. Three members of our firm went to see about the undertaking. We took our supplies at Buffalo on the steamers and took them, as well as our engines, to Chicago. About a year from that time the Michigan Southern railroad and the Michigan Central railroad came into Chicago. The Northwestern road went on and we built slowly, because at that time it was more to build 20 miles of railroad and get the capital enlisted for it, than it is now to build 1,000 miles. Then the panic came along, and the railroad failed, and the contractors pretty nearly followed suit; and shortly afterwards came the war. In the construction of this railroad E. F. Johnson was chief engineer. He took the stand in those early days that we could build a railroad across the continent. He was a practical man, and proved everything mathematically, and laid out what was ultimately a railroad to the Pacific coast. Now we have 20,000 miles of railroad constructed across this continent. We have reached the Pacific ocean, and the country between is being filled up as fast as it is possible. The resources are immense, in field and forest.

You are all cognizant of what has been done in Minnesota in respect to iron ore. The Sault canal tells the story. This year, if the volume of business keeps up, the traffic passing through that lake line through the Sault canal will be twice that which passed through the Suez canal last year. Twenty years ago we were talking of building these railroads, now they are here, bringing the product into Chicago, Milwaukee, Ashland, Duluth and Superior. They are asking for greater facilities in transportation. Are you able to go on taking care of the traffic with a channel 14 feet deep? Or, shall we have a deeper one, one that can carry twice as much with the same crew? That is the question, and these are the facts you have to provide for. I understand that we are here to see what is the feeling and sentiment of the people on this subject. There is but one way out of this matter, and as has been shown by these letters, notably from Senator Edmunds, it seems to me that a ship canal is the thing in order. A ship canal is not a canal which will carry a boat of 200 or 500 tons, but a canal which will enable us to load large vessels at any of these ports and go to New York and Philadelphia or across the ocean without breaking bulk. This is what we need at the present time, and our government, as well as the Dominion government, has begun to take action looking to the accomplishment of this thing by a joint commission—secured through the more than remarkable ability and forethought of our executive secretary—authorized to take up this matter and to see what route will be the best, before congress shall be asked to make the appropriation. We should lay out this matter, not with reference to the present only, but what will be for the good of those who come after us 40, 50, and 100 years ahead. Let us lay the foundation broad and deep. Let us lay the permanent structure of our locks so vessels coming from New York or Europe are free to pass through to the docks of Cleveland or Chicago, or the ports of Lake Superior. (Applause.)

After some announcements by Luther Allen, of the Cleveland Maritime board, the convention took a recess until 8 o'clock.

Tuesday, September 24—Evening Session.

On calling the session to order, President Howland said: "Allow me to make a few business announcements, to which I hope you will give attention. The first is of a kindly character, and therefore very characteristic of Cleveland: 'Secretary Walton, of the Y. M. C. A., hereby extends to all delegates a cordial invitation to the hospitalities of our building, at the corner of Erie and Prospect streets. We have a pleasant and well-stocked reading room, and parlors and other attractions which, we hope, you will appreciate while you are our guests.'

"I may mention that it is proposed that the members from each state and provincial delegation get together and select the person they desire shall represent their respective delegation in the committee on resolutions; each delegation is to select one representative."

President Howland then read his annual address, as follows:

PRESIDENT'S ANNUAL ADDRESS.

Fellow Members of the International Deep Waterways Association:

On behalf of the executive, and in the name of our association, I greet and welcome you from this chair.

As is indicated by the sub-title inscribed upon the programme—"International Comity and Co-operation"—it has been arranged with the executive board that the inaugural address to this first convention of our International Deep Waterways Association should dwell more particularly upon the international aspect of its work.

The history of the deep waterways movement, before and since the formation of this association, inaugurated at the Toronto Deep Waterways convention of 1894, will be fully laid before you in the report to be presented by our indefatigable secretary, Mr. Flower, to whose single-minded devotion to the interests of the association the success so far attained must be mainly attributed.

You will have seen enumerated in the circular of invitation various topics of a practical character, directed to the justification of our program from a scientific, commercial, and engineering point of view. You will also have seen that each of these will be undertaken by one of a series of speakers, eminently qualified to present them for discussion. The result, it is hoped, will be a text book covering the whole subject of our work.

It will, therefore, seem not improper that I should devote my own address to that element surrounding our movement, not apparently practical in itself, but which forms its vital and necessary atmosphere, upon which our more direct and tangible objects must be dependent for their life, growth and ultimate success.

A great scheme of engineering is bound to recognize no lines except those of nature. The scope of its benefits is universal, and admits no jealousy of flags or boundaries.

This association of which we are members had an international origin. International aims are indellibly stamped upon its name, and conspicuously wrought into its platform. The emblems of both countries are coupled in its device. It has adopted as its motto, "United Effort, Mutual Benefit."

We may encourage ourselves with the reflection that the work we have so undertaken is inspired by the governing instinct of our age. To use a phrase of the Archbishop of Canterbury—used in reference to a recent letter of the Pope to the English people—"A desire for sympathy among classes, for harmony among nations, above all for reunion in Christendom, is a characteristic of our time." That desire was the invisible presiding spirit present at the birth of our movement; and the fruition of that desire will be advanced by the accomplishment of our plans.

In universal history, nothing has contributed so frequently to the consolidation of great states into the unity of a nation as common effort in a struggle against a common foe.

If the people of the two neighboring, English-speaking nations on this continent can be induced to labor as comrades in a conquest over the obstructions of nature, which now restrict the prosperity of both countries, they will not ever afterwards be capable of again regarding each other as strangers. They will have become as the members of a Grand Army. They will have contracted sympathies that will refuse to be dissolved. The result of our work will impress the humanizing conviction that men or nations are not made poorer by their neighbor's benefits; that the river of prosperity flows not less evenly, though it waters other territories, and brings rejoicing to other nations besides our own.

It may not yet be the time, nor this the place, to indulge the language of enthusiasm. Enthusiasm lets fall no fructifying seed except it is dropped in due season and on ground which has been prepared for its reception. This is an assemblage of practical men, met for practical action. Few who are partaking in this movement, spending upon it time and substance, have any expectation of receiving, at least till a distant and contingent future, any commensurate personal return for their share of the burden and effort of promoting the cause. It is enthusiasm which moves to these sacrifices of time, labor and expense; it is the desire to lay broad foundations for great future good to numbers of your fellow men. It is an extension of that progressive public spirit, hitherto more applied to purely local objects, through the prevalence of which this continent has won its fame, and conquered its already splendid prosperity. But it is not yet for enthusiasm to flame forth in words. It is the time for the steady, low-burning fire, manifesting itself in the generation of force and action.

Proof of the necessarily international character of the objects falling within the purview of our association, is found in more than one item in the important programme which will occupy the deliberations of this convention.

One will treat of the necessity and possibility of reducing the maritime laws of the two countries to uniformity. Another refers to the subject of the control and regulation of the levels of the great lakes. Public attention is drawn to that subject by the present low water period, and by speculations upon the prospective effects of the Chicago drainage canal when completed. Upon that subject much discussion has already taken place of late in the press, and in representative political and commercial bodies, both in the United States and in Canada. It has been made obvious that there is looming up for the consideration of the people of these two great neighboring countries, a new and important subject which, like the now decided controversy concerning the preservation of seal life in Behring sea, involves a novel problem of economics, and also a far reaching question touching the domain both of constitutional and of international law.

As our Secretary's report will inform you, great progress has been made in our essentially international programme. The first resolution of the constituent convention of last year recommended that the governments of Canada and the United States should appoint a joint commission to consider and report fully upon the advisability of the two countries uniting to establish deep ship channels from the great lakes to the sea, free and neutral, at joint expense, under joint control, together with the equitable share that should be charged to each country, and whether the two countries might not co-operate in the undertaking in all matters necessarily international in character.

An act has been passed in the late Congress of the United States in the terms desired; and following it a promise has been obtained from the government of Canada to nominate a like commission as soon as the President has made the appointments under the Act of Congress. This we may hope will not now be long delayed.

So far in this respect, therefore, the efforts and representations of the association have been received in a most encouraging manner by the two governments, and the two great national representative bodies to which they have been addressed.

The platform further proposed, as a crowning step in our international work, "That as a preparation for the joint promotion of common interests, it is desirable that a permanent court should be constituted for the decision by rules of law of all questions of an international character which may in any wise arise between the people and governments of the British Empire and the United States."

Your president and executive were instructed to respectfully communicate this resolution to the governments and parliaments of Great Britain, and the colonies of the British Empire, and the government of the United States. The resolutions have accordingly been so presented. They have been addressed to the governments of the United States and Canada, and to Her Majesty's home government through the Secretary of State for Canada, and also to the executives of the self-governing provinces and colonies included in the British Empire.

It is premature to expect any action from those powers. But the resolution was also submitted by our executive, among the other elements in our platform, to a large and widely representative body, the Trans-Mississippi Congress of last year, at the city of St. Louis, througha most energetic member of our executive, Mr. McGuirk, state president for Iowa; and favorable augury may be drawn from the manner in which our resolution was received when presented to that great popular assemblage.

I am happy to state that not only was our whole platform at once cordially received, and unanimously seconded, in the resolutions of that Southwestern congress, but in regard to the clause proposing an International Court, their deliberate adoption of the principle was displayed by introducing an amendment to include another neighbor, the republic of Mexico.

I think it will be proper that I should now explain to this convention why our constituent convention pronounced this opinion in favor of the creation of an international court, and included it in the platform of our Deep Waterways Association.

Ours is a practical organization (although composed, I believe, of liberal minded men); and it has adopted this resolution into its program, not for sentimental but for practical reasons, connected with our proper aim and purpose.

The convention passed this resolution because it was convinced that such a court would be needed to guard the interests which would come into existence through the success of the objects of our association. They were also agreed that the promise of such a court would smooth the way to the favorable consideration by the peoples and governments of both countries, of the proposed international system of improvements.

In the language of the resolution in the platform, "It is desirable, as a preparation for the joint promotion of common interests, that a permanent court should be constituted for the decision of all questions between these two peoples and governments."

It would not be wise to deceive ourselves at the outset of an enterprise of this kind. The existence of a more or less latent spirit of prejudice, creating a wide-spread reluctance to complete partnership in international works, and in the benefits flowing therefrom, must unfortunately be admitted.

There is no one who will not admit that, if the exigencies of commerce were to be alone regarded, they would trace a course for the transportation and exchange of the productions of this broad continent not national, but international, in its geographical direction. It obviously follows, that any diversion from this natural route and rational order will be attended with commercial loss, and that it must lay added burdens upon the shoulders of the laboring population on both sides of the political boundary line.

Are there any good reasons for this sacrifice? It is for this association to deliberately consider this matter now in the presence of the two peoples. Are there any just causes, which, on reasonable examination, forbid these populations from abiding together, and mutually co-operating in works of improvement and courses of traffic, which naturally are to their separate and joint advantage?

Our association may expect to have three classes of obstacles to overcome in the task it has undertaken. Its first, probably its simplest duty, is to convince scientific engineers, commercial men, producers and the people generally of the practical utility of the vast scheme of improvement outlined, and of its possible execution, within limits of cost not more than commensurate with its benefits.

This, our earliest, if not our easiest task, is in fact already half performed. We have obtained the promise from the two governments of the international commission of investigation we moved for. Trusting that our beliefs are justly founded, we may await patiently and hopefully for the result of the examination about to be undertaken under the most authoritative possible auspices. But this is only the first line of the defences. We have bridged the ditch, but we have still to surmount the rampart.

We may expect to find ourselves, and the two governments, confronted by the jealousy of the powerful railway world, coupled with the resistance of localities, on both sides of the border line, which may believe themselves to be interested in confining the trade of the continent to its present customary routes and imperfect modes of transport.

We may anticipate that even this second defence is not likely to prove impregnable. The opposition may become convinced that even for it there will be ultimate compensations exceeding the temporary loss by disturbance of their present interests. But in any case, once a thorough scientific examination and full and free discussion have convinced the people of the continent that these improvements are vital to the prosperity of the immense regions surrounding the lakes, and the St. Lawrence valley, it is not to be believed that particular or local interests will be suffered long to refuse the needs of so many great states and provinces; or that the opposition will be able to resist the organized intelligence of combined cities, and the determined pressure of those innumerable populations.

But though the ditch may be crossed, and the rampart scaled, there will remain a last line of defense, an inner citadel into which the defenders of the rampart may throw themselves. We shall find frowning in front of us the ancient formidable fortress of international jealousy and distrust. To it local interests may be expected to resort as the arsenal of their arguments. We must fairly measure the strength and prepare the means of overcoming this final obstacle. It may be wisdom to direct our artillery upon the citadel while advancing our attack upon the outworks.

Expressions of confidence and comity are customarily heard in the intercourse of diplomats officially representing the two nations. Such language may truthfully represent the sentiments of those who use it. Equally sincerely, like expressions fall from the lips and pens of liberal-minded speakers and writers in both countries, and are exchanged at international gatherings like our own. But we cannot shut our eyes and ears to the evidence of very different language even more frequently held in places of power, and by men of influence; and we must know that such appeals expect and too commonly meet with a widely popular response.

Let us not—a few men, meeting in an international spirit to promote international objects—deceive ourselves. Like a ship equipped with modern appliances, our smooth words may diffuse an artificial calm over our immediate neighborhood; but let us not forget that surrounding us there may still lie a great body of agitated and threatening waters.

Statesmen or diplomatists may contemplate reference to arbitrators to be agreed on for the occasion as a probable ultimate of their disputes, but the probability affords in the meantime no guarantee to the public mind. By some untoward accident, through the violence of some reckless party or in the interest of some desperate politician, the conditions may in the meantime be unexpectedly precipitated beyond the possibility of accommodation.

Now it may be conceded that while this latent possibility of war exists, however conjecturally or remotely, it must create—not perhaps a valid objection—but at least not unreasonable grounds of argument, to the public mind, against entering into an undertaking, involving complicated interests and relations, which a state of war, or even enmity, would throw into serious confusion. Nor can it be forgotten that at the bottom of the jealousy which nations exhibit to contributing to an increase of their neighbor's prosperity, there is a tangible calculation that whatever wealth and strength the neighbor shall thus attain to, may be some day turned to the purposes of war against themselves.

The two nations are now to be asked to enter into arrangements, more eminently founded upon faith and confidence than any that have preceded them. The agreements contemplated must be in their nature irrevocable. There will be mutual and reciprocal covenants to be observed, any one of which if unperformed or afterwards violated by either side, might leave the other without compensation or power of effectual reprisal.

Now it is well known that the people of these nations have had some experience of similar treaty agreements, and it must be admitted that the experience has not been altogether satisfactory or reassuring. The history of the Washington treaty of 1871 was particularly dwelt upon at the Toronto convention. It was observed that more than one serious dispute had arisen in regard to the interpretation and execution of the treaty provisions, and that none of these disputes had ever been concluded either by agreement or by adjudication.

It was pointed out in the convention that there was a moral in the history of the Washington treaty. The treaty was liberal in its scope and in its objects. It was expected to have a beneficial effect upon the relations of the two countries. As a matter of fact it became the cause of difficulties which almost rose to a dangerous point. The situation is one which is liable to repeat itself any day. How, in the face of such an experience, could the people of the two nations be expected to commit themselves to a new, and still larger venture, upon a treaty agreement subject to the same defects?

It was therefore agreed at the convention that whatever conditions and agreements might be arrived at as the terms on which the two nations should engage in this work for their mutual benefit, would not be complete unless, like most great private contracts, looking forward to an execution under changing times and circumstances, the agreement was perfected by a provision for possible difficulties being settled by some authority appointed in advance.

All agreements however solemn are liable to be set aside, temporarily or finally, in the event of the breach of the fundamental agreement of peace between the contracting communities. The convention was unanimous that we ought to aim at removing the possibility of war itself, out of the calculations of the two nations. This could only be done by establishing some substitute for war, as a general recourse for remedying public wrongs and deciding any causes of dispute, in a certain, conclusive, and acceptable manner.

This conclusion is embodied in our platform resolution, recommending to the two nations the formation of a high court for the settlement, as far as possible by rules and methods of law, of all difficulties between them.

Our purposes, as an association for the promotion of a complete international improvement and use of the deep waterways of this continent, seem to demand nothing less than that we should devise a means whereby the public mind on both sides of the border line, may be assured that war between these nations may be, humanely speaking, removed out of their calculations; that is to say, that the possibility shall be made as remote as that of war between the states of the Union.

These are the reasons, and I think they will seem to you as they did to the original convention, sufficient ones for making a permanent means of settling differences between the United States and the British empire by means of an international supreme court, a part of our association platform.

You will observe that what we recommend goes far beyond the equivalent of arbitration clauses in ordinary contracts. It both extends the object and varies the means. It is not to be limited to questions arising under this particular agreement or treaty, relating to the waterways, but is to be a method of disposing of all difficulties that may arise in any wise between the peoples and governments of the United States and the British empire.

And in the next place the method proposed is not by arbitration, but by the establishment of a permanent court in the nature of a court of law.

I think I can now most usefully employ your time in showing why so comprehensive a scope was thought necessary, why we have settled upon this particular scheme of a permanent international court; why it is limited to the United States and Great Britain; and why, thus defined and limited, we believe our plan not to be a mere philanthropic dream but one which may be offered as a means to the desired end and a practical subject for statesmanship.

It is well to examine the reasons why we should concentrate effort on this particular view instead of leaving our sympathy to become ineffectual through diffusion over a variety of vague and vulnerable proposals.

The proposal of an international court as a security against international difficulties, and the dread of international injustice, between the two greatest popular governments in the world, which on this continent are coterminous for thousands of miles, is one of four different modes of confronting the subject.

There is a school of thinkers who cling to the doctrine of *Laissez-faire*. They would continue to rest upon diplomacy, partly because diplomacy has been the accepted medium of international negotiation in the past, and partly because they have a general disposition to conceive that a departure from those established methods is not practicable. The safety-valve upon which they rely is what I may call the primary form of international arbitration; that is the occasional arbitration of international differences.

Now it may be observed that there is no slight intended t diplomacy as a function of the state. Whatever system of final adjudication may be established, diplomacy would still have its office. Private differences do not go immediately to courts of law for settlement. That result is preceded by an endeavor to reach an agreement by presentation of facts and interchange of argument. So mutual agreement will always be considered more consistent with the honor and credit of government than the confession either of unreasonableness on our own part, or of inability to convince the other side, which is implied in the resort to determination by a judicial authority. Still will the old advice hold good—"agree with thine adversary whilst thou art in the way with him."

The attitude of government will be different in the conduct of negotiations while in the diplomatic stage, under the system our platform proposes, as compared with the present conditions, and a difference working in favor of reasonableness in negotiation. Then as now there will be a resort in the background in case of the failure of negotiation. Submission to judicial determination may carry a certain resulting moral discredit to the party found to have been in the wrong. But under present circumstances the recourse in the background of international diplomacy is the mutually terrible, mutually horrible recourse to war. War as the prospective ultimate is a prospect revolting to all good and patriotic men. The consequences are certain to be so dire and costly to both parties, to whomever the final victory may result, that it is hardly considered by cool-headed statesmen as a practical resort. It is a double-edged threat which operates as much against the party in the right as against the party in the wrong. Consequently, the dread of war is an argument to assist an unjust government in its oppression of the more reasonable party to the controversy. It operates in a higher degree, but on the same principle, as the costs, risks, and delays of litigation operate upon private disputants. The greater the obstruction and cost of threatened litigation, the more advantage the obstinate wrongdoer has to compel the acceptance of a settlement which falls far short of the justice of the case.

Statesmen who are jealous of their country's honor will be anxious to deprive its governors of any temptation to the display of chicane.

The radical evils attendant upon present conditions are but partly alleviated by what we have called the primary or occasional form of arbitration. It is only called into operation after some controversy has been continued to a point where a deadlock has been arrived at, the views developed by the two governments being manifestly irreconcilable. After this condition of things has continued long enough to imperil international peace then by way of *dernier resort*, it is at last agreed to submit the question of difference to be decided by some foreign government, with or without the formal assistance of one or more assessors appointed by each of the disputant governments.

No one will deny that the method is far from satisfactory. It can not be regarded as the final and ideal method for all time. The International Assessors partake of the weakness, from a judicial point of view, which always attaches to any arbitrators appointed on behalf of the parties. They are advocates rather than judges.

Governments, who have committed themselves long and obstinately to a particular point of view, too often will be prone to choose their arbitrators with reference to their ability and disposition to maintain that view. In any case their nominees cannot but feel, chosen as they are for a specific controversy, that a certain unpopularity will attach to them in their own country if they consent to a conclusion different from that desired by that public.

They have neither the credit and character of a constant judicial position nor the benefit of being associated habitually with their colleagues in the general hearing of controversies, between the same or other parties, arising on different occasions, with the merits now inclining to one side, now to the other.

The great disadvantage to their independence of judgment arises from the two circumstances, which are inseparable from this form of an arbitration tribunal. One is, that they are appointed, as lawyers would say, *pro hac vice;* that is to say, for the decision of a certain case after the controversy has arisen. The other, that there is a third, presumably indifferent party, as the ultimate arbitrator—the real judge.

Almost inevitable are the consequences we have seen attending nearly every great international arbitration upon a subject over which the public mind has been much agitated. Great difficulty is experienced, first in agreeing to arbitrate, next in the choice of an arbitrator, and thirdly, in loyally accepting and faithfully carrying out the decision when given.

Recriminations are sometimes not wanting. The spectacle of a dissenting opinion, from the representative of the nation against which judgment is given is too frequent.

Arbitrations accomplished with these attendant circumstances give little guarantee that subsequent questions of the like nature will be submitted to the same peaceful process of determination; hence the system forms no pledge for perpetual peace.

As an advance upon this primary system of *occasional* arbitration, a party containing many able, sincere, and distinguished advocates, urges the negotiation of *permanent* treaties of arbitration between various nations. Following a resolution passed by the Pan American Congress and at the solicitation of a body of gentlemen in Great Britain, sharing their views, a resolution was adopted by the British House of Commons and by a delegation from that body was presented to the late Congress, proposing that a general arbitration treaty should be forthwith entered into between the United States and Great Britain.

The proposition was not warmly received by Congress, or by the press of the United States. It has also been subject to criticism by cautious thinkers in England who do not altogether permit their convictions to be fathered by their wishes.

It is obvious that the treaty proposed, while aiming at meeting one of the flaws in the present modes of recourse to arbitration, would perpetuate the most substantial defects of this form of international settlement. A bond would be entered into by the two nations that every controversy, when fully developed, should be referred to a tribunal, to be constituted it is understood with the assistance of some foreign government as Arbiter. But when constituted it would still in each case, have all the faults of a tribunal selected *pro hac vice.* It would be reluctantly created only after differences had become acute, and probably as often as now, its decisions or their execution would become the cause of subsequent criticism and discontent.

A general treaty of international arbitration is likely to remain a mere dream. It is vain to hope that all nations, even any two great nations, will engage themselves in advance to submit all their differences to the decision of a foreign arbitrator. Complete confidence can never be given to an institution in which so much of the element of the lot mingles with the element of law.

And it must be remembered, that an institution which exists only by agreement, and which is on every occasion the subject of opposition, is in constant danger of being revoked by similar agreement. Therefore, there are no elements in a treaty of arbitration between two nations which give a perpetual guarantee of peace and justice between them. Yet at this, according to our preliminary axiom, a scheme of the kind must aim.

A different proposition, the third in our list, has found favor with many minds; that is, that a general permanent court of arbitration should be created between all, or a large number of civilized nations of Europe and America.

Similar proposals have been made with regard to the nations of continental Europe amongst themselves. Proposals again of nearly universal scope are being urged embracing the British empire in its fullest extent, and the other nations of Europe and America.

No definition of the methods of constitution, action, or decision, of such a body has ever been laid before the world. To take it at its best, however, it may be said that such a court of arbitration, provided it were established and successfully maintained, would grow into a standing court of law, rather than a court of arbitration. It would become better than its name, and would overcome, always subject to the same proviso, the chief defects of a court of arbitration. That is to say, the same tribunal might sit in all cases; its members would not be chosen by the contestant parties with reference to the particular case; and it would become accustomed to develop the principles and practice of international law into a system.

Unfortunately, the proviso in this case is a serious one. Mr. Blaine, Secretary of State, conceived such a scheme in relation to both continents of America and even suggested the addition of the great American neighbor and largest partner in the territorial proprietorship of this continent, the British empire.

The question to be confronted at the outset is, does anyone believe such a scheme to be practicable? Does anyone, contemplating the working out of its terms and consequences, place sufficient confidence in its prospects to willingly permit his government to become perpetually committed to it?

Would the United States, for instance, consent that a controversy of maritime law, boundary aggression, or unjust treatment of its citizens, must be submitted inevitably and finally to the decision of a court of judges, of whom a majority would be constituted by the fluctuating governments of some one or other of the revolutionary states of Central or South America?

Can we entertain the expectation that agreements commanding universal respect would be reached by courts, some of whose members had been brought up on the doctrines of English law, others trained in Spanish or Portugese systems: before whom argument would have to be heard and evidence presented in a polyglot procedure, and most of whom would be appointees of governments whose tenure was often the result of revolution or intrigue; where the arbitration of the sword and political chicane were more familiar than the grand judicial procedure which has arisen in the English speaking nations in centuries of civilized peace?

Such a tribunal could never become an international court of law. Submission to the authority of courts of law is really dependent in the last resort upon a certain reverence for their decision, justified by continuous experience of their competence, impartiality and rectitude.

Has any one sufficient faith in that result from such a nondescript gathering of jurist-consuls, to ever seriously dream of concluding the interests of his nation by its chances?

It seems to stand to reason that the first experiment in the broadening of the field of law, and the promotion of the jurisdiction of courts from the national to the international domain, must necessarily be made between nations alike in systems of law, in systems of government, in language and habits of thought. If this be granted, where are these conditions to be found so fully offered, as in the case of the United States of America, and the Republican empire of Great Britain?

To what communities would such a proposal more naturally occur than to those which divide the English-speaking realms on this continent, representatives of which are met together in this association? By none could it be so readily carried out as a natural development of their respective constitutions.

To the United States stands the credit before the world of conceiving and proving the possibility of uniting the various populations and interests of a vast continent, by means of the great invention of Federal Government. Of that system, the crowning and essential feature, without which its creation would have been doubtful, and its working thus successfully for over a century impossible, was the supreme court, with its jurisdiction over controversies between the commonwealths forming the Union, and between any one of those states and the Union itself. A similar judicial body exists in the British empire, known as the judicial committee of the privy council.

These two national courts are accustomed to respect the decisions of each other, so that you will often see the law laid down by the one, quoted and adopted as confirming the grounds of decision of the other.

I hope I may without offense refer to the magnificent tribute which Canadians offered to the repute of the Supreme Court of the United States in that case where the late lamented Minister of Justice of the Dominion of Canada, Sir John Thompson, attested his confidence in the equity of the court at Washington by seeking to submit the international dispute over the Behring sea question, to its sole decision.

The provision for a supreme court in that noble and justly venerated instrument of government, the Constitution of the United States, is contained in a very few lines, and very simple provision. A few more lines that could be contained in two or three paragraphs, would provide for the creation of a united tribunal, simply consisting of a committee of members of the supreme court of the United States, and an equal committee of members of the parallel court, the judicial committee. The constitution of that tribunal would be in effect the inauguration of a federation of the English-speaking nations.

It is, of course, not for an association like this to assume the office of the statesmen and diplomatists of the two nations by attempting to frame the details of a scheme. I will merely venture to offer a few tentative suggestions on what appear to be the cardinal points in the constitution, jurisdiction and procedure of the court.

What will seem to be of first importance is that the new court would be judicial in origin as it is to be in character. It is to be a joint committee of the United States supreme court and of the judicial committee of the privy council, nominated by those courts themselves, and from among themselves. The numbers from each court will be equal and the joint committee may chose its own president in each case, who may perhaps be given a second or casting vote in case of an equal division of opinions.

In regard to the work of setting the court in action, I think it may be preferable, and would as a rule be found possible, to leave questions arising out of public rights to take the form of complaints by individuals against individuals. Wrongs cannot be done by public authority or rights asserted on behalf of the public except through acts of agents. Recent illustrations are found in the case against Admiral Walker in Newfoundland to test the question of the French shore, and in the Sayward case at Washington when the Behring sea dispute was pending.

The execution of the sentence of the court would as a rule be an order in favor of or against persons, ordering things to be done, or declaring the status of persons, places, or things. These orders and declarations would become law in the country where they were to operate, and would be followed and enforced by the ordinary courts of local jurisdiction.

The new court, like others, would be empowered to suggest compromises and to recommend legislation to amend or supply *lacunae* in the system of International law.

Administered by a regular procedure international law would become an educating force exerted upon the people of both countries. For the purposes of morality and justice, the two nations would have entered into the same relations as exist between the Sovereign States composing a Federal Union. Right and justice between governments would be placed upon the same level as right and justice between individual subjects. They would be removed from the domain of violence, passion and political chicane, and lifted to the serene jurisdiction of law. In course of time ideas of international conduct would be developed similar to those which, through the long existence of civil courts, now rule over the spirit of private quarrels. A recourse to arms between the two peoples, over questions of territory or other property, or over alleged wrongs to their subjects, would come to seem as atrocious, as absurd and out of date, as it already appears to us when we read of two neighbors undertaking to settle their boundary disputes with shot guns.

A United States Senator, Mr. Ingalls of Kansas, has said that "the impulse of federation is the inevitable tendency of the Anglo Saxon race. The final triumph of civilization will be the league of English-speaking peoples based upon the code of Christianity, which asserts the moral unity of mankind."

It is a historical fact that a scheme of Federal union large enough to embrace both Great Britain and the original thirteen states, was conceived and mooted by English statesmen on the Liberal side during the War of Independence in the last century. It was suggested by the great Earl of Chatham at the beginning of that war; and it was again mentioned by Lord Shelburne in the course of the negotiations for the treaty of 1783, which recognized American independence.

It was, no doubt, on the part of these two statesmen an indefinite dream: the suggestion of a wish, and not a scheme of practical politics. But what was impracticable more than a century ago, may be no longer impracticable at this day.

The question of its practicability may depend upon what forms the essence of federation, and what institutions are necessary to embody it.

Chatham and Shelburne in their time, no doubt, were possessed of the delusion that representation in parliament sitting in London was an essential condition of the federation they were thinking of.

To their minds and to those of the founders of the American federation, under the circumstances and influences of their time, union for military purposes, offensive and defensive, seemed to be of the essence of any political union. But in our happier time, whether it be owing to the humanizing spread of science and civilization, or merely to the terrors which science has added to war, the balance has shifted. The primary and sufficient gain to be looked to is the securing of internal peace between the federating nations.

There are still those within and without the empire who, even under modern conditions, have not awakened from the antiquated delusion. They underrate the silent developments that have taken place in our unwritten constitution. They also overlook all the practical changes that modern science has effected.

They forget that Her Majesty is the head, not of one but of more than seven, cabinets, responsible to local electorates, which have the power of choosing them. They forget that it is possible in these days of submarine cables, for the representative advisers of the common throne to sit in simultaneous council, although divided by thousands of leagues of ocean.

The literal meaning of federation is a treaty relation between sovereign states. The continuance of their independent existence and autonomy is essentially implied. This is also the practical historical character of all recorded instances. In the formation of the American Federation none of the individual colonies sought to absorb or alter the boundaries of any other. Massachusetts did not make it a condition that Connecticut should merge her existence in that of the elder colony. Nor did New York stipulate for the absorption of Pennsylvania. Neither then or since has one state breathed any jealousy of the independence or prosperity of any of its contiguous commonwealths.

On examination it will be found that federation is consistent not only with the sovereignty of the federal units, but with every degree of freedom of legislation and administration by the individual commonwealths; and also with great variety in the distribution of those powers.

Those great jurisdictions the law of marriage and divorce, and also the vital domain of criminal law, are matters of State legislation in the Southern federation of this continent, and of Federal legislation in the geographically co-extensive Northern federation of the Dominion of Canada.

Moreover the self-governing communities of the British empire constitute an unwritten federation at this moment; and it is not deemed inconsistent with their union, that each should possess and exercise absolute independence in respect of currency and tariffs. There is nothing inconsistent with the federal idea, in the financial and fiscal power being reserved to the states, instead of being vested in the union.

Thus in the federation of the states of the first American union, powers of legislation are committed to the States which, in our Northern Federation the Dominion of Canada are reserved to the Dominion or Federal legislature; while vice versa in that greater virtual federation forming the Empire, powers which the federal government of the United States claims as its own are distributed amongst the constituent states, whether described as Kingdoms, Dominions, provinces or colonies.

It seems to me that there are, in the last analysis, only two absolutely essential conditions to the existence of a federal union; one, that the member of it should not lend aid and assistance to the enemy of any other member; the other, that means should be provided for settling controversies and maintaining perpetually the pact of peace among themselves.

It seems to follow that all that would be necessary to create and constitute a constitutional bond forming a federation between the republic of the United States, and the sister republic, of which the Dominion of Canada forms one state, would be the extension of supreme court jurisdiction to controversies between the citizens of states of the greater union.

Senator Ingalls, in the same passage I have quoted from, states that "An imaginary line separates the Dominion of Canada from the United States. It has institutions like our own. Its products, industry, commerce and manufactures are similar, and its destiny identical. The welfare of both countries would be promoted by voluntary political union, as they are already united by their railroad and telegraph systems and their navigable waters." Curiously enough, as it seems to me, he proceeds to say "the annexation of Canada would not violate the traditions of our history, and would be in accordance with the impulse of federation."

Why should it have been assumed as an axiom, that Canada must detach herself from her union, the virtual though unwritten federation of republics forming the British Empire, as a condition of entering into a larger federation? Why must federation be preceded by disintegration?

Why should an American statesman desire to so narrow and thus derogate from the credit and extension of the principle of federation, which

Professor Fiske, one of the most eminent of American scholars, has claimed —and I think with truth—to be the one great American contribution to political thought? Federation is the very contrary of amalgamation.

I refuse to attribute to the United States this alleged polypoid tendency to absorb into its own body every propinquitous substance.

A strong thinker, Carlyle, observed what all experience confirms, that quarrel is generally misunderstanding. The distrusts and animosities which keep apart individuals, classes, and nations, are for the most part, founded on misconception of facts. In no case is the truth of this opinion more striking, than in the case of the division of sympathy between the two nations of the English speaking world. The England, which is hated is an imaginary England. The British Empire which is regarded with distrust and alienation has no substantial existence at the present time.

I might quote typical sentences from leading journals and popular speakers which seem to wholly fail to recognize, that at the present time Great Britain, and the great self-governing colonies, which like the United States have sprung from her, but unlike the United States remain united with her, are republics individually, and that also in their union in what is called the British Empire they form a federal republic; not as obviously but as veritably as the United States is a republic.

The time has come for completely rewriting the antiquated classification, invented by Montesquieu, of governments into absolute monarchies, limited monarchies, and republics. At least Great Britain and her colonies ought to be written into their proper place in the classification.

Examples of absolute monarchies we may still find in Russia and Turkey, really Asiatic governments projected into Europe.

An example of a limited monarchy, in the sense in which Montesquieu wrote two centuries ago, we may perhaps find in the German empire. There the will of the Sovereign is still a weighty factor, because he retains in his hands the substantial power of the sword. But to England it has no application.

The test of monarchy or republic is not the mode of selection, nor the length of tenure of the chief office in the nation. Still less does it depend upon whether the tenant of that office bears the name of king or president. The essence of the matter is that the powers our sovereign exercises are those of an office, of duty and responsibility, a function of government in a system moulded by her people, existing by its wisdom and consent, and according to its ideas of its own good.

Every student of the modern constitution of Great Britain, or a British colony, knows that according to this test those countries are each and all essentially republican. Their government is a government of the people, by the people, for the people.

Equally antiquated is the notion that Great Britain and her colonies are aristocratic in their government. Even the social cond tions under which aristocratic tendencies prevailed in the past, are rapidly passing away under the flux of universal modern commercial conditions. They have already ceased to enter into the ultimate conditions of government.

Good work was done in their time by many on the roll of the kings and lords of England. Americans have ever been ready to render gracious homage to the virtues of her present venerable Sovereign Lady. Before her there have been Edwards and Henrys, an Alfred and a William III. English-speaking freemen will not forget that it was embattled Barons who procured the signet to the terse, undying sentences of Magna Charta.

The action and the words of the greatest living leader in the House of Lords may be taken as an authoritative exposition of its present function. Lord Salisbury has in recent years expressly and repeatedly declared the jurisdiction and place of that once powerful and ruling body to which he belongs. It is purely that of a second chamber, bound to submit its views to those of the people, as expressed in the popular house, the moment they are convinced by a sufficiently clear declaration at the polls, that the vote of the House of Commons is confirmed by their constituents, the Electorate of Great Britain. Reforms may be necessary in its constitution and practice and will assuredly be made in good time, but it is difficult to see any radical argument against the existence of the House of Lords, which would not be an argument for the alteration of the Constitution of the United States, by the excision from it of its own second chamber, the senate.

Kings and lords, if at one time, like reefs on the shore of a tidal sea, they formed boisterous breakers—opposing the incoming tide of popular government; are now submerged under the surface of the all-conquering system. They have not been removed: for, even in submergence, they perform a valuable office. They oppose the incessant shifting of the sands upon the borders of the free constitution, and defend the fundamental outlines from premature and capricious changes.

There exists no reason in fact, based on difference of constitutions, or views of government, or social tendencies, why the two peoples of the Enlish race should not be willing to throw their progress and their prosperity into common stock.

The reign of prejudice cannot be abolished at once by the simple publication of truths. Men are educated under institutions and by institutions. It is the proper task of statesmen to make the essential unity of those two great republics manifest to every one of their inhabitants in a form which will appeal to universal observation and daily experience.

Such, it is submitted, would be the effect of the creation of this permanent court. It would form the visible keystone of union of the great arch of English popular government, one-half of which is founded upon the united commonwealths forming the United States; the other, on the similar united commonwealths, home and colonial, forming the British empire.

Our time may realize what the jurists and political speculators of the fourteenth and fifteenth centuries sought when they labored to erect their Imperator Pacificus, head of the Holy Roman Empire upon a throne of universal justice.

The dream of the founders of the Mediæval Empire, in the words of Mr. Bryce, its historian, was Peace. "They looked for the erection of a presiding power common to all Europe, which should be more especially charged to prevent strife between kingdoms, and to maintain the public order of Europe by being not only the foundation of international law, but also the judge of its causes and the enforcer of its sentences."

The scheme failed in that instance, not because the hope was visionary in itself, but because in that age it was thought that political and religious government were inseparable. The emperor must be orthodox. The Reformation put an end to the Roman Empire: for orthodoxy ceased to be a matter of universal agreement.

In the historian's words—"The practical evil which the establishment of such a universal monarchy was intended to meet, that of wars and hardly less ruinous preparations for war, remains what it was then. The remedy which mediæval theory proposed has been in some measure applied by the construction and reception of international law; the greater difficulty of erecting a tribunal to arbitrate and decide, with the power of enforcing its decisions, is as far from a solution as ever."

In 1787 the object of establishing the Supreme Court of the United States, in the words of the great American scholar, Professor Fiske, "was the substitution of law for violence between states that were partly sovereign. In some future still grander convention" he continues, "we trust the same thing will be done between states that have been wholly sovereign; whereby peace may gain and violence be diminished over other lands than this, which has set the example."

Four centuries ago this still new continent arose, in virginal promise, out of the Atlantic, before the eyes of Europe. In accomplishing at length the prophecies of sages and the hopes of generations of statesmen, may it fulfil its ordained destiny and become a vision of blessing to mankind.

The two noblest sentences ever penned were "Fiat Lux" and "Fiat Justitia." May they both continue to be incorporated in the objects of our association. While we promote an investigation for the purpose of throwing light upon the practicability of vast improvements in our natural waterways to advance our material prosperity; let us not relax the parallel effort to bring those same great nations to an agreement for establishing the securities for peace and international justice upon what we believe to be broad, rational and perpetual foundations.

President Howland: The next business on the program for this convention is the report of the committee on credentials, which Secretary Flower says will have to be deferred until morning.

The next thing in order is discussion of papers on the program, and which have been distributed among you.

On motion of Mr. Smalley, seconded by Mr. McGuirk, the discussions are postponed, and the remainder of the evening devoted to five minute speeches on topics of general interest to the International Deep Waterways association.

of this convention certain rules of order, one of which is that every delegate, upon rising to speak, shall announce to the convention his name, the delegation to which he belongs, and the place from which he comes. I think, gentlemen, as Mr. Smalley introduced this motion, it is due to the convention that he now justify the motion by commencing this debate.

MR. SMALLEY'S INFORMAL TALK.

E. V. Smalley: I did not make this motion for the purpose of doing any talking myself, but with the idea that we have fresh minds here, and information which ought to be brought out. I think one very valuable contribution to this convention is the object lesson furnished in the outer hall by Mr. C. N. Dutton, which, if it should prove thoroughly practicable on the scale for which it was designed, would give an immense impetus to the movement in which we are interested.

If you will look upon this map (referring to a large map of the great lakes) you will see that the level of Lake Erie above the sea is 572 feet and some inches, and that the level of Lake Ontario is 246 feet and some inches. Lake Superior, as named by the French, does not mean a large lake, but the "upper lake." We have descended with our deep water system from an elevation of 601.8 feet above the sea level down to Lake Erie, 572.9 feet; and the whole fall to be overcome is from 601.8 feet of Lake Superior to 581.3 feet of Lake Huron, which is only a matter of twenty feet descent. When we reach Lake Erie, and look on ahead to Lake Ontario, we are faced by the descent of the difference between 246 feet and 572 feet, which is 326 feet that we have to go down for the next step in our program. We get down that distance now by the Welland canal, with a depth of only fourteen feet, but we do it by what is called the marine stairway system, going down step by step, consuming a great deal of time—a slow method and comparatively very expensive.

Now Inventor Dutton says: Instead of this multitude of locks forming a marine stairway, I will lower your great lake carrier from the level of Lake Erie to the level of Lake Ontario by two locks, or pneumatic lifts.

This is at present the key to the whole movement; because if we are to construct a deep waterway system around Niagara Falls admitting vessels of 26 feet draught, the cost is going to be very heavy indeed. But the cost of this system which we look forward to, of getting from the level of Lake Ontario in two steps instead of twenty or thirty, is comparatively modest. It seems to me we can go to congress at once with a demand for immediate steps for a survey, and construct this new canal around Niagara Falls. Whether there should be a change of the old Welland canal or a new canal on the American side of the river is a matter I do not think of very great importance. Nevertheless, we know that the Canadian government has, with great liberality, already assumed the enormous burden in the system of St. Lawrence canals and the Welland canal, in order that vessels of moderate draught may get to Montreal. It seems to me it is not asking very much on their part, if they say to us, a great population of 70,000,000, and with great wealth at our command: "We want you to build the new canal around Niagara Falls as your share of this great international movement." Then, when we are in Lake Ontario with our heavy lake carriers, the engineers will be able to solve for us the question of getting farther along.

President Howland: We have with us a representative from Duluth, the end of the route—a member of congress, and therefore near the end of things as far as the accomplishment of our project is concerned. May we not ask Mr. Towne to give us his views?

MR. TOWNE'S INFORMAL TALK.

C. A. Towne, M. C.: I am sure I had no expectation of participating in this discussion. I am here chiefly for the purpose of learning something. When I see about me men so admirably qualified to instruct me upon every branch of this most comprehensive subject, I feel an excess of my usual modesty and disposition to be very quiet. However, if absolute silence cannot be forgiven, I will say I am here from Duluth. As your president has said, Duluth ought to be at the head and beginning of that vast empire of the west and north, to find an outlet, like all forces of nature, by way of least resistance, and depending for its growth and prosperity and the realization of that great civic future, on its interest in the improvement in this deep water connection.

The other day we had a great ship come into Duluth loaded with 138,000 bushels of wheat upon a draught of 14.2 feet of water. This was upon 10 inches less draught, and taking 17,000 bushels more wheat, than the record-breaking carrier theretofore. As that great and beautiful vessel came into the harbor, and every vessel, and tug, and steamer, and every mill broke forth into a joyous welcome, it was like voicing the enthusiasm of the whole country for another step taken toward the realization of this magnificent waterway we are here to discuss.

I ought to be governed by that modesty and inscrutable mystery which characterize a man who is after votes, and be reticent on this subject. But I have already spoken my mind quite freely, and while I confess to a large degree of ignorance upon the farther reach of some problems here involved, I nevertheless have come to very definite conclusions, and I have not the slightest hesitancy in saying to you that during my service in congress it will be a pleasure to me, and I shall regard it as my duty, to work for the realization of the splendid and useful and magnificent object for which this organization exists. (Applause.)

President Howland: We have with us a gentleman who has occupied a very high position in his state, and who is very deeply interested in this question. I hope ex-Governor A. H. Burke will give us the benefit of his views.

Ex-Governor Burke said it was hardly fair to call upon him to speak upon this question. "Of course, you know my heart is with you or I would not come this distance to meet with you. I am a wheat man, and those of you who know what the wheat business is, know that I have made great sacrifices in coming here at this busy season. I am not prepared this evening to give you an intelligent talk.. I have my hands full of these topical papers, which I propose to read and digest, and probably then I may know something about the question. Of course, we are very anxious to get to the Atlantic seaboard. It is right we should. Like Mr. Smalley, I am not prepared to say by which route, but we should get there."

President Howland: We have with us a representative from Pittsburgh, President Kelly, of the Pittsburgh chamber of commerce. If he will give us his views, I am sure we will feel highly favcred and deeply interested.

MR. KELLY'S INFORMAL TALK.

George A. Kelly: While I recognize the distinguished courtesy extended to me in calling me to the floor, I must apologize for the reason that I am not prepared to speak upon the subject, either from a scientific or engineering point of view. As a representative of the Pittsburgh chamber of commerce, I desire to convey to this meeting our earnest interest and sympathy in the great questions which are to engage the attention of those present. We are in practical touch with deep waterways. I am glad to see the position taken by the Cleveland chamber of commerce in showing its sympathy and interest in this movement, and taking the position which it always should take as actively interested in matters which concern the country at large.

While chambers of commerce are organized for local purposes as a general rule, they fall very far short of their duty if they are not interested in all questions which are for the advancement of the whole country.

Our own chamber of commerce has taken a very deep interest in the deep waterways question. We bel'eve it is one of those questions now at the front, which have come to stay. The people of this country have made up their mind that it is necessary to have cheaper transportation in order that we may be able to compete with the markets of the world.

Our chamber of commerce has taken an active step in the project of a ship canal between Lake Erie and the Ohio river. We are, as a chamber of commerce, in favor of a union of the great lakes with the Atlantic seaboard. We have not only a heart to sympathize with you, but will be willing to aid you in every possible way. We are also interested in all projects concerning the enlarging or deepening of the New York canals and the building of these deep waterways wherever they will pay.

When we first undertook this agitation of a ship canal between Lake Erie and the Ohio river, we were met by a great deal of skepticism, and doubts of all kind were expressed that it was impracticable, and not a feasible project. But having examined it under the auspices of the chamber of commerce, we proposed to go forward and from an engineering point of view determine the question as to whether these deep waterways shall be built. Preliminary surveys have been made at our own expense. We have asked no contributions from others, and we believe that this ship canal will be built from Lake Erie to the Ohio river, opening up a large field of industry between Pittsburgh and Cleveland.

I am very glad to hear the mayor of this city say that this deep waterways question is not of a local character, but of national importance, and with Cleveland, Buffalo, and other cities so deeply interested in this matter, we have progressed far enough to be justified in believing that these objects will be accomplished. We are in close touch and sympathy with every movement that looks toward the development of our interior commerce, as well as the commercial prosperity of our whole country, and our neighbors across the borderland in Canada.

I expect that we will be able, before this great project of a canal from the lakes to the ocean can be realized, to place before the people of this country an object lesson of what can be done in building a ship canal that can cheapen transportation, and ally more closely with each other cities such as Cleveland and Pittsburgh, and the country lying between. The time has come when the ore must come more economically. I have heard many good things said here to-day, and one is, that—by your able and far-seeing secretary—"transportation cannot be too cheap." (Applause.)

The convention adjourned for the day.

Wednesday, September 25—Morning Session.

Called to order by President Howland, who asked Chairman McGuirk for the report of the committee on credentials.

Mr. McGuirk reported as follows:

REPORT OF COMMITTEE ON CREDENTIALS.

Your committee on credentials report that the following persons are duly accredited delegates to this convention and entitled to participate in its deliberations and proceedings:

New York—F. M. David, Walter L. Phillips, Gustave Lindenthal, Chauncey N. Dutton, C. E.; Alex. R. Smith, 129 Broad street; Thomas C. Clarke, C. E., 44 Broadway; Gen. Ed. C. O'Brien, Department of Docks; E. L. Corthell, C. E., 71 Broadway, New York city; Robt. H. Cook, Whitehall; G. F. Bixby, Plattsburgh; Wm. Pierson Judson, Oswego; Hon. C. W. Adams, Utica; M. N. Drake, J. G. Orr, J. J. H. Brown, Francis B. Clarke, Buffalo; John A. C. Wright, Rochester; F. C. Leutze, Albany; W. W. Wood, Elbridge.

Pennsylvania—L. M. Haupt, C. E., 18 S. Broad street; Emory R. Johnson, Philadelphia; Thomas P. Roberts, Geo. H. Anderson, John E. Shaw, George A. Kelley, W. P. Herbert, Pittsburgh; Matthew Griswold, M. C., G. A. McBride, Erie.

Dominion of Canada—Ald. T. Hunter, J. H. C. Hagarty, J. E. Atkinson, M. McLaughlin, J. Enoch Thompson, John Brown, Geo. R. R. Cockburn, Peter McIntyre, W. T. Jennings, C. E., O. A. Howland, M. P. P., Toronto; J. Robertson, St. John, N. B.; Capt. Davidson, Indian Head; Capt. D. H. McDowell, Prince Albert; D. McKeen, M. P., Glace Bay, N. S.; John D. Chipman, St. Stephen, N. B.; James Fisher, G. R. Crowe, Winnipeg; Richard R. Dobell, Quebec; James Conmee, Port Arthur; Hon. J. F. Wood, Hon. N. Clark Wallace, Ottawa; Henry T. Bovey, Montreal; Thomas Monro, C. E., Coteau Landing; And. Haslam, Nanaimo, B. C.

Montana—David G. Browne, Charles E. Duer, Thomas A. Cummings, Fort Benton.

Wisconsin.—Hon. Thomas B. Mills, Hon. Frank A. Flower, Capt. C. S. Barker, E. K. Thomas, Lou R. Hurd, Hon. E. Cook Kennedy, Judge F. Winsor, Rowland J. Wemyss, Robert Lenox Belknap, A. Ruyter, Walter C. Brooks, Henry W. Gilbert, West Superior; Hon. Martin Pattison, Judge D. E. Roberts, Champ Green, Frank L. Taylor, Hon. James Bardon, Hon. Halford Erickson, Wm. H. Pattison, L. C. Barnett, Superior; Col. Isaac H. Wing, Wm. F. Dalrymple, Frank Boutin, R. D. Pike, W. W. Downs, Bayfield; Hon. Jam s H. Stout, Menomonie; J. E. Jones, Hon. Wm. O'Niel, A. C. Probert, N. M. Oistad, Howard Benton, Washburn; Hon. R. M. Bashford, Madison; Hon. Clinton Babbitt, C. Ingersoll, Beloit; M. J. Woodward, Paul Jones, George May, J. Ferbruggen, Jacob J[illegible], Watertown; John Mogenson, Capt. O. Groh, P. Reis, Arthur Winter, [illegible] R. Richards, Hon. C. Ackerman, Thomas M. Blackstock, Sheboygan; Thomas Bardon, Edwin Ellis, Hon. S. S. Fifield, J. W. Cochran, Col. John H. Knight, Joe M. Chapple, Ashland; Thomas H. Smith, Frank Long, Charles Reynolda, John Pinney, Adam Dier, Sturgeon Bay; Congressmen Henry A. Cooper (Racine), Michael Griffin (Eau Claire), Edward Sauerhering (Mayville), Joseph W. Babcock

(Necedah), E. S. Minor (Sturgeon Bay), Theobold Otjen (Milwaukee), Samuel S. Barney (West Bend), Samuel A. Cook (Neenah), John J. Jenkins (Chippewa Falls), Alex. Stewart (Wausau); E. C. Deane, Racine; Governor Emil Baensch, Manitowoc; Stephen Martindale, Jr., La Crosse; Hon. Thomas B. Reid, Appleton; Hon. J. O. Davidson, Crawford; Hon. Calvert Spencely, Mineral Point; Hon. George A. Buckstaff, Oshkosh; Joseph Nesbit, Onalaska; Hon. W. E. Gardner, Green Bay; L. W. Nieman, Hon. C. E. Estabrook, F. H. Magdeburg, James Morgan, Captain W. H. Wolf, E. P. Bacon, Milwaukee; W. C. Silverthorn, Wausau.

Michigan—James Davidson, Hon. F. W. Wheeler, West Bay City; S. L. Smith, George H. Barbour, M. W. Humphrey, W. Livingstone, J. W. Westcott, D. F. Henry, Robert T. Gray, A. C. Raymond, W. A. Livingstone, H. C. Ralph, George Y. Wisner, C. E., Capt. E. M. Peck, Detroit; O'Brien J. Atkinson, Maj. N. S. Boynton, Theo. H. Wright, John G. O'Neil, Port Huron; Hon. S. M. Stephenson, M. C., Menominee; J R. Van Evera, J. M. Longyear, Peter White, William F. Fitch, Gad. Smith, Dan. H. Ball, N. M. Kaufman, Marquette; Hon. H. W. Seymour, Sault St. Marie; Wm. Alden Smith, Grand Rapids; E. S. Pease, Saginaw.

West Virginia—Gov. W. A. MacCorkle; Hon. Stephen B. Elkins, Elkins; Geo. A. Burt, Parkersburg; Hon. Frank J. Hearne, N. E. Whitaker, Wheeling; A. B. Fleming, Fairmont.

Kentucky—Dr. Josephus Hooper, Louisville.

Maryland—J. M. Callahan, Johns Hopkins university.

Nebraska—E. Rosewater, Omaha.

Massachusetts—William Watson, Boston.

United States Navy—Lieut. Geo. P. Blow, Chicago.

National Transportation Association—Frank Barry (president), Milwaukee; R. S. Lyon (chairman executive committee), Chicago.

Illinois—Richard Price Morgan, Dwight; Hon. E. D. Cooke, M. C., Hiero B. Herr (marine contractor), W. H. Cairnduff, C. L. Stroebel, C. E., E. R. Schnable, C. E., B. A. Eckhart, Capt. J. S. Dunham, O. A. Thorpe, President Frank Wenter, Wm. Boldenweck, L. E. Cooley, C. E., Isham Randolph, C. E., Geo. E Dawson, Thomas T. Johnston, C. E., H. E. Kast, C. L. Harrison, L. G. Keith, Alex. E. Kastl, Capt. J. A. Calbrick, A. L. Suesman, Richard McArthur, Chicago; Hon. Ralph Plumb, Streator; Judge C. C. Strawn, Pontiac; George Tunell, Chicago univerity; F. W. Matthiessen, La Salle; E. J. Ward, Marseilles; T. S. Easterbrook, East St. Louis.

Iowa—August Post, A. M., Moulton; Clifford S. Ham, B. B. Richards, Bart E. Lenihan, Dubuque; J. H. Bowman, Waverly; Hon. J. G. Hutchinson, Ottumwa; Hon. H. N. Brockway, Garner; Hon. T. J. Caldwell, Adel; Hon. W. W. Morrow, Afton; John Cownie, South Amana; Hugh J. Meek, Boneparte; Hon. I. S. Struble, Le Mars; Danied B. Horn, Charles Francis, C. E., Ambrose P. McGuirk, Davenport.

Vermont—Hon. Thomas H. Canfield, Hon. H. Henry Powers, M. C., ex-Governor John W. Stewart, ex-Governor Levi K. Fuller, Col. W. Seward Webb, Mayor W. J. Van Patten (Burlington), Hon. G. G. Benedi t, Col. B. B. Smalley, L. B. Lord, Gov. Urban A. Woodbury, C. W. Brownell.

North Dakota—George B. Clifford, Grand Forks.

Minnesota—(At large) United States Senators C. K. Davis and K. Nelson; Congressmen James A. Tawney, J. T. McCleary, J. P. Heatwole, A. R. Kiefer, Loren Fletcher, Charles A. Towne, Frank M. Eddy; John W. Thomas, Minneapolis; D. H. Bacon, Soudan; Capt. Alex. McDougall, Duluth; Col. Fred B. Snyder, A. L. Crocker, J. C. Reno, Horace B. Hudson, Col. W. P. Cockey, Hon. Charles A. Pillsbury, C. M. Harrington, J. B. Bassett, Minneapolis; E. V. Smalley, Col. Jas. H. Davidson, Thomas McDavitt, D. R. McGinnis, J. S. Pinney, St. Paul; E. C. Gridley, E. R. Brace, S. A. Thompson, Hon. Andrew H. Burke, Frank E. Wyman, George H. Crosby, Rev. A. W. Ryan, Beriah Magoffin, H. C. Pearson, W. A. Montague, Thomas H. Wood, F. B. Daughtery, F. E. Searle, A. C. Batchelor, Col. A. A. Harris, A. W. Marshall, A. L. Ordean, J. E. York, Wm. C. Sherwood, L. A. Barber, C. A. Duncan, C. L. Ring, Geo. W. Stevens, W. C. McClure, Ward Ames, A. B. Wolvin, George Spencer, Wm. H. Squire, Duluth; J. A. Leonard, Rochester; C. L. Alleman, J. B. Ogle, H. A. Patterson, S. J. Wright, C. H. Higgs, Mankato.

Ohio—Hiram M. Chittenden, U.S.A., Hon. D. H. Watson, Columbus; Prof. G. F. Wright, Oberlin; J. G. Butler, Youngstown; W. S. McKinnon, George B. Raser, Ashtabula; John Craig, A. W. Colton, W. J. Clark, Hon. James H. Southard, M.C., Denison B. Smith, Thomas A. Taylor, Toledo; Charles M. Hogg, Cadiz; W. H. Rowlen, Canton; Charles O. Hale, Ira; J. W. Walton, William C. Cole, U.S.N., Harvey D. Goulder, Luther Allen, J. R. Oldham, W. G. Mather, Charles E. Wheeler, H. F. Lyman, Martin Dodge, W R. Bartlett, William S. Mack, Samuel Mather, J. H. Hoyt, E. W. Doty, Capt. L. M. Coe, Hon. John H. Farley, X X. Crum, Ryerson Ritchie, E. B. Lilley, L. C. Holden, Col. Jared A. Smith, U. S. A., Cleveland; George J. Record, Conneaut; E. G. Wetherbee, Joseph Chapman, Painesville; Hon. A. E. Merrill, Sandusky; F. Fitzpatrick, Mentor; F. F. Thomas, Elyria; W. T. Harris, Defiance; E. M. Pierce, John Stang, L. A. Fauver, George Wickens, G. V. Burgess, H. W. Blakeslee, H. J. Barrows, J. B. Coffinberry, W. C. Alten, C. N. Snyder, T. F. Daniels, C. J. Washburn, F. A. Rowley, G. L. Bowman, Arthur T. Moxham, Lorain; Alex. Boxwell, Red Lion; W. W. Aker, New Paris; George W. Blasdel, Waverly.

BODIES AND ORGANIZATIONS REPRESENTED.

From such formal records as came to him, the executive secretary thought it proper to supplement Chairman McGuirk's report with the following:

Illinois—Chicago Board of Trade; Chicago Sanitary District; Chicago Real Estate Board; State of Illinois; United States Congress; Chicago University.

Vermont—State of Vermont; Burlington Board of Trade; United States Congress.

Minnesota—State of Minnesota; United States Congress; Minneapolis Board of Trade; City of Minneapolis; St. Paul Commercial Club; City of Duluth; Manikato Commercial Club; Duluth Chamber of Commerce; Duluth Board of Trade; State Federation of Labor; Duluth Jobbers' Union.

Ohio—The United States Congress; State Board of Commerce; Toledo Produce Exchange; Cleveland Chamber of Commerce; Painesville Board of Trade; City of Ashtabula; Cleveland Maritime Board; Toledo Chamber of Commerce; City of Lorain; Lorain Chamber of Commerce; Oberlin College.

Michigan—Detroit Chamber of Commerce; City of Marquette; Port Huron Chamber of Commerce; United States Congress; State of Michigan; City of Menominee; Sault Ste. Marie Chamber of Commerce.

Pennsylvania—Pittsburgh Chamber of Commerce; the United States Congress; Lake Erie and Ohio River Ship Canal Co.

Iowa—Davenport Business Men's Association; United States Congress; State of Iowa; City of Davenport; City of Dubuque.

Wisconsin—Superior Board of Trade; West Superior Chamber of Commerce; City of Superior; Washburn Business Men's Association; Ashland Chamber of Commerce; Milwaukee Chamber of Commerce; City of Sheboygan; State of Wisconsin; University of Wisconsin; City of Bayfield; City of Sturgeon Bay; the State Legislature; the United States Congress;

City of Watertown; City of Beloit; Wisconsin State Senate; Wisconsin Deep Waterways Commissioner.

Dominion of Canada—Dominion Government; Toronto Board of Trade; Toronto City Council; City of Winnipeg; Ontario Parliament; Toronto Press Association; City of Quebec; Department of Railways and Canals; Manitoba Parliament.

New York—Merchants' Exchange, Buffalo; Oswego Business Men's Association; New York City Department of Docks; State of New York; Oswego Board of Trade; State Engineer's Office; Erie Canal Committee; New York & Lake Champlain Canal Company.

West Virginia—The State; the United States Congress.

Montana—Fort Benton Board of Trade.

Miscellaneous—Western Society of Engineers; National Transportation Association; International Traffic Association; Canadian Society of Civil Engineers; Sanitary District of Chicago; United States Department of the Navy; Dominion of Canada Comptroller of Customs; United Press; Chicage University; Wisconsin University; Lake Carriers' Association; Johns Hopkins University; University of Pennsylvania; Lake Erie and Ohio River Ship Canal Company; Erie Canal Committee; National Farmers' Alliance; Corps of Engineers of United States Army; Maritime Canal Company of North America; National Society of Civil Engineers; Trans-Mississippi Congress; International Deep Waterways Association; Oberlin College; Associated Press.

DOMINION AND UNITED STATES DELEGATES.

President Howland: I wish to make an important announcement. On the printed program it is proposed that the annual meeting for the election of officers should be held on Friday morning. It has been thought best to order that this annual election be held on Thursday morning at 9 o'clock.

I have a letter from the premier of Canada, Sir MacKenzie Bowell, in which he states that the minister of railways has, with the consent of the council, instructed one of the best engineers of the department, Mr. Thomas Monro, to be present at this convention, which he hopes will be satisfactory. We had also the announcement given yesterday by Executive Secretary Flower, and the letter read to similar effect from the United States navy department, authorizing Lieutenant George P. Blow to be present at this convention.

I think that it is due to these gentlemen, in view of the honor which has been conferred upon this convention in appointing them to be present to represent their respective governments, that they should be invited to take seats upon the platform.

It is to be clearly understood that this is not done with the object or understanding that their respective governments are in any way committed to the proceedings of this convention, or that their presence is to be understood to intimate any conclusion whatever of that kind. Our whole program recommends that national governments are to hold a judicial position towards this whole enterprise until the full information has been judicially developed by means of scientific commissions, which both governments are requested to appoint. It is consistent with that attitude on their part that any representatives that they appoint here are understood to be merely complimentary, and also for the purpose of watching our proceedings; but in no way are these governments to be understood to be committed to anything we propose to resolve upon here. With that understanding I hope the convention will concur in the invitation to Lieutenant Blow and Mr. Monro to take their places upon the platform. (Applause.)

We shall enter now upon the program of papers and discussions for which we have assembled. We shall follow the program, announce the name of the paper, ask each gentleman if present, to come forward and give a brief abstract of his paper and open the matter for discussion. The convention will then be at liberty to discuss that paper under the rules. We hope discussion will be concentrated upon the more important subjects

D. R. McGinnis, of St. Paul, was called to the chair. He asked for discussion of papers in their order upon the official program.

He stated that some of the papers had been thrown forward from their proper places as arranged by the executive secretary, who, he understood, had aimed to assemble all topics of like character in the same group in order to concentrate homogenious experience and genius at one time on that group.

The plan had been admirable, but was now slightly disarranged which, however, would not detract from the value or interest of the feast. He hoped only that no one had been inconvenienced.

Frank A. Flower: Prof. Van Hise is not here to read or lead in the discussion of the paper which is now before us. With your permission I will say that, besides being professor of geology in Wisconsin university, he is connected with the United States geological survey. He is a very able man, and regarded as authority on mineralogy and mineral deposits. Therefore, I presume his paper will be not less effective if undiscussed, and we may properly let it stand as prepared.

Prof. Van Hise's paper is as follows:

The Effect of Deep Water Between the Great Lakes and the Sea in Developing Iron and Mineral Resources.

CHARLES R. VAN HISE, PH. D.,
Professor of Geology, University of Wisconsin.

Adjacent to or within a short distance of the Great Lakes there is a great variety of minerals and of building stones. The most important minerals are those bearing gold, silver, nickel, copper and iron; the building stones include the best qualities of limestone, sandstone and granite.

For many years small amounts of silver and gold have been obtained from the Lake Superior region. Recent developments northwest of Lake Superior promise a larger amount of these materials in the future.

Keweenaw Point in Lake Superior holds a place among the first three regions of the world in the production of copper, and in quality of its product it ranks first. Recent developments in the Sudbury district, north of Lake Huron, have added another district where copper is produced in important amounts near to the Great Lakes.

However, when we reach the subject of iron ore, the real importance of the lake region as a mineral producer appears. As it is well known, iron is the most important of the metals which the earth yields to mankind. It has sometimes been said that we could better dispense with all other metals than this single one, and this is probably not an exaggeration. Because of its remarkable strength and elasticity, and because of its abundance and cheapness, it is the metal which everywhere serves our most important purposes. Since 1890 the United States has been the most important producer of iron ore in the world. The quantity produced surpasses that of Great Britain, surpasses that of Germany and Luxemburg combined, and is several times as great as the production of Spain or Sweden. For instance, in 1891, in the United States there were produced 14,591,178 long tons of iron, while in Germany and Luxemburg together there were only produced 11,002,000 metric tons; yet the product for this year in the United States was less than the year before or the year following.

The large part taken by the Lake Superior region, in the vast production of iron ore in the United States, is shown by the following figures, taken from the Mineral Resources of the United States, for the five years from 1890 to 1894 inclusive. They give the product of the Lake Superior region, of the remainder of the United States, the total for the United States, and the percentage of the total contributed by the Lake Superior region:

	Lake Superior Region.	Remainder of the U. S.	Total for U. S.	Percentage of Lake Superior Region.
1890	8,944,031 long tons.	7,092,012 long tons.	16,036,043 long tons.	55.8
1891	7,621,465 "	6,969,713 "	14,591,178 "	52.2
1892	9,564,388 "	6,732,278 "	16,296,866 "	58.7
1893	6,594,618 "	4,993,011 "	11,587,629 "	56.9
1894	7,692,548 "	4,187,131 "	11,879,679 "	64.8

It is seen that the product for the Lake Superior region is more than half the total of the United States, and when it is remembered that the Lake Superior ores, both in richness or content of iron and freeness from phosphorus and other deleterious elements, surpass the iron ore from any other section of the country, it is safe to say that the value of the iron ore from the Lake Superior region is more than two-thirds of the whole production of the United States. While there was a reduction in the absolute amount produced in the years 1893 and 1894 from that of the three previous years, the recent revival of business has been promptly felt, and shipments up to the present time show that the production for the year 1895 will surpass that of any previous year. The new discoveries and developments of the present year make it probable that should the markets demand it there could be put on the market from the Lake Superior region in 1895 from fifteen to twenty million tons of iron ore.

It is clear that the United States for many years from this time is to be the most important factor in the iron trade of the world. Already the markets of the United States are scarcely entered by foreign supplies, except for special purposes which demand certain forms of manufactured iron, which do not use a great quantity of material. The large drafts of recent years upon the iron ore deposits of England, Germany, and Luxemburg have greatly reduced the quantity which is in sight; new deposits are not being rapidly developed or discovered; and already the iron masters of these countries are anxiously turning to other nations for their supply of iron ore. In the past Spain has been the chief foreign source of supply. I am informed by a professor in a German University, at the present rate of mining, unless new discoveries of iron ore are made, that the deposits of Bilboa, of Spain, the only district in the world which in output and purity could be compared with the single state of Michigan, will be exhausted within the next five years. It appears almost certain that the European manufacturers of iron must turn to central and northern Sweden for their ores. These must be carried a long way by rail before they reach the water. Also, while of excellent quality so far as deleterious elements are concerned, they are low in iron as compared with the Lake Superior deposits.

In marked contrast with the condition of affairs in Europe are those in the Lake Superior region. Never was there so much ore in sight as at the present moment. Five great ranges, the Marquette, Menominee, Gogebic, Mesabi and Vermilion, stand ready to supply all demands made upon them. Many deposits of iron ore have been developed in these ranges, the confines of which have not yet been ascertained In them many new deposits will unquestionably be discovered. On the Canadian side of the Lake Superior region, districts are known which contain large quantities of merchantable ore of excellent quality, from which not one pound has been shipped. Also it is not impossible that new ranges may yet be discovered within the United States.

The above facts lead me to believe that the United States not only will supply her own markets, but in the immediate future, under favorable circumstances, will take a larger and larger part in the colonial iron trade of the world. It appears perfectly clear that the supremacy of the mining of iron ore and the manufacture of iron has passed from Great Britain to the United States to remain for many years if not permanently. And since in the United States the Lake Superior region is the dominant factor, it appears to me to be beyond any doubt that this region is to be the most important in the production of this iron ore of the world for many years to come.

About Lake Superior there is a most excellent quality of brown-stone, which is being extensively quarried at a number of localities. Along the lower lakes at many places there are excellent qualities of limestone and sandstone, which are quarried in great quantities and shipped both east and west. Adjacent to Lake Huron and Lake Superior are great masses of granite of the widest variety of color. In beauty, strength and durability, many of these granites are not supassed by the standard grades produced from other parts of the United States. The granite industry in the Lake Superior region has been scarcely begun, but in the future it will without doubt be largely developed.

In handling vast quantities of material which must be put upon the market at a comparatively low price compared with its weight, as in the cases of iron ore and building stone, it is of paramount importance that there shall be cheap transportation. The cheapest transportation is always by water. The railroad can never hope to compete with the boat in cheapness. Already there are vessels upon the great lakes which, when fully laden, can not pass through the locks. If there were a channel to the ocean which would permit the passage of large vessels, this would furnish the conditions for the cheapest transportation of the great metalliferous deposits and building stone supplies of the lake region, and would render it possible to make it an even more important factor in the commerce of the world than it is at present Some will regard it as the highest good fortune, others will regard it as the result of design, that these great deposits of iron ore and these vast supplies of building stone are found so close to the world's greatest interior seas.

It is not, therefore, unnatural that genius, capital, enterprise and patriotism should unite to improve these wide waterways so as to make them of the utmost possible utility and benefit to the people and interests tributary to and served by them.

Chairman Crocker: We will now hear from Hon. Martin Pattison, of Superior, owner of the great Vermilion range Bessemer iron mines:

Effect of Deep Water From the Great Lakes to the Sea on Domestic Iron Mining.

HON. MARTIN PATTISON, FEE-OWNER IN CHANDLER AND PIONEER MINES,
Superior, Wisconsin.

Our experience shows that untried theories sometimes constitute as strong argument, or as reliable a basis for sound and correct conclusions, as those that have been tried and proven. It is from that standpoint my remarks are made in reference to the probable results of a ship channel that will open the great lakes to unobstructed communication with the Atlantic ocean.

I speak as one largely interested in the ownership of the Chandler and Pioneer mines on the Vermilion range in Minnesota. From these there will be shipped this year about 600,000 tons of iron ore. This is almost one-fifth of the whole output of all grades of iron ore from the head of Lake Superior, and about one-sixteenth of the entire product of the great Lake Superior district for the year 1895.

If I believed the opening of the great lakes to unobstructed competition with the rest of the world would injure or destroy my property, the natural instincts of self-preservation would drive me to oppose with all my power the vast enterprise advocated by the International Deep Waterways Association. But reasonable theories and the logic of ascertainable facts point the other way.

It is conceded that the greatest beds of high-grade ores in America lie in the Lake Superior region in the United States and Canada, directly tributary to our inland water system. To them, therefore, the principal iron and steel manufacturers on this continent must look for a large portion of their ore supply. Thus, inevitably, they are interested in our welfare, and in the probable effect of new conditions.

The present year's output of iron ore from Lake Superior will be about 9,000,000 tons. It is unnecessary to suggest that it is an enormous body of partially raw material. Where does it go, and what becomes of it? None but an insignificant part is manufactured in the region where mined. The nearest manufacturing points are Milwaukee and Chicago, from 300 to 600 miles distant by rail from the mines.

The bulk of the Lake Superior ore product goes to Lake Erie ports—Cleveland, Ashtabula, Fairport, Erie, and Buffalo. From these places it is re-shipped by rail to interior points—Allеghany City, Pittsburgh, Homestead, and other towns. There it is manufactured into finished articles, and again re-shipped on the railroads to wholesalers in the larger cities, and from them to retailers everywhere, till it finally reaches the consumers. Only an insignificant portion of it finds a market in foreign countries, because these interior manufacturers can not, after so many transshipments by rail, profitably compete with the products of other countries.

This is one of the great reasons why the trade of our foremost iron masters is almost wholly domestic. If there were an ample, free channel from the great lakes out to the sea, manufacturers could locate their plants near the mines, on the lakes, and there produce all the heavier forms of iron and steel, pigs and ingots, at figures which would enable them to compete successfully with any iron district in the world. I want to emphasize the point, without undue amplification, that the location of a furnace close to the mines is of great importance to an iron manufacturer.

The arguments in support of the position taken are too numerous to be treated in a space that would be reasonable in a gathering of this kind. They are such as are conceded to be in harmony with established principles. I shall refer to only a few of them.

Such a channel as this association advocates through the lakes will lower the cost of transportation and thus give ores to all consumers in the Ohio, Pennsylvania and other districts now depending on the Lake Superior mines for their supply, at considerably reduced rates—from 12 to 35 cents per ton below the present cost of carriage for lake freight alone.

This association demands twenty-six feet of water. The significance of such a channel is greater than we now fully comprehend. If we had a twenty-foot channel, safe, freights from Lake Superior to Lake Erie could be reduced about 20 per cent. A vessel carrying 2,000 tons on our present depth of lakes and canals could carry 3,000 tons on a draught of twenty feet. If the rate is now $1.00 per ton—that is $2,000 per cargo—the same craft carrying 3,000 tons on a twenty-foot channel, at 80 cents, would earn $2,400 per trip. This would give consumers a benefit of 20 cents per ton and the vessel owner a lump sum of $400, from which we should deduct $150 for trimming and extra fuel on account of the increased cargo, and there is still left $250, or 12½ per cent. more than a vessel earns per trip under existing conditions. Apply this proportion to the 3,000, 4,000 and 5,000-ton loads that vessels now afloat could carry on a deeper draught, and to larger boats, drawing twenty-six feet of water, and the great saving in the cost of carriage is seen at once and is almost startling.

With a twenty-six foot channel out to the sea, we could supply larger amounts of ores required on the Atlantic coast at rates which would in a short time exclude foreign competition. And we would thus increase the strength and prosperity of the country by as much money as previously went to pay foreign mine owners.

By this means the annual output of ore would be still further enlarged and manufacturing plants of high and low grades, according to conditions, more evenly distributed over the whole country as the result of cheap transportation. With it new fields for investment of capital would be made, the demand for labor enhanced and every artidle of iron and steel be cheapened and the ever-increasing use of iron in the arts wonderfully extended.

Next, we would invade foreign countries with our products of iron and steel, and consequently enlarge the field for American capital, labor and transportation. These benefits would not be confined to the United States alone; they would accrue to the Dominion of Canada as well. Cheaper transportation through the great lakes will stimulate the prosperity of the whole continent, and establish more permanently the happiness of all the people in North America!

In a conversation with Col. Joseph Selwood, vice-president of the enormous Minnesota Iron Company, on the subject of deep water from the great lakes to the Atlantic, he said: "I can see no interests that would not be ultimately benefited by the completion of such a grand enterprise. Had it not been for the deepening of the channels between the great lakes, provided by the government, there would be no cities or iron mining on the Marquette, Gogebic, Vermilion and Messaba ranges. Every increase in the depth of those channels enlarges the mineral output, lowers prices, cheapens transportation, and benefits the people."

That is the position of one of the greatest miners and iron ore merchants in the world. As an owner of iron mines, I unhesitatingly add to this my confirmatory judgment.

If, then, the great lakes channels could be deepened to their utmost available capacity and established out to the sea, it would be almost the final step in placing this continent where it could compete successfully in commerce and manufactures with all the nations of the earth.

God grant that I may live to rejoice in that day!

DISCUSSION.

Mr. Pattison: What I have heard in this convention has strengthened, not weakened, the judgment expressed in my paper as it stands. However, if I were to recast it, I should express a stronger belief than is therein stated that we could, with an unobstructed channel to the sea, not only cheapen high grade ore to all the furnaces on the Atlantic coast, but deliver it there at figures so low that it would easily take the place of the ores of any foreign district we now know of.

As to the suggestions coming from some part of the house here, that a free channel to the sea might allow foreign ores to come up to Lake Erie ports, and drive out our Lake Superior product—that is too silly to be discussed. A claim that Argentina would then sell wheat in North Dakota would be as sensible.

If the limitless mineral deposits tributary to the great lakes can have the amplest possible water transportation and an adequate outlet, no part of the world can match them in quality, quantity or price. (Applause.) I say that as an owner of mines. (Applause.)

Chairman McGinnis: C. E. Wheeler will now represent Mr. Moxham, the well-known iron master:

Ultimate Effect of Deep Water Between the Great Lakes and the Sea on Iron and Steel Manufacturing.

ARTHUR J. MOXHAM, PRESIDENT JOHNSON STEEL COMPANY,
Lorain, Ohio.

The ultimate effect of deep water between the great lakes and the sea, on iron and steel manufacturing, is entirely a matter of distribution of finished production.

It may be accepted as an axiom in manufacturing science that true comparisons are only obtained when prices are at their lowest ebb, and it is only by comparison that any general law can be reached. A naked fact standing alone, teaches but little. If we are told that Pittsburgh can make a steel bloom at $15.00 a ton, and are told nothing else, we have learned nothing. If we are told, in addition, that the eastern districts can make a steel bloom at $17.50 a ton, we know more; if, still further, we are told that the freight between the two districts is $2.00 per ton, we know all that is necessary, because comparison becomes a possible thing.

Close cost-sheets are not needed for our purpose: Trade is exchange: Exchange means movement from one spot to another spot. Through the whole civilized world there exist steady and continual tides or currents of trade, just as distinct as that of the Gulf Stream, and as powerful and certain in their action as that of the Mississippi river. E. G.: during the whole of the recent depression the Mahoning and Shenango Valleys poured their pig metal into Pittsburgh, and Pittsburgh poured its steel into eastern markets. During the same period, Chicago poured its steel into the west, and both Pittsburgh and Chicago found the current of their trade met in equilibrium in the central lake district. During this same period, eastern steel plants and blast furnaces were idle; swept silent for the time being by the current passing their doors. It needs no cost-sheet to prove that the central district was at this time making cheaper steel and iron; nor does it need argument to prove that the district tributary (as this district is) to the great lakes, is the natural home of the iron and steel industry of this country.

The first analysis does not stop here. What of the rest of the world in our comparisons? If we turn to the past, we have no current of trade outwards; but we have something else that is worth noting From 1871 to 1887 there was a current, and it was a steady one; there was no doubt as to its volume; nor any as to its direction. Its volume was large, its direction this way. This country was a steady importer of iron and steel from Europe. In 1887 this current slacked up; in 1892 and ever since it has been at a standstill to all practical intents, so far as staple products are concerned.

It is an old saying that "Nature abhors a vacuum." It is equally true that natural laws never stand still. When motion comes, which way will the current trend? For many years manufacturing cost in England and Germany has not decreased. Improvements in the art of making, improvements in machinery, have grown apace, and both reduce the cost. In spite of this the net result has been nearly stationary in prices. In England rails sold at $28.00 in 1880; twelve years afterwards (in 1892) at $26.25. This means that in England other costs have increased in corresponding ratio to the decrease due to improvements.

What has been our history?

Taking steel blooms, the largest steel staple free from pool influences: In 1889 the price was $35.00 per ton; during the succeeding years until 1894 the decline was steadily downward, till the figure of $15.00 per ton was reached. Even in rails, a strong pool has scarcely done more than regulate the steady progress of a decline; for in 1889 the price on rails was $34.00 per ton, and in 1894 it reached $22.00. In the interval, a stubborn and steady decrease. Is it not rational to predict which way the tide is to turn? Does it need any prophecy to say to-day that the United States is to be the future home of the iron and steel industry?

During 1895 we made pig iron in the Mahoning Valley at $9.50 per ton for Bessemer iron. An average English cost for the same period was nearly $9.90 a ton; the German cost still higher. Market changes may delay the turn of the tide—it will only be delay. A "boom" may flood this country for the time being with foreign products; but this is not of the question. The trend of the future, putting temporary disturbances on one side, is already pointed out and clear-cut.

For the next generation the great lakes district will be the controlling influence in the iron and steel trade of the world.

I have stated that the effect of deep waterways on the iron and steel business is entirely a question of distributive freights. The three component items that enter into its manufacture are iron ore, limestone and coal (in the form of coke). On the two former we already enjoy the benefit of a deep waterway; on the latter (coal and coke), nothing but a diversion of the route via Pittsburgh and Connellsville could influence the problem; and while a deep waterway in this direction is demanded, and will ultimately be achieved by the Pittsburgh district, it is not likely that an ocean route would be continued in this direction. The coal and coke haul is likely to remain as now for a long time to come. But on the question of the proper distribution of the manufactured product the problem of the deep waterway is of all-absorbing influence. The steel staples represent a low grade of railroad freight, and yet in 1894 this freight averaged about $2.60 a ton from Cleveland to the seaboard, or .43 cents per ton per mile. A manufacturing concern with which the writer was connected, shipped its goods over the whole United States from a fairly central point. Its average freight rate (on both long and short hauls) for 1894 was $2.17. The lake haul during the same period, on iron ore, averaged 80 cents for 825 miles, or about one-tenth of a cent a ton per mile, being only about one-fourth of the low-grade railroad haul. With all allowance for the increased cost of rails over ore and lockage over open lake traffic, it would be but reasonable to estimate that a cost of only \$1.30—if not as low as \$1.00—could be safely reached to the seaboard, or a saving of, say, \$1.30 per ton.

To measure the influence of such a reduction, it must be remembered that even the most favorably located steel factories were scarcely doing more than coming out even, during 1894, and many were operated at a loss. The effect of such a reduction in freights would be far reaching. On the low basis of 1894, \$1.30 per ton saved at the seaboard would have put, during this period of depression, a large part of the civilized world at our feet. It is well known that a decrease of a small amount in price enlarges a market far beyond its own percentage. Had we, in 1894, only increased our market 20 per cent., we would have had no panic so far as steel and iron were concerned. This is but a first effect; while the central district could have relieved the east from a competition that bore it down to temporary ruin, the east in its turn would have had other relief. On ore the deep-water freight would have been still lower than on rails; and such points as Sparrow's Point, Chester, Pa, and others, could have looked for ore at, say, \$3.60 per ton, instead of the \$4.50 that perhaps represented the average real price of foreign ore; to say nothing of the fact that the assortment offered by the lake ores makes them a cheaper mixture even at the same price.

To this must be added the immense saving of the transfers that to-day would be needed for export trade. As we have no iron or steel exports to guide us, we can only surmise what it would amount to. On grain the cost of transfer has lately been 1⅛ cents per bushel at Buffalo, while the lake freight from Duluth to Buffalo—the longest haul on this same grain—was 2¾ cents per bushel, and from Chicago 1⅝ cents per bushel. This is supplemented by a further transfer to ocean steamer at New York at a cost of 1⅜ cents per bushel; the two transfers thus equalling the freight on 800 miles.

In the above we have dealt only with periods of depression. In normal times the advantage of the deep waterway would be equally great. During 1894 the number of idle boats on the lakes was legion. It would have taken much courage to have anticipated a paying use for this tremendous fleet for many years to come; and yet at this moment—within one year—there is a scarcity of boats. It is estimated that without any contribution from the grain trade (now about to pour its volume on the lakes), there are not boats enough to bring down the ore that is needed for this year's demands. Many good judges attribute, principally, this state of affairs to the sudden advance in the price of steel and pig metal, which can not but be unhealthy because of its great rapidity. With open communication with the sea, such a state of things could not exist. Boats in small demand elsewhere would pour into the lakes, traffic be maintained on a free and healthy basis, and a great industry be relieved from being made a cat's-paw of mere chance. This, too, to the good of the lake marine. It is the false profit of a day, the will-o'-the-wisp of unnatural conditions, that creates that false relation between supply and demand which works injury to all, and builds for to-day a tonnage that may be idle to-morrow. Better for our lake marine to invite in the stranger to aid in the day of extra exertion, with the certainty of in his turn being able to share the stranger's mess of pottage, than to soar in the clouds at one turn of the hand only to stagnate in idleness the next.

To the railroads the deep waterway would be a boon beyond measure. While not admitted by the railroad fraternity, it is true that there has never yet been a well conducted system of waterway improvement that has not developed the adjoining railroads beyond all calculation; not only in relieving them from the low-grade, non-paying freight hauls, but in more than replacing the deficit by the higher grade freight that is needed for the miscellaneous wants of the increased population induced by more favored manufacturing of staples to locate along its line. Statistics are not needed. Take a map of the United States and count the number of railroad lines that run to and from all the seaports and every lake port of any magnitude. Compare these, at the same glance, with those of interior cities, and then ask what brings the larger number to those ports tributary to water. If it does not pay them why do they come there?

I can only conclude by urging that to the iron and steel trade of this country so great would be the advantage of the deep waterway that it would be revolutionary in its effect. So sorely is it needed that it is certain in its ultimate coming. More than all things else would it contribute to putting this country in its natural and proper place as the first steel producer of the world.

DISCUSSION.

Having by request read the foregoing paper in the absence of the author, Mr. Wheeler said: It may be interesting for you to know that the author of this paper, Mr. Moxham, has spent all the years of his manhood in manufacturing iron—first in Louisville, Kentucky; then in Birmingham, Alabama; then in Johnstown, Pennsylvania, and now at Lorain, Ohio, twenty-six miles from here. The chief significance of this paper is the fact that it is his authoritative declaration why he has been drawn to the great lakes for the manufacture of iron—to secure cheaper transportation. It comes to us as the conclusions of close study and large practical experience in iron and steel manufacturing. Nothing could give me greater pleasure than to read this paper—except to hear Mr. Moxham himself read it.

George W. Blasdel, Waverly, Ohio: I wish, in relation to Mr. Moxham's paper, where it says there is scarcity of tonnage, to say that scarcity is largely the result of the shoal waters in the connecting channels. I think all freights could be reasonably accommodated if there were water enough in the connecting channels to permit the great lake carriers to load to full capacity.

The Necessities and Advantages of a Ship Canal to the Ocean.

DENISON B. SMITH, TOLEDO, O.,
Secretary Toledo Produce Exchange.

Two important topics now conspicuously engage the commercial mind of the west. One is, the deepening to twenty-one feet the connections between the lakes, thus increasing the depth and the capacity of the carrier and decreasing the cost of transportation. The other is, the project of a ship canal between the lakes and the seas of the world, and thus greatly reducing the cost of reaching the old world markets with our surplus food and manufactured products.

In the last two or three decades there has been a decided awakening to the study of the transportation problem in a broader degree than has characterized public attention at any previous period in our history.

The growing i[illegible] in this great question is signalized by schemes for ship canals in [illegible] rections. Duluth and Superior have adopted one. Chicago is building one. A project, sixty years of age, for a ship canal from Lake Michigan to Toledo, has recently been revived by interests outside of Toledo. Several routes are new being surveyed for a deep canal from Lake Erie to the Ohio River. Not all of these will command the immediate aid of the government; and, in my judgment, New Orleans is neither the cheapest, most expeditious, nor favorable export route for the west and northwest.

I need not attempt here to schedule the inspirations to this devotion to transportation routes. The matchless growth along all lines of trade, commerce, manufacturing and agriculture, are well known to you; and we have come to a period when the study of the subject in correlation with these grand developments has led the public mind to expect that enterprises that are clearly necessary for the protection of the great interests involved will command the support of capital and the aid of the government.

The last half of this century has been marked by grand movements in thought and deed, but the succeeding fifty years may teach the lesson that we are now only on the threshold of triumphs but well begun. This surprising growth along the lines of commercial and mercantile life is not simply American, but world-wide, and in a sense competitive. It has disclosed, on our part, the necessity for cheaper freight cost to the markets for food, ores, coal, lumber, and all descriptions of merchandise. This necessity has successfully challenged grand conceptions and intrepidity in execution. It is an age of processes. Manufacturing and trading seek great combinations. Mining and other property is marketed at immense sums of cost. Transportation demands the largest carriers, and the ships of the lakes are enlarged more rapidly than the depth of their natural element.

It has been written that the course of events is frequently quite indifferent to the reputation of previous prophets, but our past and present progress point with unerring certainty to a greater future and no student of commercial growth can mistake their import. I seek the mantle of a prophet when I state that the interesting and startling contrast between the present and fifty years ago, in growth and progress with its natural results in more supreme conditions of wealth, enlightenment—the conquest of space, and the closer approximation of the peoples, is but the dawn of greater achievements; that the Providence of God will lead this great land of ours, and all the English speaking race, to a period of higher commercial, and all other peaceful prosperities—in science, art, fraternal love, and love of righteousness, than the world has ever seen.

The yearly increase in the size and draught of the lake marine presents an interesting proof, that increasing commerce is the sure stimulant of growth in the ship. This evolution greatly exceeds that of the railway car in point of actual carrying capacity even at the present depth of water in the harbors of the lakes.

The maximum capacity of lake vessels twenty years ago was 50,000 bushels of wheat, or 1,500 tons, while the present maximum cargo is more than 100,000 bushels of wheat, or more than 3,000 tons. But this cargo of 3,000 tons can be considerably and profitably increased by the same vessels when our lake connections and harbor depths are increased to permit a draught of twenty feet, which is contemplated by the present harbor improvement law. This depth of water will increase the cargoes of the steamers referred to, to 4,000 tons. In anticipation of this increased depth and the new lock at Sault Ste. Marie, we are already building steamers of 400 feet in length, and, at twenty feet depth of water, a carrying capacity of 6,000 net tons. To me, this growth in our lake ships is the most astonishing of all the commercial surprises of our times, and reflects unfading luster and credit upon the confidence and courage of the projectors.

The growth of the ocean carriers has also been remarkable, but not in the ratio of the lake steamers. I am indebted to Messrs. Rice, Quinby & Co., of New York, for very valuable information on this point. In 1873 nearly all the export trade was done by sail vessels, carrying 24,000 to 40,000 bushels of wheat. Now almost everything goes by steam, and the cargo is 64,000 to 80,000 bushels of wheat. Of course, there are larger carriers and equal to 112,000 bushels, but they are the exceptions. There are also steamers for mixed cargoes of still greater capacity, but the grain cargo is quite as I have described.

A very interesting and surprising feature of the lake and ocean transportation is the entire revolution in the motive power from sail to steam. The development of our coal mines, under the influence of coal railways and greatly reduced cost of freight to the great centres of trade, has so cheapened this fuel as to outstrip in economy the winds of the lakes and ocean. The transformation on the ocean is illustrated by the fact that in 1893, 1,028 grain cargoes cleared from New York, 1,025 were by steam and three by sail.

Mr. Wm. E. Ferguson, of the New York Produce Exchange, states that the exports of grain from that port in 1893 equaled 55,768,723 bushels, of which 55,597,299 bushels was shipped by steam, and 171,427 bushels by sail. This quantity of grain was transported from New York in the ships of all nations except our own. Not a cargo out of 56,000,000 bushels was carried under the stars and stripes. It illustrates the decay of the American ocean marine, while on the lakes a glorious prosperity has marked its history for forty years and yet it is a march of triumph.

The inspiration to the project of direct connection between the lakes and the oceans can be traced to the growing contests between our own and foreign countries for supremacy in furnishing supplies of grain, flour, provisions and live animals to the importing markets abroad. The great grain fields, and the almost limitless areas for stock feeding in the west, south and northwest were seen to be four or five thousand miles from the markets that must consume their surplus, and the key to successful competition with other exporting countries was hidden in the reduction of the cost of transportation thence to the lowest possible point. The world is growing, and conditions change. A few years since the United States supplied a large share of the requirements of all importing countries. We have lost this supremacy. The exports of wheat, and flour expressed in wheat, from the United States for a series of years, have been as follows—the export years ending June 30:

In 1894-5	Equal to	143,000,000 bushels.
In 1893-4	" "	162,000,000 "
In 1892-3	" "	187,000,000 "
In 1891-2	" "	219,000,000 "

In corn as grain we have rarely exported as much in a year as 100,000,000 bushels, but in the export of cattle, hogs and provisions corn is a very large element. The export value of commodities in which corn is, more or less, an element, has been about $170,000,000 per annum until some of the states commenced an unfair discrimination against us.

Of oats, rye and barley our exports are quite unimportant.

And now I review, in like manner, the movements of grain from other exporting states, and showing a marked contrast in growth over the periods I have named. The Russian crop year closes August 1. The exports of grain for three years have equalled in bushels as follows, viz:

	1894-5. Bushels.	1893-4. Bushels.	1892-3. Bushels.
Wheat	133,000,000	104,000,000	74,500,000
Rye	52,000,000	31,000,000	11,500,000
Oats	67,000,000	88,000,000	11,500,000
Barley	85,000,000	96,000,000	48,000,000

Of wheat, 418,720,000 bushels was imported by foreign states in the year ending August 1, 1895, of which this country furnished but 143,000,000 bushels, or 34 per cent.

The increased movement in 1894-5 over the year 1892-3 is 58,500,000 bushels, and is very notable. In Russia the bread grain is largely rye, and when the price at the importing market justifies, a large portion of the wheat production is exported. The possibilities for production in this great empire inspire a sentiment of grave concern. Her range of productive area, when reached by advancing railways, is almost illimitable. Her Siberian railway projects may be relied upon to immediately increase her wheat and rye exports.

The present rye crop in Russia is 800,000,000 bushels. Besides her consumption of it for bread, she exports it largely to other rye consuming states, where it comes in competition with American wheat.

The Argentine Republic furnishes another and very interesting illustration of the growth and export of grain. Very recently no surplus was produced in that country, but to-day Argentina promises to become a very important competitor as an exporter. Previous to 1892 the exports of wheat from that state were quite unimportant. Since that period the growth has been well worthy your present thought and consideration, for this state also presents enormous possibilities. It has been recently stated that "The total area of the Argentine Republic is about 1,212,000 square miles, and the area of land for cultivation is estimated at 375,000 square miles or 240,000,000 acres. The land under cultivation is said to be only 10,000,000 acres. If half of the supposed suitable land were to produce a crop of 10 bushels of wheat per acre, the result would be 1,200,000,000 bushels, which is about half of the estimated wheat crop of the world."

Their crop year commences January 1, and here is a summary of the movement of wheat from January 1 to August 9 for three years:

1894-5	35,000,000 bushels.
1893-4	46,000,000 "
1892-3	27,700,000 "

The decreased movement in 1894-5, compared with 1893-4, is accounted for by very unfavorable weather conditions previous to harvest. The acreage was greatly increased, and with propitious weather, their exports would have equaled 75,000,000 bushels, compared with 46,000,000 bushels in 1893-4.

The exports of corn have before this year been inconsiderable, but now Argentina is shipping to England at the rate of 1,200,000 bushels per week.

These statements represent a gain of 115,000,000 bushels of wheat since 1892-3. In addition to the above, the exports from India average 40,000,000 bushels and Australia 9,000,000 to 12,000,000 bushels. Various smaller European states are exporters to an aggregate of 50,000,000 bushels.

I appeal to these statements as a grand summary of necessities for cheaper access to the consumers of the world. These adverse conditions will continue to augment, and must be met by such decrease in the cost of reaching the consumers as will discourage production abroad, while it expands the area of our own grain fields.

The opinion is held, more or less generally, that we have nearly reached the limit of our productive domain. It is a very erroneous sentiment. The area now under cultivation is treated with the most slovenly neglect. The average product of wheat everywhere can be doubled by fertilizing, at a small cost, and a little more application of labor; and, besides all this, a recent government statement gives us an immense addition of area that may become productive by irrigation. Under suitable provocation the United States can produce 1,000,000,000 bushels of wheat, and of other food-making crops in proportion. Extensive areas in all the old producing states are now profitless, but at justifiable prices for the product, can be relied upon as important producing elements.

It is hardly necessary for me to state here the accepted theory that American agriculture is the corner-stone of prosperity to all interests. At no period of our existence has this right arm of our life been so prostrate as in late years. The product of the fields has yielded to the husbandman and his family but the scantiest support. His purchases and consumption of whatever the farm does not produce have been regulated by the most pinching economy. As one [illegible] reason for the late world wide adversity, this condition of our agricultural population was overlooked, or greatly under-estimated. When the farmer cannot buy freely of the merchant and the manufacturer, the cumulative effect of this scanty dealing spreads backward over all traffic. What is the cause of these low prices? It is, as I have said, nothing more or less than the increasing competition in agriculture around the world, and a production for a series of years in excess of the world's consumption. But we cannot cease production. We must increase it steadily. We have a large unemployed labor element, and we must point them to the vacant fields for support, and provide the most prompt and economical methods of reaching consumers with our surplus products.

But agriculture is not the only interest to be aided by a ship canal. It will strengthen and promote all the great interests of the west. It will reduce the cost of moving our manufactured products outside of our own domain to foreign markets, and thus expand the area of consumption. When we recall the fact that, under full employment of our facilities, we can manufacture in two years all we can sell in three, the force and effect of a radical enlargement of the market needs no further comment. In time, and with organized lines of carriers, the fruits and other products from our Pacific coast as well as the tea from the Orient will find this the quickest and cheapest route to the markets of the old world. Under such organized lines of carriers the return trips of our ships may be made as profitable as the outward bound. The importers of merchandise for the west and southwest, will also find this to be the most expeditious and and economical route. It will be the parting of the ways in many an important avenue of traffic. There is no sentiment in trade and commerce. It will be a question of economy of time and expense.

Permit me to present a few strong reasons for anticipating a low outward carriage cost by even a twenty-one foot waterway from Lake Erie to the Atlantic Ocean.

We already have steamships that could transport 6,000 tons in such a draught of water. That equals 200,000 bushels of wheat. The prevailing rates of freight on coal from Buffalo to Lake Superior ports this season have been 25 cents per net ton, and 35 cents from upper ports on Lake Erie. The freight rates on ore from Lake Superior to Lake Erie ports opened this year at 65 cents. Since harvest the rates have advanced to 90 cents. Last year the average ore freight from all points was near 65 cents per ton. The average round trip, with cargoes both ways, including loading and discharging, occupies two weeks. Assuming a cargo which will be an average one when the deep-water lake connections are completed, say 5,000 tons, and also assuming an average coal freight of 30 cents, and an average ore freight

of 80 cents, and the ship will earn in a round trip, $5,500.00. Five thousand tons equals 166,000 bushels of wheat. On a trip to Liverpool, giving the ship time corresponding to the lake round-trip with 166,000 bushels of wheat, and her corresponding earnings would equal 3⅓ cents per bushel on wheat, and 3 14/100 cents per bushel on corn. It is a startling proposition to engage to transport wheat from Duluth or Chicago to Liverpool at 3⅓ cents and corn at 3¼ cents per bushel. But it seems reasonable. I can discover no strong reasons for expecting much higher lake freights in the future, and I do not see how they can decline. The export rates quoted as an equivalent, are not based upon experimental trips, but illustrate what is likely to occur on a fairly established and adjusted system of outward and inward bound commerce. I feel justified in my estimate by a Pacific coast illustration: I have taken from the San Francisco "Commercial News," the reports of 37 ships chartered on that coast to transport wheat to England. These charters cover some weeks, and are a fair index to the Pacific coast cargoes. The capacity of these 37 ships was 2,336,000 bushels, or an average of 62,000 bushels each. The average freight is 26 cents per bushel.

The average trip outward bound is four months, which is eight times greater than I have given steamers from the lakes. Eight in twenty-six gives 3¼ cents a bushel as a parity with the San Francisco trip. Of course there is more time in port, more loading and discharging cargo, and the fuel is an added cost, but the lake steamer cargo will average twice the size of the Pacific ship, and if the latter is gainful at the compensation, the former should be largely so. It is, then, to my mind, too obvious for dispute that the great commerce in cereals, flour, meat, and the great and increasing manufactured products of all the great western states, must follow this cheap route to the sea and a foreign market. The great flour milling interest would receive a fresh impulse by a freight cost of 15 cents to 17½ cents per barrel from the lakes to the old world. The importance of flour in the commerce of the lakes and ocean is disclosed by the fact that of our exports of wheat and flour, equal to 143,000,000 bushels in the year ended June 30, 1895, more than 67,000,000 bushels of it, or 47 per cent., was in flour. The cost of moving provisions from Chicago to the European markets will be reduced from the present rate of 32 cents per hundred pounds to 8 cents or 9 cents. The cattle upon a thousand hills and valleys are now transported from Chicago to England at a cost per head of about nine dollars. I estimate a freight of five or six dollars per head as a fair equivalent to other cargo prices.

Will such a work deflect largely from organized railway corporations? I respond, that the growth of this country may be relied upon to furnish such a new highway with a commerce of its own. If it serves as a check to that spirit of American enterprise that manufactures railways, first for sale, next for the hands of a receiver, we may not regret it.

But there is one great impediment to a successful outward-bound grain cargo in the inadequate facilities at foreign ports for discharging them. English and other foreign methods are absurdly antiquated and unworthy the active spirit of the age. Until this delivery of cargoes is made more prompt, England will interpose a barrier to cheap freight on her own food.

On the subject of a route for a ship canal, I am willing to yield to conditions that may be developed by surveys. On fairly equivalent conditions, I am in favor of an American canal to the Hudson River; but if international agreements can be made, and our government will appropriate money towards the completion of the Canadian system at a much earlier date than will be required for an independent undertaking, thus saving 300 miles of distance, public opinion in the west will acquiesce in such a settlement of the question.

In a concluding paragraph, let me offer some thoughts lying outside the domain of profit-carrying cargoes. It is a procession around the world of swift, beautifully modeled, staunchly built and thoroughly equipped American freight steamers, with the American flag at mast-head, and reversing the New York statement I have just read of exports in 1893 in 1,025 ships, and not one of them flying Old Glory. That this is sentiment, needs no supporting evidence; but it is mighty good sentiment, and reaches and touches the patriotic spirit of every true American. There is a fascination in the ownership and management of beautiful vessels. It outstrips the love of horses, and is in close analogy with the love of woman. But there are phases of this grand pageant far more interesting and important than mere sentiment. Our ships can roam the world-wide seas for a winter campaign, entering the competing strife with other flags.

We can hardly grasp the thought of our ships extending their trips to Argentina and to Odessa, as well as to our Pacific coast and the Orient, when the Nicaragua Canal is completed with coal stations on the isthmus.

At the late German canal celebration the Emperor is said to have uttered an enterprising and progressive sentence, that "The seas do not divide, they connect."

A still more important suggestion comes to me: I believe we can build, at our lake ports, these great freight ships, in competition with the world, and for the world. The cheap ore for steel—the cheap coal—or if wooden ships should again be wanted, our forests of hard and pine woods—furnish the basis of a greatly expanded ship-building industry around the lakes. The cost of iron and wood workers on our ships is greater here than abroad but it is worth more, and accomplishes more. This reliance upon the evolution and triumph of our lake marine is by no means new with me. Three years since, in the National Board of Trade, when the seaboard members were advocating a subsidy for American ships, I said a ship canal and ship building on the lakes would cover all necessities of subsidy.

I want to live to see this panorama of American lake steamers carrying the stars and stripes on the oceans of the world, and that international commerce that will unite the great western empire of this country with the peoples of the old world in the bonds of a trade reciprocally profitable—the sure harbinger of lasting peace, prosperity and happiness.

REMARKS BY MR. ANDERSON.

Chairman McGinnis: I will call upon Mr. Anderson from Pittsburgh to open the discussion of Mr. Smith's statesmanlike address.

George H. Anderson : I am honored by being called to discuss this splendid paper, but I am unable to deal with the subject as it deserves. I think no one will find any fault with me when I say that the excellence of the paper is only surpassed by the polish and style of its delivery. The deep, broad sentiments enunciated by Mr. Smith are in full accord with my views. In Pittsburgh we heartily endorse these sentiments. We are in hearty sympathy with this deep waterway movement, whether it is to connect the great lakes with the ocean, or the waters of Lake Erie with the waters of the Ohio river. We have laid aside in Pittsburgh a sum of money for the purpose of settling once and for all, by the best engineering talent this country affords, the question of a practical deep waterway connecting the Ohio river with Lake Erie, and to determine whether such a system is practicable, and whether the interests of commerce will justify it. Therefore we are ready to join hands with everybody in like great enterprises.

ANNOUNCEMENTS BY MR. FLOWER.

Frank A. Flower : It may clear up and simplify the progress of our program to announce the fact which has just come to me, that Senator Hansbrough cannot be present with his paper. But he sends word that officially at Washington, personally everywhere, he will do all in his power to advance the cause of our enterprise. And, gentleman, I have found votes more effective than speeches. I may state further that ex-Congressman Wheeler, the Michigan shipbuilder, is detained by hay-fever, the attack being so severe that he was even unable to prepare and forward his paper, which we all know would have been from a practical standpoint. Dr. Shaw, the eminent reviewer and political economist, has been kept at home by illness, and Editor Rosewater, of Omaha, sends word that he regrets that he is unable to be present, but that when it shall come to work he will join us in putting his shoulder to the wheel.

Chairman McGinnis : We will then listen to a man who has worked early and late in behalf of a deep water channel from the great lakes to the sea, Mr. Fisher, and who, though not personally interested in vessels or transportation, has spent a small fortune in advancing the cause for the benefit of his people and province, of whom he is very proud, and in whose behalf his best effort is never wanting :

Volume and Value of Commerce Tributary to an Enlarged Waterway System.

JAMES FISHER, Q. C., M. P. P.,
Winnipeg.

In furtherance of the important object for which the International Deep Waterways Association was created, it was scarcely necessary, perhaps, that anyone should have been charged with the task of preparing a paper discussing the volume and value of the commerce tributary to an enlarged waterway in connection with the great lakes route. If there is one subject more than another in the interesting programme before us upon which not only members of this association, but the public at large, are already pretty fully informed, it is surely this one. Thanks to the activity and enterprise of an omnicient press, everywhere circulated and universally read, the means of knowledge upon this subject are always at our disposal. Day after day the newspapers and other periodicals furnish us with facts and figures bearing upon the growth of commerce due to the past enlargement of the water channels. These facts and figures are put up for us in the most expressive form that the wisdom of the brightest minds can suggest.

Our blue books and public reports supply them in full detail. Our trade returns and commercial bulletins are laden with statements brimfull of information on the subject as instructive as it is complete and accurate. Expert statisticians and learned political economists present us every day with statements classifying in every variety the fruits of our soil and the products of our industries.

They exhibit the growth of our farming interests; the development of our mines; the product of our fisheries; and the yield of our forests, as well as the outcome of our extensive manufactories. They chronicle for our edification the movement of all these products, and the cost thereof, by sea and land, over lake and rail. They furnish us with comparative statements of results in the pursuit of each department of industry under every conceivable condition. They deduce valuable lessons for our guidance, drawn from an expert study of the various causes, natural, political and economic, that stimulate or retard production, raise or lower prices, and lessen or increase the cost of hauling and marketing. From helps such as these, we have already such a knowledge of the commerce under discussion as convinces us that the greatest need of the day in connection therewith is cheap transportation. It convinces us, too, that the greatest factor in securing that cheap transportation, in the United States and Canada, is the improvement of our means for transportation by water.

Interest in our proceedings to-day chiefly centers, therefore, not in the subject of this paper, but rather in the discussion of questions affecting the practicability, cost, capacity and means for construction, of deeper channels along the different routes that may be suggested. But our irresistible executive secretary decreed that such a paper as this must be prepared. And how could a loyal Canadian, trained to the habits of submission that life under monarchial institutions inculcates, fail to obey the fiat of the persuasive gentleman from Superior, who is indeed the very life and soul of our growing movement, the "Flower" of our association.

I undertook the task, therefore, realizing, however, that at all events it involved no original research or painstaking investigation on my part, but simply a few hours' delving into the magazines and books and a wholesale appropriation of the labor of others.

It is not my purpose to submit any long array of figures or to produce elaborate statistics touching the extent of the commerce of the lake region and its connections. I will simply mention a few salient facts, of a general character, touching its growth, and call attention to some significant features in connection therewith, and with the conditions of that region, that may serve to emphasize the great importance not only of enlarging the channels leading from the lakes to the sea, but of eventually extending a system of canals farther into the interior.

When one looks at the enormous movement of commerce on this continent, and makes a comparison between this and other lands, one of the first thoughts that strike him is the vastness of our domestic commerce. Especially is this true of the United States of America. There is no country in the world that has such an extent of domestic traffic as you have in this favored land. The remark is fairly true also of Canada. In the two countries we have a population of about 75,000,000 of souls, composed of the busiest peoples, the most progressive communities, and the most intelligent artisans and workers on the face of the wide earth.

The product of all the industries carried on by a population so large and of such a character, is necessarily greater than that of an equal number of less progressive peoples. The wants of such a people, too, where civilization has attained its highest form and where wealth has largely accumulated, are equally great in comparison with less favored countries. Altogether, the conditions in this country, on both sides of the boundary, are such as to create an extraordinary movement of commerce for domestic purposes alone.

The foreign commerce is also proportionately large. Perhaps we do not realize the extent for instance to which our two countries supply the markets of the great consuming nation of the world—Great Britain. Canada, I may say, is a very heavy exporter to the mother land. And in the four years from 1890 to 1893 inclusive, the imports of the United Kingdom, from the United States alone, equalled those from France, Germany, Russia, Italy, China and Brazil all put together. They exceeded by nearly

$80,000,000 the imports in the same year from all the British possessions in the world, Canada included. As the years roll on Britain purchases from our two countries more and more. Comparing her imports for the four years named with those of the next preceding four years, those from Canada increased more than 60 per cent. and those from the United States over 25 per cent., while from nearly all other countries they decreased by comparison.

These remarks as to our trade generally are applicable, of course, to the entire country. But they are applicable in particular to the region whose products and supplies are in such great part carried over the lakes.

There is a further important fact, one which applies especially to the lake region. It is that the greatest development of trade, in the future, both in the United States and Canada, must be in the region tributary to the great lakes. The commerce of all parts of the two countries will no doubt greatly increase in the future as in the past. But we may look for the greatest increase of all in the region on both sides of the boundary tributary to the lakes and their connections: It is in this region that we have seen production and traffic increase at so phenomenal a rate within the past two decades. And yet production there is still in its infancy. The records of that period serve to give us a faint idea of what the traffic will be at the end of another ten years.

How short has been the time since the great northwest was an unknown wilderness! The red man but recently held undisputed sway over the districts where now the magnificent fields of yellow grain furnish a sight such as can be seen in no other part of the world. The hunters who a few years ago chased the buffalo on the prairie, are still alive to herd the cattle grazing on the same grounds.

Michigan but a short time since was one of the states of the far west; Chicago was first reached by a vessel from the lower lakes in 1834. The boats that passed the city of Cleveland, down to a period less than sixty years ago, were engaged, not in shipping the products of the great west to the eastern market, but in carrying provisions to the newly formed settlements beyond Detroit. The first cargo of grain from Lake Michigan reached Buffalo in 1836. The lake trade soon developed however, and Michigan ceased to be a border state.

The settlers in Indiana and Illinois were the pioneers of a period a few years later, and soon a few plucky adventurers made their way into Iowa and Wisconsin, their friends whom they left behind committing them to the care of heaven and their trusty muskets against the attacks of the savages around their new homes. The present generation has seen the occupation and development to some extent of the Dakotas and Minnesota and of the Canadian northwest. And what has been the result, so far as commerce is concerned, of the occupation of these western lands? The records of the lake traffic during the past 20 years furnish the answer.

Let me present a few figures comparing the traffic for some years through the Sault canal, opened in 1855, with that passing the Suez canal, opened in 1870. The statement is as follows, round figures being used:

Year.	Sault Tonnage.	Suez Tonnage.
1855	100,000	....
1865	400,000	....
1875	1,250,000	2,000,000
1880	1,750,000	3,000,000
1885	3,250,000	6,350,000
1890	9,000,000	6,850,000
1892	11,200,000	7,700,000
1894	13,200,000	8,000,000

To realize the full meaning of these figures we are to bear in mind that the commerce of the Sault is that carried to and from the ports of one only of our great lakes, and that one the most remote of all, and the one whose ports supply those regions in the United States and Canada that have been most recently, and are now most sparsely, settled. The Suez, on the other hand, is the great highway from the British and other European markets to the Orient and to Australia, carrying the commerce of continents. Again, the Sault is open for an average of about 220 days in the year, while the Suez is open every day of the 365.

A striking feature of the lake traffic, suggested by the same figures, is seen in the marvelous strides by which it has increased from year to year. In 1875, 1880 and 1885, and during all the intervening years, the tonnage of the Suez was much larger than that of the Sault. It was in later years that the proportions were reversed until in 1894 the Sault traffic exceeded that of the Suez by more than 50 per cent.

Other illustrations may be given of the immensity of the lake traffic and its marvelous growth. The following figures, for example, represent the tonnage of iron ore produced in the Lake Superior region, nearly all of which was carried down the lakes, for the years named, in round figures:

1878	1,000,000 tons.
1883	2,500,000 "
1887	5,000,000 "
1890	over 9,000,000 "
1892	over 9,000,000 "

The figures for 1893 and 1894 were somewhat smaller, arising from a well-known cause. About 55 per cent of all the iron ore produced in the United States is now carried over the lakes. A remarkable fact to be noted in this connection is the small proportion carried by rail as compared with water. In 1890 the quantity taken by rail from the mines, on the American side of Lake Superior, was less than 850,000 tons, as against 8,000,000 tons and over taken by the lakes.

How far, again, has the development of the iron industry in the northwest been due to the existence of our great natural highway, and the consequent low rates of transportation? Do we not all realize that, but for the advantages of this route in the cost of carriage, this great industry of the Lake Superior district would never have attained such magnificent proportions? In these times of close competition the slightest increase or decrease in freight rates may revolutionize trade; may build it up or destroy it. I have seen it recorded that in 1890 and 1891 more than thirty of the smelting furnaces in Ohio and Pennsylvania had to be closed for several months because the railway companies could not give them a reduction of 25 cents a ton in the rates for transportation of coke fuel.

The closing of the Sault canal for a few months would paralyze the iron ore industry on the shores of Lake Superior for a whole year. The permanent closing of that canal would mean the closing up of the greater part of the mines. Had the capacity of that canal not been increased in 1881, the rates of freight would never have been reduced to their present figures, and that industry would never have been fully developed. What will be the future of the traffic in iron ore, and what its effect on the development of the northwest if the deep-water channels are extended to the ocean and, say, to Pittsburgh?

How suggestive of an increased trade therefrom is the fact that more than 100,000,000 tons of ore are in sight in the mines already opened on the Mesaba range alone!

The growth of the lake commerce is as marked in other products as in ore. I have said that the first cargo of wheat that ever went from the upper lakes was carried from Lake Michigan ports to Buffalo in 1836. The total receipts of wheat for the years named in Buffalo was as follows:

1836	500,000	bushels.
1846 (including flour)	6,500,000	"
1856	20,000,000	"
1866	52,000,000	"
1886	72,500,000	"
1891	164,500,000	"
1892	182,000,000	"

The wheat alone carried through Detroit river in 1893 was 70,500,000 bushels, and of flour there was carried 9,500,000 barrels. Speaking of the Detroit river suggests a few figures giving at once another instance of the marvellous growth of the lake commerce and its advantages over rail transportation. These figures are taken from the table compiled by L. E. Cooley, and do not include Canadian traffic:

COMMERCE OF DETROIT RIVER.

Year.	Tonnage by water	Tonnage by rail.
1883	17,695,174.	3,087,204.
1886	18,968,065.	3,196,032.
1891	23,209,619.	3,971,776.
1892	26'563,819.	3,820,382.
1893	23,091,889.	3,659,292.

As long ago as 1889, according to an estimate published by the late Geo. H. Ely, the entire freight passing through the Detroit river was more than three times the foreign trade of the port of New York; it exceeded the aggregate foreign trade of all the seaports of the United States by 10,000,000 tons, and it exceeded by over 3,000,000 tons the total foreign and coastwise trade of Liverpool and London combined. The wheat received at Montreal in 1893 by the Lachine canal and St. Lawrence river, was about 7,000,000 bushels as against less than 130,000 bushels brought in by all the railways.

These facts give us some idea of the past development of the lake and river traffic, and it does not surprise us to be told that the entire commerce of the great lakes, American and Canadian, is equal to 25 per cent. of that carried by all the railroads of the American union. What is that commerce going to be in a comparatively few years when the present population of the great northwest shall be doubled, trebled, or quadrupled, when all the productive prairie lands shall be brought under cultivation, when all the rich ranges shall be stocked with cattle, and when the rich mining districts on the Canadian side may be as fully developed as those on the south shore of Lake Superior?

Col. O. M. Poe, chief engineer of the Sault canal, writing, early in January of 1891, his report urging the completion of the twenty-foot channel from the head of the lake to Buffalo, after describing the wonderful expansion of the lake traffic up to that period, used the following language, which can aptly be used to-day in support of a demand for the extension of such a channel, and even of a deeper one to the Atlantic ocean: "Surely such a commerce deserves every aid and encouragement that can be given to it. Give it a channel practically navigable upon a draught of twenty feet and it needs no prophet to predict a wonderful growth, but only a prophet could foretell its degree. For nearly thirty-five years I have watched its increase, but neither I nor anyone else within my knowledge has been able to expand in ideas at the same rate. The wildest expectations of one year seem absurdly tame the next."

And so it is still. Let the 20-foot channel of the lakes be extended from the foot of Lake Erie to the Atlantic, and commerce will receive an impetus that will give results as startling as the unparalleled progress of the past. And it will result in a great development of the rich northwest on both sides of the line.

I care not in what direction you may reach in the first place to Lake Ontario—whether it be by the Welland, deepened to 20 feet, or by a new channel through the state of New York. The result, in either case, will be the same. I, as a Canadian, may have a preference for the Welland; but that would only be in so far as I could be convinced that it really afforded the best route. If a new channel can be opened to as good advantage, and at less cost, then let the new channel be opened, and let both countries join in the work. Canada's expenditure in the past can be considered in fixing the amount which she should contribute.

I care not, again, whether we are to reach the salt water by the St. Lawrence, or by a new route from Oswego to Albany, or whether we get to the Hudson by Caughnawaga. All that this convention should, in my judgment, ask is, that by one or other route the two countries should unite in providing a deep channel. It is for us, at the same time, to elicit and make known the fullest information that can be obtained, showing the advantages and disadvantages of each several route.

Let us have a full discussion, right here, of every consideration that favors one route or other, in order that the governments and the people of the two nations may be well informed. But this convention is not, nor is this association, an executive body having power to act. Be it ours to agitate, and to educate and inform the public as to the advantages of the scheme generally, and as to the merits of each individual route. With the national executives of the respective nations must be left the responsibility of propounding, and with the congress and parliament the responsibility of ratifying, in the end the scheme that on the whole may commend itself to the public. What I take leave to urge is this: We are seeking an improvement in the natural water channels. It is an international waterway supplied by nature for the material good of the two nations from the head of the lake to the ocean. One nation has no greater right over it than has the other. Even the use of the St. Lawrence, where its course is within Canadian soil, has by solemn treaty been assured to citizens of the United States on exactly equal terms with Canadians, and that forever. I say, then, let the two nations unite, on proper terms and under reasonable conditions, in the completion of the work; and let the channel, when completed, be for the use, absolutely free from toll, of the citizens of both countries.

As to this route or that route, I say for myself, and I think it is the judgment of this convention, that we should not be content till we reach both New York and Montreal by a twenty-foot channel. Let it not be thought that Canada would not be benefited by a deep waterway from the St. Lawrence to the harbor of New York. As it is, we have water communication all the way.

If it shall be the judgment of the two nations that we should deepen the St. Lawrence canal, we should not even then be content till we have an equally deep channel by the Chambly and Whitehall canals, or the Caughnawaga, or by some other route to New York. Our system will not be complete without reaching both of the great ports, and be the cost what it may, these two nations can provide the means. Let us have such a channel to both New York and Montreal, and who that is familiar with the records of the lake traffic for the past twenty years will doubt that in five years after their completion, the saving in cost of transportation of the increased commerce over the route—the saving, I mean, that will be due wholly to the increased accommodation on the waters—will far exceed the entire cost of the undertaking?

Give us the twenty feet depth to the Atlantic and we will see the huge cargoes of four, five, six and seven thousand tons that will be floated on the completed channels of the lake route from the far west to Buffalo, carried along in the same great ships without break of bulk to the ocean, perhaps across the Atlantic to be unloaded at Liverpool and Glasgow. Who does not realize—and yet who can actually realize to its full extent—that the opening of such a through channel would at once result in a striking reduction of freight rates, in a vastly enlarged area of cultivation in the prairies of the northwest, in a greatly enlarged market for the coal of Pennsylvania, in an enlarged commerce in every line of industry, the extent of which we cannot estimate, but which can scarcely be overstated?

I am not going to quote many figures indicating the value in dollars and cents of this commerce. Its extent and character sufficiently indicate its value. That value has increased, of course, with the same bounds as the tonnage. We may well describe it as enormous. Taking the freight passing through the Sault alone, its value was in

1885	$ 53,400,000
1887	79,000,000
1890	102,200,000
1891	126,000,000
1892	135,000,000
1893	145,500,000
1894	143,000,000

The coal alone that was carried through the Sault last year exceeded in value over $8,000,000; wheat and flour reached $60,000,000; lumber, $11,500,000; and copper and iron ore, $37,000,000. If we take the shipping itself that is afloat on these waters, the value of it is something enormous. The entire fleet of the great lakes now numbers nearly 4,000 vessels of all kinds, giving employment to nearly 45,000 persons in service on the lakes.

The activity in shipbuilding is one of the remarkable features connected with the traffic. During the past few years the most striking feature connected with the shipbuilding industry is the enormous size and capacity of the new vessels. This department of the industries built up by the great lake route will, equally with others, be stimulated and encouraged to an extraordinary degree by the extension of the deep water system to the ocean.

Are we to be content with an extension of the present lake system to the ocean? Do we realize how trade would be increased and the prosperity of the two countries promoted if canal systems connecting with the great lakes were extended in other directions? Looking at the vast movement of coal and ore, for instance, between the lakes and the Pittsburgh district, what a stimulus would be given to that trade by the opening of a water channel in that direction? What sum expended in such an enterprise would be too great to be justified by the commercial advantages it would bring, and by the actual saving in dollars and cents in the cost of transportation?

And what of the great northwest? I do not urge that at this time our association should press for immediate steps to secure a connection between the great lakes and the Red River of the North and with the headwaters of the Mississippi. But in taking a view of the commerce that may be tributary to an enlarged waterway system, who that has formed an idea of the unbounded extent and the unparalleled richness of that region, and that has given a thought to its natural advantages in respect of water channels, capable of being utilized and improved, can fail to appreciate the boundless possibilities of development in that country through an extension of the waterways? I have said that in the northwest above all we are to look for the chief developments of commerce in the future. What that development may be we can form some faint conception of by a study of the past. The whole country, I repeat, is in its infancy. Look at the growth of the great cities of the lakes between 1880 and 1890, bounding up from a population of 1,300,000 to over 2,500,000.

Look at the great towns and cities growing up throughout the states and provinces that contribute to this traffic. In the American Union apart from New York and Pennsylvania there are sixteen great states that are to a large extent dependent on the lake route for transportation of their products. They are all states in which population is increasing and industries extending from year to year. But it is in the northwesterly of these states, tributary to the upper lakes, that we shall witness the greatest growth in the next twenty years. Wisconsin is still a new state, with a vast amount of rich land still uncultivated, and she is capable of extending her varied industries many fold. In Minnesota, Iowa, Nebraska and the Dakotas but a fraction of the lands have been brought into a productive condition.

Who can estimate the expansion of the commerce of the northwest when these great territories shall be occupied by large populations, when all their arable lands shall be brought under cultivation and their varied industries shall be developed? And what a factor in the development of those industries will be the opening of a canal from the head of the lakes to the headwaters of the Mississippi and to the Red river, bringing canal traffic to the twin cities of Minnesota and to the grain fields of Dakota. If we cannot hope in the immediate future to see steps taken to such an end we may at least give serious thought to the feasibility of such a scheme, and furnish information that may enlighten the public on the question.

And let me add a word or two about the great expansion in production and commerce that we are sure to witness in the great and rich northwest of Canada. To the capabilities of that country in the way of sustaining a great population and developing a most extended trade, considerable attention has lately been paid. Suffice it to say here that in the province of Manitoba alone, now containing less than 25,000 farmers where six or eight years ago we had to import beef and butter and other provisions for the settlers, we now have great herds of stock, and a large export trade of fat cattle to the English markets is now going on every season, and increasing largely each successive year. Ten years ago we were practically without creameries or cheese factories, which now we have in every district of the province. We have just witnessed the harvesting of the greatest crop ever seen in the northwest. The aggregate yield of wheat in Manitoba alone exceeds 30,000,000 bushels, and other crops amount to another 30,000,000 bushels. In 1894 the yield of wheat in Manitoba was about 17,000,000; in 1893 about 14,000,000, and in 1888 about 6,000,000 bushels.

The province is in the very earliest infancy of its growth; not one-tenth of its rich arable lands are under cultivation; its grazing lands, still unoccupied, are almost boundless in extent. To the west and northwest of Manitoba extends the great Canadian territory, rich beyond description in prairie and grazing land, a country destined in the future to be the home of millions.

We do not mind making the admission, however, that in the meantime population is coming in but slowly, and we realize that one of the considerations that discourage more rapid settlement is the great cost of transportation to and from the markets of the world. The question of cheaper transportation is the question of questions for the Canadian as well as the American northwest. Solve that problem and the advantage to the country as well as the expansion of its commerce, will be marvelous It has all the other conditions that will insure such a result. A thousand miles beyond the boundary of Manitoba, further to the northwest, the wheat region continues. Through this great region of Manitoba and the territories run the Red, the Saskatchewan, the Assiniboine, the Qu' Appelle and other streams. Is it feasible to connect this country by a water channel with the great lakes—in other words can canal connection be opened up between the head of the lakes and the Red river? That is the problem facing North Dakota and northern Minnesota as well as the Canadian northwest. It is a problem upon which this convention can not, perhaps, give full information, but it is a question that can be discussed, and on which we can procure information.

We should impress upon the governments of the two nations that, at least, the country should be examined, and a survey made with a view to judge as to the feasibility and cost of such an undertaking. One canal to the Red river might serve both countries. The route generally considered most feasible on the Canadian side is by the Lake of the Woods. That lake and the Rainy river furnish already the required navigation for a distance of 150 miles from the west shore of Buffalo bay at the international boundary easterly to Fort Francis, also on the boundary. Were the canal at Fort Francis, on which a large sum of money was expended 20 years ago, completed, and it is said that $250,000 would do so, the entire distance from the west coast of the Lake of the Woods to within 40 miles of Lake Superior would be navigable, save only a number of portages not aggregating more than eight miles. To that extent a channel would have to be opened, at considerable cost no doubt, but at a cost which would be fully justified in view of the advantages secured.

The most serious difficulty is met with in the 40 miles next to Lake Superior, where the great fall of land takes place. There, too, we have water communication all the way, but the fall has to be overcome. How far can modern appliances and engineering skill overcome that obstacle at a cost commensurate with the benefits to be derived from the opening of the channel?

The country between the Lake of the Woods and the Red river is one that offers no particular obstacles to the opening of a water channel. A number of gentlemen interested in bringing saw-logs from Lake of the Woods to the Red river have already secured a charter from the Manitoba legislature for the opening of a canal for that purpose. One proposal was to use the channel of the Rosseau river whose headwaters are within twenty miles of the Lake of the Woods, and which runs to the Red river partly through Minnesota and partly through Manitoba. The land between the headwaters of the Rosseau and the Lake of the Woods is chiefly muskeg and there is a run of water all the way. The character of the soil throughout the whole distance is such as to make construction easy.

I have discussed the question with men of engineering skill competent, as I am not, to pass judgment on the question, and their opinion is that the problem of connecting the great lakes with the Red river by canal is a feasible one, and that at a most reasonable cost.

If we can indeed look forward to the possibility of having even a six-foot channel to this river that flows through the heart of the great prairie region, and another to the headwaters of the Mississippi system, need I say a word to suggest the immense impetus that will be given to the development of the great northwest and to the commerce of the great lakes? I can not pretend to set down in figures any prediction of its volume, but we know what the practical results will be. Surely this convention would be taking a wise step, and will be working to a good end, if by any action of ours we succeed in at least directing public attention to the importance of such an enterprise, and if we can impress upon the respective governments, the desirability of taking means to have such survey and inspection made as will test the feasibility and cost of the work.

DISCUSSION.

Chairman McGinnis: I will call upon Col. E. C. Gridley, of Duluth, to make a few comments on Mr. Fisher's paper.

Col. Gridley said he was not prepared to make a speech, but he could not help thinking that we of the states should go slow in nursing our national pride and holding too tenaciously to American soil in getting to the ocean. If we leave this convention in the right spirit, and direct our efforts in the right channel, it will be in the way of knitting together the Anglo-Saxon race on this continent—bringing about the union of forces on this continent which Almighty God decreed, and which are now separated by artificial lines.

In emphasizing Mr. Fisher's picture of the growing industries of the northwest, Col. Gridley said: "To-day there is a deposit of iron ore aggregating 300,000,000 tons actually in sight, where four years ago the fact was not known. That ore must find its way to the markets of the world, either as raw material or manufactured. This demands deep water eastward and also makes the project of a canal from the head of Lake Superior to the Red river entirely feasible."

Frank A. Flower: For the information of our chairman and of the convention it is desirable to state, as an explanation of a breach in our program, that Lieut. Blow's orders were issued by the navy department during his absence in Virginia, so that he was unable to prepare a paper, and Capt. John Swainson, I am informed, is now on the ocean and probably will not land before we shall have adjourned.

Charles Francis, the distinguished engineer of Davenport, was an early arrival, but is too ill to read his paper, as follows:

Comparative Study of Modern Ship Canals.

CHARLES FRANCIS, C. E., M. A. S. C. E.,
Davenport, Iowa.

The ship canal or deep waterway is the subject of more thought and discussion at the present day in this country than ever before. Schemes for inter-lake communication with the view of decreasing or doing away entirely with breakage of bulk, are being put forth almost daily, and the problem of how to bring our merchant marine from the ocean to the heart of the continent is exciting continued and increasing interest throughout the country.

The purpose of this paper is to briefly analyze and discuss the most important modern ship canals, with some account of the methods employed in their construction, and this analysis and discussion will be limited to some of the greater ship canals, to wit: The Suez canal, the Corinth canal, (this is a mere passing notice) the Manchester ship canal, the North Sea and Baltic ship canal and the Chicago drainage canal, with some comments on the Panama and Nicaragua.

The Suez canal is introduced as being so remarkably successful as a commercial benefit, and also for the purpose of comparing the more modern methods of canal construction with those used on that work.

The Suez canal extends from from Port Said on the Mediterranean to Suez on the Red Sea, and traverses a comparativey flat country. The route selected took advantage of certain valleys or depressions which are called lakes, but which were previous to the construction of the canal, low lying tracts of country, at some places below the level of the Mediteranean and Red Seas. The canal has neither locks nor gates, and is in fact merely an artificial strait connecting the two seas, from both of which it derives its water supply; and the fact that the two seas are nearly on the same level, and the rise of tide very small, allowed this construction to be adopted. The whole length of the navigation is 88 geographical miles, of which 66 miles are actual canal formed by cuttings, 14 miles are made by dredging through the lakes, and 8 miles required no work, the natural depth being equal to that of the canal. The canal has a navigable depth of 26 feet, with a bottom width of 72 feet, with side slopes of at least 2 to 1.

Actual work was begun on the canal in the latter part of 1860, and by the beginning of October, 1869, the canal was filled with water from both seas and ready for use. In executing this strange work of the desert about 80,000,000 of cubic yards of material were excavated, and it is stated that at one time 60 dredging machines and nearly 30,000 laborers were employed.

One incidental which in itself was a work of no small magnitude was this: the fresh water for the use of these laborers was conveyed from the Nile at Cairo and distributed throughout the whole length of the canal.

The cost of the whole undertaking, including the harbors, is stated to have been about £20,000,000.

The harbor at Port Said is formed of two breakwaters, constructed of concrete blocks, the western one 6,940 feet in length and the eastern 6,020 feet, enclosing an area of about 450 acres, with an average depth of only thirteen or fourteen feet, excepting in the channel leading to the canal, where thedepth is from twenty-five to twenty-eight feet. The entrance to the canal at Suez is also protected by a breakwater and in connection with the harbor at this place there are two large basins and a dry-dock.

The canal is a highway for steamers 400 feet long and 50 feet beam. A delay of three days is calculated on for the passage across from Port Said to Suez. The number of vessels passing through the canal in 1870 (the year it was opened) was 486, with a gross tonnage of 654,915. In 1885 the number was 3,624, with a gross tonnage of 8,985,411.

In 1883 10 francs 50 centimes, about $2.10, was charged per ton (net tonnage), and pilot dues amounted to 70 centimes, about 14 cents per ton, on an average. On July 1, 1894, the pilotage dues were abolished, and in 1885 the transit dues were reduced to 9 francs 50 centimes, about $1.90.

The Corinth canal has very little in the way of attractiveness or benefit in it, commercially or otherwise. The engineering study was meagre, the plans very insufficient; high rates had to be paid for money borrowed to build it. Contractors failed, and altogether the work has nothing to warrant any more than a few words in relation to its size and cost.

Its length is 3.7 miles; the dimensions of the normal section are: bottom width 72 feet, least surface width 75 feet, least depth 26¼ feet. The deepest cutting was 259 feet. The total excavation was 10,000,000 cubic yards of rock and earth. Twelve years were consumed in building it and the total cost was $15,000,000, or $4,057,000 per mile.

The canal is said to have earned only $65,365.00 in the fourteen months it has been in operation, while its operative expenses have been $62,483.00. The fixed charges for that period are about $600,000.

The North Sea and Baltic ship canal, which was opened with much pomp and circumstance at Kiel in June, 1895, is, as the engineer says, "the realization of a plan long cherished by both Germany and Denmark."

The German Ocean and the Baltic are now connected by a canal answering all reqirements from a naval as well as a commercial point of view.

The canal begins near Holtenau, on the Baltic, and terminates at Brunsbuettel, on the North Sea, where an estuary of the Elbe provides a depth of 29.5 feet.

The trace of the canal shows light curves, the least radius being one kilometer and the greatest three kilometers. Reverse curves are connected by a tangent not less than 830 feet long, or double the length of the longest ship which is to navigate the canal. The total curvature is 841 degrees. The profile shows that the level of the termini coincides with the mean level of the Baltic.

The dimensions of the normal section are based upon rules providing for the passage of a war ship of 72.16 feet beam and 25.4 feet draught, and that the width of the keel level is to be sufficiently great to allow the passing of two ships of ordinary commerce, with due care, of 38.4 feet beam and 21.3 feet draught.

The total length of this canal is about 61½ miles. Eight years were required for building it, and the total cost was $37,440,000, or about $610,668.00 per mile, and a most remarkable fact is that this cost falls somewhat within the original estimate of Chief Engineer Baeusch in 1886. The most interesting engineering feature of this work was the method of constructing the canal banks across the marshes. Light trestles were placed on the berm lines of the canals, and sand was dumped from small cars running on these trestles until it displaced the soft mud and sank to the hard clay beneath. The section was then excavated between these sand dams, the material deposited outside of the dams by dredges, and the canal completed.

The deepest cut is the Gruenthal cut at the divide between the Elbe and the Eider which contains about 15,000,000 cubic meters, say 20,000,000 cubic yards. The canal banks at this point are about 65.5 feet high, and the Gruenthal bridge which crosses the canal at this point has a single span 513.3 feet, and the lower chord of the roadway is 137.7 feet above the surface of the canal, leaving abundant room for the passage of ships beneath.

The commercial value of this canal is shown by the very much shortened distances between the southern ports of the North Sea and the Baltic ports. Thus from Hamburg to a point opposite Moen beyond the Kiel mouth of the canal, where all the Baltic navigation routes intersect, the distance around the Skager and through the Sound, (that is around the peninsula of Denmark), is about 646 miles, and the time, with a speed of 8¼ nautical miles per hour, is 78.3 hours.

Between these points through the canal the distance is 221.2 German nautical miles, and the time, allowing three hours detention at the locks and a speed of 5½ miles per hour through the canal and 8¼ miles per hour in the open water outside of the canal is 33.39 hours, thus shortening the route 424.8 miles and the time 44.91 hours.

In general it may be stated that by adopting the canal route Hamburg steamers will save about 40 hours in time, and English steamers from all ports south of Harwich will save about 24 hours.

Some estimate of the traffic expected on this canal can be formed from the fact that the tonnage of vessels passing through the Sound in the summer of 1890 amounted to 300,000 tons per month.

We have here an example of a very high class of what we call engineering: The Chief Engineer, Herr Bacusch (who by the way was in charge of the work from start to finish) had made himself thoroughly acquainted with every foot of the work (and this means all the study, thought, surveys, advice, and possibly, inspiration that thorough acquaintance means) before he made his preliminary report. He must have done so, in order to have made an estimate in 1886, which was very little above the actual cost, of a stupenduous work completed in 1895.

Combined with this a rare skill and judgement must have been used in the selection of the contractors (nearly all of the work was done by contract) who did the work according to his specifications.

We quote from a late engineering journal: "It is a sea-level canal with tidal locks. The money for it was provided by an autocratic government, with the cost well determined beforehand, so that there was no delay in financing the canal, and the power of a great government was exerted to push it to a rapid and economical finish. Finally, the location seemingly presented fewer engineering difficulties than in the case of its three predecessors (Suez, Corinth and Manchester), though there were evidently enough of these to wreck the plans and estimates of less careful and conscientious engineers and contractors than those in charge of its execution."

The rapid increase in the trade of the ports to the southeastward and eastward of the Heldee, effected by the construction of railways throughout Europe, rendered it imperative for the merchants of Amsterdam to provide better communication with the North Sea than that afforded by the North Holland ship canal, or suffer its trade to pass to other ports more favorably situated for over-sea traffic.

The North Holland ship canal had been built by the Dutch government in order to make a safer means of access to the port of Amsterdam than that afforded by the Texel Roads and the Zuyder Zee, in which navigation was difficult and dangerous on account of its numerous shoals.

This canal was begun in 1865 and finished in 1876, and extends due west from Amsterdam across the peninsula of Holland to the North Sea, a distance of about 16 miles, through Lake Y and Wykee Meer.

The harbor at the North Sea end is formed by two piers, built of concrete blocks founded on a deposit of rough basalt. These piers are each 5,069 feet in length, and enclose an area of about 260 acres. About half of this area has been dredged out to a depth of 26½ feet, and the remainder left as it was for the accommodation of small craft and fishing boats.

The normal section of the canal has a bottom width of 89 feet, a surface width of 187 feet, and a depth of 23 feet.

The greater portion of this canal consists of a channel dredged out of Lake Y and the Wykee Meer between banks to be hereafter described, and the remainder through low sand dams.

One difficulty in the construction was the complete re-arrangement of the system of drainage of the region traversed by it. This drainage is now pumped into the canal.

There are two sets of locks, one set at each end. The locks at the North Sea end have three passages.

The construction of the canal began in the cuttings. The material taken from the cuttings were deposited in two banks 443 feet apart through the lakes. The nucleus of these banks was formed of sand with a coating of clay, and protected by fascines. When these banks were sufficiently high, the canal channel was dredged out between them. This form and method of construction seems to have been adopted with a view of draining Lake Y and Wykee Meer and reclaiming about 12,000 acres of land.

One curious feature is that the vessels are locked down generally from the sea to the canal, the sea level at high water being several feet higher than the level of the canal.

In the construction of the canal and harbor 21,000,000 cubic yards of material were removed by dredging, much of it at a cost of two pence per yard. The total cost was nearly $15,000,000.

M. de Lesseps, in a lecture on the Suez canal delivered at Paris before the Societe des Gens de Lettres, gave it as his opinion that unless the Atlantic and Pacific could be united by simply piercing the isthmus from sea to sea without locks as at the Suez Canal, the scheme could not possibly succeed as a commercial enterprise, because of the inadequacy of a canal with locks to pass the traffic that will frequent it, and also of the uncertainty of sufficient water to supply the lockage and evaporations.

This seemed to be his controlling idea when he assumed charge of the construction of the Panama Canal: A sea-level canal at all events and at any cost. His engineers learned, some time, whether before or after the work began does not appear, that at certain states of the tide, the levels of the two oceans differ materially; that at Colon, on the Atlantic side, the rise and fall of the tide is not more than 23 inches, while at Panama, on the Pacific, the difference between high and low water was generally 13 feet, and at times upwards of 19½ feet, which conditions call for powerful tidal gates and locks at Panama.

They probably know that the two great difficulties in the work were the great Culebra cut (of some 60,000,000 of cubic yards, largely of soft schistous rock, in horizontal layers) and the protection of the canal against floods of the River Chagres. The bed of this stream crosses the line of the canal no less than twenty-seven times, and it would seem as if the locating engineers thought that this would facilitate the work. It is quite likely also that they were guided in their location by a desire to keep as near as possible to the Panama railway, which brought them supplies and kept them in touch with civilization. The railway runs close to the river for more than half its length. But these same engineers were never brought to a realizing sense of what the Chagres was capable of until June, 1883, when the excavation had advanced so far that they considered it impossible to take a completely new line of country. At this time, at San Pablo, which is just about half way between Panama and Colon, the Chagres rose 44 feet in four hours, 11 feet an hour.

Then, and as near as I can make out, not until then, was the plan suggested of building the great Gamboa dyke and making a reservoir sufficiently large to impound at least twice the greatest flood ever known in that section, and to convey this water to the sea through small canals, to be dug for the purpose.

This sort of poor engineering assisted very largely in bringing about the dismal failure of this great enterprise. There must be added to this the reckless squandering of the money at the Isthmus,—a $100,000 a year general manager, who lived in a palace, and who was provided with servants, horses and carriages at the expense of the company (even roads were built that he might take carriage drives); $2,000,000 worth of hospitals at Panama; $20,000,000 for the Panama railway, and so on.

A very short period of this kind of thing, and very little work accomplished, comparatively, brought the company to bankruptcy. Moreover, the astonishing revelations of rascality in connection with the construction of the canal clearly proved that much of the money was diverted from its original purpose and found its way into the pockets of all sorts of jobbers.

M. Peary, in his paper on Ship Canals, read before the American Society of Civil Engineers, in August, 1889, says, referring to the Panama canal;

It is interesting, however, as showing the blind infatuation with which the *ipse dixit* of one man may be followed in the face of all facts and experience, and the results of beginning a great work without sufficient or accurate information.

It is quite true that there did appear to be a species of blind infatuation in the universal admiration in which M. de Lesseps was held by his countrymen. It is difficult to see how it could be otherwise He had but recently achieved a most magnificent success in the completion of the Suez canal, by which he had enriched very many. He was the great canal builder *par excellence*, and when he organized his Panama canal company, and attacked the great problem at the Isthmus, the world at large, but more particularly the French people, said, now the work will be accomplished.

His name will long live in history as the builder of the Suez, though the end of his life was pitiable enough. Robbed, cheated, swindled by those he had trusted and believed to be loyal friends, the poor old man died broken-hearted, literally done to death.

The Manchester ship canal makes the city of Manchester, which is 50 miles from the sea and 35 miles from the head of the tidal estuary of the Mersey river, a seaport, and is practically a competitor of the first railway ever constructed. It was expected to divert an immense amount of tonnage previously entered and cleared at Liverpool.

From the outset great opposition was encountered of course from the Liverpool interests and also from the several important railway companies whose lines cross the line of the canal, and which would be obliged to modify their routes at great expense, so as not to interfere with the canal navigation.

This opposition delayed the passage of the canal bill in Parliament for several years, and it was not until 1887 that this opposition was overcome and the bill finally passed.

The length of the canal from Eastham to Manchester is a little over 35 miles, which is separated into two divisions.

The tidal division from Eastham through the Mersey estuary to Runcom, 12 miles, thence inland 8 miles further to Warrington. This division has a normal section 120 feet wide at the bottom and 26 feet deep at low tide.

The division from Warrington to Manchester is 15½ miles long, and has a bottom width of 120 feet, a surface of 300 feet and a depth of 26 feet. There are four groups of locks. The total lift is 60½ feet.

The work is full of great interest to the engineer and to the contractor.

Perhaps as curious and novel a feature as any is the Barton swing aqueduct which carries the Bridgewater canal over the ship canal. The bridge is 234.6 feet long, pivotted in the center and furnished with a tank of equal length with the bridge—19 feet wide and 7 feet deep to the rail, thus allowing boats of 6 feet draught to pass through. This tank is provided with water tight gates at each end, so as not to waste the water of the Bridgewater canal, which is clean, or so much so that it is the boast of the district that fish can live in it. An ingenious arrangement, consisting of a U-shaped wedge, faced with India rubber, having the same shape as the tank, furnishes a water tight connection between the tank and the shore ends of the canal. To allow the passage of a vessel in the ship canal, the gates of the tank and at the shore ends are tighily closed, the U-shaped wedge slightly raised (breaking the connection between the tank and the shore) and the bridge turned.

The whole work of the canal appears to have been thoroughly and carefully engineered and executed, and was a model of perfect organization and business-like procedure.

The plant of tools included steam navvies, excavating cranes, land and water dredgers, soil transporters and tipping cranes, among the special appliances, and by a list of the plant existing in 1891, we find that in addition to these there were engaged on the work 173 locomotives, some of considerable size and power; 194 cranes, mostly steam; 182 steam engines, largely portable; 212 steam pumps, besides pulsometers; 6,300 wagons, 59 pile engines, 228 miles of railway. The number of men and boys employed at that time was 16,361 and the quantity of coal used monthly was about 10,000 tons.

Altogether it was a magnificent work, magnificently executed. Work was begun November 11, 1887, and the canal was filled from end to end with water November 25, 1893.

The total amount of excavation was 53,500,000 of cubic yards. There are 175,000 cubic yards of brickwork requiring 70,000,000 of brick, 1,250,000 cubic yards of concrete, and 220,000 cubic yards of masonry.

The total cost of the work at the opening was $77,000,000. This sum includes $15,000,000 paid for the old Bridgewater canal, $750,000 expenses of the contest with the opposing interests before Parliament. The real estate required, the railways, canals and highways to be crossed in the populous country that it traversed, all entailed enormous expenses, and changes in plans, and delay of two years in the work, occasioned by the death of Mr. Walker, and the failure of his executors to complete his contract, together with difficulty of raising more money in times of financial stringency—all these added materially and legitimately to the cost, until the cost of construction, instead of being about $810,000 per mile as estimated in 1887, was not less than $1,300,000.

I have purposely omitted any description of the bridges on this work, as, to do them justice would require a much longer paper than this can be.

The Chicago sanitary canal rapidly approaching completion, is a most interesting study to the commercial economist, but it is particularly so to the sanitary engineer—for this great canal now being constructed between the south branch of the Chicago river at Robey street, in the city of Chicago, and the Illinois river at or near Lockport, is ostensibly for the purpose of draining the sewage of Chicago from the Chicago river, (through which it now reaches the lake whence the whole city water supply is taken), into the Illinois river, where it is presumed, it can do no harm to Chicago's water supply.

Whatever may be its ultimate destiny or whatever it may evolve itself into finally, it is now to be considered as a preventive measure (somewhat heroic perhaps) against typhoid fevers or other enteric diseases in the city of Chicago, by guarding the water supply of Chicago against pollution by the sewage of Chicago.

The section of this canal in earth cuts is 202 feet wide on the bottom and 26 feet deep with side slopes of 2 to 1, thus giving a surface width of 308 feet and a sectional area of 6,630 square feet; in rock cuts the section is 160 feet wide on the bottom, 162 surface width and 26 feet deep, with sides very nearly vertical, with a sectional area of 4,186 square feet. The grade of the bottom is in earth one foot in 40,000 and in rock one foot in 20,000.

These are magnificent dimensions certainly for a ditch to carry oft 10,000 cubic feet per second of dilute sewage.

The President of the Board of Trustees comes to our relief by stating: "It is, however, hoped and expected, and everything has been done to make it possible, that this canal may some time be used for navigation as an outlet to the south, on the assumption that the United States Government will ultimately construct the necessary link from Lockport to the city of La Salle, a distance of 66 miles, and from La Salle to the mouth of the Illinois river, a distance of 220 miles."

But, setting aside the great disproportion between the size of the cana. and its name, it stands easily second (for we must yet give to the White City the highest place in construction achievement) on this continent in rapid, thorough and complete accomplishment.

The length of the canal is twenty-eight miles, of which nine miles are in solid rock—somewhat over twelve millions of cubic yards of rock excavation.

There has probably never before been seen in this country a greater number or a greater variety of devices or tools for moving material than appeared on this work.

From the concise report of the work prepared by the chief engineer, I extract the following description of some of these devices:

On Section H—a conveying machine designed by Messrs. Hoover & Mason has been constructed on a mammoth scale. It is essentially a bridge spanning the channel, with cantilever arms projecting far enough beyond each side to overhang the spoil area. On this structure are mounted the necessary sprocket wheels and other machinery for carrying a series of steel pans which form the conveyor's belt. The structure is 640 feet from end to end, it is mounted on trucks traveling upon tracks parallel with the channel, and its estimated capacity is 500 cubic yards per hour.

Section H is in earth.

On the rock sections the sides are cut down vertically by channelling machines, and the merits of the several makes can be well demonstrated on the work.

Steam drills are used and generally driven by compressed air from a central power station. The top lifts have been removed by the use of carts and team cars the traction for which latter is usually supplied by steam hoisting engines. The lower lifts are taken out by the use of cable ways, high power derricks and cantilever conveyors.

These cable ways that are here spoken of so easily and freely are in reality suspension bridges of 700 feet span, capable of supporting a load of 15 tons at least in the center. Their size may be better understood and appreciated when we know that the span of the first suspension bridge at Niagara is a little over 821 feet.

The towers of these cable ways are mounted on trucks running on rails so that the whole structure may be moved along the line of the canal to wherever it may be needed. This is merely one of the contractor's tools.

The cantilevers like the Hoover conveyor are mounted on trucks traveling upon tracks parallel with the channel, and take out about 60 cubic yards per hour, "probably," says the chief engineer, "the most perfect devices now known for hoisting and disposing of material from rock cuttings such as these."

The channeller has perhaps builded better than he knew, in this, that the sides of the rock cutting will better resist the action of the frost and the elements generally, in the first place because they are smooth, and in the second place, because they have not been shattered by the shock of blasting, the inch and a half channel between the core and the side preventing this.

Taken altogether the work on the great channel, as President Wenter says in his last annual message, "is a field of study for the engineer, a school of instruction for the contractor and builder and a grand sight for the laymen."

A word or two in regard to connecting the Atlantic and Pacific Oceans at the Isthmus: There appear to be but three projects at present, which are worthy of discussion.

The Nicaragua route, 181 miles long and having a lockage of 110 feet lift; the Panama route, 50 miles long, with or without locks; and the San Blas route across the Isthmus of Darien, 28 miles long with tidal locks and gates at the Panama end.

The Panama route follows a well established and much travelled highway. The whole line has been seen and is well known to very many people, laymen as well as engineers; the cities of Panama and Colon are now ports of entry to a large amount of shipping annually; there is a railway of easy access to the line of the canal throughout its whole length.

These conditions do not exist on the two other routes, and the saving in the simple item of transportation of material and equipment, will be very great here. On the other hand the line of the canal, as at present projected, is in the center of drainage of a very large water shed whose rainfall is, say, 130 inches per year, and it is in close proximity to the Chagres river, which has a record of 44 feet rise in four hours.

With these conditions, the cost of protecting the canal against damage by floods may be mildly stated to be an uncertain quantity.

The San Blas route seems to have dropped out of the race, although it still has its strong advocates.

The plans of this canal call for a ship tunnel at least eight miles long, all in rock.

Mr. Walter W. Evans, in a discussion of M. Menocal's paper on Inter-Oceanic Canal Projects, (which was published in the Transactions of the American Society of Civil Engineers, in November, 1879), gives the following estimate of the cost of the work:

Fourteen millions of cubic yards of rock in the tunnel above the sea level (the tunnel being 8 miles long, 150 feet high above the sea, and 80 feet wide), at, say, $3.00 per cubic yard	$42,000,000
Four millions of cubic yards of work in tunnel below the level of the sea (this part being 80 feet wide and 30 feet deep), at, say, $8.00 per cubic yard	32,000,000
Twenty-two miles of open (earth and rock cutting), at, say, $1,000,000 per mile	22,000,000
Diversion of the River Bayano	1,700,000
Twenty-four hundred acres of grubbing and cleaning, $10.00 per acre	240,000
Diversion of other streams, all small ones, say	1,000,000
Light-houses, piers, store-houses, and buildings of all kinds, say	1,000,000
Total	$109,940,000
Say	110,000,000
Add for contingencies, 25 per cent	27,500,000
Grand total	$137,500,000

Mr. Evans goes on to say; "The above estimate is considerably above the estimate of Mr. Menocal for the Nicaragua route, but I will here venture to predict that it is very much nearer the truth of what the Nicaragua Canal will cost if ever built than Mr. Menocal's estimate. We may as well stare the truth in the face now as at any other time; it is the most honest way."

Mr. Menocal's estimate of the cost of the Nicaragua Canal was at that time $65,722,147.

The Nicaragua route extends from Greytown on the Atlantic to Britot on the Pacific, a distance of 181.26 miles, as follows:

Canal	61.74 miles.
Lake navigation	56.50 "
Slack water navigation by the river San Juan	63.02 "
Total	181.26 miles.

The level of mean high lake is (after being raised 6 feet) about 110 feet, an elevation to be overcome by 10 lift locks, located in a distance of eight miles.

As stated above, Mr. Menocal's estimate of cost was about $65,750,000.

The late Mr. Ashbel Welsh, once President of the American Society of Civil Engineers, in discussing Mr. Menocal's paper, gave it as his opinion that $80,000,000 was nearer the truth, and goes on to say:

As I never heard of a canal estimate that came anywhere near the cost, and considering the unhealthiness of the climate, etc., I should add at least 25 per cent. for unknown or unestimated contingencies, bringing the estimate up to the round $100,000,000.

If it is done by the government and gets into politics, add at least 50 per cent.

In conclusion, we see from the preceding that during the last ten years, three great ship canals, the Baltic, the Manchester and the Chicago drainage ship canals, have been built, aggregating in length, if we consider the Chicago drainage canal as finished, nearly 122 miles, and costing nearly $140,000,000. In the construction of these great waterways, an amount of engineering skill, and moreover contractors' pluck, has been displayed such as was never seen before; methods of ship canal construction have taken a new departure, and great projects which fifteen years ago would be thrown out of court as utterly and absurdly impracticable may now be calmly considered and attacked without fear.

There are two important ship canals to be built in this country, wholly within the limits of the United States. The welfare and prosperity of the nation demands them, and their accomplishment must come sooner or later: The one connecting the Chicago drainage canal with the deep water navigation of the Mississippi, and the other connecting, on the American side, Lake Erie with Lake Ontario.

It is not too much to say perhaps, that upon this association rests the grave duty of seeing that these two great projects are carried out promptly while promoting its grand central purpose of securing an adequate outlet from the great lakes to the Atlantic ocean.

Wednesday, September 25—Afternoon Session.

President Howland called the convention to order and invited Mr. A. L. Crocker, of Minneapolis, to the chair.

Chairman Crocker: The first thing in order will be the selection by the convention of six names, according to the rules of our constitution, which also require that the executive committee select six further names, twelve names in all, to constitute the nominating committee, which shall report for the coming year an international president, two international vice-presidents and a president for each state and province represented.

Mr. McGuirk: In order to comply with the requirements of the chair and the constitution, I move the adoption by the convention of the following named persons to act for this occasion with the permanent committee of the executive board: Hon. W. J. Van Patten, Vermont; R. S. Lyon, Chicago; J. Enoch Thompson, Toronto; Hon. T. B. Mills, Wisconsin; G. H. Anderson, Pittsburgh, and T. A. Taylor, Toledo.

There being no opposition the selection was confirmed.

Chairman Crocker: The first thing on the program this afternoon is a paper by Prof. Johnson, of the university of Pennsylvania, which, in his absence, will be read by Mr. Flower.

Mr. Flower: I call your attention in advance to the printed paper of Prof. Haupt, of Philadelphia, in which he makes an exact comparison of the railroads having competing waterways with railroads having no competing waterways. The page containing that comparison complements and fairly proves the economical theories so ably and clearly put forth by Prof. Johnson. If I may be allowed to express the opinion, these papers by Messrs. Johnson and Haupt fully set at rest the reciprocal and complementary relationship between rail and water transportation. The two methods are friendly and mutually helpful, not inimical and mutually destructive. I will read Prof. Johnson's paper at length, as it is its own best discussion:

Effect of Deep Water Between the Great Lakes and the Sea Upon Railway Traffic and Profits.

EMORY R. JOHNSON, PH. D.
University of Pennsylvania.

The effect which a deep waterway between the lakes and the ocean would have upon the traffic and profits of railways may be discussed in two ways. Considered from the technical standpoint, the problems involved are, the comparison of actual costs of transportation for various categories of freight by rail and by a deep waterway, the consideration of the actual division of existing freight that would take place between the railroads and the waterway, and an estimation of the probable extent to which the leading classes of rail and water freight would be increased by the opening of a deep waterway. The adequate treatment of these problems would require a greater technical knowledge than the author of this paper can lay claim to. The academic man had better leave the discussion of technical questions to the trained engineers and experienced railway managers.

The other point of view from which data can be obtained for judging the effect which the deep waterway under consideration would have upon the traffic and profits of competing railroads is that which brings into prominence the theory of transportation and reveals the economic principles involved. To be more specific, transportation is a complex service required by the industrial and commercial activities of a country. The best performance of that complex service requires that several agents, capable of doing different kinds of work, shall be called upon, each to render the service for which it is best adapted. To the extent to which this ideal in transportation is attained do the services performed by the means of transportation react favorably upon industrial activity, stimulating the progress of the existing forms of business and calling new industries into being. Hence in discussing the effect of a deep waterway upon railroad traffic and profits, we must have in mind the transportation services required by society, the difference between the services performed by waterways and those done by the railroads, how the work of each agent of transportation is affected by that of the other, and how the two agents working contemporaneously affect social progress and thus indirectly influence their own individual welfare.

This paper then is restricted to a discussion of the relation of a deep inland waterway and competing railroads as agents of transportation. Although this is a practical question, more light is thrown upon it by a discussion of the economic principles involved than by the study of the technical problems just cited. However accurate and detailed our computations may be regarding the relative costs of the construction of railroads and waterways and regarding the comparative cost of transportation by each agent, the results now arrived at, will, in all probability, have little significance or value ten years hence. So rapidly is the revolution in our several means of transportation taking place, that, by the time such a waterway as we hope to see constructed can have been put through and opened for traffic, our present technical conditions may have entirely changed. The general economic laws governing transportation by water and by rail, however, will, if based upon sound principles, be as valid when this waterway is completed as they are at the present hour. This paper will concern itself with the statement of some of the more important of these economic laws.

The elaboration of these economic laws is here given to establish the following thesis, and there are four propositions in this thesis: (1) Unregulated competition among the railroads is a method of regulating their rates which is harmful to the railroads and unsatisfactory to the public; (2) the independent inland waterway is not only the most efficient regulator of the railway, and hence of great public utility, but is also (3) a regulator of rates that benefits rather than harms the railways.

This apparent paradox is true because the waterway is an agent of transportation differing from the railroad in character and performing a service not exactly the same as that done by the railroad, but one which supplements and complements that agent's work. The waterway, working in compeition with the railroad, first, brings about a division of labor that gives to each agent that kind of service which it is best calculated to perform; and, second, creates new traffic, adding to the volume of business to be done by the railroad. It thus comes about (and this is the fourth proposition of our thesis) that a waterway of ample dimensions, connecting the great lakes with the ocean, would increase, rather than diminish, the net revenues of the competing railroads. Such is the thesis to be established. The proof will be given as concisely as possible.

Society and the railroads alike are interested in the inland waterway as a regulator of railway rates. The three methods of regulating rates to which attention is most frequently directed, are regulation by means of unrestricted competition among railroads; regulation through the establishment of traffic agreements or pooling arrangements entered into by the railroads, and regulation by means of independent waterways of adequate dimensions and efficient construction.

The first of these methods of regulation has been tried and the results have been satisfactory neither to the public not to the railroads. By insisting upon the policy of unrestricted competition among the railroads, the state has not been able to put an end to unjust discriminations. At the same time the railroads have seen their rates forced down so low that net revenues have almost disappeared, and, in this competitive struggle have felt themselves unable to stop many wasteful practices. The discriminations, rebates, and expensive means employed by railway companies to secure and hold traffic have absorbed a large part of their earnings. Unrestricted competition has proven a most drastic and most unsatisfactory regulator of railway rates.

The public is coming to realize the force of the arguments which the railways have so frequently advanced in favor of legalized traffic agreements. The state, in undertaking the difficult task of regulating railway rates in the interest of the public must in the future depend for assistance upon two measures:

First.—State supervision of pooling arrangements, the state allowing only such contracts between the railroads to go into effect as have been officially approved.

Second.—The state must be assisted in the work of railway regulation by the construction, when possible, of efficient inland waterways along the routes of traffic followed by the larger volumes of bulky freight to be moved to and fro between the interior of the country and the commercial marts and ports of the seaboard.

An independent inland waterway, such as a ship canal between the great lakes and the ocean would be, is the most efficient regulator of railway rates that could possibly be established. The day for arguing to prove this has long since passed. There is no need of repeating in this connection the well known facts in regard to the influence which the great lakes, the small-sized Erie Canal and the numerous other natural and artificial waterways of the United States have exerted in lowering railway charges.*

The inland waterway, constructed according to the requirements of present commerce, is not only the most efficient but is also the best regulator of railway charges. Unrestricted competition, though it does not give shippers the benefit of cheap local rates, causes the railroads to reduce competitive charges to a ruinously low point, and renders the insistence upon sound business principles well nigh impossible in railway management. Viewed from the standpoint of the railroads themselves, the inland waterways may be regarded as a desirable competitor. Water competition is not ruinous but helpful to the railroads, because the waterway does more than compete, it both aids and complements the railroad. The proof of this statement rests upon the fact that the two means of transportation do not perform exactly the same work. The respective services are to a large extent distinct and complementary to each other.

It is not true, and need not be maintained, that freight can be divided into two distinct classes, one of which will be moved by water and the other by rail, but in general the effect of the waterway is to reduce the volume of bulky freight moved by the railroads and to increase, both absolutely and in relation to other freight, the volume of the higher classes of traffic for which the railroads obtain higher rates and to which they look for the major part of their net earnings.

An important consideration, and one that has not received due attention, is, that much of the freight taken from the railroad for water transportation involves little or no real net loss to the railroad companies.

*[NOTE.—For a discussion of this question, consult the author's monograph on "Inland Waterways, Their Relation to Transportation," published by the American Academy of Political and Social Science, Philadelphia. Many of the ideas contained in the remainder of this paper having been previously expressed in this monograph, free use is here made of Chapter VI. of that work.]

Railroads, especially the American, are doing an immense amount of business which brings them little or no direct profit. Operating expenses constitute a large share—nearly 68 per cent.—of earnings, and this is because a great deal of bulky freight is carried at a rate so low that the cost of operation often includes 90 per cent. of earnings. Indeed, it is asserted that coal, coke, stone and iron ore are sometimes carried at a loss by the railroads in order that by so doing they may keep down the prices of crude products and thus sustain industry and enlarge the volume of higher grades of traffic.

The operating expenses on the German railroads constitute only 55 per cent. of their gross earnings. Were the American railways to give over a good share of their bulky freight to the waterways, it would not materially reduce their net profits. Grain is another article of transportation on which, during a good part of the year, railroads make only a small profit. Grain rates are much lower in America than in Germany, but local freight tariffs are much higher. American railroads are making the local freights pay for the trouble of handling grain at low profit.

When shippers are able to choose between the railroad and an inland waterway such as the great lakes, a large river, or a ship canal, the freight is divided up between the two means of transportation in such a way as to introduce division of labor into the work of transportation. At any given time, the carrying business to be done tends to divide itself between the two agents in such a way as to free the railroad of a large portic·· of its bulky slow freight, and to make it possible for the railroad, at the expense of a proportionally less outlay of capital, to expand the volume of its fast freight and to increase its passenger traffic.

Many of our great trunk lines already find their tracks and terminals so crowded by their lower grades of freight that any considerable stimulation of their fast freight and passenger business would necessitate a larger investment of capital than the increased earnings would warrant. The stimulation of passenger travel on some of the trunk lines connecting the larger cities by means of more fast trains and more trains carrying passengers at reduced rates is held in check only because this could not be done without seriously interfering with the other traffic on the already busy lines. Under the conditions at present existing upon many railroads any large increase in local or long-distance freight or passenger traffic at low rates would involve greater outlays of capital than the enlargement of the traffic receipts would justify. The situation would be different were the railways able to substitute higher grades of freight for a portion of their bulky lower classes of commodities. The opening of a ship canal for the use of traffic formerly restricted to movement by rail would not, at once perhaps, effect this change, but before the waterway had long been in use such a division of freight would have taken place.

This, however, represents only one side of the influence of water competition upon railway traffic. The waterway not only introduces division of labor into transportation, but it also creates new traffic in which the railroads share quite as fully as the waterway. Not all the freight transported by water would be moved by rail if the waterway did not exist. Canals, rivers and lakes create a large share of their own traffic.

The cost of transportation determines to a large extent the amount and kinds of goods shipped. Cheap rates give to existing categories of freight a larger and wider market and introduce into commerce new articles, such, for instance, as sand, stone, straw, fertilizers and wood, which were formerly unable to bear the costs of transportation.

Again, the waterway creates traffic for the railroads as well as for itself. It makes raw materials cheaper, increases the number of those that are available for use, and thus adds to the products of agriculture and manufacture seeking transportation. The effects of increasing and cheapening raw materials are complex; cheaper wholesale and retail prices and higher wages are possible, and these in turn prepare the way for a larger and more varied consumption of goods. This means important additions to the shipments, especially of manufactured goods, the kind of freight which from its nature falls mainly to the railroads.

How the increase and extension of large inland waterways aid the railroads through the greater volume of passenger and freight traffic which results from building up manufactures, developing trade, and promoting the growth of large cities, is most clearly shown by the influence of that greatest of all inland waterways, the great lakes, on the development of the traffic in the states bordering upon them.

It has been in large part, the improvement of the harbors and channels of the great lakes that has caused the phenomenal growth of Duluth, Superior, Milwaukee, Chicago, Detroit, Toledo, Cleveland and Buffalo. The railroads have not only aided the growth of these cities, but have in turn been greatly benefited through the development which has come to these cities by means of the improvement of the water route. Indeed, the most important railroad systems of the United States are those which share in the commerce of the region round about the great lakes.

This fact reveals the true relation of the two agents of commerce. They are complements of each other. When the waterway and railroad are perpendicular, they feed one another; when they run parallel, competion results in the reciprocal development of each. The Rhine valley, as well as our own lake region, furnishes an illustration of this truth. The statistics of the traffic during the last forty years on the Rhine river and on the railroads of the Rhine valley, show that the growth of the transportation on each has been equally rapid. "Neither of the two means of communication has prevented the development of the other."

In their ultimate analysis, the interests and welfare of society and the railroads are the same. The highest industrial organization and the most rapid industrial progress require the use of all means of transportation and communication—railways, waterways and other agencies. The increase in the means of transportation and communication are the concomitant and the sure sign of economic progress. Likewise the development and successful evolution of the railroad system depends upon the variety and rapidity with which society advances industrially. The benefits are mutual and reciprocal. What is for the ultimate good of society is for the welfare of the railroads.

The question now under discussion is a dual one; the effect of deep water between the great lakes and the ocean upon railway traffic and railway revenues. Thus far in the discussion attention has been directed to the consideration of the effects which the proposed waterway would have both upon railway traffic and railway revenues. The further application of what has been said to the question of the influence which the deep waterway would exert upon railway revenues need not detain us long. If what has been said be true in regard to the division of labor which would take place in the work of transportation as a result of adding a deep waterway to the present means available for the carriage of freight to and fro between the lakes and the sea, the net revenues of the railroads would increase rather than diminish as the result of water competition.

The commercial position of the waterway and its influence upon the tariff and revenues of the railroad are well stated by the following resolution of the Fourth International Congress on Inland Navigation: "The existence and development together of railways and waterways is desirable, first, because these two means of transport are the complements of each other and ought to contribute, each according to its special merits, to the public good; second, because, viewed broadly, the industrial and commercial development which will result from the improvement of the means of communication must in the end profit both railways and waterways."

No one doubts but what there would be a great increase in the traffic carried on between the lake states, the northwest and seaboard, were the lakes connected with the ocean by a ship canal 26 or even 20 feet in depth. What the Erie Canal has accomplished in the past under the commercial conditions then existing and what is now resulting from the efforts of the Canadian government to make of the St. Lawrence river a waterway for vessels of fourteen feet draft are but the earnest of the manifold greater influences which the proposed canal would exert upon the economic development of the northern part of the United States. In this industrial progress the railroads will inevitably share. Their traffic and their revenues will grow in proportion to the extent to which the welfare of the country is promoted by the connection of the deep water commerce of the great lakes with that of the ocean by means of the proposed waterway. The railways need not fear, but may rather welcome, the construction of a deep waterway between the lakes and the sea.

Chairman Crocker requested Professor Haupt to come forward and discuss Mr. Johnson's paper.

L. M. Haupt, C. E, Philadelphia: I fully agree with Professor Johnson's position and with his conclusions, but I think I can better discuss his paper by presenting the essential features of my own, which, however, as your secretary observed, are quite as much in the line of supplement as confirmation of that admirable essay. With your permission, I will proceed:

Sectionalism and Railways vs. Deep Waterways.

PROF. L. M. HAUPT, CONSULTING ENGINEER,
Philadelphia, Pa.

Were it not for the overwhelming importance of the subject, I would greatly have preferred declining the honor of addressing this convention; but the general lack of appreciation of the benefits to be derived from water transportation in this country, and the hostile attitude of the railroad corporations to the improvement of our internal waterways is my warrant and justification for a few notes in behalf of our canals.

By way of introduction, permit me to submit a few suggestions on what might be called canal engineering; not the the physical location or construction of the canal trunk but the policy which I think must be pursued to insure the success of any movement to improve our waterways. I refer rather to the engineering of canals, politically and socially, and to the elements which militate against the consummation of these most laudable enterprises.

History is replete with examples of the failure of great projects to materialize, and I need only say that these failures are often largely due to sectionalism and local jealousies resulting from narrow views of public economies and extreme conservatism. Where is the great engineering work that has not been handicapped from the start by the fear that it may interfere with other local or vested interests? Why is not the Nicaraguan canal to-day *au fait accompli?* Ask the Southern Pacific Railway whose great president is reported to have said that the country does not need it, as that road could handle all the business offered, and the several vessels sailing around the Horn furnished all the competition necessary. National jealousies may also have had much to do in delaying the inception of this urgent, international project.

Why was work on the Hennepin Canal so long and vigorously opposed by a powerful lobby?

Why is there, at this date, so great anxiety expressed as to the lowering of the lake levels by the Sanitary and Ship Canal at Chicago?

Does anyone suppose the real issue to be so much the probable limitation of the draught and tonnage (by a few inches when the lake levels fluctuate over five feet) as the increased prestige and commerce which the city of Chicago will secure to herself from her great enterprise in undertaking this magnificent project on her own resources?

The people of Pittsburgh are bottled up and their commerce throttled by absence of a cheap line of communication to the great lakes. They want the best line possible, and its location must be fixed by existing physical conditions. These must determine the position of its terminals, and however much the good people of Buffalo, Erie, Conneaut, Ashtabula, Cleveland, or even Toronto (on the other side) may desire it, they cannot, by proclamation, bonus or otherwise, make the lake terminus at any other point than where the Creator has placed it.

But because all can not have the supreme benefit, there is no reason why they should not all have their *pro rata*, due to position and facilities, if they will work together for the project. One chamber of commerce has already adopted a report pronouncing the scheme impracticable. Shall one of the members of dependent transportation systems say to the others, because I am not the mouth, I am not of the body, and decline to be fed? Because it can not be the head, is it politic to starve the entire body?

The residents of Cincinnati, Louisville, St. Louis, and down river points, are, at this writing, looking anxiously forward to the breaking up of the protracted drought which has impounded over 25,000,000 bushels of coal above the Davis Island dam awaiting a rise. It must then go out with great risk, so that the loss of interest on boats and barges, the additional insurance, and the suspension of business and higher price of fuel constitute a tax reaching into millions, due to the uncertainties of navigation in the Ohio.

These obstacles and the improbability of early relief by river, have led the coal operators of southwest Virginia and Kentucky to desire a short cut by water to the lakes, and they do not see any necessity for the proposed canal from Pittsburgh to Lake Erie since their tonnage could not reach it by boat, but prefer a more direct route. Thus the indifferance of one section of country to the development of another retards the normal growth, restricts commerce, and increases the cost of transportation.

A remarkable instance of the baleful influence of local jealousy is to be found in the effort made by the state of New York to secure national aid in the construction of the Erie canal in 1811-12. The New York canal commission appealed to the legislatures of the several states and to congress for a government land grant to secure the work, but so great was the fear that the benefits would accrue solely to the Empire state that the bill was "pigeon-holed" by a committee, and New York was thrown on her own resources, which were, fortunately, equal to the occasion.

Then, when too late, Pennsylvania spent large sums (said to aggregate $40,000,000), in her competing system of public works, but all to little purpose. The prestige of her principal seaport was gone, and these canals are now largely monuments of her short-sighted folly—having been purchased by the railroads and abandoned. The very interesting report of the New York commission narrates that they were forced to mix the canal scheme with others relating to purely local interests and to refrain from asking any advance of money. They did, however, venture to solicit a grant of land, not to take effect till after the canal should be completed at the expense of New York.

After learning that unless grants were also made to other states for various purposes, they had no hope of passing their measure, the commissioners accepted the situation and draughted a bill which was the forerunner of the various comprehensive river and harbor bills now in vogue; but it failed to pass.

It was too big for the times and treasury, for it provided for an interior waterway from Boston to Albemarle Sound; from Lake Champlain to the Hudson; from Lake Erie to the Hudson, the Susquehanna, the Muskingum, and the Wabash; from Lake Michigan to the Illinois; from the Susquehanna to the Schuylkill and the Delaware; from the Roanoke above its great falls to the Chowan; from the Tennessee to the Tombigbee; from the Cooper and the Black rivers to the Santee; from the Savannah to the Tennessee; to construct locks around the falls of the Ohio, and to meliorate the navigation of the Potomac. The total acreage proposed to be granted pro rata was 9,900,000 acres, of which 4,500,000 was to aid New York.

As stated, the committee failed to report the bill, and New York completed this great work of 351 miles between Lake Erie and the Hudson in eight years, at a cost of about $5,700,000, alone. While tolls were at first charged, they have long since been abandoned. In 1852 the revenue was over $3,000,000, and the canal has paid for itself many times over, while its general benefit in regulating rates is inestimable. It is no exaggeration to say that it has saved to the country hundreds of millions of dollars in the cost of transportation, by its control of railroad rates; and yet it can be shown that it has had a healthful and beneficial influence in creating business for its competing lines and has increased their earnings.

The most prosperous and successful railroads of the country are those which parallel the cheapest water routes, yet railroad managers apparently fail to appreciate this paradox, and since they cannot meet the canal rates, they wage a war of extermiuation against them.

The Erie canal will never outgrow its usefulness, but it is much too small to meet the demands of modern commerce, and should be enlarged, or a new and better route be selected between the lakes and tide water. This is one of the momentous questions of our day, and one which very justly commanded the attention of the Toronto convention. It is a question of as deep importance to the great and fertile regions of the British northwest as to our grangers on this side the border.

Its solution has been discussed by many able students and masters of transportation, and while the physical difficulties are well digested, there are local prejudices still standing in the way of a final decision. The demands of Montreal and the St. Lawrence militate to some extent against those via Champlain or the Mohawk. Again there are others who think that the drop into Lake Ontario should be avoided and a bee line be taken from Lake Erie to the nearest tidal water by a series of pools and hoists or marine railways leading to the Delaware.

Until these interests are harmonized by each party or section making concessions, it will be difficult to inaugurate any project with good prospect of success.

Thus is required (*) a commission of broad-minded men representing these conflicting local interests who, with the co-operation of government and civil engineers, may select that route which will best satisfy all the physical, commercial and engineering requirements.

The economic value of a deep waterway from the great lakes to the sea has frequently been elaborated by such eminent authorities as Albert Fink, commissioner of the Trunk Line pool; Hon. Wm. Windom, chairman of Committee on Transportation to the Seaboard, and many others. A few extracts from these engineers and statesmen will serve to impress the urgency of the cause.

Mr. Fink says: "The Erie canal and the lakes exercise their influence over the southern country until it reaches a line where low ocean rates from New York to the gulf states—Mobile, New Orleans, Galveston—exercise their influence upon the rates to the interior adjacent points, Augusta, Macon, Selma, Montgomery, Houston, etc., so that it may be said the all-rail rates are kept in check by water transportation."

Mr. Windom, in addressing the Senate, June 10, 1878, said: "The wide sweep of competitive influence exerted by the Erie Canal is not generally understood or appreciated. You would, doubtless, be surprised, Mr. President, if I told you that the little ditch which runs through your state holds in check and regulates nearly every leading railroad east of the Mississippi river, and that it exerts a marked influence on the cost of transportation over all parts of the country, * * * and yet such is the fact."

To this Mr. Fink adds: "There need be no fear that extortionate rates will be charged by railroad companies; on the contrary, the fear is that water competition will be so effective as to prevent railroads from securing paying rates."

Thus the superiority of the waterway to provide cheap transportation is clearly recognized by the railway managers, who, like the woman in the fable, would kill the goose to get the golden egg—not discerning the mistake which they are making in attempting to usurp the functions of the canals by carrying low-grade raw materials at ruinous rates, and with consequent wear and tear, rather than foster their movement by water at a profit for the benefit of all parties at interest, themselves included.

It is well known that during the close of navigation the rail tariffs are about doubled between the lakes and tide-water; hence, the concerted and persistent movement now on foot to obliterate the influence of the Erie Canal is suicidal to the great cities of the seaboard as well as to the trunk lines which feed them. Can anyone suppose for a moment that the present tonnage will be maintained, with freight rates doubled by destroying the canal, and producers' prices cut in half by the inflation in value of our purchasing medium?

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*NOTE.—Provided for in the Vilas amendment to the sundry civil bill of March 2 1895.

With wheat at $1.00 per bushel there was a fair margin to the farmer and the carrier in shipping it abroad, but at 23 cents in Montana, it can hardly leave its native heath and neither the granger nor the transporter can handle it profitably. It is therefore not possible to balance our exchanges by products and our treasury must supply the deficit in gold.

The following from "Our New York correspondent" shows the drift of events and obstructive policy of certain vested interests:

[Regular Telegraphic Correspondence of the Public Ledger.]

New York, Sept. 13.—The people of New York are to vote at the next election on the question whether the state canals shall be deepened from seven to nine feet, the locks lengthened and other improvements made, all at a cost of not more than $9,000,000.

Naturally an earnest discussion has arisen as to the advisability of entering upon this large expenditure for such a purpose. A big committee of merchants, representing the various commercial exchanges, is now engaged in an active campaign in behalf of the project. It is urged on one hand, that unless the canals are thus enlarged they might as well be abandoned, for, as at present conducted, they are doing a decreasing business all the time, and are succumbing to railroad competition. On the other hand, it is declared that an expenditure of $9,000,000, and an enlargement to a depth of nine feet would be worse than useless, and that what is needed is a ship canal of 26 to 30 feet depth, of 125 to 300 feet width, and with locks upwards of 600 feet long. This canal should be constructed by the nation, with the aid of the state, and would accomodate large ocean steamers that would be able to sail through the state to the great lakes. The expenditure of $9,000,000 on a partial enlargement would but delay the carrying out of the more magnificent scheme. But it is urged on the other side that such a ship canal would take years to build, and that its cost would be so great—reaching into the hundreds of millions of dollars—as to make it practically impossible. The Board of Trade and Transportation which is a firm supporter of the canals, publishes a statement from ex-State Engineer Horatio Seymour, declaring that such a canal would be impossible of attainment for many years to come. President Orr, of the Chamber of Commerce, opposes both schemes. He is not quite prepared to combat vigorously the ship canal proposition until he can study the engineer's plans. He doubts whether a ship canal could be built for less than $200,000,000. Nevertheless, Mr. Orr condemns the proposition to expend $9,000,000 on a partial enlargement as a cruel and outrageous waste of money.

The New York Times is laboring hard and earnestly for the ship canal project and opposes strongly the $9,000,000 proposition. The two schemes, it may be said, are calculated to hurt each other. Taken apart or successively canal men might favor both, but taken together they are like two negatives in one sentence, they destroy themselves. It is suspected therefore that railroad influence is at work to kill the $9,000,000 scheme by urging at this time the federal construction of a ship canal.

Deep waterways are an important, in fact I may almost say, essential adjunct to successful railway operation in relieving the roads of their non-productive freights and in stimulating industries and population; thus providing higher class traffic.

That these conclusions are not mere platitudes nor glittering generalities will be seen by glancing over the stock lists of railroad quotations and noting the location of those roads whose securities are above par. For example, New York stock quotations, September 16, 1895:

RAILROADS HAVING COMPETING WATERWAY.	
Chicago N. W., pfd	134
C. M. & St. Paul, pfd	129
Boston & Maine	178
Boston & Lowell	206
Boston & Albany	210
Boston & Providence	265
Delaware & Hudson	130
Lake Shore	149
Michigan Central	101
New York Central	102
New Jersey Central	109
Old Colony	178
N. Y., N. H. & H	182

RAILROADS HAVING NO COMPETING WATERWAY.	
At. T. & S. Fe, pfd	18¼
Atlantic & Pacific	1⅜
B. & O	65
Canada & Pacific	56½
Central Pacific	19½
C. B. & Q	84
C. & O	19½
C, C., C. & St. L	44
C, C., C. & St. L., pfd	94
C. R'k I. & Pacific	82
Col. Coal & Iron	5
D. L. & W	162½
Den. & Rio Grande	16
Great Northern	128
Houston & Texas	3½
Illinois Central	101½
N. Y., L. E. & W., pfd	23½
Norfolk & West., pfd	14
N. Pacific, pfd	18¼
S. Pacific	25
Texas Pacific	11¾
Union Pacific	15

These quotations serve to illustrate the benefits to railroad traffic of water-borne commerce. There are doubtless numerous other factors tending to promote the prosperity of the railways whose stocks are above par, but it is no mere accident that most of these roads are parallel with, or connect the cheapest kind of internal water competition.

Although the reasons for this result are manifest in the increased population, higher class freight, larger movements and cheaper materials afforded the railways by their acquatic environments, yet the policy of railway managers as yet seems to indicate that they fail to realize the facts and to utilize the possibilities of so powerful an auxiliary for the promotion of their business. Even where the waterway can be built by the government and without cost to the corporation, there exists the most determined, covert opposition to it from railroad managers. So great has this become that in at least one of our sister states, dominated by these influences, we find legislation absolutely prohibiting the construction of canals more than three miles long or 100 feet wide, thus imposing a heavy embargo on local development and greatly restricting through traffic, compelling most of the enormous tonnage across the state to be carried by rail, and yet that same road shows an annual deficit on this business.

As this traffic could be largely handled by water at a profit for one-third the present charges by rail, it becomes a duty for a long-suffering public to enter its protest against such an extravagant policy.

During the present century there has been a rapid evolution of transportation systems from the Conestoga wagons to the 60,000-pound car and from the canal packet to the ocean greyhound, but the end is not yet. The "trolley" is now a disturbing factor and its relative economy is cutting into the local traffic of railways so that their management must be modified correspondingly and a still cheaper motor, such as compressed air or gas,

must come into use for light work. Still, there is no medium of transportation that offers so little resistance to movement of solid bodies on the earth's surface as water; hence, the canal of ample cross-section, with no current, is physically the best road-bed that can be provided.

It is practically a continuous belt on which the boats are the buckets conveying the raw materials from the mine to the mill, while the railroads are the looms in the mill, of which the trains are the shuttles, which take up the thread from the canals and weave it into the fabric of a nation. These systems are not antagonistic and destructive but beneficial and constructive. They should form inter-dependent parts of every transportation route,

"Useless each without the other."

Pennsylvania, Maryland, Delaware, New Jersey and other Atlantic States need greater commercial facilities, not as states, nor sections, but as parts of the United States, that the market range of their products may be extended and their manufactures be more readily exchanged for those of other sections. To extend the benefits of the Erie canal to the south Atlantic states and to the Ohio basin with its teeming population and resources, via the New York waterways, enlarged facilities must be provided, and to secure them there must be concerted action.

A campaign of education must be inaugurated and carried on to the finish, uniting all sections of the country in the common cause of cheapening transportation by the best known physical means, and over the most feasible routes.

This can only be accomplished by the construction of deep-draught waterways.

Chairman Crocker: These are certainly splendid papers. Shall we not have further discussion of them?

Professor Haupt: In order to carry out the closing idea of my paper, I will now offer a resolution and ask to have it sent to the committee on resolutions.* In doing so I desire to say that I am not tenacious about having it adopted as written, and it may not be adopted at all. But it is the idea that I wish to bring forward—the notion that all the great interests and localities suffering for want of more ample transportation facilities may consolidate their plans and unite their forces.

Chairman Crocker: While we are waiting, let us hear Mr. Wisner, if it is convenient to him.

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*NOTE.—The resolution offered by Professor Haupt, as follows, was referred by the committee on resolutions to the executive board of the International Deep Waterways association:

WHEREAS, The cost of transportation by water is beyond doubt lower than by rail; and

WHEREAS, The development of our internal resources is dependent on securing the cheapest possible rates; and

WHEREAS, The competition afforded by deep waterways as a matter of fact is found to be beneficial to railroads by relieving them of non-paying low-grade freights; and

WHEREAS, A systematic and continuous improvement of the canals, rivers and harbors of this country is of the greatest moment; therefore,

Resolved, That a committee be appointed to formulate a measure to be presented to congress looking to the unification of local interests and the adoption of a rational policy for the continuous and rapid improvement of our waterways and harbors.

Regulation of Lake Levels with Reference to Improving Waterways.

GEORGE Y. WISNER, C. E.
Detroit, Mich.

The depths of channels at the entrances of lake harbors previous to the commencement of improvement by the general government about seventy years ago, were from two to eight feet, and were not generally increased to a depth of twelve feet until after 1864. The natural channel at St. Clair flats was eleven feet for an average stage of water, and about thirteen feet at the Lime Kiln Crossing in the Detroit river, or sufficiently greater than the depth at the principal lake ports that any slight fluctuation of the water levels in these waterways was of but little importance. The phenomenal increase in the lake commerce since 1850 has been such that all improvements of harbors and waterways, which have been undertaken, have generally been discounted by the increased draft of vessels built to such an extent that before such improvements could be completed, every foot of available depth has been constantly utilized, and more urgently asked for.

Under an act of Congress, granting 750,000 acres of land to the State of Michigan for the construction of a ship canal at Sault Ste. Marie, the St. Mary's Falls Ship Canal Company completed two locks in 1855, 350 feet long, 70 feet wide, 11½ feet deep, and 9 feet lift each, at a total cost of $999,802. These locks were soon found inadequate to accommodate the increasing traffic of Lake Superior, and in 1870 the general government commenced a new canal with lock 515 feet long, 80 feet wide, 16 feet deep and 18 feet lift, which was completed in 1881 at a total cost of $2,150,000. The fluctuations of the lake levels, however, are often such that 13 feet to 14 feet is the maximum depth to which vessels can load, and consequently a canal and lock of still greater depth was found to be an absolute necessity.

A new lock 800 feet long, 100 feet wide, 21 feet deep and 18 feet lift, is now being constructed at an estimated cost of $4,739,000, and it is now considered certain that a lock of still greater depth will soon be required.

At the St. Clair flats the channel depth was increased to 13 feet in 1871; to 16 feet in 1873, and is now being deepened to 20 feet; but if one may judge from the unanimous sentiment of the delegates to your Toronto convention last September, works to create a still greater depth must soon be constructed.

If these fixed structures require such increase of depth, the connecting waterways, to give unobstructed facilities for rapid and economical transportation, of necessity will require still greater depths, and since the maximum limits for these channels under the present system of improvement have been nearly reached, it becomes very important to consider new methods for securing such results.

The cost of increasing the depth of the lake waterways to 20 feet has been about $1,500,000 for each foot, and for the principal lake harbors about $3,000,000 per foot of increase, from which it is evident that any permanent deepening of these harbors and waterways may safely be considered worth $4,500,000 for each foot in depth so obtained.

The importance of any slight change in the lake levels is well illustrated by the criticism by literary engineers of pessimistic tendencies upon the deepening of the channel at Lime Kiln Crossing, in the Detroit river, whereby a lowering of the water surface of the river a half-inch may have been produced. It is, however, very strange, that where such small changes have attracted so much attention, variations in depth of several feet, due to natural causes, have received no official attention with reference to their amelioration, and have met with bitter opposition whenever any attempt has been made to secure an investigation of the feasibility of such improvements.

The fluctuations of the water levels of the lakes in extreme cases, amount to about five feet on Lakes Michigan, Huron and Erie. That these variations may be materially reduced there is no doubt, and whatever that amount may be, will increase by a like amount the low water depths of all the lake channels, and by rendering such depths nearly constant, secure much greater economy in vessel construction and transportation.

The data required for a complete investigation of this problem are not to be had at the present time, but the physical facts pertaining to the matter are sufficiently well known to determine within reasonable limits what may be accomplished, and point out the lines on which future investigations should be made.

PHYSICAL DATA PERTAINING TO THE LAKE SYSTEM.

	Lake Superior.	Lake Michigan	Lake Huron.	Lake Erie.	Lake Ontario.	Lake St. Clair.
Mean level above tide water	601.8 ft.	581.3 ft.	581.3 ft.	572.9 ft.	246.6 ft.	576 ft.
Maximum depth	1,008 ft.	870 ft.	750 ft.	210 ft.	738 ft.	
Area square miles	31,200	22,450	23,800	9,960	7,240	410
Area water shed miles	51,600	37,700	31,700	22,700	21,600	
Aggregate area of basin, square miles	82,800	60,150	55,500	32,660	28,840	
Mean annual rainfall	2.6 ft.	2.8 ft.	2.8 ft.	3.1 ft	2.9 ft.	
Variation in annual rainfall	1.5 ft.	1.5 ft.	1.5 ft.	1.7 ft.	2.0 ft.	
Total rainfall on basin, cubic ft. per sec	187,400	... .	450,350	547,000	622,700	
Mean annual evaporation	1.25	1.8	1.8	2.0	2.0	
Max. range of levels	3.5	5.0	5.0	4.1	4.8	
Average annual range of levels	1.20	1 34	1.34	1.55	2.07	
Discharge of outlets, cubic ft. per sec	86,000	....	225,000	265,000	300,000	
Ruffner 1891, 1892	"	....	"	230,000	"	
Mean date of high water	Sept.	July.	July.	June.		

The annual fluctuation of the water surfaces of the lakes is a function of the amount of rainfall on the respective basins, the time when such precipitation occurs, the amount of evaporation, and the outflow of the lake outlets. The development of the country constituting the lake drainage basins has undoubtedly had a modifying influence on the lake levels. In the original conditions of the lake basins the water from rains and melting snow was retained for weeks in the forest swamps before finding its way through obstructed water courses to the lakes. With the clearing up of the forests, and the development of tile drained farms, these swamps and reservoirs have disappeared, and the water from heavy rains is generally only a few days in finding its way into the lakes, creating rapid rises during wet seasons, and equally rapid fall of the water surfaces during droughts.

Years of heavy and evenly distributed rainfall are generally those when little evaporation occurs, while long periods of dry weather are conducive to producing a maximum evaporation from the lake surfaces. From the most reliable information we have as to the mean annual rainfall and evaporation, for the lake surfaces, the former exceeds the latter by about one foot. Yet, in extreme dry seasons there is no doubt that the annual evaporation from these surfaces exceeds the amount of rainfall, in which case the discharge of the lake outlets becomes less than the drainage from the tributary watershed.

It is to this combination of conditions, working oppositely, that the extreme range of levels for different years is largely due. Years of excessive precipitation are not necessarily years of high water on the lakes, unless the times of such rainfall are so distributed as to produce a maximum effect.

The falls in St. Mary's River, at the foot of Lake Superior, make the fluctuations of that lake dependent only on conditions existing in its own drainage basin. Lake Ontario, having its outflow into the ocean directly through the St. Lawrence River, has a discharge depending on the elevation of the water surface, and inflow depending on the flow of the Niagara River, and the rainfall and evaporation on its own basin. Lakes Michigan, Huron and Erie are so connected with a system of delicately adjusted waterways that any change in the level of one of these lakes has a tendency to produce a corresponding effect in the other two.

The Straits of Mackinaw are so wide and deep that Lakes Michigan and Huron are practically the same level, except when affected by storms and unequal barometrical pressures. For a mean level of lake surfaces the difference in level from Lake Huron to Lake Erie is 8.4 feet, distributed approximately as follows:

St. Clair River,	41 miles.	5.4 feet.
Lake St. Clair,	16 "	0.0 "
Detroit River,	27 "	3.0 "

Any change in this slope produces a corresponding change in the discharge through the waterway, and so delicate is the adjustment that the slope never varies as much as one foot from the above mean and seldom exceeds four inches. For mean high water of the lakes, this slope is 8.2

feet, and for mean low water 8.6 feet, making the mean low water slope greater than that at high water. In extreme cases, the slope at the low water stage exceeds that at high water by nearly one foot, and since the discharge of any river is a function of its cross-section and slope, we have here the anomalous case of a river sometimes having its maximum discharge at its lowest stage. This is an important condition, which has not been given consideration in previous discussions of this problem, and which is really the fundamental principle which should be observed in making investigations to determine the river discharge, and in developing plans for the improvement of the waterway.

The level of Lake Erie, after reaching its maximum stage, commences to fall about one month earlier than Lake Huron and about three months before Lake Superior, showing that these lakes, when acting in their maximum natural capacity as reservoirs, are inadequate to maintain the level of the lake into which they discharge.

Lake Michigan commences to fall at the time the maximum discharge is taking place in the St. Mary's River, and sometimes falls as much as eight inches per month, which would correspond to an actual discharge of 320,000 cubic feet per second in excess of the inflow from the tributary drainage basins, making a total of over 500,000 cubic feet per second actually taken from the volume of water in Lake Michigan and Lake Huron.

Evaporation from the lake surfaces during dry favorable seasons, is probably at times as much as six inches per month, and in connection with the rapidly increasing slope in the St. Clair River, constitutes the principal cause of the rapid fall of the water levels of Lake Michigan and Lake Huron.

These sudden changes of level, corresponding to a rate of discharge of over 500,000 cubic feet per second, seem to indicate that any system of reservoirs which may be devised by damming Lake Superior, or otherwise, will be wholly inadequate to maintain the levels of the lower lakes at a stage very much higher than under existing conditions, and since the variation in the slope of the St. Clair and Detroit Rivers seldom amounts to one foot, it would seem that the natural solution of the problem would consist in maintaining the surface of Lake Erie at as nearly a constant level as possible.

An accurate knowledge of the outflow of the lakes is absolutely essential in designing plans for regulating the lake levels. Unfortunately, such data do not exist at present, and from some inexplicable reason, the departments having the authority to make such determinations, have been very adverse to making any observation to clear up the uncertainty.

In 1841 Messrs. Z. Allen and E. R. Blackwell made a few observations near Black Rock with surface floats for the discharge of Niagara River. These observations, corrected from soundings made by the United States Lake Survey, give a discharge of about 250,000 cubic feet per second for mean level of Lake Erie.

In 1867, 1868 and 1869, parties under the direction of Mr. D. F. Henry, Assistant United States Lake Survey, made three long series of observations with double floats and current meters to determine the discharge of the St. Mary's, St. Clair, Niagara and the St. Lawrence Rivers. The mean of all these observations gave for the St. Mary's River, 86,000; for the St. Clair, 225,000; for the Niagara, 265,000; and for the St. Lawrence, 300,000 cubic feet per second for a mean stage of water in the respective lakes. In 1891 and 1892 the United States Engineer Corps made two series of observations just below the international bridge in the Niagara River, and obtained for a mean stage of water a discharge of 230,000 cubic feet per second.

In the report of this work the authors publish two formulas for computing the discharge, which give results so widely discrepant that no reliance can be placed on either. The difference of 35,000 cubic feet per second between the results of these determinations make it quite evident that more reliable data must be had before the details of plans and estimate of cost for regulating the lake levels can be definitely stated.

A comparison of the annual rainfall on the lake basins, with the respective outflows, shows that the mean discharge is a little less than one-half the mean annual rainfall on the tributary basin, and about one cubic foot per second for each square mile of the basin.

In the observations made to determine the discharge through the St. Clair river, the results were reduced for that of mean stage of Lake Huron, without regard to the existing slope of the river at the time the observations were made. Since, as has been shown, the outflow of Lake Huron depends on the lake level, and also on the difference in level between Lake Huron and Lake Erie, it is somewhat questionable whether the corrections for reducing the result to that of mean lake level were correctly applied.

The action of strong winds on the lake surface often changes the levels from two to three feet; and unless these changes are known, and the proper correction made for the effect on the river discharge, large errors and discrepancies will, very likely, be found in the results. That is, while the observations may be correct for the day on which made, the result for the same stages of water obtained on some other day may be widely different.

The discharge of the St. Mary's, the Niagara and the St. Lawrence rivers depends entirely on the stage of water in the lakes from which it flows, the determination of which is, therefore, a much more simple problem than for the St. Clair.

The plans and methods for improving lake harbors, inaugurated upwards of seventy years ago, are still in vogue; but, judging from the annual complaints in regard to the deterioration of channels at harbor entrances, it is evident that the limiting depths have been reached where such methods can produce permanent results.

The general plan has been to deepen the channels of connecting waterways by dredging, and at the entrance of harbors to construct parallel piers 150 to 200 feet apart, and dredge between. This system for depths of less than twelve feet was very effective, but for greater depths the annual silting up of channels makes the cost of maintenance very great. The width between piers is also much too small for the depth of twenty feet or more, which must soon be obtained for all of the principal lake ports. The government has endeavored to maintain a depth of seventeen feet at these ports for several years; yet, at the opening of navigation for 1895, owing to the low stage of water in the lakes, and to the silting up of channels, but few of the harbors (except on Lake Superior) had navigable channels of over twelve feet. The movement of sand parallel with shores during severe storms is enormous, and wherever these harbor channels have been excavated much deeper than the adjacent bottom of lake, silting is almost certain to occur.

In the new channel, recently cut at the entrance of Toledo harbor, the government engineer in charge reports an annual filling up of 0.5 feet; or assuming the average depth of the cut to be eight feet, the work of maintenance amounts to the same as for cutting a new channel every sixteen years.

When we take into consideration the fluctuations of the lake levels, it is evident that a channel 21 feet deep at mean lake level will not generally insure safe navigation for vessels of 20 feet draft, except for a period of about three months each year. At the opening and closing of navigation, low water usually prevails, and vessels constructed for a full load on a 20-foot draft will be able to carry only a part of what would be an economical load in a waterway regulated to fixed level.

The total fluctuations of the lake surfaces being over four feet, a well devised system of regulation, which will reduce the range of levels to one foot or less, will increase the low water depth of all the channels three feet, and fix the draft for which vessels may be constructed so as to carry full loads throughout the entire season of navigation.

Two different methods have been advocated for accomplishing this result: First: To make a regulating reservoir of Lake Superior and its tributaries, and turn their surplus waters into Lake Huron at the proper season, to maintain the low water stage at a higher level than under the present regimen; and, second, to regulate the level of Lake Erie with a submerged dam near the outlet of the lake, such as to increase the low-water stage about three feet, reduce the fluctuation to less than one foot, and indirectly through the change of slope in the St. Clair River, reduce the fluctuations of the water surface of Lakes Huron and Michigan to at least one-half that at present.

With the data now at our disposal, it is impossible to state definitely what may be accomplished by either of these plans, or what the exact cost would be to complete them; but the physical facts are sufficiently well known to be able to point out in a general way the results which may be reasonably expected from the execution of either one or both of the plans, and to conclude definitely whether such an undertaking is worthy of an official investigation.

The extreme fluctuation of the water surface of Lake Superior is about 3.5 feet, with a mean fluctuation of only 1.2 feet. With proper regulating works near the foot of the lake, the low water stage might be maintained at least one foot above the present mean level, without damage to any existing structures. The extreme high stage of the lake is approximately two feet above mean lake level, and to avoid all litigation for damage from overflow, the regulation should be such as to prevent this limit from being exceeded. The present outflow for mean level of lake is about 86,000 cubic feet per second, and with regulating works completed, the outflow could probably be increased to 150,000 cubic feet per second for a period of three or four months each year, provided that such a discharge did not create currents in the St. Mary's River of such a nature as to make navigation difficult and dangerous. This amount could not safely be exceeded, and it is very likely the requirements of navigation would limit the maximum safe outflow at a much smaller amount. Lake Nepissing could also be utilized as a regulating reservoir, but the supply from this source would be small compared with that from Lake Superior, and it would not, therefore, be safe to estimate on a total of over 75,000 cubic feet per second in excess of the present mean discharge of 86,000 cubic feet. Since the evaporation and outflow from Lakes Michigan and Huron sometimes amount to over 300,000 cubic feet per second in excess of the influx from rivers and drainage, and that too when the discharge through the St. Mary's River is a maximum, it is quite evident that the supply from the regulating dams alone would have but little effect in checking the fall of the water surfaces of the lower lakes. It has already been shown that the discharge of the St. Clair River varies rapidly with any change of slope, and since the maintenance of a high level in Lake Huron when that of Lake Erie is falling will increase this slope, the St. Clair discharge would be correspondingly increased, and thus tend to prevent any beneficial results accruing from the regulating works. It would therefore appear that in order to be able to secure any substantial benefit from the regulating works at the foot of Lake Superior, the level of Lake Erie must first be regulated by a dam at the head of Niagara River.

It is a well known fact in hydraulics that where water flows over the crest of a dam or weir, any slight variation of the depth on the crest of such weir will very materially modify the volume of discharge passing over. For instance, if the top of such a weir is two feet below the general level of the water surface of a regulated lake, and a rise of three inches from a heavy rain should occur, the volume of discharge over the weir would be increased 20 per cent.; or, if such were the conditions on the proposed dam for regulating the level of Lake Erie at a time when the discharge was 250,000 cubic feet per second, corresponding to that of the present mean stage, the increase would be 50,000 cubic feet per second; and since the increment for one foot change of level at such stage is probably not far from 33,000 cubic feet per second, the change of three inches above the regulating dam would correspond to that of 1.5 feet under the present conditions of the lake outlet.

A sudden rise of three inches under the existing conditions would not increase the outflow to exceed 10,000 cubic feet per second, from which it is evident that a properly constructed regulating dam at the foot of the lake would greatly increase the discharge of Niagara River for small rises of the lake level, and consequently lengthen the period of maximum discharge and proportionately diminish its volume of flow per second at high stage. That such a dam can be constructed, there is no question; but what its dimensions should be, and what it would cost to construct it can not be stated until the discharge of Niagara River is accurately known.

Since the difference in the levels of the water surfaces of Lake Huron and Lake Erie seldom varies more than six inches from the mean slope of the connecting waterway, it is evident that if the level of Lake Erie be so regulated as to vary but little from its present high water stage, the annual fluctuations of water surfaces of Lakes Huron and Michigan will be decreased so much as to produce the necessary change in slope in the St. Clair and Detroit rivers corresponding to the variation in discharge—a probable extreme fluctuation of less than 1.5 feet.

This result will directly effect the levels of the St. Mary's River below the falls, and will unquestionably add at least two feet to the low water depths of that river.

The laws governing the flow of water over the crests of dams are definitely known, and if the level of Lake Erie be determined, near which it will be safe to regulate the water surface without damage to property, the problem of regulation becomes simply what length must be given to the dam, such that a fluctuation of six inches on the crest will correspond to a variation in overflow equal to the maximum annual variation in the discharge of Niagara River.

The solution of this problem requires an accurate knowledge of the outflow through the Niagara River for all stages of the lake level—data, which at present are so uncertain that the computed outflow by different engineers differs by amounts which would make a large river.

If this project is worthy of official investigation, the first and essential thing necessary is that the physical facts in regard to the water levels and outflow of the lakes be accurately determined. Aside from the important question under consideration, this information is badly needed to settle existing disputes as to what effect certain canal and harbor improvements are likely to have on the channel depths of the lake waterways.

With such a regulating dam in place, the annual discharge of the Niagara will be the same as under the present conditions, but at the beginning of a rise of the lake surface, the dam will add greatly to the outflow and correspondingly reduce the maximum discharge for the high water period.

It is the opinion of the writer that such a dam will be ample to regulate the levels of Lakes Erie, Huron and Michigan, but in case the future development of the lake commerce makes still further improvement necessary, a regulating dam at the foot of Lake Superior would place the levels of the entire upper lake waterway system under perfect control.

Since the water surface of Lake Erie, when properly regulated will not have an annual fluctuation of over six inches, and since the present high water plane of lake levels is 2.3 feet above that of the mean stage, if the regulated plane for mean discharge be fixed at 1.5 feet above the present mean level, the high water stage of the regulated surface would never exceed the present high water plane. And as it is fair to presume that all structures have been built with due regard to safety under existing conditions, no great damage could possibly arise from the improvement.

Since the fluctuation of the regular water surface will be small, all future structures can be built at heights best adapted for economical handling of freight, and have the great advantage of being in such state at all seasons of the year, a condition of affairs all shippers will appreciate.

In a letter published in the Marine Review of September 7, 1893, a distinguished engineer officer says in regard to the effect of such a dam on the level of Lake Ontario: "The result could only be produced by impeding the discharge of Lake Erie, and as the level of Lake Ontario depends on this discharge, it is evident that the level of the latter, as well as of the upper St. Lawrence River, would fall until the discharge over the proposed dam was restored to the present volume. Then the surface of Lake Ontario would begin to rise, and continue rising until the present level was attained. The length of time required to pass through this cycle is inderminate, but it can be assumed with reasonable assurance that the period would be so long that the people of the United States and Canada interested in the navigation of Lake Ontario, St. Lawrence River and St. Lawrence canals, would so strongly object as to prevent the construction of a dam at the outlet of Lake Erie."

This is a strong criticism from an engineer of recognized authority on such matters, and unless it can be squarely met with legitimate reasons to the contrary, might be sufficient to prevent the enterprise being undertaken.

The area of the water surface of Lake Erie is 9,960 square miles, and of the entire lake basin tributary to the lake 230,000 square miles, or approximately 23 times the lake surface. Since about 50 per cent. of the rainfall on the basin is discharged through the Niagara River, it is evident that a variation of three inches in the rainfall on the lake basin would be equivalent to a volume of water due to a three-foot change in the level of Lake Erie.

Since the variation in the rainfall on the lake watershed is over 18 inches, and produces no disastrous effects on the levels of Lake Ontario, it is difficult to understand why only one-sixth of this volume, if held back by a regulating dam, should produce any noticeable effect whatever.

The work of constructing such a dam would extend over a period of at least two years, which would make the effect only one-half that mentioned above, and the criticism can therefore be dropped as a purely theoretical one.

Cheap transportation depends largely on being able to carry large quantities of freight in full loads, long distances, without change and at rapid speed. To do this, ships must be constructed with due regard to the depths of the waterways which they are to traverse, and since the capacity of a waterway within ordinary limits varies as the cube of the depth, the draught of vessel must be such as to utilize as great a depth as possible, without causing speed to be retarded by too close proximity of keel to the bottom.

For waterways of constant depth, the most economical draught and tonnage for a vessel is easily determined, but where the water levels have fluctuations of several feet, the solution is very complicated and unsatisfactory.

On the lakes, freight vessels have generally been constructed for the deepest summer depth to be expected in the waterways, with the result that during low stage of water only partial loads can be carried, which, with detentions from groundings, greatly reduces the profits of the shipping business.

It would therefore seem almost self-evident that any system of improvement of our harbors and waterways, having for a basis the regulation of the water levels, must have a very beneficial effect in cheapening vessel construction and transportation rates.

It is a well established fact that the tendency of export products is to follow the same lines of transportation used for supplying the necessities of home consumption.

The surplus products of the Northwest will therefore very likely continue to be transported over the water and railroad routes through our eastern cities.

This convention has been convened to devise ways and means to render the cost of such transportation a minimum by setting the proper machinery in motion to have a waterway of a fixed depth of over 21 feet constructed from the lakes to tide water; but unless some radical change is made in the methods of improving the waterways of the lakes, vessels loaded for the full navigable depth of such ship canal will be badly handicapped when chartered for ports beyond the western terminus of the canal during the low water season on the lakes. It has already been shown that the cost of increasing the harbor channels and lake waterways has been nearly $5,000,000 for each foot in depth secured in both, and that under the present system of improvement, such results have not been permanent. It would therefore appear very desirable that an investigation be made of the feasibility of increasing and rendering nearly constant the depth of navigable channels of the lakes, by regulating the lake levels, and that such investigation should be made by the International Commission to be appointed, and I understand already provided for, to report on the character, route, and cost of a ship canal from the great lakes to the sea.

Chairman Crocker: Mr. Wisner having read his paper by request slightly out of routine order, discussion of it will be postponed in order to enable Thomas T. Johnston, of Chicago, who has prepared several monographs on the subject of controlling the lake levels, to read his paper on the same topic, which he may now do. You will not consider it improper if I state that the public at large looks upon this question of the control of the lake levels as one of great importance, because it involves one of the international principles for which our association is contending. For that reason it is right to give liberal space to the topic on our program, in order to afford to the public in permanent form as ample a fund of reliable information on this great subject as it is possible at this time to assemble.

We will now hear Mr. Johnston:

Regulating Levels of the Great Lakes.

THOMAS T. JOHNSTON, C. E.,
Assistant Chief Engineer Chicago Sanitary and Ship Canal, Chicago.

There has been presented the outline of a scheme for regulating and controlling the levels of Lakes Erie, Huron, Michigan and Superior by means of the combined influence of dams across the Niagara River and across the St. Mary's River. Statements have been made of how many feet the levels of these lakes ordinarily change. There are long periods when boats plying between certain harbors may be loaded to a depth of twenty feet, and equally long periods when the same boats plying between the same harbors cannot be loaded to a depth of sixteen feet. Such a period as the latter now has existence. It is interesting and useful, therefore, to note that almost every newspaper in the United States and Canada and many in foreign lands, almost every statesman in these same countries, and almost every commercial man, financier, manufacturer and agriculturist, at this time and for some months, has been concerned more or less deeply in a possible change of three to six inches in the permanent levels of several of the lakes. How much more important should be the interest in changes of three to six feet—changes just twelve times as great!

Statements have been made that the ordinary changes of level in Lake Erie may be reduced from five feet to one foot; that the low water depth of that lake may be permanently increased about four feet; that Lakes Michigan, Huron and Superior can be affected in essentially the same degree; that the tortuous channels connecting Huron and Erie can be improved in corresponding degree or rendered more tractable to improvement; that the dams projected will accomplish all these things. Statements have been made that certain investigations are desirable in order to arrange the minor details of these constructions to the best advantage; that the rainfalls vary more or less; that evaporation is more at one time than at another; that vegetation is a factor in the problem by its variable absorption of water; that certain canals and water powers and channel excavations have an influence. Statement has been made, and it is of more importance at the present time than all the others put together, that the question is of an international character; that Canada on the one hand and the United States on the other, have interests involved. This community of interest is the greatest obstacle opposed to accomplishing the end desired, at once.

The practicability of the project and the utility of its execution are the broad ideas of concern, and it may be useful to consider them from an engineering point of view. It is from an understanding of them that tangible results will be derived.

The practicability of the project has three elements:

First.—The quieting of legal points.

Second.—The finances.

Third.—The engineering merits of the matter.

The legal points are mainly involved in international features, all else being a question of legislation and damages. The international questions growing out of the use of the great lakes are multitudinous in the extreme and have confronted the engineer more than once, and in several instances the rights of one nation or the other have been ignored in making use of the waters of these lakes. Nearly fifty years ago Chicago began to divert the waters of the lakes into the Mississippi valley. Canada has for many years maintained a canal around Niagara Falls, and both nations now unnaturally drain Lake Superior through canals and locks.

It is worth while to dwell for a moment on the state of affairs at Sault Ste. Marie. There are three enormous structures at that place called locks, and two ship canals to enable not only boats but also water to gain access to the locks. Not only an immense tonnage of shipping passes through these locks but also an immense quantity of water. No one will doubt but that in the near future, at least, these locks will be taxed to their utmost capacity to pass the shipping coming to them. This means the passage through these locks, when operated once every 20 minutes, of nearly 200,000 cubic feet per minute, or about 60 per cent. as much water as Chicago now proposes to drain from the vastly larger volume of Lakes Michigan, Huron and Superior combined.

The facilities for outflow from Superior have been vastly increased by these locks, and between 2 and 3 per cent. of its average outflow can, and doubtless will, flow through them.

An extensive waterpower project is in existence to be located at this place, the effect of which will be to still further facilitate flow from Superior. The effect of this unatural drainage will be to lower the lake permanently. The total flow from the lake will not be increased, but less water will flow over the rapids and the rest through the locks and water wheels.

Since less water is to flow over the rapids there will be less depth of water there, and consequently a lower lake level.

The remedy for this evil is, of course, very simple, being the construction of a dam and sluices at the head of the rapids at a cost that will be of no moment.

As in the past, so in the future; still further liberties may be expected to be taken with the international rights involved in the use of the waters of the lakes, except that those uses are becoming so numerous that the nations may determine to place some restraint on those liberties.

The engineer has had under consideration for many years the problems of improving the navigable depth of the lakes and their harbors, and has reflected upon the vast advantages to be gained. But he has been compelled to shrink from such an undertaking, not because of any physical conditions confronting him, but because he could see no way to overcome the international questions involved. Here has been an insuperable obstacle,

On the one hand there has not been time to overcome it, and on the other there have not been enough interests at stake to set the necessary forces at work even if time permitted. The time seems at hand when great works are to be undertaken for operating deep water navigation from the lakes to the ocean, but the operations of the engineers will be completely blocked until the international questions are quieted. Once clear away this obstacle and the rest will follow.

The work on the lakes will become a parallel to those now in progress on the Mississippi river. This parallel is worth examination in further detail. The United States government has for many years been expending money to improve the Mississippi river. Prior to 1880 the expenditures were confined to local improvements just as is now the case on the great lakes. About that time, as an outgrowth of conventions similar to this and of the engineering views which had developed, it was determined that the improvement of the river as a whole was the proper and useful thing to undertake. Congress created a commission for that purpose and has sinceappropriated many millions for its uses.

In the brief period of fifteen years so much money has been expended on the comprehensive improvement of the Mississippi, that if it had been applied to the great lakes it would have made a ship canal around Niagara, or twice over regulated lake levels to the fullest extent possible, or would have accomplished a large part of a ship channel from Lake Ontario to the Hudson.

Does any one believe these things would have had existence if the Mississippi had been the boundary line between two nations?

Compare the commerce of the Mississippi with that of the great lakes. Consider the vastly greater interests on the lakes. If the lakes stood in the same relation to the United States that the Mississippi does, would there be any doubt about the United States taking equal interest in their improvement and development?

Private corporations can bring the two nations together when the question of terminating a bridge on the opposite shore is in controversy. Why not a similar arrangement when the question in hand is the construction of a dam? This convention can usefully urge the quieting of the international questions; and, considering the state of affairs at the mouth of Lake Superior and elsewhere, the time is ripe for action.

As far as the practicability of lake level regulation is dependent on legislation and damages, little need be said. Legislation on matters relating to improvements of navigable depths is amply abundant, and if lake levels be confined to their ordinary bounds no serious damage can result compared with benefits to be derived.

Practicability, as far as finances are concerned, can not be questioned. It is only necessary to make the project for lake improvement popular in order to secure the money for the work. It requires no greater annual expenditure than is now made for the Mississippi river in order to progressively prosecute a deep-water project through the great lakes to the Atlantic.

Practicability from an engineering point of view is even more certain than from a financial or legal view. There are delegates to this convention who are reconciled to the practicability of a bridge at New York, the supported ends of which are to be distant one from the other more than 3,000 feet. There are those who have witnessed the excavation of a great canal at Chicago, for the greater part with machines that were unknown five years ago, with a rapidity exceeding the expectations of the most sanguine of its projectors and at a cost much less than had been supposed possible a short time since. There are those who have seen the torrential floods of Wisconsin rivers rendered obedient to a gate-keeper's will so that so much water should pass at one place and so much at another.

Mechanical progress is taking place at rapid pace, and every confidence may be had that if the engineering difficulties be alone to be overcome, then the work is as good as done.

Of course there are, and will be, negative minds which will send forth objections and warnings, just as was the case with the works at the mouth of the Mississippi, or the Chicago Drainage Canal; but who can recall a case wherein the objections and warnings have not proved absurd?

The steamboat, the locomotive and the steamship have all survived in spite of the negations of their birth-time.

The utility of executing a project for regulating and controlling the levels of lakes may be measured in several ways, according to the point of view. Those commercially inclined will inquire as to the revenue to be derived from the investment, either directly or indirectly, or as to the effect on freight rates. The ship owner will inquire as to how many tons of freight he can carry in one hull. The engineer will inquire into the physical effect of the work, not only with reference to what he creates, but as to what he preserves.

The regulation will secure an increase of low water navigable depths in the several lakes affected to the amount of several feet, besides rendering the depths at all times more nearly uniform, and thereby enabling ships at all times to carry nearly full cargoes. This constitutes the utility with reference to what is created. The utility with reference to what is preserved may be far more important.

It is a fact that the hydraulic conditions in the basin of the upper lakes, especially, are and have been undergoing a change, the effect of which is not determined and may never be. The forests are giving away to farms. The proportion of rainfall absorbed by vegetation is perhaps widely different from what it was formerly, and just to the extent that the farm has displaced the forest, to just such extent has there been an increase in the quantity of water used. Again, the disappearance of the forest may be accompanied by change of rainfall, or in the proportion of rainfall that finds its way to the lakes rather than to the skies by evaporation. Again, conditions such as exist at the Sault Ste. Marie are having a prejudicial effect on Lake Superior. In fact, the tendency of works now being executed in the St. Clair flats, Detroit and Niagara rivers and at Chicago, and the works which it is hoped will result from the effects of this convention, is and will be to lower the levels of the lakes. It may be fairly assumed that the regulation and control of the levels will have great utility in preserving as well as in creating depths of water suited for navigation.

Consider how a depth of twenty-six feet in and through the lakes is to be secured. Unless there be control of the levels, such depth must be devised on the basis of lower levels than any which have hitherto existed. Unless there be control, the difficulty of creating sufficiently deep harbors will be more than is necessary. Such control will render the state of the lakes positive and beyond a doubt; whereas, without it, the conditions will be tentative and the result to follow from any system of works will be in a degree uncertain. If the cost of such control does not exceed $5,000,000, the expense may be rated to be small compared with the benefits to follow.

In conclusion, and by way of summary, it may be said that control is practicable from all points of view, the greatest difficulty being found in the international, and the least difficulty in the engineering questions involved. It is useful, not only from considerations of finance and convenience, but also because it will preserve existing conditions in spite of the many causes that do and will tend to destroy them.

MR. HENRY'S DISCUSSION OF LAKE LEVEL EFFECTS.

Chairman Crocker: I will call upon D. Farrand Henry, of Detroit, who had charge of lake measurements from 1867 to 1871, which are said to be the only measurements of any magnitude ever taken at Sault Ste. Marie, St. Clair, and Ogdensburgh, to open the discussion of Mr. Wisner's and Mr. Johnston's papers.

Mr. Henry said he had nothing prepared, but that there were one or two things which give an idea of how little is known about this whole matter. "I suppose," said he, "that you are aware that the current of a river of water and the motion are never at any time constant. The currents of a river are from its surface downward, more especially as they reach towards the bottom. Near the bottom the current will often be double the velocity it is at the top. These fluctuations run through perhaps a half-minute from maximum to minimum, and then for ten or fifteen minutes a larger maximum coming in.

"You will have noticed the same thing if you have ever stood at the base of the American Falls of the Niagara and felt the water coming down from the rocks. It is that same fluctuation, and the same difference in the jar. I have measured the currents in Mackinaw; and running out of Lake Michigan, the surface current would be 2½ to 3 miles an hour, undoubtedly due to the atmospheric pressure being heavier on Lake Michigan and lighter upon Lake Huron. The same thing occurs when it is combined with a wind in the Detroit river. It is not seldom the current is up stream in the Detroit river opposite Detroit, meaning a rise at the mouth of the river of perhaps three to four feet, due to an easterly wind. I have seen the current so strong with an easterly wind, that vessels, if running down stream opposite Detroit, would tail against the wind.

"Then you will find another peculiar motion, where there are bays having a small opening to the lake. You find, if you carefully watch for it in calm days, a continual rise and fall of the level of the lake in such times, right out in the open lake. It is small, not more than an inch or two. The same often multiply when coming into a bay; may be a foot or more; and then at certain times that same fluctuation will amount to several feet. Once at Milwaukee there was one of these fluctuations that came in and swept right over the docks.

"These fluctuations and changes in the water level enable us to see how very little we know about why the water is high at one time and low at another. We attribute it largely to the rainfall, but how little effect such a thing as taking away three inches of depth by the Chicago drainage canal, will have!"

Chairman Crocker: We should like the pleasure of hearing from William Livingstone, of Detroit, president of the Lake Carriers' association.

MR. LIVINGSTONE'S IMPROMPTU SPEECH.

Mr. Livingstone: I feel somewhat embarrassed in coming before you to-day for this reason: I happen to be president of the Lake Carriers' association, a large body of men representing many different interests on the lakes, and naturally I feel very conservative in any views I may express, because it may possibly be construed as reflecting entire unanimity on the part of the Lake Carriers' association, and this impression I do not desire to convey.

On the other hand I do not mean to be quite so conservative as not to be willing to express my personal convictions. But I desire to impress upon you that any statement which I make is not to be considered an official statement of the Lake Carriers' association. I think, however, that my views reflect a very large precentage of the lake carriers.

I would consider it sublime egotism on my part, with the great engineering talent here to-day, if I should attempt in any way to express an opinion of the *modus operandi* by which the greatest possible benefit can be obtained. I believe that the great amount of talent we have in that direction will eventually solve this question, and lay before this body the result of their investigations, and that what now seems to be a very serious problem will prove to be a very simple matter.

Looking at it from a carrier's standpoint, it is a burning question. With the large increase in the size of ships which has occurred in the last four or five years, at a very careful and safe estimate, the carrying capacity of the present vessels, now in commission, averages about thirty net tons per inch. So you can readily see the difficulties which vessel owners have experienced in the last two or three years.

It is going to take time to accomplish what we want. You are all aware that the whole problem we are trying to solve is practically bound up in one sentence: "How can we best carry the largest amount of tonnage for the smallest possible amount of money?"

One of the serious obstacles we have to encounter at present is the Limekiln crossing at the lower end of Detroit river. It used to be the bugaboo of the vessel men of the lakes. We finally obtained an appropriation for it, and got a channel sixteen feet deep. Then we got another appropriation, largely through the efforts of Gen. O. M. Poe, and succeeded in getting it deepened and widened. Now we have a channel of 440 feet in width and twenty feet in depth. That entire work up to the present time has only cost $702,000. Without an official estimate I feel safe in making the statement that it could be increased to 600 feet at the same depth for $200,000, or not to exceed $250,000.

When we consider that the entire commerce of the lakes from Superior and Michigan converges in the St. Clair river and has to pass through that channel, and when we consider further the enormous increase of tonnage and in the construction of vessels, we know that we require more room and more depth for safety through that channel.

In addition to this we ought to consider the situation of the channel near the mouth of the Detroit river, four miles from Lake Erie. In the fall of the year we have what we call the three-day blow, and the water is driven down sometimes three feet, making navigation very dangerous. For these reasons the channel ought to be widened.

In addition, there is a little sharp turn at the entrance, and when you leave the river there is another little sharp cut. There is a gentleman here in the audience, Capt. Westcott, who reports all vessels passing down the Detroit river. Astonishing as it may seem, for the entire eight months of the sailing season, one vessel in every 7½ minutes passed that point on an average.

I want to call your attention to another fact: in 1855 the inland marine was only in its infancy, and a man might then have made predictions not less bold than those of 1895. He might have predicted that within 40 years the total tonnage of the lakes would be 1,227,000, with a valuation of some $70,000,000, constituting more than one-quarter of the total tonnage of the United States; that this fleet would carry through the Detroit river, on the best estimate that can be got, from 35,000,000 to 40,000,000 net tons of freight, of which two-thirds would be primary products going somewhere for manufacture; that this freight movement, in less than eight months, would be something like 30 per cent. of the total freight movement of all the railroads in the United States for the entire year; that this fleet would include 39 per cent. of the total steam tonnage of the United States; that the average size of its steamers would exceed the average size of the ocean marine of this country; that the cost of transportation by this fleet would be less than one-fifth of the cost of the mere moving of freight on the best equipped and busiest railroad of the United States, and less than one-ninth of the average cost.

There is no system by which entirely reliable data can be had of the movement of freight by our lake fleet on anything like general lines, except at the Sault canal, but from the statistics there we may get a very good idea of our progress, which has been most notable in the past ten years.

In 1884 the total freight movement through the canal was 3,500,000 net tons.

In 1894 the total movement was 13,225,000 tons. The freight movement had more than quadrupled in ten years, and, in the 234 days the canal was open for business, it exceeded the total movement through the Suez canal for the entire 365 days by more than 5,000,000 tons.

The increase in the last five or six years in lake tonnage amounts to over a half million tons, and that increase has just kept the average on the sea-coast good. The increase on the lakes has kept pace with the decrease that has occurred with our commerce on the sea-coast.

I do not know whether it is now proper or not, but I want to offer a resolution, and, for the purpose of saving time, will ask that it be referred to the committee on resolutions.*

I will add that all the money that has been expended on the Limekiln crossing up to the present time has been expended by Americans. And the 160 feet we propose to have added will be on the westerly side of the channel, and the money will be furnished entirely by our American congress.

COL. ECKHART'S REMARKS ON LAKE LEVELS.

Col. B. A. Eckhart, one of the trustees of the Chicago sanitary district, was asked for his opinion of the probable effect of the Chicago canal on lake levels and responded:

Col. Eckhart: During the past four months the question as to the effect of Chicago's great drainage channel upon the level of the lakes has been agitated so extensively and the expressions of opinion thereon have been given with such vigor as to gain the attention of many who have in this way for the first time learned of the undertaking. Some jump at the conclusion that the water is already running in the channel. The existence of low water even in streams remote from the lake, in streams emptying into the lake has been ascribed to the effect of our channel.

But this ignorance of the nature of our work is not confined to the backwoods. Intelligent, enterprising citizens of our own city sometimes indicate by the nature of their remarks about this work that they think that as

*Note.—Adopted later.

soon as this channel shall have been completed, the connection between the great lakes and the Mississippi will have been made, and that lake cargoes will then be on their way down the Illinois and Mississippi rivers, and return cargoes be coming up from the Gulf of Mexico. They do not realize that provision must be made for carrying the water down a total declivity of about one hundred and forty feet; that sand bars and dams must be removed, levees and embankments must be erected; over-flow of lands guarded against, and in short, that work of very great magnitude and of long duration must first be accomplished before the waterway feature of our channel shall become part of a connecting system joining the lakes with the Mississippi.

Not only that, but the fact is lost sight of that this additional work will have to be undertaken by the general government and can not be undertaken by the people of a district limited to an area of about one hundred and eighty square miles.

This is but one sample of the misapprehensions which are afloat among those who are near the scene of operations, who are, as it were, a part of the enterprise itself. It is, therefore, not surprising if those who are remote from it fall into error in regard to the effects which may be anticipated from it. And lately, as has already been stated, the scientific men have come forward.

As it is usual to sustain any proposition with figures, our friends, the scientific men, come forward with their calculations. If it can be figured out, there can be no doubt of the effect of the channel when completed upon the lake levels. Figures never lie.

No fault can be found with honest expressions of apprehension as to the effect of this work. If there is to be a lowering of lake levels it should be known. It should be known in order either that it may be prevented or that the necessary provisions may be made to counteract the effect.

But is it known, can it be known from the data which are at present accessible, what the actual effect will be of taking from Lake Michigan the amount of water contemplated?

What has been the experience heretofore with regard to the lake level? Has it been invariable—constant from one year to another, from one series of years to another? Is it constant even from week to week? These questions need only to be stated to furnish their own answers if one knows anything of the subject. It is well known that the extremes of high and low water in the lake show a difference of from four to five feet; that there may be a difference of even a foot in a day; that a wind or a difference of barometric pressure may occasion a rise or fall of even two feet. This being so, even suppose it true for the sake of argument that the effect of the drainage channel should be to lower the lake 3 or 6 inches, what damage can be suggested that would arise therefrom? It certainly cannot be contended that all the lake craft are so built that a difference of 3 or 6 inches in the harbors or connecting channels would render them useless, since already that difference and more exists now from one period to another. Vessels are not built upon so narrow a margin of draught that a difference of a few inches or even a foot in the amount of water would render them uselesss.

But what are the facts in regard to the question? Or perhaps it would be better to ask, what are the demonstrable probabilities of the situation? For it seems to be admitted, even by those whose calculations have the darkest tinge and whose forebodings are gloomiest, that there can be no such thing as certainty in the matter.

The present channel provides for a flow of water of 5,000 cubic feet per second or 300,000 cubic feet per minute. As the population of the area drained increases beyond 1,500,000 the capacity of the channel must be increased so as to provide 30,000 cubic feet per minute for every additional 100,000 inhabitants. Or, should the general government so improve the Desplaines and Illinois rivers that they could carry 600,000 cubic feet per minute, and protect the sanitary district against claims for damages from overflow, then the channel must be so enlarged as to carry 600,000 cubic feet of water per minute.

Now, on the hypothesis that the supply of the lakes is a constant quantity it can be shown that 300,000 cubic feet per minute through our channel would lower the lake level less than 3 inches, and that a flow of 600,000 cubic feet per minute would lower it less than 6 inches. So much for the demonstrable probabilities.

But let us meet the extremists on their own ground. Suppose the lowering of the levels should be one foot or more, who is most interested? Are the cities of Lakes Huron and Erie alone interested in this question? Would they be most seriously affected by such change? If the results are to be as depicted by the extremists, what will be the effect on Chicago herself? The total tonnage arriving and departing from the port of Chicago for the year 1893 was 10,906,107 tons; that of Cleveland for the same year 8,551,637 tons; of Buffalo 9,494,649 tons.

For 1894 the tonnage at these ports was as follows: Chicago, 10,392,420; Cleveland, 9,616,990; Buffalo, 8,810,053.

It will be seen that Chicago's annual tonnage is greater than that of either the other cities named. It is nearly equal to that of New York for foreign ports.

This being the case it is easy to see that Chicago herself would be the greatest sufferer from any change in the lake level which would injuriously affect commerce. But Chicago is not asleep as to her interests. This is no new question there, though it seems to have been so recently discovered by our sister cities.

It is a common experience for those who have suddenly, for the first time come upon a new idea, to imagine that it is original with them and make the welkin ring with their shouts. I had the pleasure of assisting in securing the enactment by the legislature of the state of Illinois of the sanitary district act, under which this project of a drainage channel and waterway is being carried out. The plan had been thoroughly considered. Such calculations as were possible from the then existing data were made. The results were essentially those which have recently been reached by our own engineers. Can it be thought by the members of this convention that Chicago's eyes are closed to her own interests? Is it well known in Cleveland and Buffalo and Detroit that the modern trend of ship building is toward the building of vessels of greater capacity, demanding greater depth of water, but Chicago has not discovered it? On the contrary, is not Chicago herself from her yards at South Chicago turning out the latest triumphs and very largest models in the line of great lake carriers?

Whatever may be the future of the drainage canal in connection with an improved Illinois river as a commercial waterway, and it may be great, no one that I have heard discuss the question has ever thought that it could at all compare with the traffic that comes to Chicago doors by the way of the great lakes. Does Chicago not perceive this? Would she sacrifice the greater for the less?

No, should any such disastrous effect as portrayed by some of the members of this convention be the result of Chicago's enterprise, she would herself be the first and foremost in the ranks of those seeking to apply a remedy.

But let us suppose the worse. Let us take the other view and assume that the effect of the drainage channel will be injurious. Even then the question will not be, "Shall the work be stopped and the taking of water prevented?" but rather, "Are the benefits to grow out of the completion of this enterprise so great as to outweigh any injury to be occasioned by it?" Will the preponderance of benefit be sufficient to warrant the outlay of sums of money sufficient to counteract the alleged injurious effects?

There seems little doubt upon this matter.

The natural formations of the lakes lend themselves easily to improvements which will insure a sufficiency of water whatever may be the effect of our channel. Lake Superior itself can, at an expense small compared with the benefits to be secured, be made a great impounding reservoir releasing its volumes of water at such times and in such amounts as to provide the requisite depth of water at times when otherwise there would be low water. Works at the outlet of Lake Erie into the Niagara could be constructed so as to insure sufficient water in the harbors of that lake. In short, the expense of remedying any supposed injurious effects to arise from our use of the water from Lake Michigan would be small compared to the benefits to Chicago from the completion of its great work, and compared with the advantage to result to the Mississippi valley should the general government ever carry into effect the projected improvement of the Illinois and Mississippi rivers in connection with our channel.

Much has been said as to the powers of the general government with reference to the great lakes. It may be conceded that the general government, under its powers to regulate commerce, could remove any obsbructions to the navigation of the great lakes and might restrain the carrying on of any work which would clearly have an injurious effect upon such navigation, but it may well be doubted whether the existence of a condition of circumstances such as that supposed by the lowering-the-level-phobists would be a sufficient cause for interference on the part of the general government.

It is not with reference to the alleged effect of Chicago's drainage channel upon the level of the lakes as a whole that this matter is discussed. It is with reference to the effect upon harbors and connecting channels. As has already been stated, the modern trend is toward deeper channels, larger vessels, more tonnage.

This convention itself is the most striking evidence of this tendency. The effect of our channel on the level of the lakes is admittedly incapable of accurate calculation.

But I submit that it has been fully demonstrated that its effect so far as practical navigation is concerned will be imperceptible.

But were it otherwise, how can it be contended that such effect would be worthy of any consideration in the face of the improvements already undertaken by the general government in the way of deepening connecting channels and harbors, and in view of the objects for the promotion of which this convention is assembled?

If the United States is to join with Canada in a better system of deeper waterways to the sea, will our government hesitate over a difference of three inches or even a foot, if that were necessary, of additional depth, suppose it to be rendered necessary on account of Chicago's drainage channel?

There is too much at stake to admit of any doubt as to what would be the course of this government. The health, the prosperity, even the lives of the people of the greatest city of the Mississippi valley are largely dependent upon the solution of the question of water supply and drainage.

It is not much to say that the prosperity of Chicago is so closely bound up with that of the west, the northwest, the south, indeed of the whole country, that no action of the general government upon the matter under discussion can be predicted which will not be based upon the interests of the country as a whole.

Upon this basis Chicago can rest confident that no interference with the great work which she has so much at heart will be made, or in fact will ever be necessary.

DISCUSSION BY M. N. DRAKE, BUFFALO.

Capt. Drake: As I understand it, the main object of this convention is to foster and promote waterways in order to cheapen transportation. That being the case, I take issue with the gentleman from Chicago as advocating the very thing contrary to the objects of this association. Six inches less water means 20 per cent. less carrying capacity by our lake vessels, or an average of 20 per cent. That means just so much in addition to the cost of carrying products.

It is not the lake interests that will suffer; it is not Chicago, it is not Buffalo, it is not Cleveland that will suffer by this lowering of the lake levels. It is the whole country that is the greatest sufferer, because it will raise the cost of transporting products fully 20 per cent., simply because of the reduction of the carrying capacity of our lake vessels

We who are in the business understand the sharp competition in the European markets for our breadstuffs in the last few years. We realize that if we would hold that market or any part of it, instead of adding to the costs of getting our products to that market, we have to decrease them. In order to decrease the costs, the government has liberally contributed to the deepening of the lake channels and channels to the seaboard.

Now that paper says, "suppose it does lower the water from 3 to 6 inches?" Every one of these inches means 30 tons less carrying capacity to our vessels. You will readily see how important it is that this question be studied carefully, and means taken to obviate the damage that will certainly accrue, if our fears are realized. As a layman, I am willing to abide by the decision of the engineering talent of this country, unless it is disapproved by the results when completed.

DISCUSSION BY MR. COOLEY.

[Then followed an almost unanimous call for L. E. Cooley of Chicago.]

Mr. Cooley: The board of United States engineers, as well as all engineering consideration given to this matter, has concluded that the change would probably be at least three inches, that it could not exceed six, but that the subject was speculative, and therefore it is recommended that exact measurements be taken with a view to ascertaining facts. That was the status of the engineers of Chicago on this question in 1888, and it was known to every engineer in this country. It was speculative in 1888 and so remains.

Suppose these changes of from three to six inches should, as Captain Drake alleges, affect vessels by 20 per cent.—and we have unduly large estimates of the damage that is to be created by that amount of change in lake levels—what damage would be effected by nature's changes of three to six feet?

According to the gentleman's argument it would be 120 or 240 per cent.

Vessel cargoes must, therefore, have diminished since 1886, when the water was four feet higher than to-day, 160 per cent., which would make them at present 60 per cent. less than nothing.

This is the sure logic of the gentleman's argument.

Nobody at Chicago contends that you can take some water out of the lake and have it all there. But in view of the fact that the city of Chicago is investing in an enterprise estimated to cost $30,000,000, an enterprise that is in harmony with the policy of the federal government, we think that Chicago is entitled to some consideration. It is a waterway which is as wisely built as if it were built solely for the purpose of a waterway; and the contribution of money is just as effective to that end as if made by the general government; and she proposes to take a supply of water from the great lakes, which is absolutely essential to produce a waterway through the state of Illinois to the Mississippi river that would be of any value under modern conditions.

Ocean navigation, or any deeper channels than we are now completing, which are based on a depth of twenty feet, demand control and regulation of the water levels of the great lakes. In other words, when you talk of 26 feet for navigation, you have vessels which are enormously more difficult to handle than any vessels now on the great lakes, and they should have channels not less than thirty feet through these connecting shallows, and one-quarter mile wide. Then the present level of the lakes, without the construction of controlling works, would be utterly destroyed.

Again: under the modern conditions and future requirements, supposing you start out from Buffalo and build a ship canal to New York; to make a great canal without any sag in it by which the water shall flow from Lake Erie to Albany? If you contemplate enlarging that route it would not be suited to modern conditions. You can not hang it up on a side-hill. You have to make a series of lakes and cut deeply through the divides.

These channels will receive the flow of water from the uplands and the filth of cities, and the necessity of maintaining that channel and keeping it clear and sweet, requires the flow of water through it. In other words, the conditions of future ship navigation demand an artificial river rather than a canal. Such a canal, I believe, is required to answer the future necessities of the commerce between the lakes and the sea.

No question has ever been raised in this country but that the taking of waters and the appropriation of rivers or lakes for the purpose of feeding canals is legitimate and customary and proper. Take the Erie canal: There has ever been drawn a supply of water from Lake Erie to feed that canal. That is surely 15 per cent. of what is proposed to be done at Chicago. No question was raised as long as it was a necessity to navigation.

The same is true of the Welland, and the Sault Ste. Marie, where you have to take water to feed the canal.

It has always been considered proper to divert streams and appropriate waters and build dams for the purpose of encouraging industries.

I see nothing so sacred in these great lakes, after providing properly for their regulation, which shall prevent their being taken for any public uses which are public benefits, be it a waterway to the Gulf of Mexico or to the Atlantic ocean.

Under present conditions, when talking about these great channels, we have to consider international questions. An adequate ship canal to the ocean is impossible as an enterprise of one nation without the concurrence of the other, on account of its effect on these lakes, so clearly elucidated by Mr. Flower. There is another point of an international character in line with the president's address, and with Mr. Flower's paper, and that is in regard to the treaty of Washington, and the international rights of the two countries in the lakes and their connection to the sea.

The government of the United States has always contended that it has an inherent right to an outlet by the St. Lawrence, on the theory that the navigable course of the St. Lawrence originated on the soil of the United States. That principle was conceded to Great Britain in the original treaty of 1787, as you will notice in Mr. Flower's paper, on the theory that the Mississippi drained Hudson's bay and originated in British territory.

It was conceded in the practice of international law regarding the Danube, in which several nations have co-operated to improve that stream; and the stream is under the international control of several nations for some length.

Here are two nations, bordering opposite shores. We will suppose the boundary line ends at the 45th parallel, and that east of that point, at the mouth of the St. Lawrence, is the province of France, as Frenchmen still believe it ought to be. Can anybody contend for one moment that the United States and the Dominion of Canada would not have a right to go through that province of France to the sea? If it were not granted they would take it.

Supposing that Great Britain, instead of actually controlling one side of the straits of Gibraltar, actually controlled both sides, and owned the land underneath the water, so you could not cross through the Mediterranean to the sea without crossing British territory? Does anybody believe that that would have prevented the nations bordering on the Mediterranean for the last 3,000 years from using it as a common highway? Is the case different where you have an inclosed Mediterranean? Where you have an interest that will ultimately be greater than any that ever bordered the Mediterranean?

Does it make any difference in the construction of international law and comity whether you go down the St. Lawrence, or the Mohawk, or through the Mississippi to the Gulf of Mexico?

So, in my view of this question, any route from the great lakes to the sea is necessarily international in the character of its consequences, and must be considered on that basis. The physical conditions so demand.

MISCELLANEOUS DISCUSSION.

Question: Can you apply that to the Mississippi river as well?

Mr. Cooley: If you had to construct an artificial river as we are doing in Chicago, and develop that as a route from the lakes to the sea, and take these waters which are common to both countries, I think the question would arise. I find no difficulty in thinking so at least.

Suppose, as once existed in nature, all the flow of the great lakes was to the southward? There is no question but what 30 feet or more of depth of water then went from the great lakes to the Gulf of Mexico. Suppose it were possible to cut a channel at Chicago of such proportions as to take all the water of the great lakes, so that you could reproduce that ancient condition of 30 feet or more to the Gulf of Mexico, and extend ship navigation through the heart of the continent for a distance of 1,600 miles?

As bold as that proposition may seem, it is not beyond engineering resources. It is feasible of accomplishment from that standpoint, and would be practical if you could induce people to believe it. What objection can there lie in any project which the public welfare requires?

Capt. Drake: Thinking that possibly the figures that were so ingeniously arranged by the speaker regarding the percentage of carrying capacity might find lodgment in the minds of the members of the convention, I wish to call attention to their fallacy. In the first place, our vessels require from three and one-half to five feet mean draught without any cargo at all. Their carrying capacity is made up of their displacement above that draught. While I might have been a little extravagant as to the reduction in their carrying capacity, principally to provoke discussion, I think the principle I contend for is correct.

Mr. Cooley: I suppose then, that if a vessel has a certain capacity at low water, and lowering the lake six inches would take off 20 per cent. and raising it six would add 20 per cent., if you should raise it forty-eight inches, it would add 160 per cent. (Laughter.)

Mr. Blasdel: I want to say that under the influence of regulation no lowering of level is necessary on any lake by the Chicago or any other canal. It is possible to regulate the levels of a lake so that drainage, drought and floods, such as we often have, will not have any disastrous effect. In other words, we can raise and regulate them at whatever height is desirable, to do the most good to the greatest number, and at very slight expense. That is what we must and shall come to.

[There were calls for J. A. C. Wright, of Rochester.]

Mr. Wright: I do not know what I am expected to say, but suppose I am called out to try to correct Mr. Cooley's law. The common law in regard to the diversion of private streams is very exact. A property owner has the same right in the water as he has in the land adjacent to the water. The state of New York takes the water which it uses in the canal as the sovereign owner of the land underneath. When we come to diversion, we come to the international domain, which is very complicated. This matter reminds me of a story I read in a French journal. A dog was barking at a man and the man raised his cane to hit the animal but instead, hit his mother-in-law. "Very well," said he. "the blow was not lost."

President Howland: I think, since there is a lull in the debates, that we may profitably hear the paper by Mr. Blasdel. It is collateral to the subject under discussion and takes a view, as I understand it, intended to allay the fears which some entertain of the possibly undesirable effects of the Chicago canal.

Lake Level Regulation is a Depth-Restorative.

G. W. BLASDEL,
Waverly, Ohio.

Regulation of lake surfaces, making them higher during the season of navigation, is an essential part of any plan that is adequate to the sweeping needs of commerce, or other interests to be benefited thereby. Excavation alone to get requisite depth is insufficient, as drouth, directness of the excavated cuts, water-power canals, and lockage, lower levels.

Excavation increases the fluctuation and the slope in connecting rivers, while regulation reduces both the slopes and the fluctuations; yet it will take a combination of regulated surfaces and excavated channels to secure the best results.

Regulated surfaces secure very many benefits that can be had in no other way. Combined with excavation, it is a complete solution of the problem. The best results can be had only by a combination. It arrests the wear of time; stores water, giving an increase of sea-room in cuts and insular passages, with added safety and capacity to larger vessels; so also of the locks, shoals and channels generally.

The deep-water channel does not improve the harbors or shoals of any lake, remote from its axis, nor any canal connected with the system, while regulation improves them all in depth. It corrects the mistakes of those in charge and prevents their repetition.

Regulating works at and in the vicinity of three outlets, viz.: Superior, Huron and Erie, will improve the whole system above Niagara falls.

The injuries from low levels must be endured by both countries. The benefits of regulation are useful to both countries and the mutual benefits to both would justify the placing of the proper regulating works jointly.

This would give the right to operate on either shore, would reduce and divide cost, and no additional locks would be needed, but what we now have would be improved.

Regulation *must* be made a part of the plan of an improvement reaching the seaboard whether there is diversion of water or not at Chicago, and Superior should not be made the reservoir to draw from like the lakes on the upper Mississippi river. Regulation is not to supercede but to reinforce the existing plan of excavation, with what it now lacks added to make the system as perfect as it is possible to be. The plan I advocate uses the properties of matter advantageously; is cheaper in cost, and can be obtained sooner. Fluctuations would be reduced instead of increased as by the inadequate plan of excavation only.

Works placed at the head of Niagara and vicinity will certainly deepen Erie and St. Clair lakes and works placed at the outlet of Huron and vicinity would improve the level clear to and over the miter-sills of all the Sault locks.

It would facilitate the connections of the Mississippi river and all oth r systems. It would improve all existing improvements, though I don't claim it would work miracles.

Every inch of rise is precious and every inch of fall is disastrous. With regulated surfaces we could have stored water in all the lakes that now runs uselessly away in winter when there is no navigation and during high floods, the resulting conditions would be full lakes; the best navigable stage possible to start with in the spring, and this best stage could be maintained during the season of navigation.

These and many other benefits can be obtained in no other way. A decreased amount of water (caused by diversion at Chicago) will be made to flow in an increased navigable volume at a less rapid rate in all the connecting rivers, and all the rapids in St. Mary's river and Detroit river and mouths of affluents. It is the foundation upon which to base all existing projects.

The only interests that will not be benefited by regulation are those of the insurance and wrecking companies. Their business will be largely reduced. It will help solve the water supply at Cleveland and other points by placing larger volumes of water between the in-take and the mouths of poluting rivers and sewers.

Erie will be regulated more than Huron, and Huron more than Superior, reducing the slopes in the connecting rivers. Had this been done when I first suggested it,* we would long since have obtained the best possible results, saving millions of dollars and many precious lives

FUNDS SUBSCRIBED.

James Fisher announced that A. L. Crocker, R. R. Dobell, and Martin Pattison, had been appointed to receive contributions of money to aid in paying for the publication of the proceedings of the convention and other necessary expenses.

Capt. J. S. Dunham, of Chicago, treasurer of the International Deep Waterways association, made an appeal for donations, in response to which pledges were made as follows:

B. A. Eckhart	$ 50
Iowa	100
Duluth Board of Trade	50
Duluth Chamber of Commerce	50
Toledo Produce Exchange	50
Congressman Stephenson, of Michigan	20
Chicago Board of Trade	100
Pittsburgh and Lake Erie Canal Committee	50
Ontario	50
Wisconsin	50

*NOTE —Detroit, Michigan, March 28, 1881. Mr. George W. Blasdel, Waverly, Ohio—Dear Sir: Your letter of March 24 is received. The difference of level between the surface of Lake Erie and the surface of St. Clair is, approximately, 2.4 feet; between Lake St. Clair and Lake Huron, approximately, 5.9 feet. The rapids of the St. Clair river, at Fort Gratiot, are about two miles long, and the fall from the light-house to Black river about 16 inches. The character of the rock in the bed of the river is not known. There has probably been no permanent changes in the level of Lakes Michigan and Huron during the last twenty years. The extreme fluctuations during that time have been 3.6 feet.

Very respectfully, C. B. COMSTOCK,
Major of Engineers, Brvt. Brig. Gen., U. S. A.

John E. Shaw: On behalf of Pennsylvania I am not authorized to subscribe a specific amount, but personally I will send my check to the treasurer.

President Howland. I take pleasure in saying on behalf of the province of Ontario that we had a contribution from our legislature last year of $300 towards the expenses of the present year. I have not the slightest hesitation in saying that $50 more will be forthcoming, and I shall use my best endeavor to get a repetition, and an increase if possible, of the appropriation of last year.

RESOLUTION BY MR. SEYMOUR.

H. W. Seymour: I desire to offer a resolution.* It is known by the delegates to this convention that the two nations, United States and Canada, have agreed by statute to appoint a commission in order to determine what is the most feasible deep-water channel to the sea. In that law, drawn, I understand, by our secretary, was also included the question of the control, to a certain extent, of the waters and levels of the lakes. In accordance with that, aud as the concensus of opinion is that it is advisable that some regulations should be had in regard to affecting the standard of water in the lakes, I offer the resolution and ask that it be referred to the committee on resolutions.

Carried.

A BIG MILLER'S VIEWS.

Mr. Flower: The valuable paper by L. R. Hurd, of West Superior, prepared, like Mr. Moxham's, by a man who knows what he is discussing, has been pushed along in the program on account of the author's absence.

I have word that he can not be present and am requested to take charge of his paper. All that can be said is that the writing requires no comment. It is a dictum—the only utterance on our program by a great manufacturer and exporter of wheat products. His great mills have a capacity of about 8,000 barrels of flour per day and he has offices and agents throughout Great Britain and Europe. What he says and concludes, therefore, I suppose we would hardly dare dispute. His paper is as follows:

*NOTE—*Resolved*, this convention recognizes that the subject of scientifically controlling fluctuations, and maintaining or increasing the control in the great lakes, is of vital importance to the ports on the great lakes and the St. Lawrence river, and the immense population depending thereon for the transportation of their products. This convention also recognizes the fact that this subject is intimately connected with the general objects of this meeting, and therefore especially refers this subject to the committee on resolutions, with a view to recommending it to the two governments for international investigation and action, concurrently with the investigations already resolved upon for the commission about to be appointed.

Ultimate Effect of Deep Water from the Great Lakes to the Sea on our Grain and Flour Business.

L. R. HURD, GENERAL MANAGER DAISY ROLLER MILLS CO.,
West Superior, Wisconsin.

The future prosperity of the wheat and flour trade of the United States is to-day menaced by conditions that have arisen within the last few years.

The high degree of perfection to which our milling processes have been carried, coupled with the unexcelled quality of the wheat grown by our country, has erroneously seemed to justify the statement that "America feeds the world." Some years ago this statement may have been true, but in the face of the following facts it is obviously untrue:

Wheat and flour values have steadily declined for a period of years on account of the increased amount of wheat and flour exported by foreign countries. Russia, Argentina, India, Hungary and Australia, which have the advantages of fertile soil, mild climate and cheap labor, are now formidable competitors with the future prosperity of our foreign trade. It is about eighteen hundred miles from the grain fields of the great northwest to the ocean. The wheat fields of India, Argentina, Australia, Russia, and even of Hungary, are much nearer and generally tributary to ports which are open all the year round. The northwest can not successfully compete with these countries without cheaper transportation.

The following figures will give an idea of the extent to which foreign competition has entered into our trade:

Exports of wheat from Russia for the crop years ended July 31st:

1892-3	72,590,640	bushels.	
1893-4	99,703,360	"	
1894-5	127,006,560	"	(To July 13.)

During the same period Russia exported rye, as follows:

1892-3	10,533,680	bushels.	
1893-4	29 016,000	"	
1894-5	47,934,320	"	(To July 13.)

During the same period Russia exported oats, as follows:

1892-3	18,184 080	bushels.	
1893-4	86,483,120	"	
1894-5	65,200,560	"	(To July 13.)

The exports from the United States for the year ended June 30 were in

Wheat and flour equal to	143,073,550	bushels.
Rye	8,879	"
Corn	25,507,753	"
Oats	550,975	"

You can see how Russia increases. The Russian grain year ends August 1, and the aggregate

Wheat shipments will be near, if not quite.....	135,000,000	bushels.
Rye..........	50,000,000	"
Oats..........	75,000,000	"

Instead of the United States, Russia is now the greatest of all grain exporting countries.

Argentina has exported since January 1, 1895;

Wheat..........	35,500,000	bushels.
Corn..........	7,000,000	"

Her exports of wheat for the crop year are expected to reach 37,000,000 bushels. In the corresponding period of 1893-4 the exports of wheat were 55,400,000 bushels. The last year is decreased by a bad harvest. Exports of corn before this year are of but little account.

The point is sometimes urged that the wheat grown and the flour manufactured in the United States are so much superior to those of other countries, that the competition of foreign products will not cut any figure with our class of production. In other words, people will buy our product because it is the best.

This line of argument does not bear out the evidence of facts. People buy flour to sustain life, and they buy the flour that will do that at the least expenditure of money to themselves. The great mass of consumers are not educated to the highest degree of economy to be derived from a bag of flour; but take the cheapest article that will suit their necessity.

To sell our wheat and flour against these foreign competitors we must be in a position to give a better flour than can be bought for the same money from other sources. Can we do this?

Five or ten years ago, before the competition of these foreign countries, our wheat sold at from ninety cents to one dollar per bushel; now our farmers get from forty to sixty cents for a like bushel. To force the price any lower would be to place our farmers on a direct competitive basis with the peasant labor of Russia and the pauper labor of Argentine. Evidently we can look for no relief in this direction.

In the last twenty years the highest degree of perfection and economy has been reached in the manufacture of flour. The cost of making a barrel of flour has been reduced to a minimum. There can be no relief from existing circumstances in this direction.

Wherein, then, is our hope? Simply in being able to place our products in the markets of the world at a cheap rate of transportation.

With the completion of a channel of twenty-six, or even twenty feet, from the great lakes to the Atlantic seaboard, two distinct and decided advantages over the present conditions will prevail, namely:

1. A reduction of the transportation from lake ports to the Atlantic seaboard and to Europe.

2. Greater dispatch in the carrying and delivering of freight destined to the markets along the Atlantic ports and to Europe.

The effect of so radical a revolution in commerce can not possibly be other than wholesome, and its ultimate effect will be that of greatly stimulating our grain and flour business with the markets of the east and New England States as well as those of Europe. To these might also be added the incalculable benefit of bringing our sea ports fourteen hundred miles inland, and placing them within a night's ride of the spring and winter wheat areas and still nearer to the great milling centers of the United States.

I estimate that were it possible for a vessel of twenty feet draught to penetrate the heart of our American continent and take on a cargo of wheat or flour, as the case may be, and return with it direct to the Atlantic seaboard or to Europe, that from four to five cents per bushel could be saved in wheat freights, and from twenty to twenty-five cents per barrel on the cost of flour transportation.

The effect of greater dispatch in the carrying of freight is almost equal in importance to the reduced cost of transportation which would be secured.

Time is a mighty element in our trade with foreign nations.

Were it possible for the shipper to guarantee a "Certain Delivery," all his wheat and flour trade would be greatly stimulated and his commodity would be more readily saleable.

Markets are uncertain and capricious and with so great a distance intervening between ourselves and foreign nations, and the routes of commerce interrupted by so many obstacles, it is not strange that our foreign trade relations are more or less restricted.

When it is possible for vessels capable of ocean passage to tie up at the docks and warehouses of our mills and elevators, and steam from them with cargoes of flour and wheat direct to foreign ports without breaking bulk at the two intermediate points, the distance between ourselves and Europe will be cut in two, as the loss of time required in transferring cargoes at Buffalo and New York, or lightering through the St. Lawrence River will be done away with.

Ocean freight rates are relatively much lower than those upon the lakes, as ocean channels are deep enough to admit of the free passage of large vessels with great carrying capacity. An example of the difference between lake and ocean freights on wheat and flour may be obtained from the following figures:

It costs from 10 to 11 cents to carry a bushel of wheat from Superior or Duluth to Liverpool. The lake freight from Duluth to Buffalo is about 2½ cents per bushel, and the ocean freight from New York to Liverpool, including shrinkage, is about 2¾ cents per bushel, which make a total of 5¼ cents. The difference between 5¼ and 10 to 11 cents, which is 4¾ to 5¾ cents, represents elevator charges and commissions at Buffalo, canal or rail freight and insurance from Buffalo to New York, and elevator charges, towing, demurrage, weighing, transferring and trimming at New York.

If it were possible for a vessel to carry its cargo of wheat from the lake port where it is loaded directly to the ocean without breaking bulk, these intermediate charges, which are from 4¾ cents to 5¾ cents, would be wiped out and it would then be possible to land wheat at Liverpool wharves at about 5 cents per bushel less than now.

The same thing applies to flour. The freight on a barrel of flour from

Superior, or Duluth, to New York, a distance of about 1,400 miles, is 35 cents, while the through freight to Liverpool, a distance of 4,300 miles, is from 45 to 50 cents per barrel, or only 10 to 15 cents per barrel higher than the lake and rail freight. In simpler words, it costs 35 cents to carry a barrel of flour from the head of Lake Superior to New York, a distance of 1,400 miles, while the same barrel can be carried from New York to Liverpool, a distance of 2,900 miles, at a cost of 10 to 15 cents. These charges nicely illustrate the difference in cost between inland water freight charges where boats of lighter tonnage are used and where it is necessary to break bulk at two intermediate points, and ocean freight rate charges on unbroken bulk.

What is true of freights from the head of Lake Superior to Buffalo, New York and Liverpool, is also true of them from Chicago, Milwaukee, Cleveland, Toledo and other ports, with the exception that freight charges are somewhat different, as distances are less.

Our modern type of lake vessels with a draught of fourteen to fifteen feet will carry no more than 2,500 to 3,000 net tons. With even a twenty-foot channel these same vessels would carry 4,000 to 5,000 tons and compete with ocean vessels and ocean freights, many of which will not carry to exceed 6,000 tons. In a few years the twenty-foot channel, on which General Poe is now working, from Superior, Duluth and Chicago to Buffalo will be completed, but it will still be impossible for our lake vessels of modern type, no matter how seaworthy they may be, to reach the ocean.

I hope that the time will speedily come when the obstacles which are literally stifling the freedom of our internal commerce will be torn down, so that trade between our seaboard and Europe, and the rich central and northwestern states of the United States and western Canada may be engaged in with the least possible cost of transportation and the minimum period of delay.

To my mind the only way this can be accomplished is by continuing the deep channels now outlined, from Buffalo on to the ocean. Whether the route selected is through the St. Lawrence River or by way of Lake Champlain and the Hudson River to New York, will not have a great effect upon our commerce. The selection of routes should be left to eminent engineers whose business it is to make such surveys. The only point that should be insisted upon is that the route selected should be the one that would furnish us with a channel to the ocean at the least possible cost and in the soonest possible time. It seems to be the universal belief that the Erie canal route is impracticable on account of the great expense which would have to be incurred in deepening it twenty feet.

The time may come when rail will compete with water transportation, but if so it is a long distance away, and so far as we can now determine we must look in the future, as we do now, for cheap transportation of great bulks by water. India was practically unknown as an exporting nation until the Suez canal was built, furnishing to that country a short cut to the world's market, and I predict that the United States and the western agricultural provinces of Canada will never gain the percentage of foreign business to which they are entitled until much cheaper transportation is provided from the northwest to the Atlantic seaboard.

Canada has spent in the last ten years more than $50,000,000 in developing her waterways from the northwest, and yet that route is a long way from a sea route. Competent engineers estimate that $50,000,000 would complete a twenty-foot channel from Buffalo through to the Atlantic seaboard; and if Canada can expend $50,000,000 to partly complete her waterways, surely the government of the United States should see the advantage of expending, if necessary, several times that amount to complete a work already well begun and which will revolutionize our commerce with decidedly beneficial results.

I certainly hope that within my lifetime vessels capable of the sea passage in safety will tie up at the wharves along our great lakes, and take on cargoes which will be unbroken until they reach their destination either along the Atlantic seaboard or in Europe.

The construction of the twenty-foot channel (that may be of sufficient depth to begin with, though twenty-six feet in reality should be obtained), will be the crowning triumph of the century in which it is accomplished; and one of the grandest achievements since commerce has been known to civilized man. It will directly benefit the whole American race in a multiplicity of ways, among which will be the inauguration of a higher price level for unmoved agricultural products and the placing of this nation in closer and easier touch with the old world.

Mr. Flower: I wish the author of this paper were here to discuss it because it lays before us from a man who has learned them in actual business experience, the fundamental principles of commerce and transportation. He has a very large flouring mill at Milwaukee, which has been prosperous for years. But deeper channels and larger hulls were changing the method and cost of transportation and he went to Superior—the point where the enormous crops of northwestern wheat first reach the water—and there erected a magnificent 6,000-barrel mill. With him six other flouring mills located there, making eight at the head of these lakes with a capacity of about 30,000 barrels per day—the second flour-making center in the world.

What drew them to that locality? The absolute necessity for cheaper transportation—the same reason that drove the Minneapolis millers to build their own line of nearly 500 miles of railway (the Soo line) from Minneapolis to the lake at Gladstone.

But, Mr. Hurd says, the full capabilities of the situation can only be developed by a clean, unbroken channel from the great lakes to Boston, New York, Philadelphia, Charleston and Europe; and that without such a channel successful American competition with other bread-producing countries will be impossible.

Wednesday, September 25—Evening Session.

Session opened by President Howland, who announced the first paper of the evening by Mr. Thomas C. Keefer, formerly engineer of the Dominion of Canada, and at one time president of the American Society of Civil Engineers and of the Canadian Society of Civil Engineers; "also some statistical papers relating to the same subject, prepared by Mr. George Johnson, Dominion statistician. Mr. William Jennings, C. E., representing the Toronto board of trade, will kindly take charge of these papers." (Applause.)

Mr. W. T. Jennings: Mr. Chairman and gentlemen, I fee honoured in being permitted to read papers from such eminent authorities as Mr. T. C. Keefer and Mr. George Johnson. As many of you are aware Mr. Keefer is a gentleman of the very highest standing in the engineering profession and particularly so in matters relating to the design and construction of canals where his long experience and mature judgment is of particular value, and whose admirable reports on works embraced in this branch of our profession may be had by those interested in securing exact details.

Mr. Keefer's paper is in the form of a letter to your Secretary who, I may be pardoned for saying it, has shown wonderful ability in searching out genius and enlisting it in the services of this body as exemplified by the subject matter presented to and discussion by this Convention, and to which I have listened with great pleasure.

As the paper from Mr. Johnson giving full statistical report of the Canadian canal systems from their inception in 1779, when 2½ feet depth, or sufficient to permit the passage of a boat with 30 barrels of flour, or at the Sault when accommodation for a loaded canoe was deemed ample, to the present date, is entirely composed of statistical matter, perhaps it would be well to defer discussion on Mr. Keefer's paper, until after that from Mr. Johnson had been read.

Mr. Jennings then read Mr. Keefer's paper.

Cost, Character and Utility of Existing Great Lakes, Champlain and St. Lawrence Improvements.*

THOMAS C. KEEFER, C. E.,
Ottawa, Canada.

I have delayed acknowledgment of the invitation, with which I have been honored, to attend the first annual convention of the International Deep Waterway Association, to be held at Cleveland next week, until I could know whether I would be able to accept or not. I have also been honored by an invitation from your president to present a paper on the subject of the approaching convention, which would contain some basis of estimate for a deeper waterway between Lake Erie and tidewater.

I have not been able to prepare a paper because I do not think I could add anything to the one read by me before the World's Commerce Congress in 1893, at Chicago, on the same subject; but desire to contribute the little I am able to do to a project of such continental interest.

The international feature of your association assumes an international route for the deep waterways at whatever point they may reach tidewater, and this seems to me now to be the most important question connected with the subject, though doubtless because the association is not yet in a position to express an opinion upon it.

In view of the fact that New York is the most important terminus for a deep waterway from the lakes to the ocean, because it is the most important market on this continent, and that Montreal is the nearest point on tidewater and upon the shortest route to Europe from the great lakes—an international route, via the St. Lawrence and Lake Champlain, is in my judgment the only suitable one for the class of vessels which deep waterways on the lakes will develop, the only one which will make lake ports (including Buffalo) sea ports, and the only one which can compete with railways, because it has the maximum of wide, deep water and the minimum of artificial channel, as also the minimum of lockage to tidewater at Montreal, and is capable of the same to New York.

It is to be assumed that the steel fleet, the cost and annual capacity of which is already enumerated by millions of dollars and millions of tons, will not long remain ice-bound above Niagara, and therefore the question of route, on which the cost both of construction and transportation depends, is not a premature one. The natural channel depth of the St. Lawrence between its rapids is at least 30 feet, with ample width even where deepening is required in approaching its canals.

These are conditions of traction on which economy, safety and efficiency depend, and can be obtained on no other route.

*[NOTE.—Letter, Sept. 20, 1895, to Executive Secretary Frank A. Flower.]

With the exception of the canal at Sault Ste. Marie, the Canadian enlarged system, designed twenty-five years ago and still incomplete, has long since been outgrown by the development of the upper lake commerce, but will be useful among other things as a *raison d'etre* for your convention; and, if completed during the century, may show enough improvement in the present conditions of transportation to give impetus to your greater undertaking. There is no hope of anything further being considered here [in Canada] until the present enlargement is completed. If the addition of five feet to the draught between Ontario and the sea is considered of sufficient importance by your convention, as bearing on the question of a still greater depth, a resolution from such an influential body favoring the earliest possible completion of the St. Lawrence canals, should have the greatest possible weight (from its international character) with the authorities in Ottawa.

As to cost: The total cost of the Canadian canal system between Lake Erie and Montreal, when completed for 14 feet draught of water, will be about $60,000,000, of which $15,000,000 represents the expenditure prior to the present enlargement, leaving $45,000,000 for the cost of new and enlarged work, including one entirely new canal to replace the Beauharnois, and an entirely new route for almost the whole of the lockage on the Welland canal. All the work of excavations made previous to the present enlargement and utilized in the latter, would not represent $10,000,000, probably not more than half that sum, thus giving the cost of these canals with locks 270x45 feet in the chamber and 14 feet draught of water, somewhere about $50,000,000.

In any new canal the locks would be reduced in number, possibly one-half. The new Soulanges canal, nearly fourteen miles long, overcomes the same lockage as the Beauharnois canal, on the opposite side of the St. Lawrence, with less than half the number of locks.

For the Welland and Lachine the last enlargement is the third construction, and for all the others, the second. The spoil-banks of one generation were again removed by the next and the work of enlargement was carried on subject to the maintenance of navigation, and hampered by vested interests created by the first canal. The number of locks is excessive. Engineering, inspection, etc., have been extended over a quarter of a century for an amount of work which could have been carried out as a business enterprise in one-fifth of the time—the whole constructed as a public work, and all which that implies.

These are all the conditions and considerations we are in possession of, in the absence of location and survey, in order to arrive at a probable cost of carrying 20 feet draught from Lake Erie to tidewater at Montreal by an independent system of canals where practicable, and in connection with the existing canals where that would be preferable.

With the modern appliances for handling large amounts of excavation above and below water, a 20-foot canal between Lake Erie and Montreal with the larger locks required ought not to very much exceed the amounts which Canada has already expended upon her canals between these points. In any such work no doubt a much wider margin, between the keel and sides of the vessel and the bottom and sides of the canal, would be adopted, for traction purposes, on these short canals, in that respect increasing cost in comparison with present canals.

For the connection of the St. Lawrence with Lake Champlain in Canadian territory, surveys and estimates have been made by the late John B. Jervis and others. The intervening country is most favorable, and the total cost of reaching Lake Champlain from the point of departure on the St. Lawrence should not exceed that of reaching Montreal.

The section on which information is needed for an international route to New York, is that between deep water in Lake Champlain and deep water in the Hudson, on the plan of making Lake Champlain the feeder of this canal.

Mr. Jennings here pointed out that the suggestion made by Mr. Keefer, that a resolution from "such an influential body as this Convention favoring the earliest possible completion of the St. Lawrence canals (to a depth of 14 feet) should have the greatest possible weight (from its international character) with the authorities at Ottawa," and that he (Mr. Jennings) as the representative of the Board of Trade of Toronto was charged by that body to urge the convention to act on these lines, the feeling among the business men of Toronto being that the system as at present arranged for, and in course of construction at a total cost of about $60,000,000, should be first completed after which further progress might be made on lines in keeping with the advancement of the country and the mode of carrying freight by water.

Mr. Flower: It is not proper for me to attempt any discussion of these papers by our Canadian friends, but I cannot refrain from calling the attention of the delegates from the United States to the fact that without any great conventions, international or otherwise, the steady aim and effort of the Dominion have been to create a ship outlet from the great lakes to the sea. In that direction her effort has been a remarkable one, having made an expenditure, as I have the honor of showing in a paper of my own on another subject for this convention, of $12 per capita, while the total appropriation of the United States toward making an outlet to the ocean is only 15 cents per capita. These figures are official. They were specially prepared for my use and for this convention by officers of either government, and are down to July and September respectively of the current year. I am profoundly impressed with the difference between the two efforts that they disclose.

Mr. Jennings then read as follows :

Memoranda Respecting Canadian Canals.*

GEORGE JOHNSON,
Dominion Statistician, Ottawa, Canada.

1219. THE ST. LAWRENCE RIVER CANAL SYSTEM.

(a) Lachine canal, begun in	1821,	opened	August,	1825.
(b) Beauharnois	"	1842	"	" 1845.
(c) Cornwall	"	1834	"	April, 1843.
(d) Williamsburg				
Farran's Point	"	1844	"	June, 1847.
Rapid Plat	"	1844	"	Sept., 1847.
Galops	"	1844	"	Nov., 1846.
(e) Welland	"	1824	"	1829.

(First Welland enlargement, begun in 1841, and completed in 1850. Second enlargement, begun in 1873, completed in 1883 to 12 feet, and in 1887 to 14 feet.)

(f) Sault Ste. Marie canal, begun in 1887, opened 1895.

Connections—

Burlington Bay canal, begun in	1825,	completed in	1832.
St. Clair channel	"	1865	"	1871.
Murray Bay canal	"	1882	"	1889.
Trent river navigation	"	1837		

OTTAWA RIVER CANAL SYSTEM.

(a) St. Anne's lock, begun in 1840, completed in 1843.
(b) Carillon canal " 1826 " 1833, enlarged in 1871-82.
(c) Chute a Blondeau, begun in 1826, completed in 1832.
(The construction of the Carillon dam has rendered this unnecessary.)
(d) Greenville canal, begun in 1819, completed in 1833, enlarged in 1871-82.
(e) Culbute locks and dam, begun in 1873, completed 1876.

RIDEAU RIVER CANAL SYSTEM.

This system might be called more properly the Rideau and Cataraqui navigation, for it consists in the conversion of the two rivers into one continuous navigable channel. The work was begun September, 1826, and on the 29th of May, 1832, the works being completed, the steamer Plumper passed through from Bytown to Kingston.

RICHELIEU AND LAKE CHAMPLAIN SYSTEM.

St. Ours lock, begun in	1844,	opened in	1849.
Chambly canal "	1831	"	1843.
St. Peter's canal "	1854,	completed in	1869,
enlarged 1875-81.			

1220. The history of canal building in Canada dates back beyond the present century. The early canals were miniature, toy-like affairs compared with those now in use. The first canals were constructed to overcome the Cedar cascades and Coteau rapids. The locks were of cut stone and had a breadth of six feet and a depth of two and one-half feet on the sills and were designed for the passage of boats carrying thirty barrels of flour. These canals were begun in 1779, and finished in 1781. They were enlarged in 1804 and in 1817, and were abandoned in 1845. A canal to overcome the Sault Ste. Marie rapids was begun in 1797 and was used by the Northwest company to take up loaded canoes. It had locks.

The Dominion is well supplied with national means of intercommunication. But in many cases, owing to the formation, there are rapids render-

*NOTE—Read in convention by W. T. Jennings, C. E., Toronto.

ing navigation difficult for any size vessels and impossible for good sized ones. The early inhabitants suffered severely from the cost of transport, which was so great that a barrel of salt transported from Montreal to Port Talbot on Lake Erie was worth eighteen bushels of wheat, and a yard of cotton and a bushel of wheat were of equal value. The British government found great inconvenience and expense attending the transport of supplies. Sir J. Murray stated in the house of commons, September, 1828, that when the imperial government some years before sent out two vessels in frames, one of them a brig, cost in carriage from Montreal to Kingston a sum of money nearly equal to $150,000.

The first impulse to the construction on a large scale of Canadian canals came from the imperial military authorities. From the early reports it is plain that they thought more of military than of commercial requirements. Thus among the reasons given for having the Rideau canal only five feet deep was the one that the canal was to be used chiefly for military purposes and that a canal larger than would be necessary to transport with convenience all descriptions of naval and military stores would afford no additional security by being of larger dimensions.

The original locks of the Lachine canal were the same as those of the Rideau, viz: 108x20, with a depth of five feet.

As the commercial needs have become more pressing, the scope of the original plans have been enlarged, both as to the number and the depth of the canals, until at the present time the system of inland navigation in Canada is the largest and most complete in the world.

The river St. Lawrence, with the system of canals established on its course above Montreal, and the Lakes Ontario, Erie, St. Clair, Huron and Superior, with connecting canals, afford a course of water communication extending from the Straits of Belle Isle to Port Arthur at the head of Lake Superior, a distance of 2,260 statute miles.

When this system of canals was designed it was in contemplation to afford a depth, at all stages of the St. Lawrence waters, of nine feet, a depth, seemingly from the data then possessed, secured by means of the works proposed. The river St. Lawrence is, however, from various causes, subject to fluctuations, the extent of which it was impossible, at the time these canals were originally constructed, to arrive at with precision, and the continued observations and experiences of subsequent years have shown that while the intermediate river reaches at all times afford ample depth for vessels, in the canals themselves, at certain periods of low water, a depth of nine feet on the sill cannot be maintained.

In the year 1871 it was decided to enlarge the canals on the St. Lawrence route in order to afford a navigable depth of 12 feet throughout. Subsequently it was decided that the depth should ultimately be increased to accommodate vessels of 14 feet draught, and accordingly, in the present scheme of enlargement, while a channel way in the canals is only provided for vessels drawing 12 feet, the permanent structures, locks, bridges, etc., are built of such proportions as to accommodate vessels of 14 feet draught, the locks being 270 feet long between the gates, 45 feet in width, and with a clear depth of 14 feet of water on the sills.

1221. The difference in level between Lake Superior and tide-water is 602 feet. Between these two points Canada has built eight canals, which are as under, the length, number of locks, rise in feet and depth of water on the sills being also given:

NAME.	Length in Miles.	LOCKS.			
		Number.	Dimensions.	Rise.	Depth on Sill.
			Feet.	Feet.	Feet.
Lachine	8½	5	270 by 45	45	*At 2 locks, 18 † " 3 " 16
Beauharnois	11¼	9	200 by 45	82½	9
Cornwall	11½	6	200 by 55 (3) 270 by 45 (2)	48	At 2 locks, 14 " 4 " 9
Farran's Point	¾	1	200 by 45	4	9
Rapide Plat	4	2	200 by 45	11½	9
Galops	7⅝	3	200 by 45	15½	9
Welland	26¾	25	270 by 45	326¾	14
Welland Branches—					
*Welland river branch	⅜	2	150 by 26½	10	9 10 in.
*Grand river feeder	21	2	150 by 26½ (1)‡ 200 by 45 (1)	7 to 8	9
*Port Maitland branch	1¾	1	185 by 45	7½	11
Sault Ste. Marie	⅔	1	900 by 60	18	22
Total	71	52			

*These are branches of the Welland, but for the purposes of direct navigation their length and number of locks are not to be taken in.

†At present the depth of the canal between locks is only adapted to vessels of 12 feet draught.

‡From the canal at Welland down to the Welland river.

The Soulanges canal, in course of construction on the north side of the river St. Lawrence, will take, when finished, the place of Beauharnois canal. It will be 14 miles long; will have 5 locks, with a depth on the sills of 14 feet. The dimensions of the locks will be those of the enlarged system, 270 x 45 feet.

Of the total distance between Port Arthur and the straits of Belle Isle (2,260 miles), 71 miles are artificial, and 2,189 miles open navigation. In addition to the 71 miles, there are the St. Clair flats channel and the submerged canal between Montreal and Quebec. The former, though partly in Canadian waters and partly in the waters under control of the United States government, is maintained by the latter government, the free use to both countries being given by Article XXVIII of the treaty of Washington, 1871. The submerged canal between Montreal and Quebec is rendered necessary because it was resolved to make of Montreal a fresh water port to be frequented by the largest craft. That city is nearly 1,000 miles inland from the Atlantic, 250 miles above salt water, and nearly 100 miles above tidal water. To effect this purpose the shoal places between the two cities, aggregating 39¼ miles, the largest (17½ miles) being in Lake St. Peter, were dredged by steam power. By 1869 the increase of depth effected was 9 feet, giving a 20-foot channel to Montreal. The increase in trade and in the size of ocean steamers necessitated a further deepening of the channel. By 1878 the depth was 22 feet; by 1882 it was 25 feet, and by the end of the season of 1885 it was 27½ feet. In the straight part of the channel the dredging is from 300 to 325 feet wide, but in other parts it is 450 feet wide, and in the worst place the sides of this submerged canal are over 16 feet high. The total cost of this work to December 31, 1885, was $3,503,870, and the total quantity of dredged matter amounted to 15,230,706 cubic feet. The dredged matter removed consisted of gravel, sand, clay, boulders and shale rock.

1222. The government of Canada, in pursuance of its general policy, decided to construct a canal on the Canadian side of the Sault Ste. Marie, and in 1889 the first contract was made. This canal with its approaches is about 18,100 feet in length. The chief engineer in his report for 1894 says: "This work has been visited from time to time during its progress by eminent foreign and Canadian engineers, all of whom, so far as I have heard, speak in the highest terms of the character of the work, more especially of the works of construction of the lock, and I believe it is to be one of the finest works of its kind on this continent. Electricity is used as the motive power."

1223. Connected with the St. Lawrence system are the Murray canal, the Burlington bay and the Trent river navigation. The first extends through the isthmus of Murray, giving connection between the head waters of the bay of Quinte and Lake Ontario, thus enabling vessels to avoid the open lake navigation. The works on this canal comprise a cut through the isthmus 4½ miles long, and improvements in the way of dredging and other work to the entrance channels at either end, covering a total distance of 9½ miles. There are no locks. The first official notice of this work occurs in 1796, when a resolution was adopted by the governor-in-council to reservve 3,000 acres of land as a grant in favor of its construction. Various surveys were made at different times down to 1867. The work was begun and completed since confederation, the date of completion being August, 1880. The canal is 80 feet wide at the bottom, and has a depth of 12½ feet at low water.

The Burlington bay canal is a cutting through a piece of low land which partly separates Lake Ontario from a large sheet of deep water called Burlington bay. It enables vessels to reach the citv or Hamilton. Its length is one-half mile, and it is navigable for vessels drawing 11 feet of water.

The name "Trent River Navigation" is applied to a series of water stretches, composed of a chain of lakes and rivers, extending from Trenton, at the mouth of the river Trent, on the bay of Quinte, Lake Ontario, to Lake Huron. Balsam Lake, which is the summit, has an elevation of 589½ feet above Lake Ontario, and the total rise and fall between Lakes Ontario and Huron is about 832¾ feet. At present 160 miles of direct and lateral navigation have been opened up. There are 13 locks, with a depth of water on the mitre sills varying from 7 feet to 14 feet. The navigable reaches amount to 132¼ miles, and the unnavigable to 60¼ miles. Tenders were let for this work in November, 1894.

1224. In connection with the St. Lawrence system of canals the following tables are given of distances between Port Arthur, Lake Superior and Liverpool:

	Miles.
Port Arthur to Sault Ste. Marie	273
Sault Ste. Marie to Sarnia	318
Sarnia to Amherstburg	76
Amherstburg to Port Colborne	232
Port Colborne to Port Dalhousie	27
Port Dalhousie to Kingston	170
Kingston to Montreal	178
Montreal to Three Rivers (tidewater)	86
Three Rivers to Quebec	74
Quebec to Saguenay	126
Saguenay to Father Point	57
Father Point to West End, Anicosti	202
Anicosti to Belle Isle	441
Belle Isle to Malin Head (Ireland)	2,013
Malin Head to Liverpool	221
Total	4,494

THE GREAT LAKES.*

Lakes.	Length.	Breadth.	Area.	Height above sea.
	Miles.	Miles.	Sq. Miles.	Feet.
Superior	390	160	31,420	602¾
Huron—with Georgian bay	400	160	24,000	576¾
St. Clair	25	25	360	570¾
Erie	250	60	10,000	566¾
Ontario	190	52	7,330	240
Michigan	345	58	25,590	578¾

Lake Michigan is wholly within the United States, and is connected with Lake Huron by the strait of Mackinaw.

1226. The Richelieu and Lake Champlain system.

This third line of improvement was designed with a view of placing the St. Lawrence in communication with Lake Champlain and the state of New York system of canals, which leads to the Hudson river and the port of New York. Boats leaving Canadian waters for New York enter the mouth of the Richelieu river at Sorel on the St. Lawrence, 46 miles below Montreal and 114 above Quebec. From the mouth of the Richelieu vessels ascend 14 miles to St. Ours, where they are lifted 5 feet. Proceeding up the Richelieu 32 miles further they enter the Chambly canal, which in a space of 12 miles raises them by lockage 74 feet more, and after traversing 23 miles more of the Richelieu the vessels reach the Canadian frontier. The total length of canal navigation between Montreal and New York by this route is 85 miles, and the total lockage ascending and decending is 283 feet; the total distance is 457 miles. The distance from Sorel to the boundary line is 81 miles, and from the boundary to New York city 330 miles. The St. Ours lock is one-eighth of a mile in length. Its dimensions are 200 feet by 45 feet, and the depth of water on the sills is 7 feet at low water.

The Chambly canal has 9 locks, and the depth of water on the sills is 7 feet. The dimensions of the lock vary from 118 feet to 125 feet in length and from 22½ feet to 24 feet in width.

This completes the general view of the canal systems connected with the St. Lawrence river and its tributaries.

*Note by F. A. F.—In the United States the following are accepted:

	Elevation.	Area sq. m.
Superior	601.78	38,875
Huron and Michigan	581.28	50,400
Erie	572.86	10,000
Ontario	246.61	7,220

1229. The following statement gives the amount expended on canal works and maintenance:

Lachine canal	$ 9,751,030
Beauharnois	1,611,690
Soulanges canal (under construction)	987,953
Williamsburg canal (being enlarged)	3,438,941
Cornwall canal "	5,054,565
St. Lawrence river canals, surveys, etc	956,900
Murray canal	1,217,470
Welland canal	23,703,866
Sault Ste. Marie canal (under construction)	2,791,874
Ste. Anne's canal	1,170,216
Carillon and Grenville canal	4,025,930
Culbute canal	379,494
Rideau canal (including Perth branch)	4,560,286
Trent canal	1,091,896
St. Ours lock	121,538
Chambly canal	637,207
St. Peter's canal	646,432
Total	$62,237,296

In addition to the above there have been expended from income:

Renewals	$ 2,050,414
Repairs	4,730,432
Staff and maintenance	5,903,108
Making the total expenditure	$74,921,250

1230. Of this amount the sum of $20,692,244 was expended before confederation, $4,173,921 by the imperial government and $16,518,323 by the provincial governments interested. The total amount spent for construction and enlargement alone is $64,287,710, including in this sum the cost of the Baie Verte canal, at one time considered a feasible plan for uniting the bay of Fundy and the gulf of St. Lawrence.

1231. The total cost of the construction of the Welland canal to 30th June, 1894, was $24,100,286. Of this amount $222,220 was contributed by the imperial government, and $7,416,020 by the provincial government prior to confederation, leaving $16,447,044 as the expenditure since confederation. Of this last amount $337,991 represents renewals chargeable to income.

The sum of $2,086,462 has been paid out for staff, and $1,914,781 for repairs. During the same period the repairs have been $5,855,368. The expenditures for staff, maintenance, repairs and renewals was $4,339,234, leaving $1,516,134 to represent the surplus to meet interest.

The total revenue from canals since confederation is $10,238,368, being an average of $379,199 a year.

SUMMARY STATEMENT OF THE TRAFFIC THROUGH THE CANADIAN CANALS, 1883 TO 1893.

Year.	Canadian Vessels.			Tonnage.	United States Vessels.			Tonnage.
	Steam.	Sail.	Total.		Steam.	Sail.	Total.	
1883	7,513	12,845	20,358	3,318,020	833	3,699	4,532	688,952
1884	6, 53	11,489	17,642	2,77[illegible],924	801	3,279	4,080	818,004
1885	5,845	11,4 7	17,312	2,681,639	730	3,065	3,7[illegible]5	547,438
1886	6,590	13,254	19,844	2,945,613	914	2,233	4,147	667,953
1887	6,750	12,241	1[illegible],991	2,847,952	782	3,101	3,883	566,680
1888	6,405	11,256	17,661	2,640,322	774	3,147	3,921	631,777
1889	7,230	12,163	19,393	2,695,582	1,109	3,433	4,542	830,648
1890	9,220	11,435	20,655	3,139,472	1,010	2,354	3,364	721,397
1891	8,711	10,535	19,246	3,135,454	1,209	2,393	3,602	838,116
1892	9,236	11,941	2[illegible],177	3,401,965	1,169	2,759	3,928	871,795
1893	9,322	11,535	20,857	3,434,054	1,432	3,153	4,585	1,286,295

Year.	Total Number of Vessels.	Total Tonnage.	Passengers.	Freight.	Tolls.	Increase or Decrease.
			No.	Tons.	$	$
1883	24,890	4,006,978	87,719	3,036,571	388,732	+ 33,273
1884	21,722	3,393,928	84,430	2,622,213	320,401	— 68,331
1885	21,107	3,229,077	70,571	2,673,641	300,421	— 19,980
1886	23,991	3,613,566	78,762	2,969,093	347,962	+ 47,541
1887	22,874	3,414,632	82,914	2,820,525	303,035	— 44,927
1888	21,582	3,272,099	75,797	2,761,597	317,854	+ 14,819
1889	23,935	3,826,230	81,362	3,166,368	380,616	+ 52,762
1890	24,019	3,860,869	127,135	2,913,047	330,510	— 50,106
1891	22,848	3,973,570	146,336	2,902,526	346,686	+ 16,176
1892	25,105	4,273,760	152,439	3,031,736	373,848	+ 27,162
1393	25,342	4,720,349	134,189	3,546,989	329,014	— 44,834

1234. There was an increase of 237 in the total number of vessels, a decrease of 320 in the number of Canadian vessels and an increase of 657 in the number of United States vessels; the total tonnage increased by 446,589 tons. The increase in the quantity of freight carried was 515,253 tons, in the number of passengers 18,250, and in the amount received for tolls $44,834.

1235. As the question of the tolls charged on wheat and other food products passing through the Welland and St. Lawrence canals has been the subject of international correspondence between Canada and the United States, a short statement of the facts concerning them may not be out of place.

In 1882 tolls on the Erie canal were abolished, and, as a consequence, shippers and forwarders, in Montreal and elsewhere, interested in the grain trade, urged upon the government the opinion that abolition of tolls on the Welland and St Lawrence canals would result in attracting a largely increased volume of east-bound freight, especially grain, to these canals and the St. Lawrence route to the seaboard. By the order-in-council, therefore, dated 5th June, 1884, the tolls on wheat, indian corn, oats, barley and rye passing through these canals for Montreal and Canadian ports east of Montreal were reduced by one-half for the then present season of navigation. The full amount of toll was collected and a refund made on proof of delivery of the grain at Montreal.

This reduction was again authorized (peas being included) by an order-in-council dated 17th June, 1885, and by an order dated 4th July, 1885, a further reduction of two cents per ton was authorized for the season of navigation only, tolls to be collected and refunds made as in the previous year. This concession was made year by year, by special orders-in-council. During the years 1887, 1888 and 1889 oats were not included, but in 1890 were, if for export, again placed on the list. By an order-in-council, dated 25th March, 1891, the reduction was again continued, it being provided that transshipment at Canadian intermediate ports did not prevent the refund being made, but no refund was made upon grain transshipped at Ogdensburg, N. Y., and passed down the St. Lawrence canals to Montreal.

By order-in-council, dated 4th April, 1892, the reduction was again authorized, but was made applicable only to products so carried and actually exported. It was also provided that intermediate transshipment must take place at some Canadian port, or the right to the rebate would be lost.

The United States government contended that this last provision amounted to discrimination against that country, and therefore, in August, 1892, adopted a system of tolls by which twenty cents per ton was levied on all freight carried through the Sault Ste. Marie canal to any port in the Dominion of Canada. On the 13th February, 1893, the Canadian government passed an order-in-council providing that, for the season of 1893, the tolls on wheat, indian corn, peas, barley, rye, oats, flaxseed and buckwheat passing eastward through the Welland and St. Lawrence canals, respectively, should be ten cents per ton, payment of the toll for passage through the Welland canal entitling the products to free passage through the St. Lawrence canals. In consequence of this, the discriminatory toll levied by the United States government on freight through the Sault Ste. Marie canal was removed.

1236. The following table shows the quantity of wheat, barley, corn, oats, peas and rye passed down the Welland canal from the ports west of Port Colborne, in each year since 1882. As previously explained full tolls were paid in 1882 and 1883; a refund of half the toll or ten cents per ton was allowed on grain for Montreal during 1884 and up to June, 1885, and since that date of eighteen cents per ton, leaving only two cents per ton actually payable.

GRAIN PASSED DOWN THE WELLAND CANAL, 1882–1893.

Year.	Rebate Allowed.	Full Tolls Paid.	
	To Montreal.	To Ontario Ports.	From United States Ports to United States Ports.
	Tons.	Tons.	Tons.
1882	180,694	....	63,881
1883	186,814	10,650	121,876
1884	142,194	12,153	104,537
1885	90,569	11,909	117,346
1886	203,940	9,881	151,551
1887	185,034	11,838	134,868
1888	160,358	25,599	169,664
1889	267,769	19,075	213,766
1890	228,513	16,899	245,932
1891	*295,509	6,805	202,710
1892	†261,954	8,942	201,540
1893	‡301,806	25,555	222,958

*Including 17,817 tons transshipped at Ogdensburg and no refund made.
†Of this amount 4,341 tons of wheat were transshipped at Ogdensburg.
‡Of this amount 71,455 tons of wheat were transshipped at Ogdensburg.

FREIGHT CARRIED THROUGH CANADIAN CANALS IN 1892 AND 1893.

1237. The following table gives the quantities in tons of the principal articles of freight carried through the Canadian canals during the seasons of navigation in 1892 and 1893:

ARTICLES.	Welland Canal.		St. Lawrence Canals.		Chambly Canal.		Rideau Canal.	
	1892.	1893.	1892.	1893.	1892.	1893.	1892.	1893.
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
Flour	17,084	15,235	8,546	13,889	285	480	369	369
Wheat	232,019	258,392	262,890	236,010	....	....	65	182
Corn	192,548	441,092	59,340	287,783	....	....	20	17
Barley	6,433	18,599	9,340	2,547	....	98	82	18
Oats	37,173	31,283	44,294	28,343	3,034	1,141	1,551	289
Rye	9,392	3,671	10,119	5,841	....	....	81	34
All other vegetable food	32,815	36,981	54,597	42,700	907	832	463	160
Lumber	86,072	129,295	37,475	47,108	91,464	72,386	29,622	34,487
Coal	211,616	233,096	178,073	275,324	86,500	97,889	3,625	13,835
All other merchandise	130,438	127,179	302,081	218,831	88,576	140,044	60,488	54,843
Total	955,554	1,294,823	966,755	1,158,376	270,766	312,870	96,366	104,234

ARTICLES.	Ottawa Canals.		St. Peter's Canal.		Trent Valley Canals.		Murray Canal.		Totals.	
	1892.	1893.	1892.	1893.	1892.	1893.	1892.	1893.	1892.	1893.
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons	Tons.	Tons.
Flour	26	14	2,215	1,541	....	70	41	55	28,530	31,653
Wheat	28	8	....	....	....	5	765	414	495,767	495,011
Corn	4	2	....	....	....	....	....	....	251,912	728,894
Barley	76	....	....	....	....	....	573	38	16,504	21,300
Oats	4,579	2,309	....	....	....	....	51	16	90,682	63,381
Rye	57	70	....	....	....	....	34	19	19,683	9,635
All other vegetable food	1,749	571	....	....	....	....	1,983	1,508	92,514	82,752
Lumber	469,727	382,442	4,572	4,831	1,573	1,153	2,539	987	723,008	672,689
Coal	....	....	36,597	26,931	....	....	850	1,983	517,261	649,058
All other merchandise	170,765	196,105	15,658	14,303	20,976	29,991	6,893	11,320	795,875	792,616
Total	647,011	581,521	59,042	47,606	22,513	31,219	13,729	16,340	3,031,736	3,546,989

1239. The total quantity of freight passed eastward and westward through the Welland canal from United States ports to United States ports, for a period of thirteen seasons, is as follows:

YEAR.	Eastward.	Westward.	Total.	Total passed through.
	Tons.	Tons.	Tons.	Tons.
1881	96,266	97,907	194,153	....
1882	110,286	172,520	282,806	....
1883	174,912	257,699	432,611	....
1884	163,998	243,081	407,079	837,811
1885	168,212	216,297	384,509	784,928
1886	244,916	239,562	484,478	980,135
1887	189,427	151,074	340,501	777,918
1888	221,062	213,689	434,751	878,800
1889	297,853	266,231	563,584	1,085,273
1890	318,259	215,698	533,957	1,016,165
1891	300,257	247,543	553,800	975,013
1892	300,733	240,332	541,065	955,554
1893	384,559	247,108	631,677	1,294.823

1240. The following is a statement of the revenue received by the government from the canals since confederation:

Years ended 30th June.		Years ended 30th June.	
1868	$403,879	1882	$325,232
1869	400,263	1883	381,604
1870	414,887	1884	372,562
1871	488,539	1885	321,289
1872	466,847	1886	328,978
1873	486,433	1887	321,785
1874	510,776	1888	317,902
1875	410,980	1889	333,189
1876	390,337	1890	354,816
1877	390,857	1891	349,432
1878	373,814	1892	321,475
1879	337,675	1893	357,090
1880	341,598	1894	387,789
1881	356,558		

1241. The geologicial position of Canada renders it advisable, in the interest of trade and commerce, for the United States and for Canada to give one another the fullest facilities for the transfer by rail of their goods and products.

The provinces of Ontario, Quebec (in part) and Manitoba find their advantage in having an arrangement by which their exports and imports may be brought into and sent out of Canada via the United States.

The several provinces of Canada are brought into closer commercial relation by means of the three great railway systems—the Intercolonial, the Grand Trunk and the Canadian Pacific. Before the first and third of these systems were completed a large portion of the interprovincial trade was carried through the United States. These outside channels of trade are still used, being convenient, and, to a considerable degree, competitive routes.

The United States people find it to their advantage to use Canadian routes both for the purposes of trade with Europe on the east, China and Japan on the west, and with Australia, and for interstate carrying trade.

In these circumstances we have: 1st, the traffic between Canada and countries other than the United States via United States territory, and that between the United States and countries other than Canada via Canadian territory.

2nd. (*a*) That between Canadian ports or places and Canadian seaports through United States territory, and (*b*) that between United States ports or places and United States seaports through Canadian territory.

1242. The first kind of transit trade—that mentioned in paragraph 1008—is secured to the traders of the two countries by article XXIX, of the treaty of Washington, 1871, which provides as follows:

It is agreed that for the term of years mentioned in Article XXXIII, of this treaty, goods, wares or merchandise arriving at the ports of New York, Boston and Portland, and any other ports in the United States, which have been or may from time to time be designated by the President of the United States, and destined for her Britannic Majesty's possessions in North America, may be entered at the proper customs-house and conveyed in transit, without the payment of duties, through the territory of the United States, under such rules, regulations and conditions, for the protection of the revenue as the government of the United States may from time to time prescribe; and under like rules, regulations and conditions, goods, wares and merchandise may be conveyed in transit without the payment of duties, from such possessions through the territory of the United States for export from the said ports of the United States.

The remaining part of the article provides for reciprocal privileges for the use of Canadian seaports by United States traders.

Article XXXIII provides that the agreement shall remain in force for a period or ten years from the date at which it came into operation, and further until the expiration of two years after either of the high contracting powers shall have given notice to the other of its wish to terminate the arrangement.

Article XXIX has not been denounced by either party to the agreement.

1243. The second kind of transport of goods was to a certain degree regulated by article XXX of the treaty of Washington, 1871, but since the abrogation of that clause, in 1885, it has been carried on by virtue of authority given by statutes, in respect to the United States, and in respect to Canada, by order-in-council and chapter 32 of the revised statutes of Canada, 1886.

The United States act is that of July 28, 1866, (United States revised statutes, section 3006), which, as it was not repealed on the ratification of the treaty of Washington, 1871, revived on the abrogation of article XXX The act of 1866 is as follows:

> Imported merchandise, in bond or duty paid, and products or manufactures of the United States, may, with the consent of the proper authorities of the British provinces or republic of Mexico, be transferred from one port of the United States to another port therein, over the territory of such provinces or republic, by such routes and under such regulations and conditions as the secretary of the treasury may prescribe, and the merchandise so transported shall, upon arrival in the United States from such provinces or republic, be treated in regard to the liability to the exemption from duty or tax as if the transportation had taken place entirely within the limits of the United States.

For this second kind of transport there is, therefore, no treaty agreement. On the repeal of article XXX. of the Washington treaty, 1871, an order of the United States treasury department issued, that all goods, etc., entering United States territory from Canada in transit from other points in the United States should pay duty, but further research brought to light the act of 1866, under which the bonding system, as applied to this kind of transport, has been continued.

1244. As respects Canada, an order-in-council passed 4th December, 1856, provides for transit of goods by railway from United States places through Canada to United States places. An order-in-council dated 12th March, 1860, says: "Free goods and others in transit through Canada by any continuous railway shall be dealt with as heretofore in accordance with section 2 of the customs regulations of 1856, excepting that triplicate reports are dispensed with." An order-in-council, 7th December, 1883, provides regulations. The customs act also makes regulations.

1245. The United States returns supply data showing the extent to which Canada avails herself of the arrangement under article XXIX and under the act of 1866.

1250. The following table gives the proportion of Canadian and United States tonnage that have used the Welland canal:

WELLAND CANAL.

(Up and Down.)

5-Year Periods.	Total Tonnage of Vessels.	Canadian Tonnage.	Per Cent.	United States Tonnage.	Per Cent.
1851-55	4,729,607	1,954,625	41·32	2,774,982	58·68
1856-60	5,572,079	1,931,761	34·67	3,640,318	65·33
1861-65	5,716,528	2,261,499	39·56	3,455,029	60·44
1866-70	5,936,186	2,735,265	46·07	3,200,921	53·93
1871-75	6,857,494	3,286,287	47·92	3,571,207	53·[illegible]
1876-80	5,358,641	3,331,430	62·17	2,027,211	37·83
1881-85	3,765,923	2,356,112	63·57	1,409,811	36·43
1886-90	4,769,721	2,710,128	56·[illegible]	2,059,593	43·18
Total	42,706,179	20,567,107	48·16	22,139,072	51·84

The United States tonnage was more than the Canadian during the period 1851-75. The Canadian tonnage was more than that of the United States during the period 1876-90.

The period of the greatest use of the canal was that of 1871-75.

The greatest year of use was 1871, when 1,554,118 tons of shipping passed through.

The smallest year of use was 1864, when only 446,106 tons of shipping passed through.

The year of highest percentage of United States tonnage passing through was 1860, when 69 per cent. of the whole tonnage belonged to the United States.

The year of the highest percentage of Canadian vessels using the canal was 1880, when 80 per cent. of the total was under the flag of Canada.

In 1850 the tonnage locked through was 587,100 tons, of which 49 per cent. was Canadian and 51 per cent. United States.

In 1892 the tonnage locked through was 1,192,301 tons, of which 49.66 per cent. was Canadian and 50.34 per cent. United States.

In 1893 the total tonnage was 1,487,743 tons, Canada being represented by 33.2 per cent. and the United States by 66.8 per cent.

Taking the whole period 1850-93, the United States has used the canal for 24,315,707 tons of shipping and Canada for 22,180,672 tons, the United States using it for 2,135,035 tons more than Canada used it. By percentages the United States shipping using the canal during 44 years was 52.3 per cent. and Canadian 47.7 per cent.

During 23 years, 1869-1893, 4,310,894 tons of vegetable foods and 4,558,689 tons of heavy goods have passed through the Welland canal in transit between ports in the United States.

The vegetable foods consisted of flour, 142,633 tons; wheat, 1,662,034 tons; corn, 2,006,362 tons; barley, 55,385 tons; oats, 245,725 tons; rye, 3,680 tons, and other articles of food, 195,075 tons. The heavy goods comprised 122,097 tons of railway iron; 119,936 tons of other iron; 265,443 tons of salt; 3,627,150 tons of coal, and 424,063 tons of ores.

It is evident, therefore, that the use made of the privilege of transit by the United States is very considerable.

President Howland: We are now prepared for Mr. Joseph R. Oldham's paper on a subject to us very interesting, "Is a type of vessel to navigate fresh and salt water practicable?" I have the pleasure of resigning the chair the remainder of the evening to Mr. Smalley.

Mr. Smalley, taking the chair, called Mr. Oldham to read his paper, saying that he could not refrain from giving expression to the feeling that there had been about as much genius displayed by the secretary in conceiving as by the authors in carrying out the program, the interesting subject given to Mr. Oldham being an illustration. Mr. Oldham read as follows:

Is a Type of Vessel to Navigate Fresh and Salt Water Practicable?

JOSEPH R. OLDHAM, N. A. AND M. E.,
Cleveland, Ohio.

When Mr. Flower honored me by requesting a paper entitled, "Is a Type of Vessel to Navigate Fresh and Salt Water Practicable?" I felt that I could not creditably comply with such request, as I had already written on a cognate subject; but more especially was I deterred on account of the limited time during a busy season of navigation to prepare anything worthy of your attention. However, in a leisure hour I thought I would try to write something original and useful, which I now beg to submit for your approval, and as my paper has been very hurriedly prepared, I must solicit your indulgence.

I think I could design a large screw steamer that would answer fairly well for a combined ocean and lake trade, and if time permitted I would have submitted some such plans to this convention. Such a design however, would necessarily partake of a compromise between the typical ocean and lake steamers. For instance, consider one feature intimately connected with the economic working of a steamer: I refer to the loading and unloading arrangements. These facilities, on the great lakes are the most efficient in the world as the following example will show, but they are generally dissimilar to the common arrangements for doing like work in Europe or elsewhere, and such facilities as exist are not likely to be greatly improved in foreign countries, until the federation of the world:

One day of last month the steamer Masaba arrived at Erie, Pa., at 4:30 A. M On that day she was unloaded of 2,250 tons of iron ore. She then proceeded to Ashtabula, a distance of about 48 miles and loaded a partial cargo consisting of 1,232 tons of coal, and she was actually on her way to Lake Superior before dark on the day of her entry. To express this feat of modern mechanical ingenuity in other words, I may say that a total of 3,482 tons of freight was handled and the steamer was entered and cleared from two ports, nearly fifty miles apart, all within a period of fifteen hours, elapsed time. Messrs. Pickands & Mather assure me that some of their steamers have done better than this, and it appears to me that such work as I have described can not be equalled in any other seaports to which steamers trade.

As regards structural strength, I know of no lake steamer that is strong enough for the fall and winter trade, say between New York and the British Isles, though as a small steamer the Pathfinder might do fairly well if she had a surface condenser, about twenty per cent. more horse power, and half a dozen steam winches, masts, derricks and sails. It must not be forgotten that as soon as a deep waterway is opened to the ocean, our steamers will have to compete with foreign vessels. In that competition the first cost of construction will be an important factor, for in addition to the effect of more or less capital being invested in such an enterprise, there is the continuous expense of insurance, which is one of the heaviest items in the disbursements of a cargo steamer, as the following table may serve to show:

DETAILED COST OF WORKING SIX OCEAN STEAMERS FOR ONE YEAR.

Crew, wages and provisions	$69,000 00
Port charges	55,000 00
Stores, docking, painting, etc	51,000 00
Insurance	45,000 00
Loading and discharging	40,000 00
Bunker coals	35,000 00
Brokerage and commissions	20,000 00
Total disbursements	$315,000 00

The gross profits of the six steamers for the twelve months, amounted to $350,000.00. Hence the profit for the year's working amounted to 10 per cent. without allowing for depreciation. It may be worthy of remark that with high efficiency in foreign steamers, the bunker coals are almost a minor dibursement, being even less than the cost of insurance.

Hence the importance of keeping down the first cost of a vessel. Every one is aware that the absolute dimensions of a steamer, as of a house, will directly affect the first cost, but it is not perhaps generally so well understood how the relative dimensions or proportions affect the cost of construction as well as the cargo capacity. Let me briefly illustrate this: A modern Atlantic cargo steamer should be about 450 feet long, 50 feet broad, and 34 feet deep. Such a vessel would carry 8,500 tons dead weight on 26 feet draught of water.

Parenthetically let me add that my late colleagues and friends, John Price and G. B. Hunter, are now constructing for Milbank Hudson, of Sunderland, a steamer 465 feet long, 56 feet broad and 34½ feet moulded depth, displacement at 26 feet mean draught, 14,500 tons She will carry a dead weight cargo of over 10,000 tons, and a measurement cargo of 14,500 tons, of 40 cubic feet per ton. The propelling power of this steamer consists of three cylindrical boilers, each 14 feet 3 inches in diameter, 11 feet 9 inches long, triple expansion engines $24+46+75 \times 54$ stroke of piston, working pressure 180 pounds. The indicated horse power in ordinary working will be about 2,800, and speed of ship loaded, 10 knots. This, however, is a spar decked vessel and is consequently not suited for a continuous North Atlantic trade, particularly as her speed is comparatively low.

By this, you may understand that the steamer I propose will not be too large to successfully compete with modern ocean tonnage, but the draught of water to which such a steamer could be safely laden, is too great for trading on these lakes.

It may be said, why not make her shallower and increase the breath and length? To this assumed query, I may reply that the cheapest type of ship is a deep one, and the dearest a broad one. Moreover, very broad and shallow vessels are the most expensive to propel. Now, if it were required to carry the same dead weight, viz: 8,500 tons on 20 feet draught of water, the length of the proposed vessel would require to be increased from 450 to 520 feet, and the breadth of beam from 50 to 57 feet. This change in proportion would augment the first cost about 20 per cent. so that if the proposed steamer cost $300,000, the alternative (shallow) vessel would cost about $360,000.

On the other hand, if the proposed length and breadth were considered sufficiently great for these lakes with 20 feet of water, the carrying capacity would be reduced from 8,500 tons to 6,500 tons. From this it would seem that if our steamers have to compete with foreign vessels, an efficient and economical steamer for a combined lakes and ocean trade should be large and consequently deep; and to profitably utilize such a depth, a large proportion of her cargo would require to be shipped at a deep water ocean port, or at the east end of Lake Erie, if the new canal permits of vessels drawing about 26 feet of water passing through it.

This does not involve a breaking of bulk, as the final load could be carried on the 'tween decks or in separate holds. This is not an uncommon practice in many trades, and occasionally vessels deviate largely from their true course, to take on cattle or other cargo, which would not be generally necessary in this case.

Again, the combination steamer should be flushed decked and of the "three-decked" type with as few erections above deck as possible. The boilers should be located just as they generally are on lake steamers, but the strength of the engine and boiler houses should be more than doubled.

As the proposed deep waterway may be constructed before the next large steamers to be built become old or obsolete, it might be well to consider the advisability of adopting surface condensation and other economical adjuncts to the modern marine engine at once, as greater efficiency and consequent greater economy would result from their adoption, even now, on these lakes.

There are several other features of steamship construction or equipment, which if time permitted us to discuss, might prove interesting and edifying, but I shall only ask your attention while I touch on one of these features: I refer to measurement for register tonnage. Our lake steamers have greater register tonnage in proportion to their carrying capacity than any class of steamers in the world, while some types of British steamers have the lowest register tonnage. This is an all important item to the shipowner there, as the port and harbor dues sometimes exceed 30 cents per. registered ton. There are large passenger steamers in the British Isles carrying 1,500 hundred or more passengers with a register tonnage of only 300, and some of their steamers have less than no tonnage.

If it does not weary you, I will explain what tonnage is: One hundred cubic feet represents a register ton, so a rectangular box 4.63 feet in length, breadth and depth, would equal the capacity of a register ton. Now all the permanently enclosed spaces, except the house required for navigating the steamer, are added to the cubical space under decks to make up the gross register tonnage. To compute the net register tonnage, an arbitrary deduction is made on account of the space required for the proper working of the boilers and machinery. The cubical contents of this compartment is augmented by an actual allowance of 1¾ times such space for coal-bunkers, or if the actual engine and boiler space exceeds 13 per cent. of the gross tonnage (in screw steamers), such tonnage may be reduced 32 per cent. to make it the registered tonnage. On these lakes, our tonnage measurers invariably make the deduction for machinery space equal to the actual space with three-quarters of such space added.

This system, however, is not so favorable to the struggling shipowner (none of which are to be found in this blessed country, I admit), as the alternative rule, which is much more liberal. Indeed, a British steamer is commonly capable of carrying two and a quarter times her register tonnage in dead weight tons of 2,240 pounds, as the following table will show;

In other words, the proportion which the net registered tonnage of an ordinary British steamer bears to the dead weight ability or carrying capacity is about 44 per cent. The registered tonnage of lake steamers is a much higher percentage of the cargo carrying capacity. This will severely handicap the present lake shipowners when engaged in a distant foreign trade. Let no one attempt, however, to evade our tonnage measurement laws by "breaking" the decks and forming "well deckers."

Let them rather amend our tonnage acts so as to favor flush decked ships. Therefore our shipowners, at least before entering the ocean trade, should insist on the deduction for the register tonnage of their large cargo steamers, being 32 per cent. of the gross tonnage plus crew space.

The following table may serve to show the comparative tonnage of the three principal types of cargo steamers, viz: Three deckers, spar deckers and well deckers:

COMPARISON OF GENERAL EFFICIENCY BETWEEN A THREE DECKER, SPAR DECKER AND WELL DECKER.

	Three Decker.	Spar Decker.	Well Decker.
Length in feet	284.0	284.0	284.0
Breadth in feet	38.0	38.0	38.0
Depth in feet	24.75	27.0	22.3
Gross tonnage	2,130.0	2,144 0	2,296.0
Net tonnage	1,381.0	1,390 0	1,494.0
Dead weight ability, at 2,240 pounds per ton	3 580.0	3,580.0	3,580.0
Cargo capacity, at 40 cubic feet per ton	3,629.0	3,860.0	3,969.0
Equipped weight, gross tons	1,465.0	1,455.0	1,375.0
Metacentric height in inches	13.25	10.0	5.0
Point of maximum stability in degrees	34	46	45
Point of vanishing stability in degrees	56	71	71
Tensile stress on gunwale angle in tons	6.0	6.18	5 31
Dead weight efficiency $\frac{D.W.}{E.W.}$	2.44	2.46	2.60
Registered tonnage efficiency $\frac{D.W.}{R.T.}$	2.59	2.58	2.39

D. W. means dead weight.
E. W. means equipped weight, i. e. ship empty but ready for sea.
R. T. means register tonnage.

One great advantage of a large and deep channel to tidal waters would be that our lake steamers could then be at work all the year round. If we had half a million tons built and equipped for the ocean trade, representing a capital investment of say $30,000,000, the loss by depreciation and inactive capital would amount to at least $1,800,000 per annum, for I think our vessels deteriorate quite as fast while laying up in this frigid climate, as they do whilst at work. When the good lake steamer is water borne to the ocean her sphere of operations becomes unlimited, but it must be remembered that Brown hoists, steam cranes, floating coal cars, elevator legs and ore chutes may all be wanting in many Pacific and Atlantic ports, and in the islands of the sea. Therefore steam winches, derricks or cranes must be carried as part of the ordinary equipment. Boiler tubes, spare crank and propeller shafts, a spare screw propeller and other spare gear must be on board, as engine and boiler shops do not exist everywhere. Moreover the ship's engine staff must be capable of fitting any and all of these into their places, and must also be able to convert their engines into a two-step compound or single engine according to the nature of a possible breakdown.

The master must be a man of business, capable of holding his own in mercantile transactions with clever Greeks, sharp Maltees or learned Parsees. He should also be an amateur surgeon and more than half a pharmaceutical chemist. Masts and booms are a necessity in the foreign trade, and at least sufficient sail should be carried to keep the vessel out of the trough of the sea in the event of a breakdown of the machinery. With our lake steamers thus furnished and equipped, and supported by the unlimited credit of this country and by the prestige assured to all that floats under the stars and stripes, Superior-Duluth and Buffalo, Chicago and Cleveland may soon become marine emporiums more rich and famous as the home of ships employed in a distant foreign trade than Alexandria or Carthage, Liverpool or New York have ever been or ever can be.

DISCUSSION.

Chairman Smalley: The chair would like to ask one question. This paper relates to the utility of lake vessels for ocean service: A large part of the cargo service of the foreign carrying trade is done in the small type of steamers which do not belong to great lines at all, and yet seem to be able to compete for freight with those lines. I would ask Mr. Oldham whether, in his opinion, these steamers could go on a 20-foot channel?

Mr. Oldham: More than one-half of the foreign tonnage vessels do not load above 20 feet. The majority load about 18 feet; such vessels as you speak of load about 19 feet. When I advocate the building of a large steamer, I am building for the future. Builders are now constructing vessels larger than the Great Eastern. Since last year 10 steamers have been under construction 80 per cent. larger than the average lake steamer of last year. We are now building one 430 feet in length, which will carry double as much as the largest lake steamer that existed last year.

Question: Mr. Oldham spoke about the boats passing through the Canadian Sault canal Will the new Canadian canal allow our boats to go through?

Mr. Oldham: Oh, certainly. I noticed particularly the time occupied in taking three vessels through and making the level. There must be about 30,000 tons of water in that canal, and they made the level in 6 minutes and 20 seconds. There was 30,000 tons of water transferred from Lake Superior into that lock in 6 minutes and 20 seconds, and the total time in locking three vessels through was 23 minutes.

Chairman Smalley: The friends of the deep waterways movement are under great obligations to the Chicago drainage board of engineers for their intelligent and public spirited advocacy of this movement. Mr. Wenter, the president of that board, is in the hall, and I know you will be pleased to hear from him. (Applause).

PRESIDENT WENTER'S REMARKS.

Hon. Frank Wenter: Some three weeks ago Mr. Cooley, my colleague on the board of trustees, handed me an invitation to be present at the deep waterways convention in the city of Cleveland. At the following meeting of the board a resolution was passed to appoint a delegation to be present at this convention. I am here as one of that delegation.

There was one subject discussed here, the question of lake levels, in which we in the city of Chicago are very much interested. When I found that a frank, generous sentiment prevailed here, and heard reports entirely different from those we have received through the newspapers, I felt that the cause of Chicago needed no defense, consequently had pleasure in quietly keeping my seat.

However, I am very thankful to be called upon to say a few words. Our enterprise in Chicago is a more severe burden upon the tax-payers of Chicago than the world's fair. The world's fair brought millions to Chicago; this does not bring any millions; it takes millions out of the tax-payers. But the time will come and is not far distant when the millions will be coming to Chicago.

This channel is at present in law only a drainage canal; yet the time will come when the United States government will take hold of it and continue where we leave off; and with the assistance of the government we will make one of the great waterways from Chicago to the Gulf of Mexico.

Only three years ago the first spade was put in the ground, when there was nothing to be seen but lines drawn by the engineer over a distance of twenty-eight miles through a wilderness. To-day 70 per cent. of that gigantic work is executed; 70 per cent. of the material is taken out of the cut of the channel and placed upon the embankment.

Anybody who has ever had the opportunity to witness the operation will say it is the most gigantic and inspiring piece of work that man has ever executed. You will presently have an opportunity of seeing some pictures thrown upon the canvas which will give you an idea of the work.

We purchased 6,500 acres of land to enable us to execute that work as it should be. We spent about $2,500,000 for that property. There are over eleven miles of solid rock to be chiseled through in such a manner that the machinery required to do it is marvelous in its ingenious construction.

I am proud of being connected with this enterprise for two reasons. It is certainly a great work, and anybody connected with it, whether his name will go down to posterity or not, has reason to be proud. Second, I am proud because the enterprise so far has been conducted without a whisper of scandal concerning it. In two years hence the work will be finished. I want to say in behalf of the Chicago drainage board we extend our thanks to the citizens of Cleveland, and to the gentlemen that represent this deep waterways convention, for the kindness which they have shown to us and hope to see them all in Chicago. (Applause.)

Chairman Smalley: Some years ago there appeared upon our lakes a new type of vessel, rather uncouth in appearance; ridiculed at the time by many of the old vessel men. It has won its way, and a large fleet of those vessels is now in constant operation on the lakes. One went out on the Atlantic to Liverpool and around to South America, and is now in service on the Pacific coast. The inventor and builder of these vessels is known by name to you all, Capt. Alexander McDougall of Superior, the father of the whaleback. I know you want to see him. (Applause.)

CAPT. ALEX. M'DOUGALL'S REMARKS.

Capt. McDougall: I have come unprepared to say anything on any of the subjects before the convention. Having listened to Mr. Oldham's ideas of a vessel that might be adapted to both ocean and lake service, I may say I have had some experience in that line and it has taught me a lesson. I am deeply interested in the great canal project connecting the lakes with the sea; I think transportation to foreign countries without breaking bulk may be accomplished some years hence, but salt water and fresh water navigation I think will not mix any more than oil and water.

As to the great ships and the great canal, I have given that matter a great deal of careful attention, and have many figures to show that the great ship is not the cheapest ship on a short route. When we talk of great canals, the great Canadian canal, and the project of the Erie canal should not be lost sight of. It is a question if in the end they will not be great competitors of this great canal of 26-foot channel.

In using lake vessels for ocean service, we must take into consideration a probable change of crew and the character of the crew. A vessel adapted for lake service, such as would go through the Canadian canal, would cost probably $50,000 more to make her a sea-going ship.

She is then prepared to combat with the salt water and its effects upon metal, which are very injurious to both the ship and her machinery. The bottom of the vessel must be coated with a heavy coating of cement, or some other non-corrosive substance, and the outside of the ship must be prepared in the same way with a very expensive paint, two coats.

She has to be built more staunch in many respects, and the crew are men adapted to a long voyage, which requires more or less rest and recreation at the end of the voyage; while in the lake country our system of dispatch is what the men call, "turning so fast that it makes them dizzy." That system of dispatch gives greater advantages than the cost of transferring the product which we carry to the seaboard. The cost of transferring a bushel of wheat in Montreal or New York is one-fourth of a cent.* The ship owner and the ship master and his crew are here incident to the location, and advantages are taken of dispatch and cheap management which can not be had on the ocean.

I am to-day connected with ships on the Atlantic and the Pacific, as well as in the lake country. We can man a ship in the lake country for one-third the cost that we can in the Pacific coast. Vessels may in future be built very much like our standard box-car. We made a commencement here in Cleveland, building vessels of iron for the canal trade; and when the Canadian canals are finished, I have no doubt something will be furnished in the way of a cheap vessel for that trade.

I have great enthusiasm in predicting the large tonnage to be expected from Lake Superior. It is easier to-day to go to the mouth of the Yukon river in Alaska, than it was twenty-six years ago to go to the head of Lake Superior.

Last evening I was talking with a gentleman who knows more about the wheat trade of the northwest than any man living. He told me there was enough wheat in the northwest to-day to fill every elevator in Chicago, Milwaukee, St. Paul, Minneapolis, Duluth, Superior, and all the boats that can carry it to the end of lake navigation, and that millions of bushels will spoil for the want of storage.

We have just west of us 400,000,000 tons of iron ore as plainly in sight as the people in this room which can be mined at such a low rate that the cost, royalties excepted—and they are too high—will produce iron out of that country for all the nations of the earth.

We need an outlet—not one or two, but three or four, as I understand Mr. Flower and Mr. Cooley have already claimed. It is only through such a move as this that the people of the country will get the fever sufficiently to make the pull necessary to get that great through waterway which will be such a benefit to this nation. (Applause.)

Chairman Smalley: What Capt. McDougall has said will

*Note—The present intermediate charges at Buffalo are much more than that, and there are transfers and tolls before the cargo reaches Montreal.—F. A. F.

remove any lingering feeling of rivalry, if there ever was any in this convention, as to the different routes to the sea. It is evident we are going to meet them all in due time. There is a gentleman in the convention who has had some experience in bringing ships with foreign cargoes from the ocean into the lakes through the present channels—O. A. Thorpe, of Chicago. Will he please come forward? (Applause.)

MR. THORPE'S ACTUAL EXPERIENCE.

Mr. Thorpe: I don't pretend to know very much of the scientific construction of a steamer suitable for ocean as well as lake traffic; but I have had some actual experience with steamships in salt and fresh water combined. The undertaking, although costly, was very instructive and interesting. So many theoretical calculations, arriving at scientific results in reference to the benefits to be derived from a sufficiently deep canal from the lakes to the ocean for transportation without breaking bulk have been placed before us, that were it not for the fact that they are the figures of practical business men, we might hesitate, and accept them with some reservation.

I am, from my little experience, prepared to say that we do not need to hesitate on that point.

When, three years ago, a little insignificant steamer, not much larger than a good sized tug-boat, wound her way up the St. Lawrence river, through the lakes and their channels, carrying a flag which nobody had ever seen floating from a mast before on a steamer of any size, she was heralded through the press of the country, and her passage of the canals and lakes was almost a triumphal procession. Why?

Because that little incident awakened and brought forth a hope which had long been entertained and a wish which had hardly taken the shape of a hope with the population of this great interior country, that we would at once come nearer to the ocean, or bring the ocean, so to speak, up to our ports in the interior.

When, a year later a little ocean steamer of the same dimensions ploughed her way up our great central river, she was met by a delegation of prominent wholesale dealers and others from St. Paul and Minneapolis, and a little deep-waterway convention was held right there.

I do not forget how long the faces of these gentlemen became when they saw the little ocean boat lying beside one of Mr. McDougall's big whalebacks. Had the canals been big enough to bring a big ship into port, there would not have been an excursion on the day we arrived.

Actual figures arrived at by these experiments show conclusively and emphatically that a great amount can be saved in spite of what theorists say to the contrary by shipping cargoes long distances without breaking bulk, not speaking of what is lost in damage to goods by removal.

In wheat and corn the loss by reloading at different points amounts to big fortunes.

Our little steamers carry only a small amount and have to reserve per cent. of their carrying capacity for coal. A vessel carrying 100,000 to 130,000 bushels would not need to reserve more than 8 or 10 per cent. of her carrying capacity for coal, to make the ocean trip from coast to coast.

Again, a steamer carrying 3,000 tons of cargo would not need more than four or five inexpensive men in addition to the crew of that little boat. Then again, small as our boat was, she had to lighter two-thirds of her cargo in order to get through the canal at the St. Lawrence river.

Arriving at her destination and unloading her cargo, we loaded her up with wheat and flour—and there is nothing that pays a poorer rate of freight shipppd from the lake to the ocean. The result was, as regards the second experiment, a saving of 14 per cent. compared with what these two small cargoes could have been forwarded at by other means from and to the same places at the cheapest possible rate. And if the St. Lawrence canal had had the same amount of water as the Welland canal, she could have gone through and saved another 10 per cent., making a saving of 24 per cent.

These are not theoretical calculations, gentlemen, they are reliable, actual figures.

They demonstrate most emphatically at what minimum expense our products can be shipped from western ports to the markets of the world if we only had the facilities. We are all agreed, that the sooner we get such a deep water outlet the better.

Mr. Drake: Some of the delegates would like to know whether the 14 per cent. saving was on the part of the shipper or whether it was the profit of the carrier.

Mr. Thorpe: The vessel was chartered, the charterer paying a certain amount of money for the ship and the crew and paying for everything himself. The vessel got a certain hire per month. The saving was to the freight owners, the parties who handled the cargo and chartered the ship.

Chairman Smalley: President Howland now has the floor.

President Howland announced the committee on resolutions to be as follows: Wisconsin—Gen. M. Griffin, M. C.; Illinois—Col. B. A. Eckhart; Michigan—Hon. H. W. Seymour; Ontario—John Brown; Quebec—R. R. Dobell; Ohio—H. D. Goulder; New York—M. N. Drake; Pennsylvania—George A. Kelley; Iowa—A. P. McGuirk; Manitoba—James Fisher; Minnesota—Col. E. C. Gridley; Vermont—Hon. H H. Powers, M. C.; At large—F. B. Snyder, James Conmee, E. V. Smalley, T. H. Canfield, J. A. C. Wright, D. B. Smith, William P. Judson, Frank A. Flower, Lyman E. Cooley.

Chairman Smalley: Isham Randolph, of Chicago, chief engineer of the Chicago Sanitary and Ship canal, will now present his paper, accompanied by illustrations thrown upon the canvas.

Modern Methods of Canal Excavation.

ISHAM RANDOLPH, C. E.,
Chief Engineer Chicago Sanitary and Ship Canal, Chicago.

The mission of your organization is a grand one. It is for you to make clear to the off-spring of the dear old mother-land that blood is thicker than water, so thick that even the roaring of Niagara cannot drown the voice which speaks to the dwellers on either side of the water line which marks the boundaries of their heritage in the new world, saying in language which cannot be mistaken, ye have a common interest in a common cause! That cause is the upbuilding of American prosperity which shall bless alike those who sit under the folds which bear the cross of St. George or those whose flag of stripes and stars they fling to the breeze and call "Old Glory."

, It is for you to tell the people of these United States and the people of the Queen's Dominion where and how to build a waterway from the very heart of this great continent so that the men of the interior may "go down to the sea in ships" and "do business in great waters" which flow through their own rich prairies and will bear the produce, which is bursting their barns, out to the world by the cheapest method of transportation which has been known from the days when Noah freighted live stock on the high seas, down to the present instant of the world's history.

You must point out the favored line which is to take the sweet waters of the world's greatest fountains and lead them on to meet the salty sea, and you must prove that your route is practicable and that its cost will be an expenditure so reasonable that no heavy burden will ever be laid upon the people of either Canada or of the United States should the work be undertaken and prosecuted to completion as an international enterprise.

You have invited me to speak upon a subject which may be taken as a gauge of the practicability of the great projects which are taking your time and thought, namely: "Modern methods of excavation."

In selecting an equipment for any work those appliances should be chosen which will give the maximum of attainment for the minimum of cost; which, of course, means that the device should be adapted to the material which it is expected to remove. For more than two years now I have been holding intimate relations with modern devices for excavating materials, and although but two classifications are recognized in the specifications for excavating the channel of the sanitary district of Chicago, I venture the assertion that no excavation has ever revealed a more heterogeneous aggregation of solid matter than is found in the stretch of channel between Robey street, Chicago, and Lockport, Ill. To meet the many special conditions which developed on this work, a vast amount of human ingenuity has been called into play, with a success which is attested by the present stage of advancement of the work. Over 70 per cent. of the entire volume of 39,972,862 cubic yards (12,330,594 solid rock, 27,652,168 glacial drift) covered by the existing contracts for the sanitary channel and ship canal, has been excavated and lies in continuous heaps, which look like mountain ranges, along the right of way.

The earliest contracts were awarded in 1892, but on June 1, 1893, only 1,006,252 cubic yards had been excavated. It is, however, the devices themselves which I am expected to describe. The excavators which first tickled the soil were the veteran plows, slushers and wheel-scrapers, which form the mainstay of the railroad contractor on earth work. The most notable evolution from these veteran appliances was the New Era Grader, the essential points of which are a great breaking plow, attached to a wheeled running gear, with a revolving apron, driven by gearing which is propelled by the wheels of the running gear, and is so located that the soil which is thrown from the plowshare falls on it, and is carried up at an angle of about 40 degrees and discharged into wagons which are driven alongside. As fast as one wagon is loaded it drops out of line, and an "empty" takes its place. This machine is very efficient in soils which are easily plowed. It is propelled by from 12 to 16 horses, requiring two drivers and one man to operate the machine. Under favorable conditions these machines will put out 100 cubic yards per hour.

Steam shovels form the next class of dry excavators. Of these, we have fifty on the work—some of them the latest and most powerful developments of the machinist's art in that branch of mechanism. Of this number nineteen are of the Barnhart (Marion Steam Shovel Co.) make, eighteen turned out from the shops of the Bucyrus company, eight are from the Vulcan works of Toledo, and two are from the Vulcan works of Chicago; one of the last named has not been installed at this date.

One of the Barnhart shovels on this list is practically a dredge mounted on wheels. It has four sets of trucks, one at each corner of the frame, is 23 feet wide and 50 feet long; the boom is 50 feet long, and 2½ cubic yards dipper. The advantage in the use of this machine is its ability to load into cars on top of the cut in which it is working, but it is so ponderous that it loses time in moving, and its record up to August 1 has not equalled that of the ordinary steam shovel manufactured by the same builders; for the first half of August it averaged 830 cubic yards per shift.

The Barnhart shovels have been very successful in handling all of the more fragile materials without blasting and the tougher clays and cemented gravels after blasting. The latest "A frame" Bucyrus shovels, built with a special view to the difficult materials—cemented gravel, heavy boulders, boulder clay, and blasted rock—have proven very efficient and valuable machines.

The Osgood shovels have especial advantages in dealing with the heavy boulders and tougher materials. They are chain-rigged machines. The crowding is done by an ingenious rigging of chains to the dipper handle, the handle being crowded or released by the winding or unwinding of the chain on its drums. The dipper is hoisted and lowered by two chain cables working in twin sheaves at the end of the boom. The advantage of the chain rigging over the rack and pinion gear for handling and crowding the dipper is in the greater freedom of play without danger of stripping rack or pinion under heavy strains.

The Toledo Vulcan shovels have also done good service. The last two shovels put on the work were built from original designs by the Vulcan works of Chicago. They are unusually heavy, weighing 72 tons each; dippers 2½ cubic yards. The expectation of the builders is that they will handle 1,000 cubic yards of the more difficult material in ten hours; they may, but there is an old scripture which says, "Let not him that putteth on his armour boast himself as he that taketh it off." Their armour is now being tested. These shovels deliver the material which they excavate to cars which are disposed of in various ways. Some are hauled off by locomotives to distant dumping grounds; others are hauled up steep inclines and contents deposited in spoil-banks close at hand.

On one of the sections material is loaded by steam shovel directly into skips or hods and carried off by cableway. The methods of disposal form a separate head of this discourse.

Two sections of this work are thorough dredge cuts. On these the type of dredge which is so familiar in all of our lake harbors is used; the material is loaded into scows and towed away by tugs to the allotted dumping area in Lake Michigan. The conditions have not been favorable for record making by these dredges; the largest average output for any one month has been 870 cubic yards per shift of 10 hours. This, however, I do not regard as by any means a measure of the efficiency of the machines, as one of these dredges has loaded as high as 1,800 cubic yards in ten hours. The price paid for this work is 21 cents on one section and 23 cents per cubic yard on the other, which also covers the towage cut into the lake to a point about nine miles from the place of excavation, and this through six miles of the crooked and congested channel of the Chicago river.

It is proper to take up the methods of conveying the dry excavation to the spoil-banks. On several of the sections what is known as the Heidenreich incline is used. This name is given it because it was brought into successful use by the contractors of that name, although the first of these devices which ever came to my knowledge was constructed by J. O. Wright of the Western Dredging & Improvement Company, and used under very unfavorable conditions on our "river diversion" work. This device consists essentially of an incline, the frame of which in elevation is a triangle having two nearly equal sides, one of which forms the base, the other pointing upwards and projecting beyond the base; the third side forms the roadway which carries the tracks on which the cars are moved.

There are two standard gauge tracks on this incline, spaced 10 feet between centers. The top section of each track for a length of about 10 feet is pivoted like a teter-board and becomes a tipple. The whole frame is mounted upon trucks whose direction of travel is at right angles to the longitudinal section of the incline; the platform of the base is extended sufficiently to carry engine, boilers, hoisting machinery and dynamo for electric lighting. This device travels on tracks parallel with the channel; a trestle extends from the foot of the incline down into the channel.

There are two cars used for alternate loading and dumping. A car is let down into the pit and when loaded by steam shovel the signal is given to the engineer on the incline, who starts the hoisting machinery and hauls the loaded car up—onto the tipple where, as soon as its center of gravity passes the axis of the tipple, it is thrown forward and its contents dumped. As soon as it is empty the counter weighting of the tipple causes it to right itself and the empty car is returned to the pit. Meantime the car on the other track has been loaded and is being hauled up. The incline and its approach is moved forward by means of wire cables wound on a capstan and so attached to the incline and approach as to insure that all parts move simultaneously. There are nine of these devices in use upon our channel, showing an efficiency and economy which attests their fitness for the work. On the thorough earth sections their best record for any one month has been 958 cubic yards per shift of 10 hours.

Christie & Lowe Method.—As a further development of the inclines just described, Christie & Lowe terminated the incline so that the car would pass from it onto a bridge spanning the spoil area, the abutments of said bridge being mounted upon tracks traveling parallel with the channel. The double track of the incline becoming a loop track on the bridge, thus avoiding switches. The cars used are side-dumpers and have a capacity of eight cubic yards. The hoisting apparatus is similar to that used with the inclines only of a greater power. The bridge is moved ahead as soon as the height of the spoil reaches nearly to the bottom chord. The bridge with its approach is moved along by capstan and cable, as is the incline. The best month's average made by steam shovels working with these devices is 821 cubic yards per shift.

Mason & Hoover Conveyor.—This apparatus was devised by the men whose names it bears. It is essentially a bridge spanning the channel with a cantilever arm extending out over the spoil area, the whole carried on trucks which travel on tracks on each side of the channel laid parallel thereto. The bridge carries a steel belt made in 4-foot sections, like pans, interlocking and hinged with 2-inch axles carrying flanged wheels 12 feet in diameter. This steel belt works in a metal trough with rails on each side on which the pan wheels travel, which fits the cross-section of the channel and extends up to the apex of the cantilever. There are huge sprocket wheels, one at the end of the cantilever and one at the apposite end of the bridge, constructed so that the 12-inch wheels at the 4-foot intervals will drop into recesses on the circumference of the sprockets. The entire length of this steel belt is 1,300 feet.

The driving power is transmitted by manilla rope, and the engine is 14x17. A separate car carries two 150 horse power boilers which supply steam for running the conveyor and also for propelling the plow which leads it. This plow is of great strength, double ended, so that it may be drawn back and forth across the channel, without turning, and cut a furrow each way. An ordinary hoisting engine operates this plow. The cable is made fast to each end of the long plow beam, and from the end next the hoisting machine it is wound around the drum and passed on across the channel through a pulley-block and then made fast to the other end of the plow so that direction of motion is governed by the direction in which the drum is revolved.

The conveyor is driven at the rate of about 120 feet per minute; the plow is started at the top of the cut and the successive furrows are lower and lower until the bottom is reached; the material thrown from the plow-share rolls down the side of the cut onto the conveyor. As the bottom is reached the efficiency of the plow diminishes until at last the bottom has to be cast on with shovels, which is a slow process. The device advances about two feet at a time. Its best recorded achievement for any month is 509 cubic yards per 10-hour shift.

Bates Conveyor.—This apparatus consists of a car on which is mounted the motive power—50 horse power engine, boiler and necessary gearing for driving the conveying belt. The car moves parallel with the channel; a frame extends down from the car into and across the channel excavation carrying at short intervals concave rollers on which a roller belt 22 inches wide is caused to travel; this belt passes under a hopper in which a pair of cylinders set with great steel knives, which intermesh, revolve and break up the clay, which is dropped into the hopper by the steam shovel—(60 H. P., Toledo).

The granulator is driven by a 120-H.P. engine. The granulated material is delivered on the belt, carried up over the power car where it is delivered on another similar belt, carried on a bridge which spans the spoil area. This is a very efficient apparatus and shows for its best record 920 cubic yards per shift as an average for one month.

On some of the sections the steam shovels load into cars, which are run in trains and hauled away to the dumping grounds by locomotives, of which there are thirty-two on the work. It is needless to go into a detailed description of the several kinds of cars used, or to discuss the comparative merits of the Corey, the Pelter, and others.

The Thatcher pneumatic dumps present the greatest novelty in dump cars. They are side-dumpers—the body pivoted on a longitudinal axis at the center of its width. The dumping is effected by means of an air cylinder attached to the running gear with the outer end of its piston rod attached to the under side of the car bed. When the train is made up, all of these cylinders are connected continuously by hose with each other and with air pump on the locomotive. The engineer operates the dumps by manipulating the air valves, in the same way that the air brakes are handled. On some of the sections the loaded cars are hauled up out of the cut on steep inclines by hoisting engines of great power, and when on the upper level delivered to horses or locomotives to be hauled away to the spoil area.

Hydraulic Dredges.—The location of several of the sections occupied the old bed of the Des Plaines river and the muck and alluvial deposit was so deep that dry methods of excavation were out of the question. The contractors secured one hydraulic dredge and built another one on their work. The hulls of these dredges were about 105 feet long and 33 feet wide. The machinery consisted of a battery of four horizontal boilers 100 horse power each; one centrifugal pump 6 feet in diameter driven by a 250 horse power Westinghouse engine. The engine shaft coupled directly to the pump shaft; the suction pipe, 20 inches in diameter with flexible joint where it leaves the hull, has a rotating cutter on its end, the cutter being driven by shafting carried down on the upper side of the suction pipe; this pipe is so rigged that it can be raised or lowered at the will of the operator. The discharge pipe is 18 inches in diameter. There is a single spud at the stern of the boat which acts as a pivot; swinging lines are run out from the bow of the boat and made fast to each shore.

When at work the boat swings back and forth through the arc of a circle of which the distance from tha pivot spud to the cutter on the end of the suction pipe is the radius. The eroded material is drawn up with the water, passed through the pump and delivered through the discharge pipe in the settling basins. The end of the discharge pipe is often several thousand feet from the dredge.

Two of these dredges handled for us about 1,750,000 cubic yards of material. The best record of either dredge was 11,000 cubic yards in twenty-four hours. For work in alluvial and sandy soils where there is water available for flotation and pumpage, this method of excavation is the most efficient and economical which has ever come to my knowledge. It is destined to play a most important part in the canalizing of rivers, the removal of sand bars and the reclamation of lands subject to overflow. The cost of the dredges which I have just described was about $40,000 each.

A very ingenious contractor who had a large amount of muck on his section improvised a dredge at a cost of about $10,000, which did excellent work at very small cost. He mounted a 12-foot Heald & Cisco centrifugal pump on a scow, rigged up suction and discharge pipes, rotary cutter, etc., and run the machinery with an engine and boiler which he had on hand as salvage from the utter failure of another ingenious device which he had gotten up for excaxating.

We pass now from the devices used on the earth, or glacial drift sections, to those used upon the rock sections.

Channeling Machines.—Throughout our rock sections the sides are cut down vertically by channelling machines, of which we have had as many as 82 in use at one time on the work. These devices consist, essentially, of a vertical boiler mounted on four wheels, and carrying a vertical engine which supplies the power for propelling the machine by means of a worm gear, and at the same time operates the channeller, which is a great chisel with a "Z" shaped cutting-edge made fast by clamps to the lower end of the steam piston rod. A section of track of proper gauge is so laid for this machine that the chisel will come directly on the line of the edge of the channel, and the machine moves back and forth, cutting its way until the limit of depth for the slope on which it is working is reached. Each machine will cut about 100 superficial feet per shift of 10 hours. Taking a channel of the dimensions of ours, the cost of channeling amounts to about 6 cents per cubic yard, or about 17¾ cents per square foot of surface channeled. We have had upon this work both the Ingersoll & Sargent and the Sullivan machines.

Drills.—On great works the ring of the churn drill and the merry click-click of the jumper has almost ceased to be heard, and instead the ear is wearied with the din of emitted steam, and the quick, sharp impact of the drill as it chips its way down into the rock. The steam drill has wrought a mighty revolution in the cost and the celerity with which rock excavation can be made. We have on our work about 193 of these. They are driven largely by compressed air. Ten of the rock sections are equipped with air compressors, from which power is taken all along the section to run the drills, pumps, etc. Our contractors consider that the cost of a compressor plant on a work of this magnitude is money well invested; such an equipment costs about $12,000. Its convenience, and the ease with which the power can be distributed through pipes and hose, commend it to general approval.

Dynamite is the staple explosive on our work, and so far we have used about 5,000 tons. For some time we used about seven tons per day.

The blasts are set off by electricity so that all charges are exploded simultaneously. Overlying the solid rock on some of the sections there is a great deal of glacial drift that could not be excavated by the steam shovels until it had been shaken up by explosives. For this class of blasting, holes have been drifted in horizontally just above the rock line, back 12 or 15 feet from the face of the cut and the burrows or galleries thus formed have been loaded with dynamite and exploded. This method of horizontal burrowing is called "coyoting."

We now come to the devices used for removing the rock from the channel.

The Lidgerwood Cableway has proven a very efficient conveyor. The carrying cable is stretched across the channel from the tops of supporting towers. These towers are strongly built of wood about 90 feet high, placed far enough apart (usually about 700 feet) to span the channel and the spoil area. Each tower is mounted upon a platform about 40 feet wide and 108 feet long, the towers being mounted on the ends of the platform nearest to the channel. They are firmly guyed to the corners on the outer end of the platform which is heavily ballasted to resist the up-setting strain which comes upon the tower from the weight of the cable and its load.

The towers are designated as head and tail towers; under the head tower is the operating machinery. The platforms are mounted on sixteen pairs of standard gauge car wheels whose travel is parallel to the channel and at right angles to the cable. On one of the platforms is mounted the operating machinery, boilers and hoisting engines; on the cable a cage, or truck, is mounted carried upon three grooved wheels which support it and travel on the cable; immediately below these three sheaves, three more sheaves are carried by the cage; two of which are used for hoisting and the third for dumping. The hoisting engines operate the three cable drums with their respective cables, one of these connects with the head tower end of the cage, is wound on the power drum, passed up again over a suitable sheave in the top of the head tower, thence across to the tail tower, around sheaves properly located to prevent interference with the other cables, and thence back to the tail tower end of the cage, completing the circuit and making an endless rope.

This cable drags the cage back and forth. The hoisting cable and the dumping cable are wound on the same drum. The hoisting cable passes from its cage pulley through a sheave which is attached to the lifting chains of the skip or hod; this skip is a pan made of boiler plate steel having a capacity of 90 cubic feet or $1\frac{9}{10}$ cubic yards of rock in situ (figuring the expansion as 80 per cent.). These three lifting chains are hooked to the two sides and back of the skip and brought together and fastened to the lifting block in the rear of the lifting block, and attached to it by a connecting bar in a smaller sheave around which the dumping rope plays. This pulley is made fast by a chain to the rear lifting chain of the skip. When the skip has been loaded, lifted out of the pit and run out to the spoil-bank, the dumping cable which, as before stated, is wound on the same drum with the hoisting cable and virtually travels at the same speed, is, by means of a lever, thrown onto a drum of greater diameter which winds it up more rapidly than the lifting cable and tips the skip forward, discharging its load. The empty skip is then returned to the pit and a loaded one removed. This dumping apparatus was devised by H. C. Locker of the firm of Mason, Hodge & Co.

The engineer operating one of these machines operates entirely by electric bell signals, in obedience to which he moves the cage back and forth; hoists or lowers the skip and causes it to dump at the proper place. The life of the main cable is measured by the number of cubic yards it will take out before becoming unsafe, and is considered to be from 70,000 to 75,000 cubic yards. Large masses of rock are often lifted out simply by attaching a chain to them and making them fast to the lifting apparatus. Stones containing three to four cubic yards are moved in this way. One stone weighing 16,800 pounds was safely landed on the spoil-bank.

The best performance of any one of these machines, of which we have any record, is 615 cubic yards per day, but this is far above the average performance, which may safely be taken as about 400 cubic yards per day. There are 19 of these appliances on our work.

Brown's Cantilever Conveyor.—This machine has proven wonderfully efficient in handling blasted rock and has the best record of any device on the channel. It is essentially a platform about 40 feet square carried on four sets of trucks supporting the four corners. These trucks travel on two tracks solidly laid with heavy railroad steel, three-foot gauge laid parallel with the channel. These tracks are 39 feet center to center. This platform carries the engine, boilers and machinery necessary for operation. From it a steel tower composed of four corner posts properly braced and stayed rises to a height of 53 feet on the channel side and 60 feet 8 inches on the spoil-bank side and supports in equilibrium a bridge 355 feet long on an angle of 12° 50′ with the horizon, the down grade toward the channel across which it extends about 140 feet.

This bridge carries a track on which a trolley car runs. This trolley car is hauled up and down its length of travel by an endless cable wound on a hoisting drum in the engine house below; it carries a very ingenious construction of sheaves, triggers, etc., for raising and lowering the skips and dumping them on the spoil bank. The excavation is made across the channel giving a working face corresponding with its width; nine skips are required for operation and from 40 to 45 men (muckers) are engaged in loading them. The skips or hods have a capacity of 75 cubic feet or about 7,500 pounds of broken limestone. The time consumed in lifting a skip, running it off and dumping it on the spoil bank and returning it to the pit, is about 50 seconds. The best record of any one of these machines is 890 cubic yards in 10 hours and 45 minutes, but this is considerably above the average day's work, which may be taken at 550 cubic yards. We have eleven of these devices on our work.

On two of our sections are devices known as the Hulett-McMyler High Power Derrick and Conveyor. The high power derrick constructed by them is an excellent derrick, self poised, mounted on a turn table like a swing bridge and capable of hoisting very heavy loads. The scheme as at first worked out was that the high power derrick should hoist the skip out of the pit and discharge its load onto a car on an incline at right angles to the channel, but mounted on tracks which traveled parallel with the channel. The car on the incline was then hauled up to its high end and dumped. These devices have not won a name for themselves which is likely to place them on future public works of this magnitude.

The high power derricks in use on Section 14 are very ponderous and powerful. They too are mounted on turn tables like swing bridges and are self poised instead of being counterweighted as the McMyler machine is; it has double booms which counterbalance each other.

From the platform resting on the turn-table, a tower rises to a height of about 100 feet; within this tower, at its base, is housed the operating machinery for rotating and for hoisting and lowering the skips. The mechanism is very powerful and ingenious. The booms are each about 160 feet long. They are worked in pairs, one on each side of the channel. This is necessary, because the booms will not reach across the excavation. They are moved along on rollers and blocking just as houses are moved. Their performance has not met the expectation of their projectors and their best record so far is 372 cubic yards per shift of ten hours.

I have covered all of the main mechanical features presented on our work, many of them the outcome of its stupendous requirements. This work is bound to exercise a wonderful influence as an educator, and to embolden men to undertake enterprises more vast than were considered practicable before its success had been demonstrated.

The average price of glacial drift excavation on our work is 28.94 cents; the average price of solid rock is 76.31 cents but this class of rock work, under similar conditions, will never go as high again. Projectors and contractors have learned from us that it can be done at a profit for less money. Our last rock work, 640,000 cubic yards, was let to most responsible contractors for 59 cents.

But, gentlemen, you can make our schedule of prices the basis for your estimates, and you can show to the governments at Washington and at

Ottawa that you can build a waterway which shall be a glory and a source of wealth and strength to both governments for an outlay which is insignificant when contrasted with the mighty results it will produce. And if governments withhold the sinews of this peaceful conquest of natural obstacles you can show to capital that it may make this great venture with an assured pledge of a return such as capital loves to gather in.

And now, God speed your work, and may hand join in hand and genius, skill and strength be yours to lead the lakes to the Atlantic, through channels whose depth and generous width will suffice to float the most majestic creations of modern naval architecture. And not this alone, but let the westward trend of mighty waterways go on until the commerce of the lakes may drop down through the Mississippi into the gulf and thence to Occidental seas through the Nicaragua canal.

Mr. Seymour: Of course a technical paper like Mr. Randolph's can not be discussed. It is of all the greater value for our volume of proceedings, making for the public an interesting and instructive exhibit of the mechanical wonders developed by the attempt to minister to our great and growing commercial necessities. While waiting for Prof. Wright's paper, which, I understand, will also be illustrated, I will offer another resolution* and ask simply that it be referred to the appropriate committee. This new machinery and these new appliances for fairly rushing through great public enterprises have to me a peculiar significance. Sometimes I think that the machinery of our modern civilization is superior to the civilization itself. So with the almost engineering miracles described by Mr. Randolph. Private skill and genius have gone much farther in producing appliances for the economical improvement of navigation than our governments have in making use of these powerful adjuncts of national progress.

Luther Allen: I suppose it is understood that the sessions to-morrow will take place in the assembly rooms of the Cleveland chamber of commerce, in the Arcade. To-morrow evening there will be a reception and luncheon to the convention in the same rooms, with toasts and music, and on the following morning our chamber will take pleasure in affording delegates and guests an opportunity to ride about the city.

Then followed the illustrated paper by Prof. Wright:

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*NOTE.—*Resolved*, That the growing increase of the tonnage of the lakes renders it imperative for reasonably safe navigation that the water channels now being constructed through the shoals of the connecting waters of the lakes be increased from 300 to 500 feet in width.

Relation of Glacial Deposits to Canal Routes.

G. FREDERICK WRIGHT, A.M., D.D., L.L.D., F.G.S.A.,
Oberlin, Ohio.

The recent remarkable advancement in our knowledge of glacial geology brings to light a large class of facts of the highest practical importance, especially to those who are developing mines, laying out railroads and projecting canals. In presenting the subject it will be profitable to give, first, a general statement of the facts which should guide the special investigator, and then, by way of illustration, to mention a few facts which have already been worked out with a considerable degree of fullness.

It is now established beyond all controversy, that within a comparatively recent period the conditions of Greenland extended over all the dominion of Canada and the northern part of the United States, and that ice, thousands of feet in thickness, produced by the accumulation of snow over Labrador and the region about the southern part of Hudson bay, slowly moved outward in every direction along the lines of least resistance until it was melted by the warmth of more congenial climes. Into the question of the cause of these climatic conditions it is not important that we now enter; but the marks of this ice movement are unquestionable in their significance. Canadian boulders have been transported several hundred miles from their parent ledges, and deposited in such positions that any other agency than glacial ice is excluded from the problem. Everywhere over this area, also, the rocks are scored and scratched in lines parallel with the movement of the ice, showing the enormous force that was exerted upon them by the superincumbent weight.

The glaciated area, also, is indicated, especially near its margin, by a great depth of boulder clay, which is an unstratified deposit composed of the grist ground up by the glacier, as it moved over the rocks, and dragged along under it and spread out over the surface of the country. The depth of this glacial grist, or "ground moraine" as it is called, averages probably one hundred feet over central New York, northern Ohio, Indiana, Illinois and Missouri, and over the whole of Michigan, Wisconsin, Iowa and Minnesota, and over eastern Nebraska and Dakota.

The southern boundary of this glaciated area runs through Nantucket, Martha's Vineyard, Long Island, to Perth Amboy, N. J.; thence northwestward, crossing the Delaware river near Easton, Pa.; the Susquehanna 20 miles below Wilkes Barre, reaching its northern angle near Salamanca, N. Y.; whence it turns southwest approximately parallel with the Allegheny river, touching it at Warren and Franklin, and entering Ohio six or eight miles north of Beaver; thence running through Columbiana, Stark and Holmes to Knox county, where it turns more to the south, passing through the eastern parts of Knox, Licking, Fairfield, Pickaway, Ross, Highland and Brown counties to the Ohio river near Ripley. Thence it follows the river to the vicinity of Cincinnati, where it crosses into Boone and Kenton counties, Ky., and follows closely the Ohio river through southeastern Indiana almost to Louisville. Here, turning northward, it leaves a large triangle free from ice, whose apex is at Martinsville, about 20 miles south of Indianapolis. The line crosses the Wabash river into Illinois at New Harmony, and reaches its most southern point near Carbondale, where it turns northwesterly, keeping on the east side of the Mississippi river to the vicinity of St. Louis. Thence it runs westerly to the vicinity of Topeka, where it turns to the north, keeping nearly parallel with the Missouri river and about 100 miles west of it until reaching the Dakota line, whence it coincides pretty nearly with the course of the river.

Everywhere down to this margin boulders occur which can be traced to the areas of granite rock which stretch north of the great lakes in Canada. The movement was westward from Lake Superior, as well as southward, so that Lake Superior boulders are found in central Dakota, west of the Missouri river, as well as in northeastern Kansas, southern Illinois and central Ohio.

The significance of these deposits with reference to canals consists in the extent to which they have modified preglacial lines of drainage, producing lakes and waterfalls, and the extent to which they serve as vast reservoirs in which the rainfall is held back from flowing too rapidly to the sea.

Since pre-glacial time was immensely longer than post-glacial time has been, pre-glacial erosion had succeeded in draining nearly all the lakes, and in cutting deep channels across the mountains and through the rocky plateaus which were elevated to any considerable distance above the sea. The narrow valleys of the Hudson, the Delaware, the Lehigh, and the Susquehanna rivers, where they have sawn across the mountains, are evidences of the enormous extent of pre-glacial erosion. While Niagara river, since gla ial times, has receded only seven miles and a half from Lewiston to the present falls, and the Mississippi river the same distance from Fort Snelling to the Falls of St. Anthony, the Ohio river, in pre-glacial times, had worn a larger and deeper channel all the way from Louisville to the headwaters of the Allegheny and Monongahela rivers, and the Mississippi a still wider, deeper and longer gorge from Cairo to the sources of the Minnesota.

If we could remove the glacial deposits in the northern part of the United States, we should uncover an area deeply seamed by rocky gorges whose positions are now only partly revealed in the existing topography. We should then find a channel several hundred feet deep leading along the line of the Mohawk from Lake Ontario and entering the Hudson river at Waterford, two miles above the present Fall of Cohoes. We should find a buried channel extending from the mouth of Grand river, on the north side of Lake Erie, to the head of Lake Ontario, sufficiently deep to drain the entire lake. All over the northwestern states these buried channels are brought to light by borings made to obtain water, gas or oil, but not with sufficient frequency to indicate with clearness all the lines of drainage. The following will serve as illustrations:

Borings at Syracuse, N. Y., reveal a buried channel at least 450 feet deep, carrying it 100 feet below sea level. In the Cuyahoga river just above Cleveland the rock bottom is 200 feet below the present bottom of the river. The Tuscarawas river at New Philadelphia is 175 feet above its ancient bed. The Beaver at the junction of the Mahoning and Chenango is 150 feet. Mill creek, in the suburbs of Cincinnati, is 120 feet above the rock bottom, and the Ohio river 150 feet. The rock bottom of the Big Miami at Hamilton is as much as 90 feet below the low water mark of the Ohio at Cincinnati. At St. Paris, Champaign county, Ohio, a boring penetrated to a depth of more than 500 feet without reaching rock or passing out of glacial debris. Southwest of Chicago in Kankakee, Livingston and McLean counties, deeply buried pre-glacial channels have been brought to light, but whether running toward the Mississippi or toward the lake or connecting the two, is not quite certain.

Partially filled up channels and morainic dams are conspicuous at the following places: West of Minneapolis extending from the Minnesota valley to the Mississippi a mile or two above the Falls of St. Anthony; Devil's Lake in Wisconsin is held in position by a great morainic dam; Rocky river in Ohio, between Berea and Cleveland, repeatedly crosses and recrosses its buried valley. What are called the "onion beds" near Berea occupy the depression of the ancient valley. Hon. Mr. White's stock farm just above Rockport is in a re-eroded portion of this buried valley which opened into Lake Erie by a broad mouth about a mile west of the present mouth of the river. From the whirlpool below Niagara Falls to St. Davids' there is a buried channel opening outwards with a very broad mouth. This however does not extend quite down to the water level at the whirlpool. Lake George, New York, is held n place by a morainic dam at each end.

Of the partially filled pre-glacial channels affording attractive routes for canals and railroads, we may mention that followed by the Champlain canal between Fort Edward and Fort Ann, 160 feet above tide; the Mohawk valley, with its low pass between the Hudson and Lake Ontario at Rome, New York, of 455 feet; the pass from Utica, New York, into the Chenango valley, at Hamilton, about 900 feet; from Seneca lake to Chemung at Horseheads, 879 feet; from the Grand river in Ohio to the Mahoning river at Warren, 936 feet; from the Cuyahoga river into the Tuscarawas valley at Akron, 971 feet; from the Black river, Ohio, to the Tuscarawas valley at Harrisville, 911 feet; from the Sandusky river to the Scioto through the Tymochtee gap, 912 feet; from the Maumee river to the Wabash at Fort Wayne, Indiana, 740 feet; from Lake Michigan to the Illinois river at Chicago, about 590 feet, (this being the lowest pass from the upper lakes to the Mississippi valley); from the Red River of the North to the Minnesota river through Grand Traverse and Big Stone lakes, 978 feet; from Green bay to Rock river, in Dodge county, Wisconsin, about 900 feet.

Through most of these passes canals of one sort or another have already been dug. An illustration of the way knowledge of this subject may facilitate the projection of a canal route is close at hand in the contemplated canal from Pittsburgh to Lake Erie, where Nature has long since foreordained the route. Big Beaver creek occupies a pre-glacial channel filled through most of its course with sediment to the depth of about 100 feet, and through a part of its course to a considerably greater depth. In only two places does it pass over a rock bottom. At Beaver falls the pre-glacial channel to the west was so thoroughly filled as to turn the water over the present rocky bed and thus furnish a permanent dam to facilitate slack water navigation above. Again a morainic dam at Lowellville, where the Mahoning river crosses the Ohio line, there is rock in the bed of the river for a short distance, which also may easily be made to facilitate slack water navigation farther up. At Warren the Mahoning river makes a sharp angle to the southwest, but the main valley continues directly north into the headwaters of Grand river. The separation between these two valleys is simply a glacial debris of unknown depth, and not over 50 feet above the level of the Mahoning river. Thence northward down Grand river, similar conditions extend for the greater part of the distance By this route rock cutting is reduced to a minimum, and a comparatively slight amount of dredging will render the streams navigable, while the lockage over from the Ohio to Lake Erie is no greater than that required upon the Erie canal between Troy and Buffalo, and the distance is only about 100 miles.

Glacial deposits are of the greatest service, also, in storing and regulating the water supplies upon which all canals must depend. The contrast in this respect between the glaciated region and the unglaciated is marked. The vast glacial deposits of loose material all over the northern parts of the United States act as a great sponge to restrain the water from rushing at once and rapidly to the sea. A striking instance of the service thus rendered is seen on Long Island, where it may be said that the very existence of a great city like Brooklyn is possible only by reason of the proximity of the great terminal moraine which forms the backbone of the island. Through a kind provision of Nature, this vast moraine, two or three miles wide and from 150 to 300 feet in height, is composed of sand and gravel, which is almost perfectly worthless for agricultural purposes; so that it is left free from contamination for a city's water supply. So vast is this deposit, and so well adapted to holding water that large streams of pure water issue from it at frequent intervals throughout the whole length of the island. Brooklyn avails itself of this supply by driving wells along the line of the moraine, and diverting the water to meet the immediate wants of the city. By this means the supply can be almost indefinitely increased.

A striking illustration of the contrast between the permanence of the water supply in the glaciated region and that of the unglaciated appears in comparing French creek, in northwestern Pennsylvania, with the Monongahela river. French creek has scarcely more than one-tenth the drainage basin of the Monongahela, and the precipitation over the two basins is about the same number of inches annually. But the supply of water in French creek during the dryest part of the season is said to be as large as that from the Monongahela. The reason is readily seen. French creek rises and has its course through the vast moraine deposits of Erie and Crawford counties, Pennsylvania, where glacial lakes and swamps abound, and the water is held back to be distributed in a pretty equal volume throughout the year. Whereas in the Monongahela there are no such lakes and bogs and no deep blanket of drift to absorb the falling water, but it hurries off as quickly as possible to swell the torrent of the Ohio during times of flood.

Nearly all the lakes, even the great lakes, are nothing but glacial reservoirs regulating the flow of the water to the seas. The plans that are in prospect for increasing the storage capacity of the great lakes, and of regulating and equalizing the flow of water through them, are slightly to accentuate the work already done by nature. A slight constriction of the channel of St. Clair river at the mouth of Lake Huron, can easily be made to correct the evils that may result from the Chicago drainage canal in lowering the levels of Lake Michigan and Lake Huron. Similar constrictions of the outlets of Lake Erie and Lake Ontario would remedy any evils which might arise from the same cause in those two lakes. Engineering skill can easily satisfy any demands which may be made upon Chicago in reparation of the injury which might otherwise arise from the great diversion of water required for the purposes both of their drainage and of a ship canal to the Mississippi.

A striking instance of the effect of glacial deposits upon the storage basins available for water supply is to be seen in the so-called Finger lakes of central New York, which give such constant flow to Oswego river. These lakes are all held in position by morainic dams at their northern ends, and their outlets flow over great depths of glacial debris. The upper Hudson river is less valuable for storage of water, both because of the steep gradient of its channel, and because of the smaller amount of debris left in the basin, arising from the fact that the ice movement was outwards from the Adirondack mountains as a subcenter. The ice, therefore, carried the glacial grist from it, rather than to it. The low dirt dam at the south end of Lake George, however, brings that body of water within reach of the canal between Lake Champlain and the Hudson.

But it is not always true that glacial deposits facilitate excavation. On the contrary, they sometimes render it more difficult and dangerous. Some of the tough clays deposited in temporary glacial lakes are the hardest of all material to remove. The contractors who built the Valley railroad from Cleveland to Akron experienced immense difficulty with such deposits at various places along the line. The material can neither be shovelled, nor picked, nor blasted with any ordinary degree of success, and long litigation ensued in endeavoring to adjust the rights involved, since the material did not come properly under any of the names mentioned in the contract. In many locations, also, where a moraine is prominent, the boulders will seriously interfere with excavation. Nor are the risks from letting loose ponded water to be ignored. Many of the glacial lakes are held in position by such slight barriers that a little disturbance might drain them suddenly and give rise to serious floods.

Such an event occurred in the early part of the century in connection with "Runaway Pond," which is on the watershed between the Lamoille and Missisquoi rivers in northern Vermont. Originally this emptied into the Lamoille river, but the owner of a mill site on the Missisquoi thought to increase his water supply by digging a small channel through the sandy ridge that formed the northern limit of the lake. No sooner was this done than the current washed out the loose material in its way and emptied the whole body of water into the Missisquoi, which rolled down like a Johnstown flood, levelling forests and sweeping everything before it for many miles.

In the early part of the century, also, the course of Poultney river, which empties into the head of Lake Champlain, between New York and Vermont, was changed in a similar manner. It formerly ran along for several miles behind a slender glacial dam past Fairhaven to the Westhaven line, where there was a waterfall of sixty or seventy feet. Some one in malice cut a small stream across this dam a mile or two above the falls. Whereupon the water speedily enlarged it, abandoned the falls, and eventually washed out a wide, deep valley in the sand and gravel, depositing it in East bay, below a second fall, and completely destroyed the navigation of that arm of the lake.

But time forbids entering more fully into the endless details of this most interesting and important line of investigations. Enough has been said, however, to show that the civil engineer needs to give attention not only to general facts of geology, but should study glacial geology with special care, for the knowledge afforded by it may often guide him in his work, enabling him to avoid danger and expense, and to push on boldly with enterprises which otherwise might seem beyond hope of accomplishment.

DISCUSSION.

W. T. Harris: I would ask if it is not a fact that glaciers found their first outlet to the Ohio river through western Ohio?

Mr. Wright: You must notice the difference between preglacial drainage and the post-glacial drainage, where the water ran over at Toledo through the Maumee into the Wabash. That was a temporary outlet, while the ice formed a dam.

Mr. Harris: Previous to that, the outlet was down the Maumee river, reaching an outlet to Cincinnati. You will find bedrock in the eastern end of Lake Erie. When you get to the western end of Lake Erie, it is 130 feet lower as compared with Lake Erie at the state line.

Thursday, September 26—Morning Session.

Session opened by Canadian Vice President James Fisher, and in the absence of Mr. Flower, on motion of Mr. McGuirk, W. J. Van Patten of Vermont was requested to act as secretary pro tem.

Chairman Fisher: We will now listen to the report of the committee on nominations.

REPORT OF COMMITTEE ON NOMINATIONS.

Mr. McGuirk: Your nominating committee respectfully submit the following report:

For International President—O. A. Howland, M. P. P., Toronto.
United States Vice President—Lyman E. Cooley, C. E., Chicago.
Canadian Vice President—James Fisher, Q. C., M. P. P., Winnipeg.

EXECUTIVE BOARD.

A. L. Crocker, Minneapolis, Minn.
Hon. Frank A. Flower, West Superior, Wis.
Capt. J. S. Dunham, Chicago, Ill.
James Conmee, M. P. P., Port Arthur, Ontario.
Hon. H. W. Seymour, Sault Ste. Marie, Mich. (Since resigned.)
R. R. Dobell, Quebec, P. Q.
Thomas H. Canfield, Burlington, Vt.
Denison B. Smith, Toledo, Ohio.
Hon. S. M. Stephenson, M. C., Menominee, Mich.
Hon. George H. Anderson, Pittsburgh, Pa.
Gen. Edward C. O'Brien, New York city, N. Y.
Ambrose P. McGuirk, Davenport, Iowa.
E. V. Smalley, St. Paul, Minn.
Hon. A. H. Burke, Duluth, Minn.
Hon. Don M. Dickinson, Detroit, Mich.
Ryerson Ritchie, Cleveland, Ohio.
Hon. Frank J. Hearne, Wheeling, W. Va.

Additional members to be elected by the executive board under the constitution.

Your committee recommends that the terms of the executive board for one, two and three years be determined by lot at their first meeting. Also that the delegation from each state and province select a state or provincial president, and report the same to the executive secretary, and that care be taken in doing this to avoid duplicating offices in one person.

Respectfully submitted.

AMBROSE P. MCGUIRK, *Chairman.*
W. J. VAN PATTEN, *Secretary.*

Mr. Seymour: Mr. Chairman, I move the acceptance and adoption of that report.

Carried.

Chairman Fisher: We will now have the pleasure of hearing Prof. Tunell of Chicago university:

Ultimate Effect of Deep Water Between the Great Lakes and the Sea on Domestic Shipbuilding.

GEORGE TUNELL, B. S.,
Fellow in Economics at the University of Chicago.

Within the past few years, in fact so recently that only those particularly interested know of its presence, there has suddenly sprung into existence abou' the great lakes a most important industry—that of building iron and steel ships.

The change from wooden to steel vessels has been rapid and will soon be quite complete; the ribs of oak are being rapidly supplanted by ribs of steel. Lieut. Charles C. Rogers, U. S. N., in wri.ing of the changes which have marked the construction of the lake fleets, says: "The history of marine architecture does not furnish another instance of so rapid and complete a revolution in the * * * * materials of floating equipment as has taken place on the great lakes since 1886."—[Eleventh Census, Transportation Business of the Great Lakes, p. 26.]

During the past fiscal year considerably more than one-half of the entire tonnage constructed has been of iron and steel.—[Letter from the Commissioner of Navigation.] The vast importance of this new industry may legitimately claim, for a little time at least, the attention of this convention, whose action may have a far-reaching effect upon the future of this most important industry. By the construction of a deep waterway from the great lakes to the sea, the shipyards about the lakes will be thrown into competition with those located on the Atlantic seaboard; for then, of course, vessels of all sizes will be able to pass in and out of the great lakes with ease and facility.

Can the shipbuilders of the great lakes stand the competition of the builders of the Atlantic seaboard? Are the ship yards of Cleveland, Chicago, West Superior, West Bay City, Detroit and of other cities likely to be forced to the wall because of the competition of the great yards on and across the Atlantic, or is it probable that the former may enjoy a greater degree of prosperity because of the wider field of activity thrown open to them?

Is it possible that our ocean shipping may be more speedily restored as a direct result of this deep waterway which will enable ships constructed on the great lakes to pass freely to the ocean? The province of this paper is to throw some light upon the questions which have just been raised.

In seeking the answer to the first of the questions which were just introduced we shall investigate the relative advantages of two cities which are at the present time the centers of great shipbuilding activity: The one located upon the great lakes, the other upon the Atlantic seaboard—Cleveland and Philadelphia. These two ports, it is thought, may be quite properly compared, for the first is now the most favorably situated of the lake ports for the cheap construction of iron and steel ships, and the second holds the same place among the seaboard ports.

It would be easier, simpler and more satisfactory, if it were possible, to compare the cost of the finished products, but this unfortunately is impossible because there exists no common unit of production. Variations in architecture, or in the character of the materials used, might render our conclusions entirely worthless. It is only possible to institute such comparisons where well-established grades exist. Resort must therefore be had to other means of measuring the relative advantages of these two localities. It is thought that satisfactory results can be obtained by a comparison of the cost of materials and labor employed. We shall first consider the comparative advantages in point of materials possessed by these two cities.

Let us suppose that the shipbuilders of both Cleveland and Philadelphia purchase their supplies of iron and steel in Pittsburgh, for Pittsburgh is still regarded by many as the most favorably situated locality in the United States for the production of iron and steel. Cleveland in this case would clearly have an advantage, for its distance from Pittsburgh is not one-half as great as that of its rival, and it may therefore be inferred that the freight charges would be in its favor.

The actual facts are however, even more favorable to Cleveland for she is herself the center of great iron and steel works and can manufacture the materials used in shipbuilding at as small a cost, and many of the best authorities think at a smaller cost, than any other city or locality in this country. Mr. Franklin H. Head, a recognized authority on iron and steel, unhesitatingly declared that he believed that iron and steel can be produced at as small a cost in the Cleveland district as in any other locality in the United States. Mr. James M. Swank, general manager of the American Iron and Steel Association, corroborates the testimony of Mr. Head. In a letter recently received he says: "Mr. Franklin H. Head, whom you have recently consulted, is probably not wide of the mark when he says that iron and steel can be made as cheaply at Cleveland and its vicinity as at any other point in this country."

Mr. Luther Allen, secretary of the Globe Iron Works Company of Cleveland, holds the opinion that iron and steel can be manufactured more cheaply in his locality than anywhere else in the United States and cites a convincing fact in support of his position. "Mr. F. H. Head," writes Mr. Allen, "is correct in his statement that iron and steel can be made as cheaply and even more cheaply in this vicinity than anywhere else in the United States. The fact that the Johnson Company located their plant at Lorain, Ohio, in the Cleveland district, after looking the country over very thoroughly for the most advantageous location, goes to prove that this statement is correct."

It is generally supposed that Cleveland is at a disadvantage as compared with Pittsburgh because much farther away from the districts in which coke is manufactured. The disadvantage in the matter of coke is, however, more than counterbalanced by a decided advantage in the matter of ores for most of the ore used at Pittsburgh in the manufacture of steel passes through Cleveland on the way to its destination.

It has been shown, and this point is to be noted, for it plays a prominent part in the discussions of the latter part of this paper, that Cleveland can not only produce the materials used in the construction of ships cheaper than they can be produced at Philadelphia, but can at present manufacture them more cheaply than any other city in the United States.

That the yards of the whole Atlantic coast must be at a great disadvantage as compared with those of the lake region in the matter of supplies of iron and steel inevitably follows from the fact that the coast possesses neither coal nor good iron ores—the chief materials used in the manufacture of iron and steel.

The almost absolute absence of coal fields along the seaboard is very plainly shown by a map prepared for the eleventh census by Mr. John H. Jones. The scarcity of good iron ores along the coast is so well known that no evidence will be introduced to establish the point.

Turning now from the cost of the materials used in the construction of ships to the other great item—the cost of labor—we find that the two cities are substantially on terms of equality. Unfortuately this point can not be substantiated by statistics. It follows, however, from the very nature of things, for no great difference in wages could long exist as the two cities are not widely separated, transportation charges are small, and shipbuilders as a class are not bound to the soil by poverty, but possess sufficient means to move about should it be desirable to do so whenever there is a possibility of obtaining higher wages.

Thus Cleveland possesses a decided advantage in the matter of materials, and is on terms of equality in the item of labor with the most favorably situated Atlantic port for the cheap construction of ships. This conclusion is not only supported by facts and general reasoning based upon them, but it is also substantiated by the testimony of practical men who are regarded as authorities in their line of work.

Your attention is now invited to the consideration of the final and larger question raised at the beginning of this paper—the probability of the speedier restoration of our ocean marine because of the construction of a deep waterway from the great lakes to the sea. The disappearance of our flag from the high seas may be due to our inability to compete with foreign nations along either or both of two lines, namely, the building of ships and the sailing of ships.

That we have not in times past been able to build iron and steel ships as cheaply as they could be built abroad seems to have been admitted on all sides and is supported by the statistics of construction. No iron and steel ships have been constructed by us on foreign account except such as were designed for special service. As our registry laws make it impossible to purchase ships abroad and sail them under our flag, our ability to sail ships as cheaply as foreign nations has not recently been thoroughly tested.

The facts submitted by Mr. E. T. Chamberlain, commissioner of navigation, in his very valuable report for 1894, appear, however, to indicate that we can run ships as cheaply as any other nation. There are others who agree with him and who have shown themselves ready to venture their money in the attempt, which is, of course, always a sure test of faith in one's convictions. The writer of this paper agrees with Commissioner Chamberlain and believes that the causes commonly assigned in explanation of the decline of our shipping are of no validity and never have been of any force, most of them having existed when we had a flourishing instead of a declining marine. They cannot, therefore, explain the decay of our shipping.

To my mind the greater costs of production of iron and steel ships in this country, our registry laws being what they are, is the real explanation of the disappearance of our ships from the seas. When the time arrives in which we can construct ships as cheaply as they can be made abroad, our flag will once more be seen upon the seas.

Is that time coming, is it near at hand, and will it be hastened by the construction of a deep waterway from the great lakes to the Atlantic seaboard?

To these questions it is confidently believed an affirmative answer can be given. "To conceive extravagant hopes of the future," said Burke, "is a characteristic of mankind," but the facts in this case seem to fully warrant the answer which has been rendered.

With the advent of the iron ship propelled by steam, Great Britain's ascendancy in the shipbuilding industry began. And why? Very largely for the sole reason that she possessed abundant and cheap materials, and cheap labor and capital, for the construction of iron and steel ships. Our shipbuilding industries, on the other hand, were doomed because we did not possess, and could not obtain, as cheap materials, as were available in Britain. Great changes, have, however, taken place in this country since steel ships became the decisive factor in the ocean carrying trade of the world. The iron and steel industries of this country have progressed by leaps and bounds. From a position of comparative insignificance we have advanced to that of the greatest iron producing country in the world. Hand in hand with this increase in production there has been a rapid decrease in the cost of production. To be sure, the cost of production of iron and steel has also been diminished abroad, but not as rapidly as at home; and, as a consequence, the difference in the cost of materials used in shipbuilding has greatly diminished, and on occasions during recent times, has quite disappeared. The prices of ship plates could not be obtained and compared. Prices covering pig iron and steel rails have, however, been secured, and they will demonstrate this point quite as well, for there always exists a fairly constant relation in the prices of the various forms of iron and steel. For example, the price of steel, bears a fairly constant relation to that of the pig iron from which it is made.

To more readily show the convergence of American and British prices, the figures for the last quarter of a century have been charted. British prices of steel rails could not, unfortunately, be obtained back of 1876. The American prices up to 1895, were taken from the Statistical Abstract and those for the current year from the Iron Age. The British prices of pig down to 1895 are those of Sauerbeck; those for the current year were taken from the London Economist. The prices of steel rails are those of the London Economist. As is seen by the chart there now exists but a very small difference between American and British prices of pig iron and steel rails and it seems to me legitimate to argue that there is in all probability but a slight difference in the prices of American and British ship-plates. That this is really the case follows as a necessity if a statement recently received from Mr. Swank be correct. He says: "Here in the east, the Cramp ship-yards at Philadelphia are generally recognized as possessing the best facilities for the cheap construction of ocean vessels; they are not much below those of British ship-yards."

This we know could not be true if the cost of ship-plates, the principal material, were made much greater.

The difference in the cost of the principal material used although no longer great, is probably, however, still large enough to render it impossible for our builders to compete profitably with foreign builders.

Is this small difference likely to remain and prevent the revival of our shipbuilding industries, or is it likely soon to disappear?

It is the custom of those who have been disappointed in the past to look forward to the future with peculiar pleasure and of those who have found this life a disappointment and a burden to find relief in the promises held out to them of the pleasures of the life to come. The immediate past of our shipbuilding industries has been disappointing, so let us, too, look to the future. What is it likely to bring forth? May we hope that the prices of iron and steel will fall still lower and soon be no greater than British prices, and as a result may we look forward to the restoration of our shipping, once our pride and boast?

The answer to these questions will be sought in an investigation of the relative advantages in the way of natural resources possessed by Great Britain and America for the production of iron and steel. In making this comparison I shall quote freely from leading technical journals and other authorities. Your attention will first be directed to fuel and iron ore. "Fuel," says The London Iron and Coal Trades Review in an issue of the summer of 1893, "is much cheaper to-day than it has ever been in the industrial history of America, and it can unquestionably be sold in Pennsylvania and Alabama with a profit at a lower price than in any other part of the world."

Instead of fuel in this country becoming more expensive, it is really becoming less expensive, for our inexhaustible mines of bituminous coal are just being opened up and worked to best advantage.

A directly opposite condition of affairs obtains in Great Britain, and it appears that the law of diminishing returns is becoming operative, and its results are being reflected in prices. The chart which I present will clearly show the facts which I have just stated. The prices which have been charted are those for steam coal at Newcastle and Cumberland coal at Baltimore. Baltimore prices were used because no others were obtained for bituminous coal. It would be more satisfactory to have prices at one of the great producing centers of this country to compare with prices at Newcastle, but it was impossible to obtain them. I can not speak as to the character of the two kinds of coal. If they are equally good it is to be noted that American prices are absolutely less than the British. But if they are not equally good the point I set out to make is nevertheless established, for it was seen that British prices have increased slightly while American prices have declined quite appreciably since 1879.

The disadvantages incident to more expensive fuel are but trifling when compared with those which Great Britain must contend against because of an ever increasing cost of good iron ores. The most remarkable feature of the pig iron industry of Great Britain is its increased and ever increasing dependence on foreign ores.

The output of domestic ores has fallen off nearly 50 per cent. in that country in the past few years. In the London Economist (December 29, 1894, page 1,600), we find that the total imports of foreign ore, to the end of November of that year, amounted to 4,097,000 tons, and if we assume a proportionate quantity for December, the total imports for the twelve months would amount to about 4,437,000 tons, which would be with one exception the largest import that had taken place in the history of the trade.

The value of this import is officially returned at about £3,000,000, which is more than the official value of all the iron ore produced in Great Britain in 1893. Put in another way, the average value of the ores imported in 1894 was about 13s. 4d. per ton [which equals in terms of our money $3.24] while the average of the ores produced in Great Britain is only about 5s. per ton. "The question is naturally raised [says the Economist] why should British iron masters import such large quantities of iron ore from other countries when they have ample supplies of ore at home so much cheaper? The answer is that the home ores are not generally suitable, except to a comparatively limited extent, for the quality of iron mostly in demand—that is to say, pig iron suitable for Bessemer and open hearth processes of making steel."

The worst, however, has not yet been stated. The Bilboa ore district of Spain which up to this time has been chiefly drawn upon is approaching exhaustion and other districts must be resorted to. The Economist of the date just mentioned goes on to say concerning the other sources that "the two most important iron ore producing districts tapped up to the present time are the Almeria and the Cartagena districts in the south of Spain, and the Grangesburg and the Gellivara districts in Sweden. It is doubtful, however, whether we will be able to command ores from these localities as cheaply as we have hitherto done from the north of Spain, and if this should prove to be difficult, we may have to face a permanent, and in the course of time, considerable, increase of cost in the manufacture of pig iron due to this cause."

That the fears just mentioned are not peculiar to the London Economist is evidenced by the following statements taken from a paper read before the British Iron Trade Association June 29, 1893, by Mr. J. S. Jeans, its secretary. After referring to and offering an explanation for the greater relative advances made by some other countries in the production of iron and steel, he said: "But there is another point of view from which this matter may be regarded [and] with some anxiety. In the year 1877 we made only about 8 per cent. of our total output of pig iron from imported ores, whereas in the year 1892 more than 20 per cent. of our output of iron was obtained from iron ores of foreign origin. * * * It appears to be probable that this dependence of Great Britain on foreign sources of supply to the extent of over 20 per cent. of our requirements implies a standing menace to our iron industry."—[Bradstreet August 12, 1893, page 514.]

Now let us turn from the lamentations of our British cousin to the confident utterances of our own iron men. I shall quote from a report of the progress of the iron and steel industries of the United States from 1870 to 1890, prepared by James M. Swank and published by the Department of the Interior. After submitting certain figures he says: "From the above table it is evident that the United States is the greatest producer of iron ore in the world, and is, as a consequence, more independent of foreign sources of iron ore than any other leading iron making country. To this it may be added that new iron ore fields are being constantly discovered and developed and the supply for the future promises to be practically inexhaustible. There is, however, a scarcity of Bessemer ores on the Atlantic coast, and the imports are chiefly to supply this want."—[Bradstreet, February 11, 1893, page 94.]

Since Mr. Swank prepared the report from which I have just quoted the remarkable Mesaba range of high grade ores in Minnesota has been discovered and partially developed. Among this gathering I do not suppose it is necessary for me to speak of the ease with which the ore is removed from the mines of that district, of the facility with which the ores can be reduced, their freedom from deleterious ingredients, and their high yield of metallic iron. These things are well known to you and will not be dwelt upon.

Our growing independence of foreign ores is also set forth in the preliminary summary of the annual statistical report of the American Iron and Steel Association for 1894 and is commented upon as follows by the London Economist: "A preliminary summary of the annual statistical report of the American Iron and Steel Association has been published, from which a good deal of useful information is to be gathered. One fact prominently brought forward is that the iron and steel industries in the United States are becoming more and more independent of imported raw materials."—[London Economist, May 25, 1895, page 686.]

In the light of the facts which have just been presented, covering British and American supplies of ore, let us examine one of the stock reasons assigned for our inability to compete with our British cousins in the production of iron, namely, the great disparity which exists in the distances over which the raw materials must be transported. It is generally stated that in Great Britain the various raw materials needed in the manufacture of pig iron are found in the closest proximity, while in our own country they are separated by vast distances; our sad condition being usually illustrated by the shipment of Lake Superior ores to Cleveland and Pittsburgh, a distance of about 1,000 miles, there to be met by the fuel of Pennsylvania and Ohio. Now, does this state of affairs really obtain at the present time? Apparently not, if the figures which were given a few moments ago are accurate, for it was then stated that the ores imported into Great Britain from Spain and Sweden, in 1894, amounted to nearly 4,500,000 tons, and in value equaled the entire British output. The cost of transportation from Spain and Sweden to the west coast of Great Britain cannot, I believe, be less than that from Lake Superior to Lake Erie ports. In fact, it must be more.

That our furnacemen about Lake Erie, who need Lake Superior ores, were at no disadvantage as compared with British furnacemen who used ores imported from Spain and Sweden, will be seen on a comparison of the prices of the various ores.

According to the London Economist [of Dec. 29, 1894, p. 1,600] the average price of the imported ores for the year 1894 was 13s. 4d. or $3.24 while the average price of Lake Superior ores at Lake Erie ports for the same year was but $2.95 according to the figures kindly furnished me by W. L. Brown of Chicago.

According to these figures Lake Erie furnace men had a clear advantage over their British rivals in the item of iron ore of 29 cents in the ton. It cannot be maintained that the ores imported by the British were superior in quality to our Lake Superior ores for better ores than the latter when all things are considered are not mined in large quantities anywhere else in the world.

The growing disadvantages under which the British iron men labor are already reflected in the quantity of pig iron produced. There has been no progress for a dozen of years.

If the struggle for public favor which has been in progress for some time between steel and iron continues to issue in favor of steel, the disadvantages under which the British are now laboring will be increased many fold, for then it will be necessary to resort to even a greater extent than at present to foreign sources for ores suitable for the manufacture of Bessemer steel. The growing dependence on foreign ores bodes ill for the future of the British iron and steel industry.

The two causes commonly assigned for our failure in the past to produce iron and steel as cheaply as it is produced in Great Britain, are the greater distances by which the materials used in the production of iron are separated and the higher rate of wages prevailing in this country. The first cause we found to be rapidly disappearing. Let us for a moment turn our attention to the second. Fortunately we are not here obliged to discuss the fundamental principles underlying the determination of the rate of wages but merely the smaller question of the attitude of labor and the tendency of wages in the United States and Great Britain.

We have found that the cost of production of iron in this country has rapidly diminished and at present hovers about the cost of production in Great Britain. Granting that our ironmasters are handicapped in the race with their British competitors because of the higher wages which the former pay, the question with which we are concerned is merely this—is the handicap likely to be reduced or increased? On this point The London Iron and Coal Trades Review says:

Labor has not become cheaper. On the contrary, the tendency is for

British labor to become more and more dissatisfied and despotic. The cry is now for an eight-hour day, and this is demanded without any equivalent concession in the matter of wages. It is a moot point whether British labor has of late years become more efficient.—[Brad. June 2 1894, p. 351.]

It may be argued in opposition that our laboring men have been and are likely to be far from passive, and this is freely granted, but it is believed that any unprejudiced person who has followed the movements of the laboring classes in both countries, will admit that British labor has been far the more aggressive. But if this be not admitted and it is maintained that the higher wages prevailing in this country will make it impossible for our iron men to compete with the iron men of Great Britain, it is then asked, why the iron industry and all the other industries of Great Britain have not been transferred to the Continent where wages are much lower than in Great Britain.

To what point will such reasoning lead? If the higher rate of wages which is paid in any particular country can be assigned (without reservations) as a reason for inability on the part of the people of that country to successfully compete with any other people among whom a lower wage scale obtains, then it may also be urged that a higher return to capital (usually referred to as interest or profits), also acts as a handicap.

If this be admitted, then it must be granted that where the net product of the joint efforts of labor and capital are the smallest, for interest plus wages equals the net product, there we shall find a community best able to compete for the world's markets. In other words, the country possessing the poorest resources, and inhabited by the laziest, least intelligent and most unskillful people, is the country which is to be dreaded above all other countries as a competitor, which is certainly a most anomalous and unbelievable condition of affairs.

A large return to capital, accompanied by a liberal reward to labor, means a large net product. Any industry which can not pay the current rate of wages and interest, is not yielding as large a net product as the other industries of the country. It is not believed that this is true of the iron industry of this country.

Let us now return from the digression and recall the points which have been discussed and the conclusions which we have reached in order that we may hasten on to their final application. The explanation of the decay of our ocean marine was found in the greater cost in this country of the, chief material used in the construction of ships and it was predicted that when the cost of materials in this country should fall to the cost of materials abroad our ship building industry would revive. This time it was believed was not far distant, for our iron and steel industries have been steadily marching on, like the soul of our countryman, John Brown, while the British industries have remained about stationary; the cost of production with us has been gradully declining while with our British rivals it has been slowly increasing; it was found that the Atlantic coast does not possess either coal or good iron ores and is therefore very unfavorably situated for the cheap production of iron and steel; it was also discovered that certain of our lake districts are most advantageously situated in respect of both these raw materials and can therefore produce iron and steel much cheaper than they can be made in the territory along the Atlantic coast.

It may, therefore, be confidently expected that the prices of iron and steel in the lake region of this country will be the first to reach the level of British prices. It may even be questioned if the prices along the Atlantic seaboard will ever reach the level of British prices, because of obstacles imposed by nature. But, if they should, it will probably be due to the fact that iron and steel can be shipped from more favorably situated interior localities by a deep waterway to the ocean, and laid down for less than foreign prices, and not to a diminished cost of production on the coast.

The tendency of the iron industry is away from the coast.

It seems hardly necessary to draw the final conclusion; but, perhaps, it may be better to do so. Under existing conditions, if prices of iron and steel at the lake ports were much below British prices, and ships could, consequently, be built more cheaply than abroad, it would avail us nothing; for, at the present time, there is practically no access to the sea from the great lakes.

When the grand object for which this convention is assembled has been realized, this will be changed and the restoration of our ocean marine will be very near at hand. In the history of our new marine the lake ports will take the part played by the New England towns in the history of the old marine.

PROF. TUNELL'S TABLE OF PRICES—COAL.

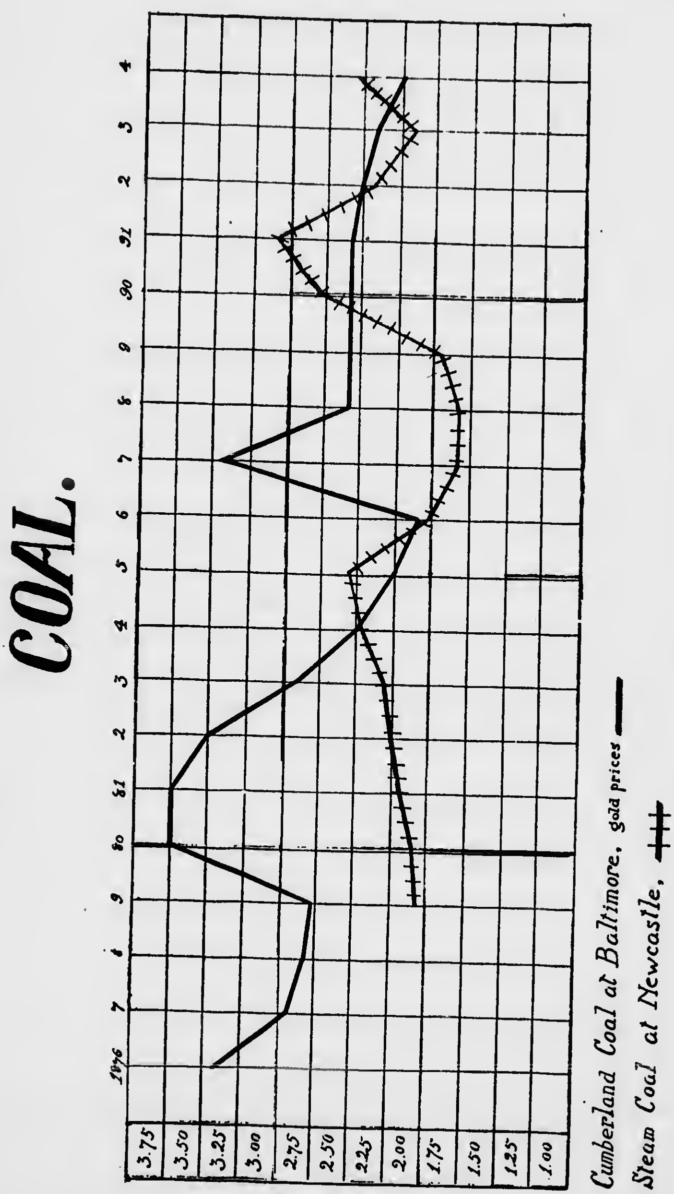
YEAR.	AMERICAN.*	BRITISH.†	YEAR.	AMERICAN.	BRITISH.
1876......	$3 43	......	1886.....	$2 10	$2 01
1877......	2 96	......	1887......	3 45	1 82
1878......	2 82	......	1888......	2 60*a*	1 82
1879......	2 79	$2 07	1889.....	2 60*a*	1 95
1880......	3 75	2 11	1890......	2 60*a*	2 80
1881......	3 75	2 21	1891......	2 60*a*	3 10
1882......	3 50	2 25	1892......	2 50*a*	2 43
1883.	2 90	2 31	1893......	2 40*a*	2 17
1884......	2 50	2 43	1894......	2 25*a*	2 55
1885......	2 25	2 55			

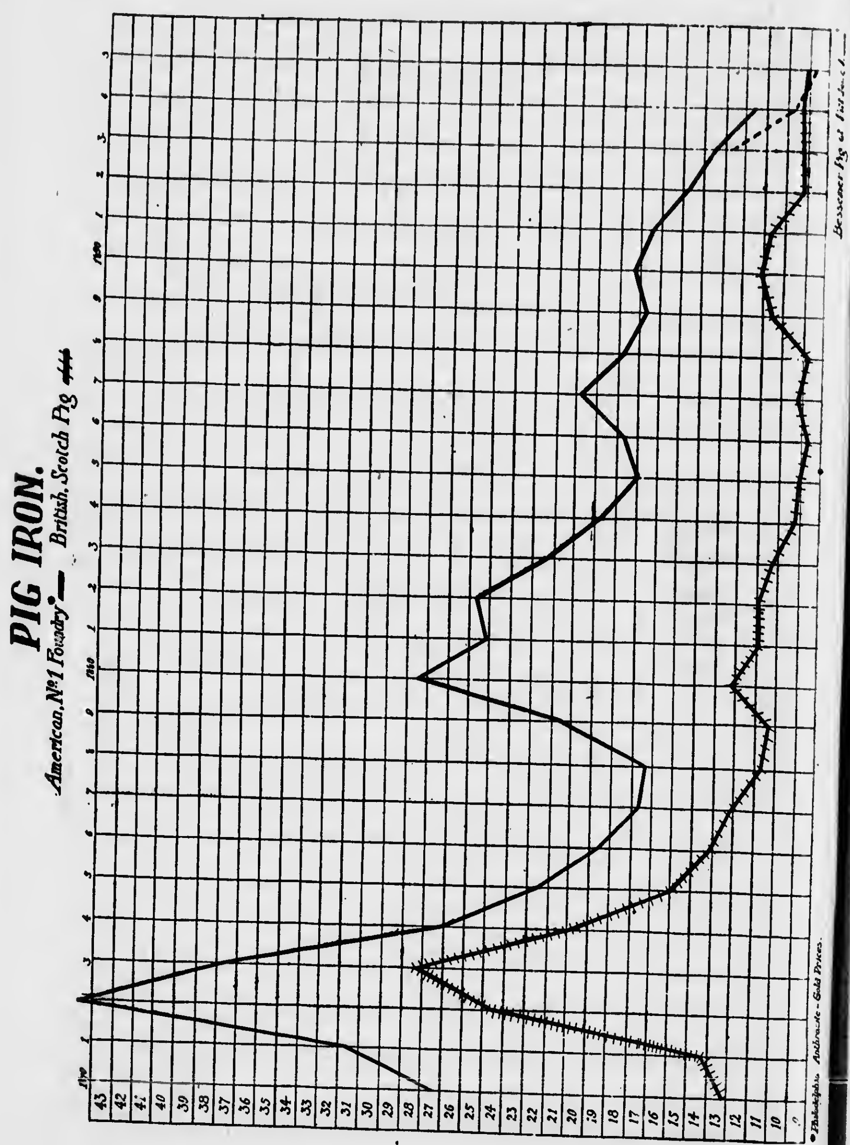
*a*The price on board fixed at Baltimore by the Seaboard Coal Association.
*Statistical Abstract, 1894, p. 411. The American prices are for bituminous (Cumberland) coal at Baltimore. The prices for 1877, 1876 and 1878 are gold prices.
†Steam coal at Newcastle. The price is that for January 1 of each year. Taken from the Bulletin of the Bureau of Statistics, 1895.—Economist figures.

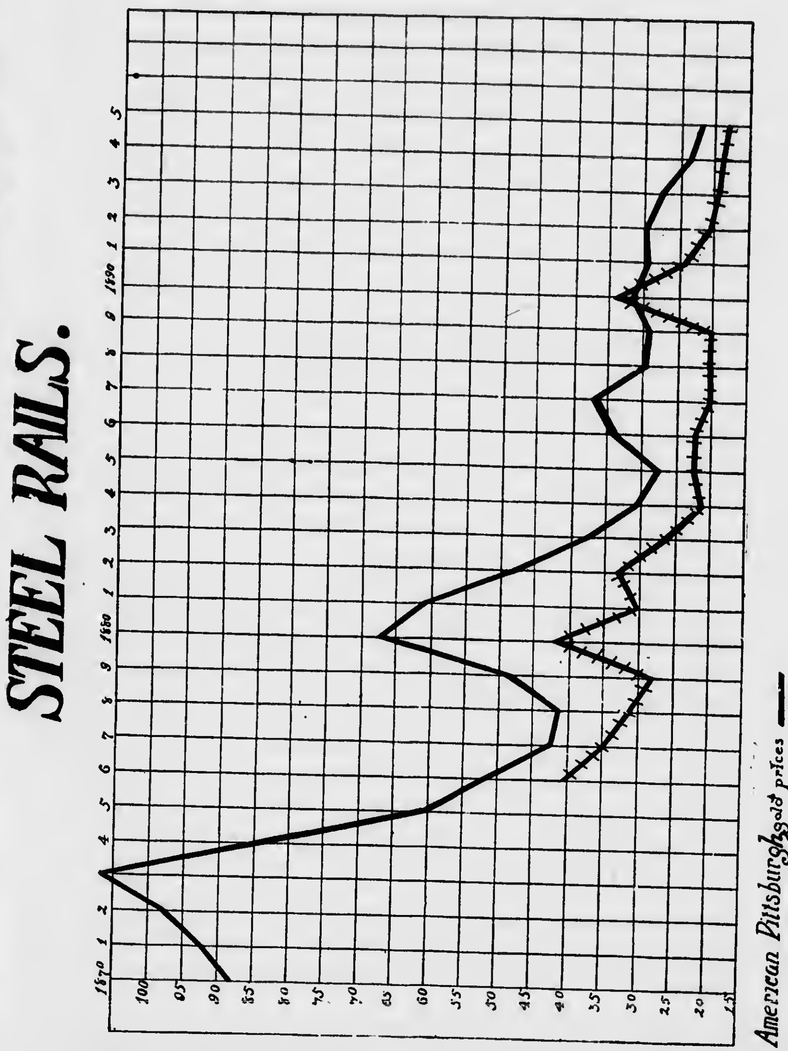
STEEL RAILS.

YEAR.	AMERICAN.*	BRITISH.[2]	YEAR.	AMERICAN.	BRITISH.
1870......	$88 00	....	1883......	$37 75	$26 76
1871.....	92 59	....	1884.....	30 75	21 89
1872......	102 75	....	1885......	28 50	23 11
1873......	106 75	....	1886......	34 50	23 11
1874......	84 60	....	1887......	37 08	20 37
1875......	61 11	....	1888......	29 83	20 37
1876......	52 53	$41 36	1889......	29 25	20 07
1877 ...	42 84	35 28	1890......	31 75	34 06
1878......	41 66	31 63	1891	29 92	24 02
1879......	48 25	27 98	1892......	30 00	20 37
1880......	67 50	42 58	1893......	28 12	19 46
1881	61 13	30 41	1894......	24 00	18 85[3]
1882......	48 50	33 45	1895......	22 00[1]	18 25[3]

*Statistical Abstract, 1894, p. 412. Gold prices. 1 Iron Age, Jan. 10, '95, p. 75. 2 Economist prices taken from Aldrich Vol. I. 217-218. 3 London Economist, Jan. 13, '94, Jan. 5, '95.


COAL.
3.75
3.50
3.25
3.00
2.75
2.50
2.25
2.00
1.75
1.50
1.25
1.00
1876
7
8
9
80
81
2
3
4
5
6
7
8
9
90
91
2
3
4
Cumberland Coal at Baltimore, gold prices
Steam Coal at Newcastle,


PIG IRON.
American, No. 1 Foundry*
British, Scotch Pig
*Philadelphia Anthracite - Gold Prices.


STEEL RAILS.
1870
1880
1890
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
American Pittsburgh gold prices
British,

[PROF. TUNELL'S TABLE OF PRICES—CONTINUED.]

BESSEMER PIG—PITTSBURGH.

YEAR.	AMERICAN.[1]	BRITISH.[3]	YEAR.	AMERICAN.	BRITISH.
1870......	$27 41	$13 22	1883......	$22 38	$11 37
1871......	31 72	14 34	1884......	19 88	10 23
1872......	44 80	24 78	1885......	13 00	10 18
1873......	37 93	28 53	1886......	18 71	9 71
1874......	27 15	21 28	1887......	20 02	10 28
1875	22 66	15 99	1888......	18 88	9 71
1876......	19 71	14 23	1889	17 75	11 61
1877......	17 77	13 22	1890......	18 40	12 06
1878......	17 38	11 78	1891.....	17 52	11 85
1879......	21 50	11 44	1892......	15 75	10 18
1880.	28 50	13 26	1893......	14 52	10 29
1881......	25 12	11 94	1894......	12 66	10 38
1882......	25 75	12 00			

1895[2] { $12 50@13 00 Iron Age, Jan. 10, '95, p. 74. $10 14 London Economist, Jan. 5, '95.
12 00@12 50 " " Apr. 4, '95, p. 723. 10 16 " Apr. 6, '95.

1 Pig iron, No. 1 anthracite foundry, at Philadelphia, gold prices. 2 Standard No. 1 foundry. 3 Scotch pig iron, Sauerbeck's figures.

PIG IRON.

1893—Jan. 5.	$13 60@13 75.	Iron Age,	Jan. 5, 1893.
Apr. 6.	13 75@13 90.	do	Apr. 6, 1893.
July 6.	13 15@13 40.	do	July 6, 1893.
Oct. 5.	11 75@12 00.	do	Oct. 5, 1893.
1894—Jan. 4.	10 75	do	Jan. 4, 1894, p. 21.
Apr. 5.	10 35@10 50.	do	Apr. 5, 1894, p. 667.
July 5.	11 50@11 65.	do	July 5, 1894, p. 22.
Oct. 4.	10 90@11 00.	do	Oct. 4, 1894. p. 579.
1895—Jan. 3.	9 85@10 00.	do	Jan. 3, 1895, p. 22-23.
Mar. 7.	10 15@10 25.	do	Mar 7, 1895, p. 502.
July 4.	13 50@13 65.	do	July 4, 1895, p. 31.

Chairman Fisher: I will ask Mr. Livingstone to preside. Mr. Livingstone took the chair as requested.

DISCUSSION.

Alexander R. Smith, of New York: I believe that the last speaker said that he agreed with the commissioner of navigation, and that the cheaper prices in iron and steel construction would restore our shipping, and enable us to compete in the foreign markets. In 1889 ships were built in the United States 50 per cent. cheaper than in foreign countries, notwithstanding which, only 23 per cent. of American commerce was carried in American bottoms. By the adoption of protective laws our commerce increased from 23 to 90 per cent. For thirty years we have been building ships cheaper than any foreign country, and when these protective laws were taken away, although we still built ships cheaper than any other country, their methods enabled them to compete, so that in 1860 we only carried 60 per cent. and to-day only 14 per cent. If the gentleman's argument is correct, when we built ships cheaper we ought to have carried more commerce.

Prof. Tunell: We cannot compete with the foreign subsidies and bounties, without like bounties and subsidies of our own, and those we do not and may never have.

Effect of Deep Water Between the Great Lakes and the Sea Upon the Export Lumber and Timber Trade.

RICHARD R. DOBELL,
Exporter, Quebec.

Perhaps there is no other article of western production that will derive so little direct benefit from the deepening of our waterways as lumber and square timber brought from Michigan and other points west of Lake Superior and Wisconsin. The reason for this I need not enlarge upon, when it is known that the bulk of the square timber which is made on the shores of the great lakes, when brought down to a shipping point, is only carried as far as Garden Island by barge, there rafted up and floated down the river, passing through the rapids without the least damage, and so delivered in the booms, at Quebec.

Unfortunately, this trade is gradually being restricted, for the simple reason that the oak forests of Michigan, Ohio and Indiana are pretty nearly exhausted, so that it is difficult even now to get the average and size of logs necessary for the English market.

The large pineries of Michigan and other western points have also been pretty well cut through, and the enhanced cost now of standing timber makes the price for this pine too high for what can be obtained in England; the consequence is that the square timber exporting business is becoming less each year, and will soon be a thing of the past.

The lumber and deal trade is in much the same position. Fifteen years ago, very large quantities of deals were made in Michigan and sent forward to the English markets, and these, no doubt, would have benefited considerably if they could have been sent through without breaking bulk.

One of the greatest drawbacks in handling western lumber is that the large barges which carry the lumber to Kingston have there to discharge into smaller barges, which is more or less injurious to the lumber, and very often necessitates leaving portions of a barge-load for some other craft to carry down to Montreal. Here arises the necessity for a continuous deep channel from the lakes to salt water. A considerable saving would be effected in the cost if there were unbroken deep navigation out of the lakes, as lumber can be floated from any port in the vicinity of Michigan to Kingston at $3.50 per M. feet, while the charge for the short distance from Kingston to Montreal, in small barges, is $1.75 per M. feet.

If the large barge could go through direct, the bulk of this $1.75 would be saved to the shipper of the lumber and to the consumer, ultimately.

With this, as well as in square timber, there is a falling off in the export trade, and it is not now of such importance as would make it alone a feature to influence the carrying out of this work of providing deeper channels. For some years no doubt, a certain quantity of western manufactured lumber will be sent to Europe, and it would probably stimulate this trade a little, and certainly cheapen the cost, could it be sent through without breaking bulk at Kingston; but the whole volume at present is not sufficient to make it much of an argument in favor of the expensive work required.

DISCUSSION BY MR. DOBELL.

Mr. Dobell was asked to discuss the points of his paper. He said:

I do not think it is necessary to detain you many minutes, because the paper which I prepared at the request of our very indefatigable secretary, Mr. Flower, is hardly of importance sufficient to occupy your time to-day. The bulk of our lumber trade is carried on in the manufacture of square timbers of oak from Michigan, Ohio, Indiana and as far south as Arkansas, brought by railway to Toledo, taken in schooners at Garden island, and rafted down to Quebec, where it is put into ships and sent to Europe. It is therefore quite necessary for our interest to have deeper waterways.

I am not sure but we can trace Cleveland as being one of the off-springs of Quebec. Years ago Quebec had a large ship-building trade. For the last ten years we have not built one ship in Quebec. All the shipwrights and carpenters who were educated in Quebec were forced to come to these upper lakes and settle in Buffalo, Toledo, Bay City, Cleveland, Superior and Detroit. We therefore think that to some extent these cities are indebted to Quebec as the nursing mother of their industries. When I went to Quebec, nearly 40 years ago, we used to load from 1,200 to 1,500 sailing ships annually. When I left Quebec, less than a week ago, not one sailing ship had been in the harbor for five weeks. That trade has completely passed away from us, owing very largely to the depletion of the forests and the change of trade, against which Quebec has been powerless to combat.

As far back as 15 years I claimed that Quebec was suffering as our far-west is suffering to-day. When our canals were made in the earlier history of this country, they were thought to be quite sufficient for any future trade. At that time navigation from Quebec to Montreal could not be accomplished by any vessel of more than 400 to 500 tons. Now a steamer of from 8,000 to 9,000 tons passes from Quebec to Montreal.

I believe that this very work which we are initiating to-day—the deepening of our lakes—will bring Quebec again in touch with your city of Cleveland and the far-west, and will again enable Quebec to take her place as a shipping port of the great industries, not only for this country, but the whole of Europe.

A. L. CROCKER'S PAPER.

Chairman McGinnis: A. L. Crocker will follow:

Mr. A. L. Crocker: In preparing this paper, the attempt was first made to gather statistics on the world's lumber business, with prices and freight rates, then to make a comparison of the same with the resources, prices and freight rates of the lumber supply tributary to the great lakes as a transportation factor, with a view to developing what effect a more perfect navigation and lower rates would have in bringing the lumber of the great lakes into the markets of the world, and what part such lumber would play in those markets.

The meagre statistics obtainable precluded this plan. And, too, the fact that European markets can not be compared in magnitude with our home demands and are largely supplied from north Europe, along with the fact that soft mahogany of the African west-coast, existing in vast quantity and cheaply marketed, is now entering largely in consumption for many uses and at prices that the high priced stumpage of the United States can not compete with.

Limiting our views then, a glance will suffice to note in passing, the export and import reports of the lumber business of the United States as given by the last census. We find in round figures as follows:

	Lumber.	Logs and timber.
Exports	$9,355,000	$2,636,608
		Other Lumber
Imports	$6,137,000	$1,420,000

The Pacific coast ports shipped	$ 770,000
Atlantic ports south of New York city	5,412,000
Atlantic ports north of New York city	316,000
New York city	2,354,000

The item of shipments from north Atlantic ports is so small that it may be disregarded in the comparison. South Atlantic and Pacific ports evidently do not draw their supplies from the great lakes, and we are therefore left with New York as the export point for great lakes lumbermen. The estimate of 25,000,000 feet is given for New York.

Although somewhat foreign to the subject, it may be interesting to notice who our foreign customers are:

Portugal and Spain take	$ 122,000
West Indies	2,009,000
South America	1,738,000
Canada	526,000
Central America	406,000
Pacific ocean countries	439,000
Africa	317,000

We import two-thirds as much as we export; and Nova Scotia, New Brunswick, Quebec and Ontario furnish it all and New York and New England take practically all of it.

Coming directly and finally to the subject under discussion, the lumber trade on the great lakes, I find no words so fitting with which to state the facts and make plain the existing situation as those furnished me through the columns of the Northwestern Lumberman.

The white pine industry of the northwest has been one of the more important agencies in the settlement and material development of the great interior of this country. In its original state, the Mississippi valley spread between the great lakes and the Rocky mountains, a vast, treeless empire, rich in agricultural capacity, but needing lumber to render settlement and improvement possible. To the northeastward, stretching from Lake Huron on the east to the Red River of the North, in the far northwest, lay the great white pine belt, covered with countless billions of as fine timber as ever grew on earth. In the midst of this wealth of forest area spread the great lakes, ready to float on their waters the product of the mills to distant tributive markets. Into these lakes flowed the streams which were to convey the logs to the mills. Nature seemed to have laid out all the grand plan and provided the contiguity of resources so that settlement and development of the prairie region could be accomplished with startling rapidity.

Without doubt the phenomenal growth of this country in population and wealth has mostly resulted from the relation of the pine supply of the northwest with the opulent lands of the Mississippi and Missouri river valleys. Out of the western extension of the pine belt runs the mighty Mississippi, which for many years has borne the logs of the northern forests to the mills along the stream to St. Louis. Thus, almost simultaneously from Lake Huron to the upper Mississippi waters, the white pine industry sprang into importance as a development and a civilizer.

The Michigan and Huron product spread out into Ohio, Indiana and lower Michigan and the east, and some overflowed into Michigan markets. The products of the Michigan and Wisconsin forests were conveyed by easy passage to Chicago, the greatest lumber market of the world.

Analyzing these great lake sources of supply, and grouping them according to market and transportation influences, we might have the Lake Huron district, the Lake Michigan district, the central Wisconsin and Mississippi river district taken together, and finally the Lake Superior district. The attraction for the Lake Huron and Michigan district, comprising western Michigan and eastern Wisconsin, was divided between the eastern demand and the great corn states to the south. The product of the district, composed of central Wisconsin and Mississippi river pine lands, was drawn to the prairie states to the west and southwest. Finally, we have the Lake Superior district, composed of the Duluth-Superior, Ashland, Ontonagon, Marquette and Sault Ste. Marie points, estimated to possess in standing pine 15,000,000,000 feet, with a production this year of 700,000,000 feet, of which 70 per cent., it is estimated, goes to Tonawanda, and 25 per cent. to Chicago and Michigan points.

I am only here to make a presentation of the facts as I find them, not what I might prefer as bearing on the necessity for a deep-water route to the Atlantic coast. I find the facts to be, then, as follows: The district I have designated as the Lake Huron district is practically exhausted, and what remains is in few hands. Some 300,000,000 of Canadian logs are floated across Lake Huron to supply the saw mills of this district. The Lake Michigan district is in a lesser but increasing degree of exhaustion, and is drained largely to the south, to Chicago and the markets in the corn states. The product of the central Wisconsin and Mississippi river district does not seek the great lakes, but is, and will be absorbed by the prairie states west and southwest. There remains then the Lake Superior district with an estimated 15,000,000,000 feet of standing pine, which at the present rate of consumption would last something over 20 years. I am aware that timber estimates are dangerous; and it is possible that 20 years from now there may be another equal term of years given as the life of the standing forests.

The point I make, however, is that the enormous and growing home demand will absorb the supply. The total of the great lakes product for 1892 was 8,903,000,000; for 1894, 7,763,000,000. The experience of those in Wisconsin and Michigan who have attempted the export business is, that all that is required for export is the best quality, and which disposed of leaves the remaining stock unsaleable. Wisconsin and Minnesota are the present and the future white pine supplyers of the country, and much of the standing timber of those states is not of a quality for export.

A further consideration of the possibilities shows that the great timber resources of the west coast are straining every nerve to reach markets; that they are not shipping by water round the Horn to the eastern states; that they are shipping high-grade stuff by rail in large and increasing quantity to the east.

I am not prepared to indorse the claim made to me recently by the general freight agent of one of our largest trans-continental railroads, viz: that they would shingle the whole country with west-coast shingles; but I offer some of the items bearing on this part of my subject that may be interesting. Of the three great timber states of the west coast, viz: Washington, Oregon and California, we may disregard the last two, as their product does not now come east largely. My Washington correspondent offers some figures and statements worthy of note. The total product of the Washington state mills is 1,200,000,000 feet, 1,800,000,000 shingles. The rail shipments to the eastern states from Washington in 1894 were 4,279 cars lumber and 12,295 cars shingles. The rail shipments covered thirty-four states. An estimate is all I can get of the Superior-Duluth business in this line, and the estimate is made that 2,500 cars go by lake and rail to eastern points.

This shipping route is suffering from the difficulties incidental to new lines, and the complaints are loud at breakage in transit, poor facilities and many other annoyances.

These things, however, are improving, and the statement is made that any improvement east in water transportation will be hailed by west-coast shippers, as they claim already they are extensive shippers to Ohio, Indiana, Illinois, Iowa, Minnesota, Pennsylvania, New Jersey, New York and New England. Even now we are shipping, they say, doors to Portland, Maine, spars to Barre, Vermont, masts to Boston, and shingles to Buffalo, Philadelphia, Baltimore and other points.

Anything lessening freight rates will certainly greatly enhance shipments.

Chairman Livingstone: I observe there is no disposition to discuss these two papers, treating of the relation of the lumber trade to deep-water transportation. That arises, I dare say, from the fact that very few of us have a full understanding of the subject.

I am unfamiliar with the details and conditions of the lumber trade, but from very close marine connections, have been made aware that the amount of lumber going eastward from the upper lake region is now on the increase. In fact, I believe that the shipments from the Lake Superior districts are growing rapidly, and I gather from Mr. Crocker's paper that they will be likely to continue to enlarge for some years.

Vesselmen do not like to encounter rafts, but they are rejoiced to see an enlargement of the shipments of manufactured lumber.

We shall now hear from Mr. Dutton:

Pneumatic and Hydraulic Locks.

CHAUNCEY N. DUTTON, C. E.,
Washington, D. C.

Children of Steam and Steel! History knows three great epochs, each begun by a great benefactor of mankind. The unfamed savage who learned that the plant sprouts from the seed, founded agriculture and gave us control of the food yield; Prometheus, who stole for us the fire of the Gods; and James Watt, who applied fire to the engine and gave us power—power, the foundation for the works of Fulton, Stephenson, Bessemer, and the band of discoverers and inventors who have overcome the resistance of nature and the restraints of distance and altitude, and made possible a gathering such as this.

As the works of these men lengthened the distance over which goods could be carried, our commerce and the areas of highly productive organization have extended away from navigable waters, to which they were confined before the Age of Steam and Steel, and over obstacles then insurmountable and with impetus renewed by each improvement in steam and steel, our civilization, the civilization of Northern Europe, has pushed to the Pacific at right angles to the great continental mountain and valley systems, on east and west lines.

Commerce keeps to the path of settlers. We are forced to make and keep our main transportation system on these lines by the circumstances of the early settlement and history of the continent, the location of the centers of population and production, and the conditions of our foreign and domestic trade. Not least among the compelling forces are these great lakes. They lie midway on the near side of the great middle trough, the treasure house of the continent. Good grades approach them from every side. Their depth is such that on them we can navigate great steamships, use the last improvements in steam and steel, and realize the lowest possible freight costs; and their length, lying 1,000 miles along the trend of trade, is such that we can pay for loading and unloading our cargoes and still find great profit in their use. For these reasons they add 500 miles to the radius of the area from which our products can be shipped.

From their use our people have learned the value of water carriage—first-class water carriage, with channels so wide and deep that big ships can steam through them at good speed. We see that on the great trunk lines railroad freights average over six mills a ton mile, and on the lakes less than one mill; and that whereas the lowest cost of conducting transportation over the great trunk lines averages four mills, in our largest lake steamships it is less than one-sixth of a mill. We see that breaking bulk at Buffalo costs almost as much as 1,000 miles of lake transportation, and that if we had first-class navigation to New York we could save almost the entire cost of rail or canal freights between the lakes and the seaboard.

The products of the whole interior continent assemble on these shores to make gain by the cheap carriage, and seek to pour eastward through the water-gap. The continent lies to them as a gigantic funnel, of which they are the nozzle; and that nozzle is stopped and the march of a continental commerce broken by the 326-foot wall at Niagara.

How to take our commerce down this leap and other smaller leaps that lie in its way to the sea is the question that has brought us here; and because I have given thought to it, and the result of my study is deemed by some to be of value, the managers of this association have asked me to tell you what I know about locks.

About the close of the fifteenth century Leonardo Da Vinci invented the lock now in general use, and built the first one at Milan in Italy. Such are the merits of his designs that his lock is built to-day substantially on the lines he first laid down.

In the first third of this century an English inventor made a gated tank, mounted it on wheels, and pulled it up an inclined track; and another hung it on cables running over sheaves and counterbalanced it. These were the first balance locks. Neither of these systems of locks had enough merit to come into use. One of the incline plane locks was built on the Chesapeake & Ohio Canal, in the District of Columbia, two miles above Washington, about 1874, but failed to do what was expected of it. The state engineer of New York recently published designs for a lock of the second type, 225 feet long, counterweighted with something over a thousand tons of cast iron, hung on 88 link-and-pin chain cables, running over 88 pulleys on two shafts, each 230 feet long, supported in 176 bearings, and controlled by a great number of small air or electric brakes operating on the shafts. The mechanical defects which made this system a failure in England were not left behind when the design was brought to America.

In 1874 Edwin Clark, an able English engineer, recently deceased, invented the system of mounting the lock chambers in balance on hydraulic rams. He built balance locks on his system at Anderton in England, La Louvriere in Belgium, and La Fontonettes in France. Anderton and La Louvriere are successful. La Fontonettes has given a good deal of trouble. No mechanic has yet put in successful practical use an apparatus in which a number of hydraulic cylinders are so controlled and synchronized as to move all at equal speeds, as they must in operating a lock chamber. Edwin Clark patented devices for the purpose; but he was too good a mechanic to use the devices he patented. He mounted each of his lock chambers in his balance system on a single central ram, and steadied it by central parallel guides, leaving the ends free so that the structure could contract and expand freely from the transverse central plane in which he located his rams and guides.

This construction is correct, and must operate perfectly if all its parts are well designed and strongly built, and kept in good repair. The principal thing to look out for in locating such a system is the foundation. All the weight is concentrated upon a single ram and foundation; and if the foundation yields at all, the apparatus is thrown out of line and must be taken down and rebuilt. This trouble, together with the enormous weight and cost of lock chambers or caissons large enough to contain a ship and the water in which it floats, and strong enough to sustain the strains resulting from mounting so great a mass with so much leverage on a single support, and the difficulty of making cylinders of the necessary size and strength, limit the use of hydraulic locks to small barge canals. They do not help us toward a solution of our problem.

The state engineer of New York considered the system inadequate for locks only 225 feet in length; our locks must be more than twice that length.

A number of engineers have proposed to build floating locks, in which the lock chamber is supported on a float or floats, the buoyancy of which is so nearly equal to the weight that a slight change in weight will cause it to ascend or descend. The best of these seems to be the invention of Carl Hoffman, a German engineer. One of Hoffman's locks is being built by the German government.

It is the opinion of the engineers with whom I have discussed it, that Hoffman's floats, which are steel cylinders, will leak and become water-logged, destroying the balance; and that his system of leveling his lock and controlling it during its translation is not well designed, and will have to be remodeled.

All of the balance locks I have referred to have a great defect in common. They must land in a dry well, or one in which the water is maintained at a level so low that the floor of the lock chamber never comes in contact with the water, because that would destroy the balance and make the apparatus inoperative, as is the incline plane lock at Washington. When this lock, which is now abandoned, was used, a caisson full of water containing a loaded boat was let down; but the up stroke could only be made with an empty boat and a foot depth of water.

My study of the lock question began in 1877, two and one-half years after Clark patented his hydraulic balance systems, and for years my work was on the same lines as Clark's. I tried to perfect a hydraulic balance system which would be free from defects in design and operation.

In 1890 I got out of the rut and conceived the idea of making balance locks operated by compressed air, which I have since worked out to the satisfaction of my associates and myself.

The distinctive features of this system are as follows:

1. The weight is directly supported on an elastic cushion of air, and the downward effort of the contained water on each square foot of the lock floor is balanced by an upward air pressure.

The structure is simply a big tank, and all its parts are in tension except the lock chamber, which is subject to the hydrostatic pressure and accidental and unequal stresses resulting from the run of the waves in the use of the lock and probable shocks from the bumping of vessels, and must therefore be strongly framed.

2. The locks operate directly in the lower level of the two which they connect. No dry or walled-and-gated-off pit is necessary. The lock which

connects with the lower level floats like a pontoon, responding freely to fluctuations of the water.

3. The connection with the upper level is such that the stroke of the locks can vary as much as is necessary to accommodate the changes of the water levels; the sill is low enough to give the required draft at low water and the gate is high enough to contain high water. No guard locks are necessary, nor overflow weirs in the canal. The canal banks can be built high and strong enough to retain the water at its greatest height. Thus the construction and use of the canal are greatly simplified and the delays much reduced.

4. The apparatus to control the locks during their translation, so that they can not get out of level, is strong, simple and almost frictionless, perfectly automatic in its operation, and requires no care, not even lubrication.

5. The gates are simple, strong and easily replaced. Each opening is closed by a single gate which can be taken out and replaced in a few minutes. It moves with a good mechanical motion in a quadrant of a circle, and is operated by a wheel segment on the gate and a pinion meshing therewith on the lock wall, the simplest, strongest and easiest to operate of all mechanical devices. All the gates in a canal can be duplicates and a few spare gates kept on hand will provide for replacing any disabled gates.

6. The entire apparatus is controlled by a system of inter-locking levers, operated by one man. There can be no confusion or mistimed manipulation, for all the acts necessary to lock a vessel are in ordered sequence, controlled by inter-locking levers, so that no operation can be done out of its order, or until the preceding operation is complete.

The air pressure in the locks is independent of the lift, being equal to the pressure due to a column of water from three to seven feet higher than the draft of the vessels. In locks with a least depth of 26 feet over the sills the pressure will be 14¾ pounds per square inch.

On this system it is practical to build and operate locks 160 to 170 feet in lift without incurring any difficulties or dangers not encountered in locks one-tenth of that lift. A lock 326 feet lift could be built and operated. I would, however, advise against it at present, because the pit in which it worked would be so deep that no diver could go to the bottom of it to grapple a sunken log or other object accidentally getting into the pit. That is the practical limit on the height of the lift—human endurance. When any one devises a way to go down to any depth beneath the surface of the water, then it becomes practical to build and operate lifts of any height whatever—1,000 feet, if trade demanded it.

Quick-acting, high-lift locks have wholly altered the plans on which canals should be constructed. So long as it was necessary to overcome a considerable descent with a large number of low-lift locks with long basins between them, the engineer had to look for a long and easy grade. Now he will so locate his canal that the levels will be few in number and the locks as high as possible. Instead of looking for easy hills he will if possible bring his level to the base of a precipice and leap at a bound to its verge.

Do not imagine that I seek to give you the impression that the idea of lifting ships by compressed air originated with me. So far as I am aware it originated with Col. Haskell, an American engineer, inventor of the pneumatic dry dock, which is in common use wherever there is shpping. The pneumatic lock is a pair of pneumatic wet docks. The principle of operation is the same as in Haskell's dry dock.

The technical description of the lock is published in pamphlet and elsewhere. The principles are clearly demonstrated by the working model on exhibition. I hope you can all spare time to examine it, and then go and see a ship lifted on a pneumatic dry dock.

My associates and myself being satisfied that the designs of the locks were workable, and as nearly correct as could be expected after so few years of study, turned our attention to applying them to the great continental trade problems which we are here to consider. The highest lift ship lock yet built is at the Sault, and many engineers doubt if a higher lift is workable on Leonardo's model.

To get down the 573 feet from Lake Erie to the sea, at Montreal and New York via the St. Lawrence and Lake Champlain and cutting through the divide between the Champlain and the Hudson, substantially the location of the Maritime Canal of North America, would require thirty such locks on the line to New York, and five more to reach Montreal.

The Caughnawaga and Champlain-Hudson projects of the late John Young and Smith M. Weed, for a navigation climbing up from Lake St. Louis to the summit of the divide between Champlain and the Hudson, would require forty locks to reach New York and three more to reach Montreal. It would be folly to build locks which would not accommodate the great vessels of the lakes, or too small to handle the immense tonnage in sight; while to provide for the near future the draft should be 26 feet. Therefore the lock adopted would have to be deeper and more costly than the new Sault Ste. Mary's lock, and the locks would certainly cost $5,000,000 each. This would make the eighteen locks between Erie and Ontario cost $90,000,000. An inch of steel costs much less than fifteen feet of masonry, and therefore the high-lift lock is much cheaper to install than the masonry lock.

The pneumatic lock will enable us to reach New York with only five locks, and Montreal with two more, making seven in all on the triangular navigation. The voyage will be shortened more than a day; and the cost of the locks will be so small that we can afford to make the canals big enough for ships to make river speed, say 30 feet deep by 300 feet bottom width—10,300 square feet cross section.

Between Lakes Erie and Ontario the best thing to do first to overcome the 326 feet difference in altitude is to build a pair of tandem locks, each 160 feet lift, 28 feet over the sills, 65 feet wide, and 510 feet clear length. These would require 13,000 tons of steel, worth $80 a ton, or $1,040,000. The excavations and approaches will cost twice as much, making the total cost of the locks between the two lakes about $3,000,000. These locks would accommodate the largest freight steamships, and every merchant ship afloat except the Lucania, Campania, St. Louis and St. Paul.

The other locks to reach New York would be located at the Long Sault, at Coteau Rapids, and at Waterford, in New York; and to reach Montreal additional locks would be located at Caughnawaga and at the head of Montreal harbor.

A summary of the resulting navigation is as follows, by the Maritime Canal, from the great lakes to the seaboard:

Locks 26 feet draft, 65 feet wide, 510 feet clear length. Will lock vessels carrying 12,000 tons freight. Draft equal to that of Detroit River.

Sailing distances and canal mileage:

New York to Montreal......	365 miles,	60 of canal;	2 locks.
" " Buffalo	720 "	75 "	5 "
" " Chicago	1600 "	75 "	5 "
" " Superior .. / Duluth.....	1700 "	75 "	6 "
Buffalo to Montreal..........	365 "	40 "	6 "

When the route is first opened, there will be 90 miles of artificial canals between New York and Buffalo, but 15 miles will be afterward cut out.

The grade descends from Buffalo to the eastern terminals, New York and Montreal.

The altitudes of the lakes above tide level, are:

Lake Superior..	601.8 feet.
" Michigan and Huron..............................	581.3 "
" Erie..	572.9 "
" Ontario..	246.6 "
" St. Francis..	155 "
" Champlain.............. ....about	100 "

The sentiment of those most concerned in connecting the lakes and the sea in the United States is now practically crystallized in favor of the St. Lawrence-Champlain route. I will not waste time in criticising the competing routes. Unfortunately some friends of the general project had mixed with their advocacy a total misunderstanding of the feelings and purposes of our Canadian neighbors. To satisfy myself on this point, I spent a year in Canada.

So far from any antagonism, I found the question much better understood there, and broad and liberal views entertained.

Sir John Thompson's government readily granted the charter, 56 Victoria, Chapter 66, of the North American Canal Co.

Had there been equal liberality at Washington or Albany, the work would now be financed and ground broken. The indifference of many congressmen to this great project has delayed the work at least a year. If the people of the interested states of the United States really want this work carried out promptly, let them instruct their congressmen to grant to it such a charter that it can be financed and built. Private capital stands ready to take it up strongly as soon as the United States permits, and to submit to every just limitation and control in the exercise of corporate powers.

APPENDIX—DESCRIPTION OF THE PNEUMATIC LOCK.

The pneumatic balance lock operates on the principle of weighing in a scale, the scale pans being represented by the locking members, and the scale beam by the compressed air charge. The locking members are similar steel tanks or caissons, in the decks of which are formed troughs or lock-chambers, to accommodate the vessels to be locked, and water to float them, and having end openings which may be closed by gates.

Beneath the lock-chamber, and extending the full length and width thereof, is an open-bottomed air chamber adapted to retain a charge of compressed air, its lower walls being permanently immersed or "sealed" in the water of the lower level. The height or depth of this air chamber is equal to the lift of the lock plus enough clearance to insure absolute safety. The total height of the caissons is equal to the lift plus draft plus clearances.

These locks may be placed parallel, and each one lift the full height from the lower to the upper level; or, they may be set tandem (i. e., one in advance of the other), and operate one between an intermediate level and the higher level, the other between the intermediate and lower levels, in which case the lift of each lock is half the distance between the upper and lower levels.

The site of the locks is preferably, but not necessarily, in rock. To prepare it for the locks, the lower level is expanded and deepened to form a pit or well, in which they work and which is part of the lower level, wide enough for the locks, and in depth equal to their lift plus the draft plus clearances.

A suitable structure, as a head-wall or aqueduct, supports the upper level, and has gated openings with which the adjacent gated openings in the lock-chambers register when they connect with the upper level.

Interlocking parallel guides on the head-wall and on the locks retain the latter in correct position, but allow them to move vertically.

The lock structures are free to expand and contract toward the guides, which are the only fixed lines about the structures, every other part accommodating itself automatically to temperature changes.

The air-chambers of the locks are connected by a valve-controlled conduit, and the manipulation of the locks is effected by transferring the compressed air through the connecting-pipe from the elevated and descending to the depressed and ascending lock.

The structures are naturally in unstable equilibrium, and are prevented from tilting sidewise by guides and rollers; and from pitching endwise by a parallel motion apparatus consisting of large hollow steel shafts extending along the sides, and carrying lantern pinions, which mesh with and roll between vertical racks, one rack of each pair being built on the side of the lock, the other on a structure adjacent to the lock on terra firma. The shafts have no bearings, but hang freely in the racks, on the pins forming the teeth of the pinions. The shafts move vertically at one-half the speed of the locks. Should one end of a lock tend to move faster than the other, it tends to revolve the shafts at a corresponding speed; and the shafts transfer the tendency to motion to the other end of the lock and keep it level.

In such locks as are proposed for the Maritime Canal, the shafts will be 12 feet in diameter, with walls ¾ of an inch thick; each shaft will carry 10 pinions about 60 feet apart. The teeth of the pinions will be 8-inch pins. The racks will be of cast steel. The air main will be about 21 feet in diameter, and branches 15 feet in diameter will connect with each side of each lock. The main air valve is an immense return bend with a three-way water valve at the bottom, having a water-supply pipe and a water-waste pipe. To close the main air valve the three-way water valve is manipulated to admit water to the return bend and trap it; and to open it, the three-way valve is manipulated to let the water in the return bend run out and untrap it. The three-way valve is a balanced hollow piston valve operated by a crank which always turns one way with a quarter-turn and stop motion. The crank shaft is driven by a small electric motor. Besides the main air valve, similar valves are located in each branch pipe, so that any part of the air pipe system can be cut out without stopping the locks. To connect the air main and air chambers of the locks, we use large loops of flexible pipe made of heavy cotton duck reinforced with rope netting and lined with leather, which gives impenetrability, the duck and netting giving the necessary strength. This connection is adopted in preference to stand-pipes and underground work because of its accessibility.

To provide for accident to the flexible connecting pipes, each outlet from the air chamber has a safety cut-off valve. The valve used in the main air conduit is an ideal valve for the purpose; but does not apply well on the locking members because of the height of the traps, and the weight of the water necessary to seal them. In this location a valve is used which consists in an inclined gridiron valve seat, a sheet of rubber packing, and a roller. The rubber sheet valve is attached at one edge to the valve seat and at the other edge to the roller; and normally the rubber sheet is wrapped around the roller, and the valve is open, the roller being held up by ropes which wrap around drums on a shaft above and parallel to the roller and the valve seat, the shaft being held from turning by a release mechanism, operated by electricity. Should it be desired to close the safety valve, it can be done in five seconds without shock by operating release mechanism and releasing the roller, which rolls over the gridiron valve seat, and deposits the rubber sheet valve thereon, thus closing the valve.

The quadrant pontoon gates are all duplicates, and are box girders built of steel plates, crescent-shaped in plan, the seating faces on the gate and lock being parts of a cylindrical surface generated about a vertical axis, about which the gate moves with a quadrant motion, by the agency of a gearing consisting of a wheel segment on the gate and a pinion on the lock wall, the pinion being driven by a small motor. When open, the gate lies out of the way in a segment shaped pocket formed in the lock wall. This gate requires no clearance, and permits the lock to be used by any vessel that can lie between the gates. If a piece of paper can be inserted between the vessel and the gate, the gate can be operated.

Every vessel using the locks will cease to be self-propelled at the distance of 2,500 feet from the locks. At this point it will be connected at stem and stern by booms to cars running on a cable road controlled by the operator of the locks, at the interlocking lever station. After the vessel is connected to the cars, the cable will be set in motion and tow the vessel into the lock at a speed which will ensure the least loss of time without incurring danger; and the cable will stop automatically, without shock, when the vessel is properly entered. The cars remain on the lock and hold the vessel in position while the lock is moving, and when the stroke is finished and the gates opened for her exit, the cable will be set in motion pulling her out and giving her steerage way. The use of electric motors in lieu of the cable is under consideration.

It would be impossible to maintain an exact balance between the weight of the loaded lock and the lift of the compressed air, because the weight would vary with the running waves in the upper level, and the lift with the running waves in the lower level, and also with changes in the density and temperature of the adjacent atmosphere, were the latter not provided for. To ensure conditions of stability therefore in the elevated lock (the lower one floats and takes care of itself automatically) a balance tank or pneumatic accumulator is provided and connected with the elevated lock. The load on the accumulator can be varied. When the lock is elevated it is connected with the pneumatic accumulator which is loaded to give a maximum pressure, say one-quarter more than enough to balance the loaded lock; and this pressure acting in the air chamber of the lock, holds it up firmly against stops or anchors, the anchors being subject to a strain equal to one-fourth the weight.

If the load or the lift of the compressed air varies, the strain in the anchors varies correspondingly; but there is no effect upon the stability of the lock until the load is increased one-quarter. It is impossible to overload the lock very much, because the extra water would run over the gate; and therefore the structure is rigidly supported on an elastic and non-collapsible column of compressed air; and should any accident occur, the structure would fall up instead of falling down; for the anchors being the weakest part of the system, would be the first to give way; in which event the compressed air would expand and raise the lock to such a height that the load and pressure would be in equilibrium, and the lock would remain supported safe from danger until repaired.

The manner of effecting the stroke of the locks and the locking of vessels is as follows: The locks move oppositely (one up and the other down) and synchronously; and when one lock is elevated, the other is depressed. The stroke of the locks is so adjusted that the depressed lock contains a less draft—say 28 feet of water—and the elevated lock a maximum draft—say 29 feet of water. While vessels are entering or leaving, the air valve is shut; the depressed lock floats like a pontoon; and the elevated lock is rigidly supported as above described.

When the locks are to be operated, the gates are shut, the water is run out of the space between the adjacent gates in the head wall and the elevated lock, the connections with the pneumatic accumulator are closed and the main air valve opened, permitting the air chambers of the two locks to communicate. The air in the elevated lock being at ¼ higher pressure, expands into the depressed lock and raises it; and the elevated lock descends because it is the heavier member of the balance system, it containing an additional foot draft of water, and the motion continues until the ascending lock brings up against its stops and the descending lock reaches a position where equilibrium of effort is established between its weight and the lift of the compressed air. The main air valve is now closed and the elevated lock connected with its pneumatic accumulator, which induces within its air chamber the excess pressure and lift desired for safety. The depressed lock, however, is not yet wholly down, because when it commenced its down stroke, it contained a surcharge of air; and to fully lower the lock, the excess compressed air is drawn off into a pneumatic accumulator, the load on which has been diminished to this end. The locks being now in their new position, the gates are opened and vessels can leave and enter if desired.

DISCUSSION OF MR. DUTTON'S PAPER.

Chairman Livingstone: Perhaps Mr. Dutton, himself, will open the discussion of his paper.

Mr. Dutton: When I look at this convention I realize that I see a body of men not one of whom says "Go," but "Come on." You are all men used to doing what you want done, and not to talk about it any more than is needful in order to arrive at wise conclusions before proceeding to action. I hope and believe I am a man like unto you in this respect.

Now this convention, a representative body of men, representative of all that is most progressive, enterprising and forceful in two of the greatest peoples of the earth, have met at this central city of our land-locked middle sea, to determine how best these lakes may be unlocked, so that our commerce may go out to fight its battles on equal terms. The reason for this convention is the necessity for a great ship-canal uniting this lake, Erie, with the sea, and thus providing an adequate outlet for the commerce of the great heart and treasure-house of the continent.

Do you believe that it is necessary; that our commerce justifies it; that it will bring good into your life, and into the lives of those we love and of all our people? Do you believe that it can be done—that the hour is come for it to be?

Then why not do it? If you want to see it yourselves, if you want to benefit by it yourselves, you must do it yourselves. And the way to do it is to do it. When the people of the great west and northwest say they want it and are willing to throw their power into it, to strive for it, they will find they have men with the brains, energy and executive ability, and the money too, to put it through at once. They will get the ship canal to the sea, because they try hard for it, just as Chicago got the world's fair and the drainage canal.

But how to do it—that is the question. Some of you may feel that you cannot decide upon a definite plan. I am not in that class. I and those who are working with me feel assured that we know what is best to do, and how best to do it. There is but one practical route, and that is nature's own—where nature has done most man will have to do least—the great continental route, which serves every man and every section—Quebec and New England, as well as Michigan, Wisconsin, Minnesota, Ontario and New York. I mean, of course, the St. Lawrence-Champlain route, which has the greatest length of wide, deep waters, the least of artificial channels, will have the least number of locks, and in which our ships will go down hill all the way to the sea, and have the water flowing with them.

By this route there will be 720 miles and 5 locks between New York and Lake Erie, 365 miles and 6 locks between Lake Erie and Montreal, and 365 miles and 3 locks between Montreal and New York.

The eminent geologist and glaciologist whose paper is before you, Professor Wright, has stated the most important new fact brought to light by this convention—the bringing out of which alone is a great work, and justifies our being here, and which has a most important bearing on the question of route. I mean his statement that a buried pre-glacial channel, of great width and depth, exists between South bay, the southern end of Lake Champlain, and the Hudson river.

If this be true—and it appears to be be true—the question of route is forever settled. We must locate the axis of this buried channel with the drill, dig out the glacial drift which stops it up, and let the waters flow again where once poured the mighty St. Lawrence.

I wish to corroborate Prof. Wright, and to state that my own personal examination of the ground had led me to the same conclusion. I have walked and driven over every foot of the valleys between Lake Champlain and the Hudson river. A careful study of all the maps and charts led me to believe, before I saw the ground, that the true route for a ship canal between Lake Champlain and the Hudson must depart from the lake at South bay.

Everybody told me that the South bay valley was a tumbled-mountain wilderness, 500 to 600 feet in elevation. I did not believe it then, because I believed the vast waters of the St. Lawrence system never turned the Devil's Elbow, but must have flowed in the broad deep channel through South bay. I am proud to put it on record that I was the first engineer to hold and announce this opinion.

When I inspected the ground, I found the so-called mountain-wilderness to be a broad and gentle valley, with a maximum elevation of about 130 feet above the lake. Its origin was manifest. There are the glacial markings and the finest example of moraine formation I ever laid my eyes on—sand-hills and clay mounds, and strings of boulders, just as the glacier dropped them ages ago, and not spoiled by washing—for the country for a considerable distance has no drainage except by seepage through the glacial sands. Nature has settled the route. The question is not, what route, but what is best to do first to open the route laid down for us.

What we want to do first is to get the ships we have on the upper lakes down into Lake Ontario. When we have a modern ship-canal down the Niagara escarpment, and the large vessels of the upper lakes can descend to Lake Ontario as expeditiously as they now go up into Lake Superior, the question is solved.

The first big ship that makes the descent will carry all opposition down with it. The backbone of the whole question is the opposition of those whose living is made out of present conditions —the pecuniary interests which thrive on your necessities—and want to keep the great west bottled up in Lake Erie. The neck of the bottle is the 326-foot drop of the Niagara escarpment. Let us smash the neck of the bottle. Let us break the back of the opposition by getting one ship down into Lake Ontario. Do that and the interests which now oppose you will turn in and help you through to the sea.

That you may benefit by the latest information bearing on the projected ship-canal joining the two lakes, Erie and Ontario, I will yield the remainder of my time to Gustav Lindenthal, civil engineer, of New York.

Mr. Lindenthal: A short time ago I was requested by certain capitalists to make a reconnoisance of the Niagara peninsula for the purpose of determining if it be feasible to build a ship-canal between Lake Erie and Lake Ontario, and if the topography of the country is such, that the Lake Erie level could be carried to the Niagara river at Queenston, and the fall of 326.3 feet concentrated into a small number of quick-acting, high-lift locks. I carefully examined the ground, and collected all the existing information bearing on the subject.

From my report I may give you a few of the results of my investigations as follows:

No engineering difficulties of a serious nature will be encountered in the construction and operation of such a ship canal upon either one of three practicable routes.

The Lake Erie level can be carried to the head of navigation in the Niagara river, and the descent can be made with two locks, each of about 160 feet lift. Good holding ground extends the entire length of the summit level of the canal from Port Colborne, on Lake Erie, to the heights of Queenston, near Brock's monument. The site for the locks is favorable to the use of locks of the greatest practicable lift, which, with the pneumatic lock, is about 160 feet; and topographical conditions, therefore, are favorable to the economical construction and operation of the canal and locks.

The general plan includes the gradual deepening of the harbor of Port Colborne, and of the Welland canal to 26 feet, also the rebuilding of the guard lock at that place, and of the aqueduct at Welland for the passage of vessels of the greatest dimensions that may be used in the future for lake freight traffic; the Welland canal would be deepened only as far as the railroad bridge just north of the first lock, near Thorold; at this point the new canal would depart from the Welland canal with a curve of 15,000 feet radius; continue in a tangent about four and one-half miles long, passing south of the village of Stamford, and then with a curve of 15,000 feet radius to a second tangent about four miles long, running nearly northeast, crossing the escarpment about 1,500 feet west of the monument, passing to the northwest of the village of Queenston, and continuing through both locks and the intermediate meeting basin, into the Niagara river, at a point a little north of the steamboat pier, where there is deep water and a moderate current. The line would have only two curves of 15,000 foot radius, a total curvature of about 90 per cent., and two long tangents. The total length of the new canal would be 43,500 feet, exclusive of locks.

On another route with perhaps cheaper excavation, the canal length would be 45,000 feet.

I have also made a preliminary estimate of the cost and can state that 26 feet can be carried out from Erie to Ontario for such a sum that the enterprise promises to be a profitable investment and tempting to private capital, because the traffic in sight is sufficient to pay good returns on the money invested, and this without counting on the natural growth of the traffic on the lakes, which is steadily going on, or on the profits from collateral enterprises, such as the sale of water-power.

Times change. It is but a few years since the engineer, in building canals, was confined to timber and masonry for materials of construction. But iron and steel can now be obtained very cheaply, and in great single masses shapes can now be cast or rolled, or forged, which a few years ago were beyond the capacity of our largest iron and steel works. It makes it possible to construct ships, bridges, buildings, and other structures of a size never dreamed of before our time. So in canals. The masonry lock with timber floor and gates is giving place to steel locks. Canal construction can be cheapened as railroad and bridge building has been cheapened.

It is entirely feasible to substitute for the old Welland canal, which has 25 locks, a new canal with but 2 locks. The dimensions of the present Welland locks are 14 by 45 by 245; of the new locks they can be 28 by 65 by 550. A 1,600-ton vessel can now pass the Welland ordinarily in 24 hours. A 10,000 ton vessel will be able to pass through the new canal in 6 hours or less.

The carrying capacity of the Welland canal, limited by its locks, is about 7,500,000 tons per season of 200 days. The new canal and locks would have a capacity of 25,000,000 tons with vessels averaging 3,000 tons, and its capacity will be increased without enlargement as fast as the average tonnage of the present lake vessels increases above that tonnage.

Its capacity can also be increased whenever, and as many times as may be necessary and profitable, by building additional locks, for which the plans so provide. Yet the new 26-foot canal with 2 locks capable of passing a 10,000 ton vessel in 6 hours will actually cost less than the old Welland canal with 25 locks, which can pass a 1,600-ton vessel only in 24 hours.

Steel lift-locks are the first great step toward a practical ship-canal from the lakes to the ocean, because they will effect a great saving in cost, time and water. With their use it will be entirely feasible to build and operate canals where without them it would be impossible.

Private capital has created in this country a railroad system greater than any other in this world. But it is now nearly finished. Capital can no longer find profitable employment in building new railroads or in extending the existing system.

It must turn to new enterprises; and the most profitable enterprise of the near future, in my judgment, will be ship-canals for the transportation of the bulky freight, food stuffs and raw material at the lowest possible rates.

If the same genius of organization, inventive skill, resources of capital, and concentrated energy, which have built up the great railroad systems of this country are applied to the construction of a ship-canal from the lakes to the ocean, then the purpose of this convention will be accomplished.

I believe that this work can be done cheaper and better by private enterprise. Government work is too slow. If the Sault Ste. Marie canal could have been built with one large appropriation instead of many small ones, the work could have been done in two years instead of eight years. With the history of this work before us, it is evident that in the case of an enterprise requiring as many millions as will an outlet to the sea, it is almost hopeless to expect the government to furnish the means and finish the work in less than two generations.

Private enterprise, once thoroughly prepared must, on the contrary, push the work to earliest completion to keep down the interest account during construction.

It is my judgment that a modern ship-canal to Lake Ontario is the first step necessary toward the realization of the greater enterprise.

The preliminary work for this part is well in hand, and I believe that but a short time will elapse before actual construction is begun.

Mr. Thorpe: I would like to know the length of the season that the St. Lawrence canal is open.

Mr. Lindenthal: Two hundred and twenty days.

Mr. Dutton: The St. Lawrence is open four to five weeks longer than the Erie canal. I mean that part between Lake Erie and Montreal, where we want to go. It opens simultaneously with the opening of Lake Erie and Lake Ontario. The lower part of the St. Lawrence, below Montreal, opens later because it lies farther north in a colder climate, and receives the northern waters and the heavy ice from the Ottawa, Saguenay and other rivers of Quebec. Lake Champlain and the Hudson also open early. The first warm south wind brings the warm moist air from the gulf-stream up the gap of the Hudson and Champlain and the ice usually rots in a day or two.

Mr. Thorpe: I would like to know the distance by the Erie and Oswego routes across New York and the distance around by the St. Lawrence and Champlain. Why not take the shorter route, across New York from Buffalo or Oswego to Albany?

Mr. Dutton: A ship canal from Buffalo to Albany would be about 365 miles long. A canal from Oswego to Albany about 200 miles long. Neither route has been surveyed for a ship-canal and accuracy is impossible. The Oswego route would, of course, imply a Niagara ship-canal. The distance by either route from Buffalo to New York would be about 520 miles. Either would require a great many locks; both have a summit level near Rome, the local water supply for which is short, and water would have to be brought from Lake Erie, 200 miles, in a steel pipe, because the country will not hold water in a canal perched on a hillside, above the natural drainage lines.

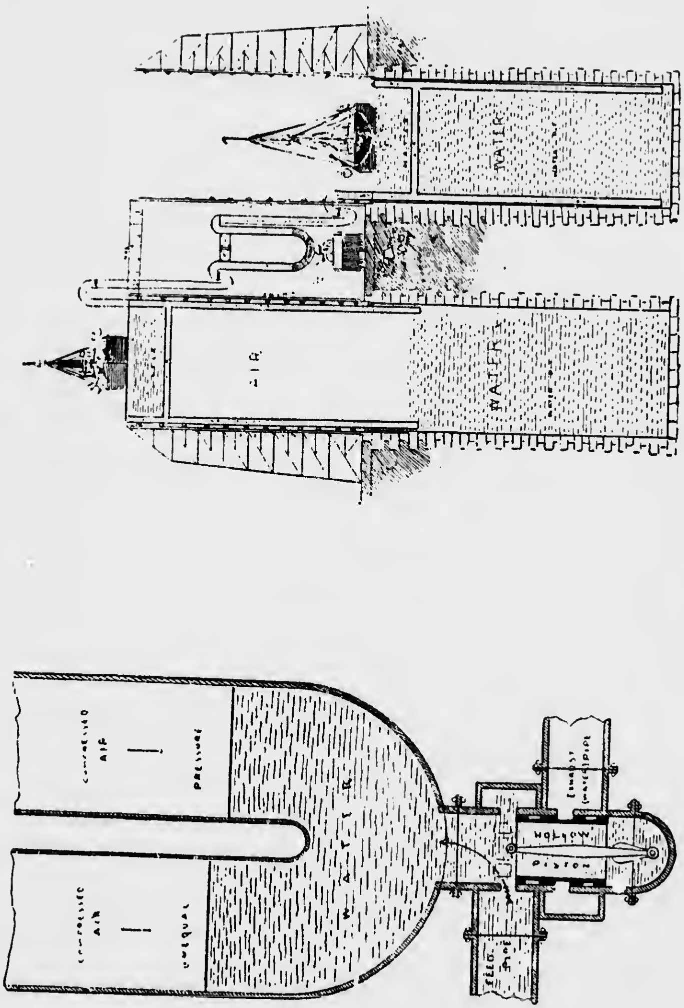
The St. Lawrence route is 720 miles from Lake Erie to New York—200 miles longer. Its season of navigation is also longer. But its canal mileage is shorter, its leakage less, and its locks many times less in number. There will be only 90 miles of artificial canals, subsequently reduced to 75 miles; and this short canal mileage will be for the most part in cutting, below the natural drainage plane, so that we will have to provide means to keep water out instead of means to keep it in.

It may be well to call attention to the great natural advantages of this route. From where we strike the Niagara river to where we depart from the St. Lawrence there is 320 miles of open water exceeding 30 feet deep except in a few short places not aggregating 5 miles. The Niagara river is a grand port with 70 feet of water, a straight channel, a perfect natural breakwater at its mouth, and good lines of soundings coming in. Lake Ontario is 720 feet deep. Lake Champlain is 402 feet deep. There are 250,000 to 300,000 cubic feet of water per second; and the canal mileage is so short that the few cuts necessary can be made artificial rivers, 300 feet or more in width by 30 feet deep.

Another thing I want to point out: It will do you no good to build a canal and put one end of it in a brook. You must have both ends in water, and in deep water. Now the Hudson from Coxsackie up is shallow. The flow is not sufficient to wash the sand out and keep the river open above 8 feet deep. Unless you can bring more water to the Hudson, your ships can't get to New York, and there is only one place to go for water, and that is the St. Lawrence system. We must bring some part of the St. Lawrence water back into that buried channel Professor Wright tells you about. Dig that channel out and you will have 30 feet in the Hudson, and the St. Lawrence will never miss it. In fact, Montreal has too much water and is building a mole to keep it off.

Again I urge you, if you want the canal to turn in and build it. It will cost money—$100,000,000 to get to both Montreal and

DUTTON PNEUMATIC LOCK.



SECTIONS—DUTTON PNEUMATIC LOCK

big New York. But we must not let that stagger us. A single railroad system earns $140,000,000 every good year.

Another point: You have time and again seen transportation systems put in operation here in the west which were thought to be twenty-five years ahead of the times. Yet in every instance within five years it was taxed to the limit of its capacity, and the people were crying for more facilities. This will be the history of the ship-canal.

Mr. Thorpe: What seems to be cheapest is often the most expensive. The St. Lawrence canal would be the cheapest canal I want to raise the question of time. "Time is money." The shorter cut you can make from the lakes to the ocean, the better, even if it costs ten times as much. It will be of such benefit to this nation, it will be a great economic investment, even if it costs $100,000,000. It is not a question of saving money, it is a question of making money available as fast as possible. A route open two weeks longer in the year would be a great benefit; it would be a saving every year all through the ages, and the expense of building a canal is an expense once for all. The questions of saving time in passing through it, and of maintaining it, are the more important questions.

Prof. Haupt: It is not always the distance that regulates time in canal traffic; sometimes the longest way around is the nearest way home. The question of cross-section, and the speed which a vessel can make, must be considered. This is a question for the engineers. We believe that whatever route shall be selected will be that which will require the least time.

John A. C. Wright, of Rochester: I would say in answer to Mr. Thorpe's question in regard to lineal measurement, this convention is not here to decide questions of routes at present; but my understanding would be to go from Lake Erie into Lake Ontario, by the best and most feasible route that is to be determined. Then, when you are in Ontario, carry on a campaign of education. The question of going further is merely detail.

Mr. Dutton: In answering Mr. Thorpe, I would like to say, this proposition to connect Lake Erie and Lake Ontario includes locks 65 feet wide, 26 feet draught, 28 feet over the sills, 29½ feet in the lock chamber, so as to put 3½ feet between the keel of the ship and the floor of the lock.

Chairman Livingstone: Col. Roberts will come next:

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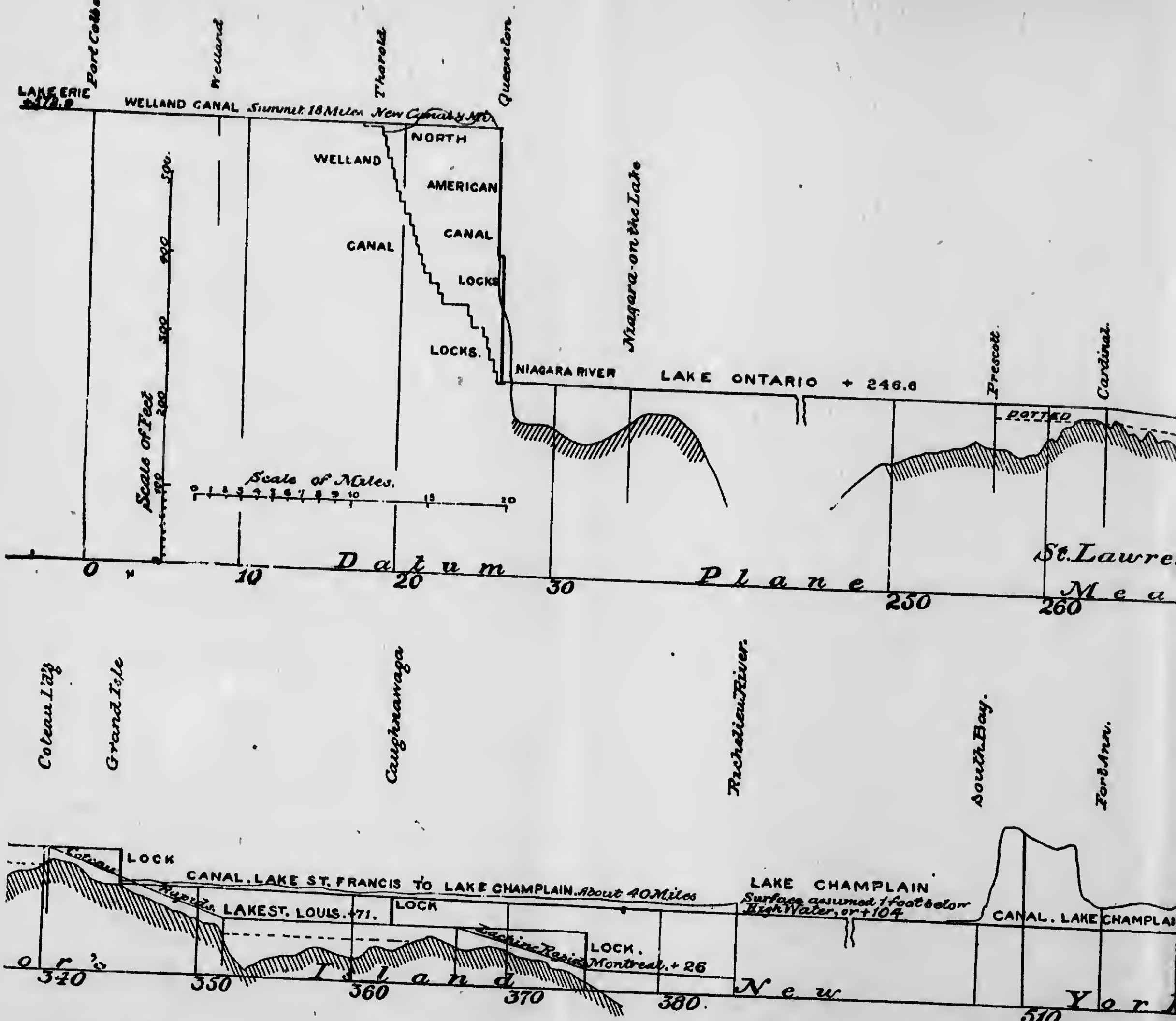
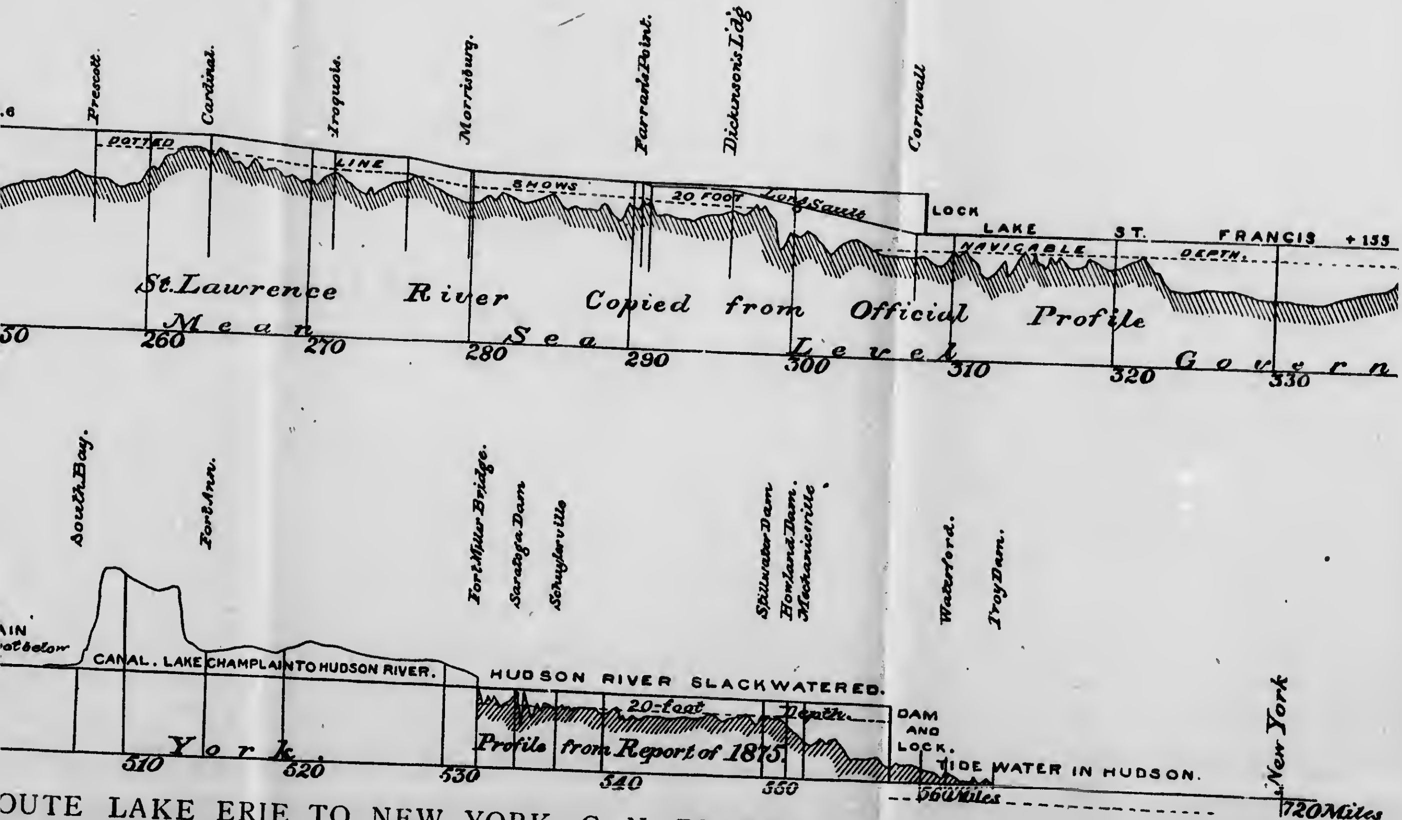


PROFILE OF CANAL ROUTE LAKE ERIE



OUTE LAKE ERIE TO NEW YORK—C. N. DUTTON.

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Enlargement of the Erie Canal.

THOMAS P. ROBERTS, C. E.,
Chief Engineer Monongahela Navigation Co., Pittsburgh, Pa.

Having for a number of years past taken an interest in the projects which have at various times been presented to the public by engineers looking to an enlarged canal connection of the lakes with tidewater, I wish to contribute a few hastily prepared observations of my own on this subject, to the general fund, for what they are worth; for I take it that until surveys are actually made and careful investigations instituted as to the business to be accommodated, the type of vessels best adapted to the canal, etc., every one is free to express his opinion.

The first point to be settled in my estimation is the size to be adopted for the canal. On this point I am satisfied that the canal designers will never come to a unanimous agreement. The size I would recommend is the size that is plainly within the means of the state of New York, or of a corporation, or of the United States to build.

Is ten feet depth enough? Let us stop a moment to consider this question. As canals compare with each other approximately as the cubes of their depths, a ten-foot depth canal ought to have approximately three times the carrying capacity of a seven-foot depth canal. We might ask again, are the people of New York then making any serious mistake in their proposal to deepen their canal from seven to ten feet? I would say yes, if I believed they would ever have occasion to abandon such a canal. What folly it would be to abandon good locks of ten feet depth, if we could keep them and still have a fifteen or a twenty-foot depth lock along side of them. I may be in error, but I believe that much the greater proportion of the Erie canal can be widened and deepened, when the time comes for it, by modern dredgers working in summer, and rock blasting done in winter, without in the least interfering with its ordinary use.

When I was traveling along the Welland canal several years ago with the division superintendent of that work, upon my expressing surprise at the good order in which the old ten-foot canal down the Ontario slope was maintained, he replied: "Why, sir, we never throw away canals in Canada. That canal comes in use yet for rafts, and is kept prepared for emergencies interfering with the operation of the new canal."

Now, I believe the Erie canal with fifteen, twenty, or twenty-five feet depth would be better than with ten feet depth, and believe also that there would be business enough to warrant a much larger construction than is to be voted upon by the people; but I do not believe the state of New York will make any serious mistake in deepening the old canal, as at present proposed, at least on the western division. There will be always small and light draught vessels adapted for the local trade desiring to pass through any ship canal, no matter how wide and deep it may be, and it will be a relief to larger vessels if they are not delayed at locks by smaller craft such as might pass through locks ten feet depth.

I am told that coal rates from Buffalo through to New York, 500 miles via the Erie canal, seven feet deep, is not more than 60 cents per ton. How unfortunate indeed it is that Pittsburgh is not in Buffalo's place, though I fear if Pittsburgh were there the coal shippers would think such a rate good enough for them, and never vote to enlarge the canal. The coal rate from the Pittsburgh mines to New York on a distance of less than 500 miles, via rail direct, is $2 per ton. I have nothing to say against any route yet proposed, whether it be via Lake Ontario and Oswego; or Ontario, the St. Lawrence, and Lake Champlain; or Buffalo, Lockport, etc. Whichever one the New York people decide upon, and actually construct, will be the favorite one in Pennsylvania.

So long, however, as the routes are merely talked about, and not even surveyed, as before said, even a Pennsylvanian may express his views. Having recently made a tour across New York by rail on a line parrelleling the Erie canal, I may be pardoned for expressing some surprise that the plan of enlargement of that canal, so ably introduced to the profession by Mr. E. Sweet several years ago, and so fully debated by other engineers, is not more frequently brought up for discussion. I am free to confess that since reading the paper referred to, I have always thought the best route was the old one via Buffalo and Lockport, modified as Mr. Sweet proposed so that Lake Erie water would pass through to the Hudson. I believe there are other engineers who will agree with me after even a cursory examination of the country (and nothing more is really required to give one an intelligent understanding of Mr. Sweet's proposition) that it has all the elements of practicability.

Briefly summarized, it is the widening, deepening, and necessary rectification of the worst curvatures of the present canal from Buffalo to Newark, about 130 miles, the construction of a new canal from Newark to Utica, about 115 miles, on a line south of the old line, which it would be necessary to adopt to carry Lake Erie water to the Rome level, and finally the canalization of the Mohawk river from Utica to Troy, about 100 miles.

The Erie canal passes practically its entire length through a glacial drift formation, for seldom will solid rock be met with in the comparatively shallow depth of a canal excavation. The rounded contours of the hills, the extent of flat country, the material in the beds of the streams, especially in the Mohawk, all betoken this glacial origin, the debris of which is easy to excavate.

Whatever possessed Pennsylvania, Virginia and Maryland to attempt to rival De Witt Clinton in canal building surpasses my imagination. Clinton's task with nature's assistance was a very easy one indeed, and as it was the only natural one, the tree he planted has flourished and is about to grow I hope still more, while ours, at least in Pennsylvania, has been dead for many decades and beyond all hope of resurrection.

Two things must conspire to ensure the success of canals in this country, viz., favorable natural conditions and an enormous commerce. We have an enormous commerce through Pennsylvania, far greater, when way freights are included, than that which passes through New York; but nature has made it impossible for the tidewater to be reached via canal from the Ohio on a scale commensurate with the volume of business, although canals are possible of construction both to the Susquehanna and the Potomac, which would be on a par with modern railroads; but as railroads can be constructed through the mountains for much less first cost, the inducements to rival them by a method where this difference will be met with less operating expenses, are not sufficiently attractive to warrant the hope that any such canals will be built.

From the Ohio river, however, to Lake Erie, the natural or engineering problems are very much easier; and as the requisite volume of commerce is also there, no surprise should be manifested if a modern canal is constructed across this territory. With this project we are actually ahead of New York, because we have the surveys made and know exactly what can be done. As this projected enterprise is certain of becoming an accomplished fact, I hope in the near future, the minds of its friends naturally turn to the questions connected with canal routes to tidewater through New York. The victory has already been won for deep waterway towards the west and northwest via the lakes. The few remaining incompleted details will soon be solved, and in the solution of the problems of deepening the lake channels by the national government, I wish to remind this convention that Pittsburgh was represented at the Detroit, Washington and Toronto conventions, and voted aye every time, and instructed all the congressmen within the sound of her voice to vote the same way in congress, and they did so vote.

Let us take a glance at Mr. Sweet's project. Taking water from Lake Erie at Buffalo, the canal passes eastward to Lockport, thirty-eight miles without locks; surely a very fine first division. At Lockport there is a drop of about fifty feet. Mr. Sweet in 1884 suggested for this place two lifts of twenty-five feet each. More recent successful experience in Europe with lifts would apparently dictate the employment of one fifty-foot lift there, which could be passed in the time occupied in one lockage; say twenty minutes. So then with one lift or stop we reach level number two. This level, sixty-four miles long, would extend to Brighton, a point a short distance east of Rochester. A sixty-four mile level almost an air line in the direction of the traffic is certainly a fine division. At Brighton another lift of about forty-eight feet would be advisable, followed possibly by two locks; thence level number 3 would extend about twenty miles to Macedon, where with a twenty-foot lift lock a fourth level would be reached. This level would extend the remarkable length of 115 miles, from Macedon to Utica, including in this length the old Rome level, fifty-three miles long.

We have now advanced across the state of New York from Buffalo eastward to Utica at the head of the Mohawk, a distance of 231 miles, with only six stoppages absolutely necessary to lock or lift, and have descended from the level of Lake Erie about 145 feet. Now this same point, Utica, can only be reached via the projected Niagara river-Lake Ontario-Oswego and Syracuse route, by locking down 328 feet from Buffalo to Lake Ontario, and locking up 183 feet from said lake to the Rome level; or a lockage n one route of 511 feet as compared with 145 by Mr. Sweet's plan.

Mr. Sweet puts great stress, as well he might, on the crossing of the Seneca valley by an acqueduct embankment nearly two miles long and forty feet in height, as embankments of such length and height on a great canal form a serious engineering problem. I think it might be better solved in the interest of safety, and very likely cost as well, by substituting for the embankment a rivetted steel plate structure, supported on columns or walls, cemented for its preservation from oxidation, and lined with flexible timbers to prevent the impact of vessels directly against its inner sides. The sides of such an acqueduct would necessarily have to be rigidly braced and perhaps continuously trussed horizontally on lines exterior to the prism; and its channel divided by an open work guide-line of timbers rendering it impossible for vessels to come in collission in passing through it.

I have read what has been said of the open lake, high speed navigation, and know also that time is money, especially with great steamers carrying very large crews. I have nothing to urge against the idea that in the future we will have a canal which will enable the lake ports to be reached by ocean-going steamers through New York harbor; but in all seriousness I will ask is it known that ocean-going steamers of any existing type are better adapted for a combined lake, canal and ocean service than vessels of a barge type, which may be designated to suit the canal and the lake?

Ocean-going steamers seldom, if ever, ascend the Mississippi higher than New Orleans, although for months at a time they could safely reach Memphis, and even St. Louis, or pass up the Ohio to Louisville. Because they can do it is no evidence that they will frequently want to do it. So I believe that a special type of steamer, or barge, very large, may be designed specially well adapted for canals; not carrying great crews nor designed for high speed, which could reach Utica from Buffalo via Mr. Sweet's canal, at less cost than they could reach the same point via Lake Ontario. Such vessels, able to propell themselves through the canal at the limit of speed, say five miles an hour, if need be, can be taken in tow on the lakes in fleets of three or more. Such vessels might be constructed for twenty-dollars per ton of capacity, as against high speed express freight steamers of three times this tonnage cost.

Without pretending to be a prophet, I am convinced that the construction of the canal will bring about a revolution in methods of doing business on the lakes, the full effects of which we, as yet, but little dreamed of. Pray then, don't let us build canals to suit some fancied ship model, but build our canals first and let the ship model take care of itself.

At Utica at all events the rival lines through central New York meet on common ground, and I must say both have a delightful engineering prospect when the gaze is directed down the Mohawk valley. So much has been said and sung about a damsel known as the "Belle of the Mohawk Vale," that little or no attention has been paid to the stream which passed her doors, and to the practicability of its canalization. But there the Mohawk flows for fully 100 miles, in a remarkably direct line to the Hudson, unbroken by but two falls, and but few serious rapids. In general its bottom is smooth and wide; rarely would any important work of rectification of its general bank lines be required, and not more perhaps than five miles of entirely new or "cut of" channels would be necessary to adapt it to a noble slack-water navigation.

I have been engaged on the surveys and work of improving a number of our western rivers in several states, but while I can recall many rivers of less rapid descent, I know of none more direct, and with areas of watersheds considered, none which affords as strong a low water flow; hence it would furnish a wide and commodious waterway, upon which vessels could be easily navigated night or day and move with considerable speed in the deep pools made by the dams. If steamboat navigation had not been regarded as an experiment at the time Clinton set to work, there never would have been a separate tow path canal down the Mohawk valley; but with steam power, the flood currents in the river need not be feared, especially in view of the reduction in the flood velocities due to the dams. I think it may be shown that when Utica is reached but little Lake Erie water will be needed, the discharge of the Mohawk with but little assistance promising to be ample for a slack-water navigation. This is a consideration which will be found of great moment when calculations are made involving size of canal prism, current velocities, etc., and which mount up to the millions in cost.

There might be times, of course, when great floods would render navigation dangerous on the Mohawk, as they do on the Ohio, but the duration of such periods will be much less in the case of the Mohawk as compared with its much larger western rival.

Mr. Sweet suggested dams of 10 to 12 feet lift in this river, in which opinion I agree. He did propose adjustable dams, but as the late Col. Merrill of the United States engineers, with whom I have served in past years on river improvements, observed, adjustable dams, rising from the bed of the stream, say from 18 feet channel depth and then 12 feet more, or 30 feet in all, are possibly beyond the limit of lift of adjustable structures. But there is nothing to prevent adjustable tops being placed on permanent sub-structures or low dams, such as might be safely permitted to remain up over winter and during the great floods of the Mohawk. With this modification any reasonable depth could be mentioned for purposes of navigation, without depending much on dredging to secure depth, something to be avoided when possible—especially in silt-bearing streams, and when freshets come the adjustable tops could be lowered so that no perceptible increase in the height of floods would be experienced; and very often this manipulation of the dams could be executed without interfering with the navigation of the stream. This is at all events the system which will be recommended for consideration on the canalized Beaver and Mahoning rivers, which form parts of the projected Lake Erie and Ohio river ship canal.

Mr. Sweet, I believe, on the entire Erie canal line would reduce the locks and lifts to say thirty, or considerably less than half the number of locks on the present canal. This would certainly be a wonderful improvement.

In the old days when our Pennsylvania engineers were at work on canals, they did construct two sixty-ton boat canals from the Ohio near Pittsburgh to Lake Erie. One branch extended to Cleveland, the other to Erie, and each had more than 130 locks. We propose now to reach Lake Erie, of course on a better route, with only about thirty-five locks, so that from Pittsburgh to the Hudson, there now promises to be a canal, with fewer number of locks in it than the one now in use from Buffalo to Troy.

Surely these great projects are worth the serious consideration of our people.

No matter where the canals may be built, which pass from the lakes either to the sea or to the Ohio river, or to the Mississippi, the construction of one will hasten the work on all the others.

We need have no fear that there are going to be many of these great canals, for but at few points will the demands of commerce meet with that favorable response from nature without which no money nor engineering talent can produce a modern canal.

ERIE CANAL DISCUSSION.

W. T. Harris: I would ask the gentleman what lift he proposes?

Mr. Roberts: I would not advise more than 20 feet.

Mr. Harris: In counting 30 locks, you count on one deep lift?

Mr. Roberts: Yes.

Denison B. Smith: I wish to ask Alex. R. Smith, of New York, whether State Engineer Seymour reported a lack of water for any such improvement of the Erie canal as is contemplated by a 20 or 21-foot channel, especially for what is called the long level of the canal?

Alexander R. Smith: He doubted the availability of the water supply.

Mr. McGuirk: I would ask the New York gentleman if he took into consideration the improved machinery of the Chicago drainage canal.

Mr. Dobell: I would ask the New York gentleman whether he considered in connection with his proposed Erie canal enlargement the very extravagant cost of right-of-way.

L. M. Haupt: In regard to the Manchester ship canal I think one-half of the expense was devoted to the purchase of valuable franchises and for parliamentary expenses. Therefore, that is not a precedent for any other part of the world.

Mr. Lindenthal: I would like to ask Mr. Smith the question whether, in his judgment a depth of 9 feet in the Erie canal is the most economical depth for the transportation of freight to New York? Because if it be so, is the Canadian government not making a mistake in building its canals down the St. Lawrence river at a depth of 14 feet? And is the policy of the government in deepening two lake channels from 9 feet to 21½ feet not a great waste of money?

It seems to me, that the gentleman, in his solicitude for the deepening of the Erie canal to 9 feet, to be soon voted upon now in New York, and which every one here hopes will be carried out, has overshot the mark. If freight can be carried cheapest in steel barges towed by a steamboat, requiring no more than 9 feet depth of water from Chicago to New York, then it is a most remarkable discovery, the importance of which it would be difficult to overestimate. For my part I must confess great skepticism of his proposition, and I venture the opinion, that it is a campaign argument for the $9,000,000 appropriation for the deepening of the Erie canal, which the gentleman mistakenly believed would be opposed here. Instead of it, he finds every one heartily in favor of it, although his arguments convince no one.

Mr. Alex. R. Smith: I understand the Canadian people are not making great progress. At New York we have an enormous population, which naturally attracts commerce. The conditions under which the Erie canal is operated are no criterion of its capacity.

Frank A. Flower: No one should be befogged by the idea of mere physical "capacity." Mere capacity is not what is being sought, but such freedom from intermediate and unnecessary transfer, pool, wharfage and other charges, from the wastage of breaking bulk and from the inevitable cost of long trips as will make freight-carriage cheaper, not simply a physical possibility, as Mr. Smith contends.

Mr. Davis, of Bay City: There has been a great deal said as to how we are going to transport this product from the west to the east. I have made a study of that question all my life. I have vessels coming through the Welland canal and from Duluth and from Chicago. I must say, the Welland canal as it is now, with the 14-foot draught reduced to 13½ is a very expensive canal to go through.

At Ogdensburgh I pay 20 cents toll per ton, and in Canada

10 cents. I have always thought that the Erie canal ought to be owned by the United States government, and that the government ought to let the engineers take hold and make a good canal out of it. But to navigate a big ship through it from Chicago or Duluth to Liverpool, I don't think would pay. But if we build a good canal and have it operated by the United States government as it should be, no railroad could ever compete with that canal. Instead of paying 4 and 5 cents, the freight would be reduced to 2 cents, and it would be sent through to New York for 4 cents; and the man in the west would be almost as well off as the man in New York. Let practical engineers decide what is the best.

Mr. Dutton: It seems to me that Mr. Smith allows the 900,000 tons of grain carried on the Erie canal to obscure his mental vision so that he entirely loses sight of the larger question of the 60,000,000 or more tons moved by some more efficient agency. Admitting that the enlarged Erie canal can carry four times the amount of freight it now carries, and carry it cheaper, what provision shall be made for the vast traffic, now exceeding 60,000,000 tons, which cannot make use of the Erie canal? Some of this freight pays as much as $10.00 per long ton; the great part of it pays $3.00 and more; and its volume is now five times greater than the alleged capacity of the enlarged Erie canal.

It is true that a part of it is high-priced package freight, on which even high freight rates bear lightly; but the great bulk of it is the agricultural and mineral products of the west, which can not bear the present cost of transportation.

The majority of this convention represents the producers of this freight; Mr. A. R. Smith represents the traders of New York who deal in it. They charge up the freight, with the other costs of conducting business, to their patrons; the western producers on the contrary, must pay the freight first, and put up with what, if anything, is left. They can not, as our New York traders do, transfer the burden to other backs. They must bear it as best they can until a way is found to better their condition; and the object of this convention, it seems to me, is to find such a way.

John A. C. Wright: I wish to put the question of the New York and Erie canal upon a better basis. In the first place Mr. Smith came here as the representative of the present Erie canal interest, to fight for the Erie canal. Several men from New York came here with the idea—it has got abroad some way in New York—that this International Deep Waterways association would be antagonistic to the Erie canal interest. It is very unfortunate that the impression exists in New York which does exist; you would have a better delegation than you have to-day if that impression had been removed. The Erie canal is the New York state canal system. New York has a pride in it, and believes it should remain the state system. You would find great antagonism to any idea to disturb that canal. There is a referendum to be submitted to the votes of the people for improving that canal by deepening it 2 feet, at a cost of $9,000,000. There is opposition to that from the farmers, who look upon that as something paid by them to bring western produce in competition with them at their homes. There is opposition in the exterior counties which share the expense, but do not get direct returns. Looking at it from the New York city point of view, the Erie canal turns the tide of western traffic, and builds up the supremacy of the Empire state. By reason of this the farmer only pays 7 per cent. of the state taxes. Now in regard to the physical question: it is impracticable to build a ship canal on the Erie canal route on the question of interference with all other thoroughfares. You see it goes through the city of Rochester, and we have dozens of lift-bridges. They cost $75,000 and get hung up every few hours.

We want your support in favor of the Erie canal. A deep waterway to the ocean, as we look upon the map, and as any intelligent man can see, must be through Lake Ontario and from Lake Ontario to the sea. We don't pretend to say which route. If we can apply electricity to the Erie canal, it will double its capacity.

Mr. Smith, of New York, says that the Erie canal carries cheaper than your big lake steamers, and that a deep waterway is unnecessary because the Erie canal can do it so cheap.

Gentlemen, when you visit the docks of Cleveland, and then visit the Erie canal in Rochester, that sort of statement will not go.

Supposing we have electricity applied through the Niagara Power company to the Erie canal to perfect its capacity for transportation; that's no argument against our also endeavoring to have a deep waterway to the sea by whatever route is best and feasible. (Applause.)

Frank A. Flower: No speech in this convention has done my heart so much good as that of Mr. Wright's. He is a great-hearted, fair, full man. He came here with some misconception of conditions and the moment he learned the error, owned up and turned in to help bring New York into line. He mentions the small delegation from the Empire state, and says it is owing to the wrong impression as to the attitude of our association which prevails there. As to that, I will say that I sent probably 1,000 letters and telegrams to leading men throughout New York, to enlist their help, or at least to induce them to come here and defend their interests. All alone, for two days and nights, Mr. Cooley and myself defended the interests of New York in the Toronto convention, and in the beginning I assumed the same burden here. I held out to the verge of offensiveness to make a New York man temporary chairman of this convention, and to give that state two places on the international executive board. I want so manly a delegate as Mr. Wright to know these things; want him to know that we have never been in any way or sense hostile to the Erie canal or to his great state, which is my native soil, but that, on the contrary, we have defended and saved her when she was not enough alive to her interests to be on hand to save herself. (Applause.) I feel that there is no valid reason for the prevalence of wrong impressions in New York, and no excuse why that state has so small a delegation in this convention. Those who are here, however, are all right and mighty good men.

Denison B. Smith: There has been a great deal said upon the subject of the temper of this convention towards the Erie canal. I haven't met any gentlemen here who have expressed the slighest opposition to the improvement of the Erie canal. I presume if the question was presented here at this moment, there would be no sort of objection to it whatever. I want the New York gentlemen who have been talking here, to entertain a little different idea of where the money came from which New York proposes to expend in the improvement of her canal. When the Erie canal was opened, and for thirty-five years, the toll on a bushel of wheat from Buffalo to Troy was 5 cents a bushel or more.

Just think of that, and think of the condition of trade now! The state of New York was reimbursed by the west for her outlay, and a very large accumulation of money was made besides, by the tolls paid on western products on the Erie canal. I think it is this sum of money that is proposed to be spent on the improvement of the Erie canal, and this is what the west has on deposit somewhere down there. I think friend Smith talks without much reflection about the comparative cost of moving freight. Cheap coal means rapidity, and these beautiful steamers are calculated to run twelve miles an hour, and the profit is in getting there quickly. While you are getting to New York from Buffalo through the Erie canal with your vessel, a steamship would be in Liverpool discharging. It can not be possible that it will not be so.

CHANGES IN TRANSPORTATION.

H. W. Seymour: It seems to me to be almost axiomatic that deep waterways are the cheapest means of transportation. Living, as I do, at the Falls of Ste. Marie, seeing the great commerce passing through those lakes, I consider that there was scarcely any settlement in all that region before the Ste. Mary's Falls canal was constructed, and that after that canal was constructed by a grant of 750,000 acres of land by the United States to Michigan for this purpose, the settlement and developmet of that region commenced. But after the present lock was completed, commerce increased, and freights were cut in two.

James J. Hill said at the West Superior convention: "If you will give us 18 feet of water through the lock, I will cut freight rates in two."

I believed that statement then, but now it is verified.

With the completion of the new lock next year, and the completion at the present time of the Canadian lock—which is 900 feet long and 60 feet wide, and which has now 20 feet and 6 inches over the mitre-sills, while ours has only 14 feet 3 inches—commerce will not be congested as it has been during the summer, thirteen vessels at one time pressing tight up at the government dock awaiting passage through; yet it is comparatively a short time since that lock was made supposedly large enough.

Did the opening of the Canadian locks decrease the congestion? The superintendent told me they were passing up forty ships a day there.

The Sault Ste. Marie canal passed 119 vessels in one day this summer through the lock, carrying a tonnage greater than the entire tonnage which passed through the canal in 1855, the first year of its completion, such has been the growth of commerce.

A little over 106,000 tons passed through in 1855. This year the superintendent told me over 15,000,000 tons have already passed through; more than double the tonnage which passed through the Suez canal during the entire year.

I believe the day of long distance canals is over. Superintendent Wheeler said that he carried on investigations sufficient to enable him to state that a well-equipped railroad would carry freight as cheaply as a 1,000 ton vessel running on a parallel water route, traveling eight miles an hour. That settles the question of shallow long-distance canals. (Applause.)

The time has come when the Erie canal has lost, to a certain extent, its usefulness. Its boats are far below Mr. Wheeler's limit, and the railroads are carrying a large portion of the trade. Do you imagine that 9 feet of water will meet the demands of commerce, and sufficiently cheapen freight to satisfy the producers of the northwest and the consumers of the east?

The producers are entering into sharp competition with the farmers of Argentina, Russia, and India. Whenever the Nicaragua canal and the Panama canal are completed, the farmers of Dakota and the shippers of Superior will study which is the cheapest route. If they can ship their freight via Puget sound cheaper than through the route of the great lakes, breaking bulk at Buffalo, and through the shallow Erie canal, they will send their freight westward.

It is a question which more vitally concerns the east, whether this trade shall be diverted westward, or whether it shall follow the old lines to the seaboard and to the markets of the world. (Applause.)

I believe that the best route is the route which nature has pointed out. I believe that this convention should declare for a deep waterway around Niagara Falls, connecting this lake system together.

When we get to lake Erie the rest will be taken care of. New York will then see to it that all the smoke pipes don't run out of the St. Lawrence. We want the time to come when not only the productions of the west—wheat, meat, lumber and iron—shall be shipped to the markets of the world, but when the ore shall be made into ships, and the ship with its cargo sent to the markets of the world and both sold, and their net wealth returned.

We have the material and it is for us to make cheap transportation by improving the route which nature has pointed out, and removing the obstructions which nature left—which is most cheaply done—and it will afford the best facilities for the freight carriers, and then we shall settle the question of cheap transportation.

International questions need only extend to that portion of the St. Lawrence after we pass Ogdensburgh. Canada has already a water route from the great lakes to the sea. She has a canal with greater depth than we have, and yet we have almost the entire tonnage of the lakes.

She has a 14-foot channel through the Welland canal around Niagara falls, and she is improving her canals around the St. Lawrence, making a 14-foot waterway there; and yet this great northwest, groaning under the severe competition of the world, is compelled to break bulk at Buffalo, and unload its vast products into boats that are like peanuts and pay pool and elevator charges and other expenses which bear too heavily upon the producer.

Can't we have something which will be equal at least to our Canadian neighbors and have vessels adequate to our commerce?

We should make a 30-foot channel around the falls of Niagara, and the rest will follow.

It was said by some who saw the Erie canal under construction, that they would not wish to live longer than to see it finished. It was a prodigious work for the men of that day. Distinguished statesmen said when the construction of the Ste. Mary's canal was proposed, that you might as well build a canal to the moon. The growth of our population and wealth has been such that our vessels, which were considered visionary and extravagant when built, have become too small to accommodate the traffic. We must be broad, we must look well into the future. (Applause.)

REMARKS BY S. A. THOMPSON.

S. A. Thompson, of Duluth: France has spent millions of dollars upon waterways, as well as millions of dollars upon railways. I have a map at home showing in red ink and blue ink the improved rivers of France, and it looks like a colored plate showing the circulation of the capillaries and veins. You can not put your finger on any place on that map without touching a navigable waterway, either natural or artificial. They began in the century before Christ was born to build canals. Even through the dark ages of the decade which included the war with Germany, they kept it up.

When the people of this continent understand, as do the people of France, the value of these waterways, something will be accomplished. We find in certain parts of this country railroad men opposed to waterways improvements. Very recently there was an article published in Chicago concerning the insurmountable difficulties of the canal project. The people of England said that the Suez canal would never be built, and that if it was built never a single vessel would go through.

I want to tell you as a matter of fact that the best thing that could happen to every railroad in this country and Canada would be to have a waterway built 20 feet deep parallel to every mile of its track.

When they changed the depth of the water in the river Main from 4 to 12 feet between Frankfurt and Mainz, the railroads were greatly frightened. During the first year traffic increased 65 per cent. Of that increase the railroads got 36 per cent. The next year the business of the river had a further increase of 4[illegible] per cent. and the railroads had an increase of 54 per cent.

When they talked of building the elevated railroad in New York city, the surface roads thought it would destroy their business; but the surface roads to-day are paying better dividends than before the elevated was built.

It may be a surprise to some here to know that the Pennsylvania railroad either owns or controls and operates 800 miles of canal to-day.* When the great flood came a few years ago, and destroyed the canal along the Potomac river, money was furnished at once to reconstruct that canal; and men who are at the head of the Chesapeake & Ohio railroad say that the improvement of the Kanawha river was the best thing for their traffic. If they saw things as they actually exist, instead of opposing us, they would help us ask for $100,000,000 appropriation for deepening our waterways.

It is my judgment that the perfected invention of the machine—the Dutton lock—a model of which is on exhibition here—will do for inland

* NOTE—Railways own one-third of all the canals in England.—F. A. F.

navigation what the invention of the locomotive has done for railroad transportation. There have been on the continent of Europe twenty hydraulic locks. At the Fontinettes there is a double hydraulic lock which takes the place of five locks, and makes a transfer in six minutes, which used to take twenty-five.

Mr. Thorpe: I wish to make remarks referring to the former question. I wish to call the attention of Mr. Smith, of New York, to the fact that the time is not far distant when our dairy products will far surpass in importance, as articles of export, our grain products. You are doubtless all aware that these articles—butter, cheese, beef, pork—do not admit of much handling, and there would not be much profit in transporting them through a shallow canal where they have to be re-handled.

Even if the Erie canal as it now is would offer to carry these products free entirely, they would not be shipped that way. You are doubtless aware of this, although you may not have thought of it for the moment.

Thursday, September 26—Afternoon Session.

Session called to order by A. L. Crocker, who said that until a few topics which had been pushed forward on the program to accommodate belated authors could be reached he would call for extemporaneous speeches, and began with bringing forward Judge H. Henry Powers, M. C., of Morrisville, Vermont, following with others in the ensuing order:

GOOD-OF-THE-ORDER-SPEECHES.

Judge Powers: I am as intensely American as any man alive, but it seems to me that here is a question international in its character, to give to the people of both nations a highway to the sea. I do not care where it goes. Personally, I think the route by the way of Lake Champlain the best, but whatever the engineers say is wisest, we of New England will be satisfied with, provided we can have our deep waterway to the seaboard.

What we positively must do, however, and do soon, is to build a canal from Lake Erie to Lake Ontario. We need not take into consideration so much whether the inland canal can or can not carry ocean craft—we can rely on the shipbuilders to look after that.

One of the speakers last night proved satisfactorily that the whaleback is itself equally suitable for fresh and salt water travel. Let us not diverge from our original intention, or we will never accomplish anything. Let us stand by our declaration of principles, which is to build a deep waterway, not a nine-foot waterway, but an adequate waterway, to the seaboard.

Luther Allen, Cleveland: This is an utter surprise to me. I will simply say that the city of Cleveland, in which we all have a pride, has welcomed this convention with open hearts, assured that its objects were of vital importance. Our interests are the interests of every lake port. We have no petty jealousy against the City of the Straits, or our sister city at the foot of Lake Erie. We are all working together with a common impulse for the best interest of the country bordering upon these great inland seas. The fact that this convention has met in our city is proof, I think, that we stand a central point, equally friendly toward all, and if it shall be the pleasure of this convention, we shall be glad to have you come back to us again next year. We will endeavor at least to do as well as we have done this time, and better if posssible.

In relation to the qnestion which is before this convention, I have to say that Cleveland is intensely interested in it, looking at it from the broad, comprehensive standpoint of American citizens. We want this deep waterway. The American people want it. When I say the "American people," I mean the people on both sides of these great waterways as they now exist. We are all Americans. (Applause.)

It is my hope, and I think I voice the sentiment of the Cleveland delegation and of her chamber of commerce when I say we hope, that this convention may take tangible and effectual steps. I agree with the gentleman from Vermont that we should confine ourselves to one definite line of work. If we can get as the result of this convention, or of the labors of this association, a deep water channel on either side of the Niagara river connecting Lake Erie with Lake Ontario, the rest will take care of itself.

Gentlemen, on behalf of the maritime board and the Cleveland chamber of commerce, I return our hearty thanks for your coming. It has been a pleasure for us to meet you and to look into your faces and to note that you are earnest in what you propose to do. No convention that I have ever known during my connection with this city has brought together so earnest and intelligent and enthusiastic a body of men as I see before me here.

George H. Anderson, Pittsburgh: I am a little like Mark Twain, who said that his best extemporaneous speeches were always made after a great deal of preparation. I am not able to do justice to this subject on so short notice. We have been associated here with men of an unusual amount of intelligence and ability on the great subject which brought this convention together. I am proud to be connected with such a body of men. You are the pioneers in this deep waterway movement, and like all pioneers your leaders are men of enormous power and energy.

I am satisfied that in the lifetime of nearly all here present the results of our undertaking will be accomplished.

I want no better legacy of this sort to leave my children than the fact that I was here and in my humble way took part in these important deliberations.

If we carry out these great purposes that are inaugurated in this convention, they will dignify this nation and this continent to such an extent that we will command the admiration of the world.

I hope this is not the last time I shall have the pleasure of meeting with you, but that we shall renew our acquaintance some future day in Pittsburgh. Therefore, I will only say, God bless you, *auf wiedersehen.*

Col. F. B. Snyder, president Minneapolis city council: I preside over the deliberations of a body nearly as large as this, and which attends to the affairs of our fine city, which, by the by, has 200,000 people. Minnesota has an extent of 84,000 square miles. You could put down upon it all of New England and half of New York. Into her fresh-water lakes you could drop Rhode Island and not make a ripple. Minnesota has an extent of hard-wood timber which would cover the whole of the state of Massachusetts leaving out the Berkshire hills. You can put the whole of Ohio and part of Indiana on her green wheat fields; and up in the northwest are those great and extensive forests of pine from which we have been cutting for fully 25 years. We cut in Minneapolis alone more lumber than any other point in the United States—more than 500,000,000 feet a year. We have vast herds of cattle and sheep. Sleeping in mother earth, beneath the busy tread of her citizens, are vast ore beds waiting to be dug out and sold in all the corners of the earth.

Is it necessary when I tell you of all these things to add that we of Minnesota are heart and soul interested in the deep waterways project? I will leave you right here with this answer, a thousand times we are. I was entrusted with a very pleasant task when I left home, and with the permission of this body will present an invitation to meet next year if you choose, or at any time, in the beautiful city of Minneapolis.*

Horace B. Hudson, of Minneapolis: It seems hardly fair to call on a newspaper man to make a speech in public; but I am too much interested in the deep waterway subject to refuse to respond. I need hardly tell you what the interest of Minneapolis is on the deep waterway question. Mr. Snyder spoke of the great grain fields, the lumber interests, and the great mines of our state; but he did not tell you that the mills of Minneapolis are capable of producing 40,000 barrels of flour every day in the year. That means a large ship load every day.

Minneapolis is also, by reason of being the metropolis of the northwest---as we call it—the distributing point for merchandise of every kind for a territory which has now upward of 3,000,000 souls. We distribute more agricultural machinery than any other place in the world. Most of the goods sold in Minneapolis and St. Paul wholesale houses come from the east. It is therefore of great importance that Minneapolis should have cheap transportation for the goods which come from the east; and it is quite as important that she have cheap transportation for the products which she sends to the east.

Minneapolis is a convention city. We have handled the Christian Endeavorers, the Republican National convention, and other large gatherings, and we will do our very best if you will come to meet with us next year, or at any time.

Wm. Livingstone, of Detroit: I think you have had statis-

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*NOTE—Minneapolis, Sept. 25, 1895: The city of Minneapolis cordially invites the International Deep Waterways association to hold its next convention in Minneapolis.

We wish to assure you that the various public boards, as well as the citizens of that city, are in harmony with the aims and plans of your association.

The city has already expressed itself by formal resolutions, a copy of which we herewith hand to you.

Very respectfully,

FRED B. SNYDER, *President City Council.*
A. L. CROCKER, *President Board of Trade.*
J. F. COLDERWOOD, *President Commercial Club.*
HORACE B. HUDSON,
Secretary Northwest Business Federation.
JOHN C. RENO, *Delegate from State at Large and Chairman Waterways Com. Board of Trade.*

tics enough to last you for some time to come. I just want to say a word about the great, wide, open-hearted hospitality which we have received in this beautiful city of Cleveland; and I think I voice the sentiment of every member of this convention when I say, we appreciate it in the very highest possible degree. (Applause.) Attentions have been showered upon us at every hand, and it has been done in such a quiet, modest, unobtrusive way that it has given us no opportunity to say a word in response. I believe that Percival said somewhere:

> There are moments in life that we never forget,
> That brighten and brighten as time steals away,
> That add to the charm of the happiest lot,
> And lighten the gloom of the loneliest day.

I am sure every memb r of this convention who has enjoyed the pleasures and attentions of the last few days will, in the future, as the years go by, remember the hospitality we have received here. I can say from personal knowledge that Cleveland don't know how to do otherwise. I have become so accustomed to it that I expect these things whenever I come to Cleveland, but I like it just the same. (Applause.)

John E. Shaw, of Pittsburgh: I wish to tender my compliments to the chairman for calling upon me to speak upon this occasion. I consider it a distinguished honor to be a member of a body like this.

I don't suppose that any district in the United States can sympathize with the objects of this convention so fully as the district from which I come. I have been impressed with the remarks made here, that the great lakes commerce is bottled up at the foot of Lake Erie. You have the cork out of the bottle through the Welland and Erie canals; but at Pittsburgh we are hermetically sealed, so far as the cheapest possible transportation is concerned.

The greatest volume of commerce will always move along the line of least resistance; and the line of least resistance is the line of lowest cost to transportation; and the line of lowest cost for transportation is the modern waterway.

In Pittsburgh we are proceeding along practical lines in this direction. The investigations we have made in regard to deep waterway transportation have been very interesting, and have developed some startling results. One of them is the probable effect upon your lake cities. I am pleased to know that you call your neighboring cities sisters. It is a common thing in Pittsburgh to call Cleveland our sister city; and our inter-commerce communications between every city on the lakes are of such immense volume that we cannot afford to be out of the sisterhood.

One-half of the commerce which comes through the Sault canal is the crude material which you send to us, and which we return to you in the manufactured article. One-third of all the commerce of the Detroit river is the same.

But there is a barrier between the lakes and Pittsburgh to overland transportation, which Pittsburgh, single-handed and alone, is going to pull down.

Note the effect of that on the lake cities. On careful investigation I have found out that six of our lake cities consume in one year 16,500,000 tons of bituminous coal, and that through our waterway, on the most conservative estimate, we can carry that coal to these cities at such a reduced cost from present transportation as to make the cost of coal in Duluth and Superior $1.50 a ton, and in the same proportion all along the way.

That means a saving on the price of coal to these six cities of $11,500,000 a year; and that is enough in less than 20 years to build a $200,000,000 waterway from your lakes to the ocean. (Applause.)

If this economy is introduced between your ore fields and our coal and coke fields, the conditions are present for the introduction of economy in the manufacture of iron and steel, which will create a commerce that will demand, as Captain McDougall said, four channels to handle the business from the lakes to the Atlantic seaboard.

I appreciate this educational work which th's convention is doing. It is the corner stone upon which must be built the final, lasting structure.

But, instead of taking more of your time I will say that, as your tireless and omnipotent executive secretary has invited me to a place on your program, I will p:esent my paper now, without reading it, for your consideration at leisure in the formal volume of proceedings.

I hope the association will continue to meet until its great objects have been fully attained. And sometime I hope—indeed I am sure—you can come on a vessel out of Lake Erie to Pittsburgh for your convention :

The Relation of the Lake Erie and Ohio River Ship Canal to the Commerce of the Great Lakes and to the Commerce of the Proposed Deep Waterway to the Atlantic Ocean.

JOHN E. SHAW, SECRETARY PROVISIONAL COMMITTEE, LAKE ERIE AND OHIO RIVER SHIP CANAL.
Pittsburgh, Pennsylvania.

IRON AND STEEL: In 1894 Pennsylvania produced 3,657,388 tons of pig iron, or 50.6 per cent. of the total production of pig iron in the United States. In 1894 Allegheny county produced 1,782,079 tons of pig iron, or 26.8 per cent. of the total production of pig iron in the United States. In 1894 Ohio produced 900,029 tons of pig iron, or 13.5 per cent. of the total production of pig iron in the United States. In 1894 Illinois produced 604,995 tons of pig iron, or 9.09 per cent. of the total production of pig iron in the United States. In 1894 Allegheny county produced 52.9 per cent. of the total amount of pig iron produced in Pennsylvania. In 1894 Allegheny county, Mahoning and Shenango valleys produced 2,596,515 tons of pig iron, or 10.3 per cent. of the total production of pig iron of the world. For the first half of 1895 Allegheny county, Mahoning and Shenango valleys produced 1,648,370 tons of pig iron, or 40.3 per cent. of the total production of pig iron of the United States.

The amount of ore required by these three districts for the year 1894 was 4,154,424 tons; and the amount of ore required by these three districts for the year 1895, on same ratio of increase for last half of 1895 over first half, as last half of 1894 shows over first half, about 54 per cent., will be 6,939,539 tons, of which Allegheny county will require 4,150,680 tons, and the Mahoning and Shenango valleys 2,788,859 tons.

In 1894 the total amount of pig iron, crude steel, and rolled iron and steel made in Allegheny county, Pa., was 5,171,949 tons. In 1894 Allegheny county's production of rolled iron and steel amounted to 1,496,204 tons, which was equal to 52.2 per cent. of the total production of rolled iron and steel of Pennsylvania, and 31.25 per cent. of the total production of rolled iron and steel of the United States.

In 1893 Pennsylvania made 3,215,686 tons of Bessemer steel ingots, which was 66.12 per cent. of the total amount made in the United States.

In 1893 Pennsylvania made 63,613 tons of crucible steel ingots, which was 81.27 per cent. of the total amount made in the United States. In 1893 Pennsylvania made 737,890 tons of open hearth steel ingots, or 83.55 per cent. of the total amount made in the United States. In 1894 Pennsylvania made 2,865,392 tons of rolled iron and steel, or 59.8 per cent. of the total amount made in the United States. In 1894 Pennsylvania made 714 935 tons of Bessemer steel rails, which was 70.36 per cent. of the total amount made in the United States.

COAL: In 1893 the counties bordering on the canal produced 26,283,262 tons of coal, of which there was loaded at mines for shipment, 17,749,110 tons; 7,541,487 tons were made into coke, and 992,665 tons sold to local trade and used at mines for steam and heat.

Of the above total production in 1893, the Monongahela river counties produced 24,780,081 tons, and of this 23,679,147 tons were produced in Allegheny, Westmoreland, Fayette and Washington counties, and of the total of said Monongahela river counties there was loaded at mines for shipment 16,348,717 tons, 7,541,487 tons were made into coke, and 889,877 tons sold to local trade and used at mines for steam and heat. About 3,000,000 tons of coal is annually shipped eastward from the Pittsburgh district. In the year ended June 30, 1895, 1,441,540 tons of coke was shipped to points east of Pittsburgh.

In 1894 the bituminous coal sent to Lake Erie ports from Pennsylvania amounted to 7,761,391 tons. In 1894 the bituminous coal sent to Lake Erie ports from Ohio amounted to 2,971,134 tons; and the amount of bituminous coal sent to Lake Erie ports from West Virginia in 1894 was 512,264 tons. In 1894 the bituminous coal forwarded by vessel from Lake Erie ports amounted to 5,452,029 tons; and the amount of bituminous coal consumed at Lake Erie ports in 1894 was 4,793,260 tons.

In 1894 the total amount of coal passing up through the Detroit river was 6,264,590 tons. In 1892 the total amount of coal passing up through the Detroit river was 7,318,126 tons. In 1892 the total amount of bituminous coal passing up through Detroit river was about 5,000,000 tons. In 1895 the amount of bituminous coal psssing up through the Detroit river will probably exceed that amount, of which at least two-thirds, or 3,300,000 tons, will come from the Monongahela valley.

In 1894 the bituminous coal passing up through the Sault Ste. Marie canal was 2,264,314 tons; two-thirds of this, or 1,509,543 tons, came from the Monongahela valley.

In 1894 the Pittsburgh, Mahoning and Shenango valleys ore coming through the Sault canal amounted to 4,154,424 tons; and in 1894 the Pittsburgh coal going up through the Sault canal amounted to 1,509,543 tons, making a total of 5,663,967 tons.

In 1895 the Pittsburgh, Mahoning and Shenango valleys ore passing through the Sault canal, estimated requirements, will be 6,939,539 tons; and the amount of Pittsburgh coal, estimated, to pass up through the Sault canal will be 2,200,000 tons, making a total of 9,139,539 tons.

It is safe, therefore, to say that the coal and ore tonnage of three districts furnishes considerably over one-half the entire tonnage of the Sault canal, which, in 1894, was 13,195,810 tons; and more than the total tonnage of the Suez canal, which was in 1894, 8,036,175 tons; and the coal and ore tonnage through the Detroit river, according to the above estimate, for 1895 would be 10,239,539 tons; which is over one-third the entire commerce through the Detroit river in 1894, which was 24,263,868 tons. From these figures is apparent the very prominent part taken by Pittsburgh and the Mahoning and Shenango valleys in creating the tonnage movement of the great lakes.

The tonnage of the Cuyahoga customs district (which only embraces Cleveland, Ashtabula, Fairport and Lorain) in 1890 was 9,929,378 net tons; and as the above iron and coal producing districts on the proposed canal do the largest part of their lake business from these ports, they furnish in a large part the tonnage of that district.

COKE: Total coke produced for the year ended June 30, 1895, was 7,411,360 tons. The coke shipped west to Pittsburgh for the year ended June 30, 1895, was 3,604,220 tons. Pig iron produced at the points below, west of Pittsburgh, during the same year is as follows:

Shenango Valley	715,000 tons.
Mahoning Valley	523,043 tons.
Illinois	765,075 tons.
Total	2,003,118 tons.

It takes one ton of coke to make one ton of pig iron; therefore the above represents the amount of coke that went to each of these points for blast furnace use.

There is now lying in the harbor of Pittsburgh, loaded in boats, about 1,100,000 tons of coal and other heavy freight, awaiting a rise to go down the Ohio river. This is a larger tonnage than was ever accumulated in the harbor of any city in the world.

The total tonnage of American vessels of the entire great lakes, January 1, 1895, at the twenty ports where there are custom houses, was 1,232,963 tons; so that the present tonnage loaded on vessels in the harbor at Pittsburgh would fill to full carrying capacity at least 60 per cent. of the American vessels on the great lakes.

From the statement of the National Association of Car Service Managers, for the year ended March 31, 1895, we find that the full car loads receiving and discharging cargo in the cities named below were as follows: New York and New Jersey, 596,473; western New York including Buffalo, 512,007; Philadelphia, 1,108,940; Chicago, 638,739; Pittsburgh, 1,211,725, Mahoning and Shenango valleys, 315,663. It will thus be seen that the Pittsburgh district handled more full car loads than any of the other associations named, and its territorial limits are smaller than any named except the Mahoning and Shenango valleys. Considering the heavy character of the freight handled at Pittsburgh, a fair estimate of tonnage of these cars would be twenty tons per car; and therefore, the tonnage represented by the cars handled in the Pittsburgh district would be 24,234,500 tons; and for the Mahoning and Shenango valleys, 6,313,260 tons; or a total for the two districts of 30,547,760 tons, representing only as stated, full car loads.

FINANCIAL BENEFITS TO LAKE CITIES AND COMMERCE, AND TO THE CITIES AND COMMERCE OF THE TERRITORY REACHED BY THE CANAL FROM ITS CONSTRUCTION AND OPERATION: In 1894 the ton mileage rate on ore on the great lakes was $\frac{89}{100}$ of one mill per ton per mile; on coal, $\frac{37}{100}$ of one mill per ton per mile; on wheat, $\frac{66}{100}$ of one mill per ton per mile; on coal on the Erie-Hudson canal, $1\frac{20}{100}$ mills per ton per mile; on coal from Pittsburgh to New Orleans via Ohio and Mississippi rivers, including return of empty barges, $\frac{33}{100}$ of a mill per ton per mile.

The ton-mile rate on ore from Ashtabula to Pittsburgh, including transfer at lake, which is charged in the freight rate, is $8\frac{85}{100}$ mills.

The ton-mile rate on coal from Pittsburgh to Ashtabula, including transfer at lake, is 8 mills; the rail carrying rate, not including transfer, is $6\frac{93}{100}$ mills; on ore from Ashtabula to Mahoning valley, including transfer at lake, is $7\frac{66}{100}$ mills.

Allowing the canal a toll of 25 cents a ton on ore to Pittsburgh, 15 cents a ton to Mahoning and Shenango valleys, on the basis of a branch canal to reach the furnaces on the Shenango vall y, and 20 cents per ton on coal from Pittsburgh through to Lake Erie, allowing the vessel one mill per ton per mile through the canal, which is about two times the average rate at which coal and ore were carried on the lakes in 1894, one-third more than that for which wheat was carried, $\frac{20}{100}$ of a mill less than the rate for coal on the Erie-Hudson canal, and three times more than for coal down the Ohio river, the saving on commerce and the earnings of the canal will be as follows: Saving to the furnace operators on ore in the Allegheny county, Mahoning and Shenango valley districts, \$4,478,898.74 for the estimated requirements for 1895, and total earned for the canal, \$1,455,998.85. The saving on coal on deck of steamer at Lake Erie ports would be 72 cents per ton. At this rate the saving on coal going to Lake Erie ports from Pennsylvania in 1894, would be \$5,588,561.52, and the revenue to the canal would be \$1,552.378.20.

In six lake cities in 1893 the consumption of bituminous coal was 16,462,328 tons. Pennsylvania being so large a factor in supplying the consumptive demand of the lakes, under present conditions of transportation, it is apparent that when coal going through the canal can be sold at 72 cents per ton below present rates, it will fix the price of all bituminous coal sold on the lakes; and a reduction of 72 cents per ton on the above amount consumed in six lake cities, would be a saving on their fuel account per annum of \$11,852,876.16, a sufficient saving in the fuel account of six lake cities in 20 years to build a \$200,000,000 deep-waterway from the lakes to the ocean, making it apparent at once that the commercial benefits of the proposed canal to the great lakes is vastly superior to that which Pittsburgh alone will secure, and yet Pittsburgh is going ahead single-handed and alone to build this canal with whatever help she can secure outside, and will gladly concede any benefits to any or all lake cities, from its construction and operation.

At the present average cost of coal at the tipples in the Pittsburgh district, to any vessel, namely 80 cents per ton, coal can be sold alongside at the Lake Erie ports, coming through the canal at \$1.13 per ton; and the vessels engaged in this traffic can get their full supply at the selling price at the tipples, which, at present is 80 cents per ton. Adding the average rate by lake on coal for 1894, Pittsburgh coal can be sold alongside, at the lake cities named below, for the following prices: Chicago, \$1.61½; Milwaukee, \$1.61½; Superior and Duluth, \$1.50½; Green Bay, \$1.62½; Manitowoc, \$1.61; Detroit, \$1.38; and for Canadian supply could be sold on board vessel at head of the Welland canal at about $1.20. Adding 15 cents to the Lake Erie price for transfer at Buffalo, and 60 cents per ton—the Erie canal rate in 1894 to New York—Pittsburgh coal could be sold alongside at New York harbor at $1.98. And when the deep waterway to the ocean is completed, with the cheaper cost of transportation and without breaking bulk, Pittsburgh coal could reach New York and be sold alongside at $1.63 per ton.

A comparison of the selling prices of bituminous coal in the lake and Canadian cities and New York harbor, will make apparent the commercial benefits from these proposed deep waterways. That the present railroad systems, or any proposed system of overland carriage by rail can never bring about this enormous saving to commerce is also apparent.

There are nine railroads operating wholly or in part betwen Pittsburgh and the great lakes; the total cost of road and equipment of these lines is $172,141,738.82. The average ton-mile rate on all freight on said lines is about 6½ mills, which is below the ton-mile rate above given on the ore and coal coming to and going from the Pittsburgh district, and yet the financial statements of four of these roads has recently shown a net loss on their business. As the lowest class traffic has required a ton-mile rate above the average of that of the total freight carried, it is not hard to see that it would have been business economy for these railroads to have put a sufficient amount of the enormous cost of their roads into a ship canal and had it relieve them of this low-class freight.

Coke has not been considered in the above statements to the producer and consumer, and yet as above shown the coke that went to the Illinois blast furnaces for the year ended June 30, 1895, was 765,075 tons. The present price of coke at the ovens is $1.35 per ton; rail freight to Pittsburgh 65 cents per ton; and allowing 15 cents per ton for transfer to deck of steamer, the same rate through the canal as on coal, and the same rate on lake as on coal, coke could be sold alongside in Chicago at $2.96½, or say $3.00 per ton. The present selling price at Chicago of coke is $4.00 per ton.: or, in other words, representing a saving to the furnaces at South Chicago and Joliet, which make practically all the pig iron of Illinois, of $765,075 on the coke required for the year ended June 30, 1895.

Besides, coke could be sold at Cleveland at $2.48 as against $2.90, the present price. The rate on coke to Braddock on the Monongahela river is 15 cents less than to Pittsburgh, and by making the transfer there to lake vessels, and going through one lock on the Monongahela river, and through the canal, would make the price of coke at Chicago and Cleveland about 12 cents per ton less than the low prices above given.

From the figures given, the beneficial results to commerce from the construction of waterways connecting Lake Erie with the coal fields of western Pennsylvania, Ohio and West Virginia, ought to be apparent. In thus connecting the ore and fuel, the fuel supply of the great lakes and the cost of manufacturing will be so materially reduced to all the territory between the ore and coal fields that it will result in a tidal wave of commerce to go out through the proposed deep waterway to the ocean that will reach the shore of every nation of the world.

GOOD-OF-THE-ORDER SPEECHES (CONTINUED).

Chairman Crocker: We will resume our enjoyment of five-minute speeches:

Rev. R. G. Hutchins: This takes my breath away. I had supposed that being a minister gave me immunity in this company from speech-making.

But I am profoundly interested in the work you are undertaking. The grandeur of human enterprise is simply sublime. It seems to be the fashion of the hour to boast a little. The coal fields of Pennsylvania have been spoken of; one-third of the whole surface of the state of Ohio is underlaid with coal.

I suppose we have salt enough in Ohio to savor the whole earth, if all other supplies should fail; and we have oil and building stone, and it is unnec y to say that we have gas here. (Laughter.) So you can imagine what this deep channel to the sea will mean to Ohio. We have prided ourselves that we are in the gateway between the east and the west; that the transcontinental lines of railroad must pass over our soil. But the grand characteristic which is most impressive is the presence of the lake on the north, connecting us with the great fresh oceans to the west and the Atlantic to the east and the river on the south connecting us with the Mississippi and the gulf. You are in a noble work and I thank you for the courtesy you have extended to the pulpit in requesting these few words.

Major N. S. Boynton, Port Huron: I have been educated since I came here. I know more than I did when I arrived, but one thing has not been discussed as much as I would like to have it, and that is: How are you going to maintain the levels of the great lakes after you have tapped them on all sides and at both ends? I know my friend Mr. Wisner said it could be done by damming Lake Superior on the north and the Niagara river on the east. This is a problem that has to be solved by the engineers who have knowledge of these things. I have watched during the last forty years the fluctuations of the water in Lake Huron and the St. Clair river. In my own city we have what is known as Black river. Thirty years ago it ran at the rate of three to four miles an hour the year round. To-day, seven months in the year it has no current at all, because the country has been settled up. I can remember when that country was all timber-land and swamp; and the water fell from the heavens and remained to a certain extent upon the surface, and found its way down the stream till it reached the St. Clair river or Lake Huron. The same is true of the Saginaw river which enters the Saginaw bay.

Are you going to have rainfall enough to keep the levels of the lakes, so you can get a deep waterway from Lake Superior to the sea? For the last three years the government dredges have been working at my place, and three days before I came here I was told by a civil engineer that Lake Huron at that point is eight inches lower than it was last year at this time. He holds with me that the deeper you make your channels, the more water will flow through them; and the more water that flows through them, the lower the lake levels will become. You propose to tap Lake Michigan at Chicago, as has been admitted by Mr. Cooley, at least three inches if not six; then here you are going to tap Lake Erie—which is already tapped—with a canal running down to Pittsburgh.

Mr. Blasdel: May I interrupt you a moment? Chicago only proposes to divert 5 per cent. of the water that passes your city of Port Huron; and 5 per cent. of retention or storage would equal 5 per cent of the diversion—no damage.

Mr. Boynton: The world is sort of tipping on account of Chicago. New York won't be in it after awhile; she will be tipped way up high and dry, and Chicago will pull the world all over that way. Can you maintain the level of the lakes and get this deep waterway down to the seaboard?

Mr. Blasdel: Certainly; and by regulating the outflow have higher general levels and deeper harbors than ever before.

Lieut. Geo. P. Blow, U. S. Navy, Chicago: I did not expect to be called upon to speak on this or in fact upon any other subject. I consider it a very great compliment, however, to be called before such an association as this. While I do not object to speaking to you as an individual, you all will appreciate the fact that I can not speak in an official capacity, which leaves me in a rather awkward position. As a representative of the United States Navy department, although not a delegate, I have been accorded the very great privilege of attending this convention as a student, for the purpose of study and information.

I take a great deal of pride in having been with this association at its birth, when the idea first originated. I have seen it as a germ, and have seen the germ develop. I am proud to say still further, that the idea of deep waterways in its present form, while new to some, is not altogether new to the navy, as I have been working in the same general line from the time that I first came upon the great lakes as a representative of the hydrographic office.

They say that "familiarity breeds contempt.' You, gentlemen, who have lived on the lakes all your lives, do not realize what you have before you. Three years ago I was ordered on the lakes as a representative of the hydrographic office of the navy at the world's fair. I do not think since my arrival at Chicago there has been a day that I have not marvelled at these great lakes and their possibilities. There has not been a day that I have not learned something new of them, something which to me is still astonishing.

As I said before, I do not think you realize what the possibilities of the future are. In following up my investigations, I have succeeded in obtaining a great deal of valuable information which has been placed upon our hydrographic charts. At first I found it very difficult to obtain correct data, but I got the best and most reliable that I could and published it. This information was appreciated at once, and it soon became much easier to collect data for the hydrographic office publications.

About this time the call for the convention at Toronto was issued and I was ordered there as one of the delegates. From that time I have seen a wonderful increase in the amount of interest in such matters as deep waterway communication, cheap transportation, and kindred subjects, and as an outsider who has no business interest involved in this matter, and as a citizen of the United States, and not of any particular locality, I am possibly better able to appreciate this growth than many of those present.

At the first convention we suffered from what may be called a famine of information. But the germ was there. It has developed, and it will take months to properly assimilate the valuable information which has been placed before us, and now we are actually suffering from indigestion.

My remarks are of a purely individual character, and express my own personal opinions; but I think the fact that a naval officer is present under orders is an indication of the direct interest the navy department has in the objects of this convention. I think also the fact that the navy department has extended its hydrographic office service to the lakes is a further indication of direct sympathy with the movement.

It must be remembered that no one department is authorized to express or outline a policy for the government. Hence to avoid any possibility of misconception, I have found it desirable, and consider it proper, that I should withdraw from all active participation in this convention. It was not from any lack of interest, but because it would be in decidedly bad taste for me to take any active part in discussions, when I am here merely for observation and instruction.

I wish to congratulate you, gentlemen of the convention, and also the public at large, and the citizens of the United States and Canada, upon the progress which has been made in one short year. I believe that the ideas which have been given utterance here by men who have made these things the study of their hearts and lives, will be distributed by the press and by each one of us and our friends, so that the next convention will show a still more overwhelming opinion in favor of the objects of this association. I do not intend to discuss matters of policy; but I will say, referring back to the eloquent address of Mr. Seymour this morning, which to me is conclusive, that the first "Sault" canal was built when the territory surrounding Lake Superior was almost unknown, and yet before that canal was completed the demand had outgrown the limits and capacities of the locks, and another canal had to be built alongside of it. A third increase of size and capacity is nearly completed and the traffic is still increasing, and before long there will have to be a fourth enlargement of the Sault canal. I believe that the same relative conditions will exist in the future if we build one canal to the sea—there will be business enough for two, and possibly for all three of the routes. So far from one canal taking away the business of the other, it will develop the country and make business for it. These are my personal opinions, and must not in any way be taken as official expressions. It is not the opinion of an over-enthusiast; it is based on what has gone before, and what is likely to follow. (Applause.)

Chairman Crocker: This means that the navy of the United States says, practically, that it expects ocean navigation in these lakes. Let us now hear from Gen. Jared A. Smith of Cleveland.

Col. Smith: If there is anything a man wants in the army it is promotion. I have been waiting to get the title of general for the last 30 years, and have come just as near it as the boy was to being twins. He came within one of it. Some six years ago I was on duty in the state of Maine. The two political parties, the Democrats and the Republicans, in their state conventions took occasion to pass resolutions condemning the improvement of our highways by water at public expense. They denounced, especially, the improvement of the Mississippi river, and every western improvement. They said it was a great waste of public money, and they protested against it, and against paying taxes to pay for the improvements on our western lakes.

At that very time there wasn't a man in the state of Maine who put a biscuit into his mouth, but ate it at less expense than he would, if the Mississippi river and other western waterways had not been improved.

The state of Maine did not raise oats enough to feed its horses, and the food of her people would be insufficient without the produce of the west.

This principle is general and a reduction of rates, such as follow directly or indirectly from deepening our waterways, is of benefit to all, not only the producer and consumer, but other hands through which the produce passes. The vender of fruits upon the street corner can deal in articles which were otherwise beyond his range, and the farmer sells his produce at home at better rates than he could otherwise receive in the neighboring village.

But the people in those Maine conventions had not looked into this subject. They had no assemblies like this to enlighten them upon the subject of the great causes and benefits of cheapened transportation.

Within my own recollection on the subject, rates by rail from the interior to the seashore have been reduced more than one-half and without loss to the railroad. Grain has been shipped from St. Louis to Liverpool at less rates by the Mississsippi river route than it costs to ship it to New York by rail, and that is one of the reasons why freights by rail have been reduced.

But the great lakes and connecting rivers make another

competing route A few years ago the city and state of New York were losing some of their commerce by reason of these routes and the tolls upon the Erie canal. It was impossible to get freight from Buffalo to New York or intermediate places to New York at such rates as would give the best results to the business and commerce of the cities and state. The matter was represented to the legislature of New York state with the result that the canals were made free. This because more money could be made for the state with canals free than when charging tolls.

I remember some years ago reading a speech made in congress by a representative of an eastern state who said that New York had built its own canals by levying taxes upon its people, therefore, let the west improve its own water channels. In the annual report of Mr. Seymour, who at that time was state engineer of New York, it is stated in substance that the people of New York have never paid a cent of taxes for the construction or maintenance of the canals of the state, but on the other hand these canals have brought a surplus into the treasury of the state over and above the cost of construction, maintenance, operation and repairs—an excess over all these of some forty millions of dollars!

New York simply used its credit in bonds, which were sold and the canals were built with the proceeds. The bonds were redeemed and the great surplus paid into the treasury by receipts from tolls.

Who paid those tolls? I think that one of those farmers down in New England paid for a part when he bought his barrel of flour. I think the western farmer paid for a part in his decreased receipts for produce and in the smaller price of his farm and everything that he owned.

Every saving in the cost of transportation from the grain fields of Manitoba and Minnesota or elsewhere is increasing the area which can be profitably tilled as well as giving greater benefits to that which is already under cultivation.

[At this point the speaker was interrupted by the return of committees to report]

RESOLUTIONS PRESENTED AND ADOPTED.

By Geo. H. Anderson, of Pittsburgh:

Resolved, That this convention extends its heartiest thanks to the maritime board and the chamber of commerce of Cleveland, for their generous welcome to and graceful entertainment of, as well as the liberal and complete provision for the present gathering and for the many kindly courtesies extended to officers, delegates and guests.

By George Y. Wisner, of Detroit:

Resolved, That the thanks of this convention and of the International Deep Waterways association are heartily extended to the several departments of the governments of Canada and the United States, and especially to the secretary of state and the secretary of the navy in the latter, and the minister of railways and canals of the former country, for many generous and valuable services to the officers of this association.

By Alex. R. Smith, of New York:

Resolved, That all the people, and the transportation interests of the United States and Canada, have been materially served and benefited by the splendid contributions of those who furnished essays, papers, maps, models, debates, labor and money for this convention, and that we hereby extend to them, on behalf of the public, our most heartfelt thanks.

By C. W. Baine, of Cleveland:

Resolved, That under the constitution, the executive board of the International Deep Waterways association be and is hereby empowered to continue the work of agitation and legislation, to publish the official proceedings of this meeting, together with such other matter as may be deemed advisable, and to provide generally for continuing the present deep-water campaign.

By W. T. Harris, of Defiance, O.:

Resolved, That this convention is deeply indebted to the officers and agents of the United Press and the Associated Press and their collateral organizations, for promptly and freely distributing to the newspapers of the world facts and information regarding this gathering, and also of full and accurate proceedings thereof; and be it further resolved, that the convention and the association are indebted, and extend their cordial thanks, to the entire newspaper fraternity, and quite especially to that of the city of Cleveland, for the ample and faithful manner in which they have promoted the interests and published the proceedings of this gathering.

By Isham Randolph, of Chicago:

Resolved, as strongly as words will express, That the gratitude and thanks of this convention are hereby extended to the officers of the International Deep Waterways association, and most especially on behalf of all the interests involved in both countries, to its executive secretary, for the energy, ability and single-mindedness with which this great international enterprise has been carried forward to a successful and permanent issue.

By O. A. Thorpe, of Chicago:

Resolved, That this convention extends cordial greeting to the great Southwestern Waterways convention to be held in Vicksburg on October 22 and 23 next, and wishes them every success in the attainment of their great object, and that the executive board send delegates to represent their organization in that convention.

By Lewis M. Haupt, of Philadelphia:

Resolved, That the International Deep Waterways convention assembled at Cleveland extends its cordial greeting to the great western states conference to be held at Topeka, Kansas, October 1, 2 and 3, and wishes them every success in the attainment of their great object, and that we sympathize with all efforts to cheapen transportation through adequate waterways.

By Hon. Martin Pattison, of Superior:

Resolved, That the profound gratitude of the people of the United States and Canada is due, and by this convention in their behalf is tendered, to Hon. William F. Vilas, of Wisconsin, a senator of the United States, for the wise management and unflagging zeal which resulted in the enactment, in March, 1895, of a law creating an international commission to investigate and report upon the entire subject of an adequate ship channel from the great lakes to the ocean and of controlling the levels of the said lakes in the interest of navigation, by international co-operation or otherwise; and the same thanks are due and hereby gratefully extended to the Dominion authorities for their prompt and complete reciprocal recognition of the said enactment.

DETAINED DELEGATES.

At this point Mr. Flower read letters and telegrams from Archbishop Ireland and others who were expected to be present and said: "I have been holding open the program for Thomas Curtis Clarke, of New York. Word comes that he is prostrated by the intense heat and can not undertake the journey. His paper, therefore, may as well be disposed of at this time.

"I have also a cordial letter from Eugene T. Chamberlain, commissioner of navigation of the United States, whose progressive writings and sound conclusions in transportation economics have been quoted in this convention by Prof. Tunell. You will not consider it inopportune, I hope, if attention is called at this time, to the free participation by papers, letters and personal presence of public officers from both sides of the boundary. We have no less than four Canadian officials here in person; an elaborate paper by the Dominion statistician; two representatives of the United States navy and two of the United States war department, besides a liberal sprinkling of congressmen and many letters of sympathy and endorsement from persons high in public station.

"This will be regarded as a most encouraging indication of a general effort on the part of the governments to draw nearer to the people than it has hitherto been thought a duty, in order to learn by personal presence, in voluntary and representative gatherings, not only what the masses are doing and demanding, but in precisely what temper they are demanding and doing.

"I assure you most heartily, that of the wide and pleasant correspondence growing out of our movement, no letters have given me more satisfaction than those by branches of government announcing that delegates had been appointed to our convention.

"I will now lay Mr. Clarke's paper before you:"

New York and Deep Water to the Great Lakes.

THOMAS CURTIS CLARKE, C. E., M. A. S. C. E.
New York.

At the Toronto Convention last year, Mr. Cooley spoke the plain truth when he said: "The line of domestic transportation determines the line of foreign shipment."

The history of the New York and Canadian canals shows this so clearly that he who runs may read. These canals were begun about the same time, and have been gradually enlarged until the Erie Canal can now pass boats of 250 tons burden, and the Canadian canals vessels of about four times that capacity.

The distance from Chicago to New York, by the Erie Canal and the lakes, is 1,373 miles, of which 350 miles is artificial navigation.

That from Chicago to Montreal is 1,263 miles, of which but 70 is artificial navigation.

Owing to the less total distance and greater length of deep water, grain was carried from Chicago to Montreal for an average rate per bushel, in 1893, of 5⅝ cents, while the rate from Chicago to New York by the lakes was, in 1893, 6¼ cents per bushel.

Notwithstanding the higher cost by the Erie Canal route, its tonnage in 1893 was 4,275,662 tons, and that of the Welland 1,294,823 tons, of which only 663,156 tons went to Montreal; the rest crossed Lake Ontario and went to New York.

The reason why so much more freight goes to New York than by the cheaper route to Montreal is because the greater part is intended for domestic consumption, and New York is a better market than Montreal.

Hence it is agreed, by Americans at least, that New York is the port to be aimed at, and the question is how to cheapen transportation thither.

The cost of transportation can be lessened either by very deep ship canals or by canals deeper than those at present in use, connecting with lake vessels and requiring trans-shipment.

If a ship canal is built at all it should be deep. The Suez Canal is twenty-seven feet deep, and the ships passing through it draw so much water that there is seldom over two feet of water under their keels. The best speed they can make is four and a half miles an hour.

A ship canal between our lakes and the ocean should at least provide for a vessel like the new steamer Victory, 380 by 48, and carrying on twenty feet draught 7,000 net tons, or 233,000 bushels of grain. The prism of the canal should have a bottom width of 150 feet and a depth of not less than 25 feet.

The economical speed of a steamer like the Victory in deep water is thirteen miles an hour; and in such a canal, with five or six feet of water under her keel, she should make seven miles an hour. With modern improved locks the time of lockage, including slowing, should not exceed half an hour.

Unless the ship canal is given these dimensions, transportation through it will not be as economical as by a canal of nine feet deep, including cost of transferring into barges, as we shall hereafter show.

Without going into long descriptions, we may say at once that there is but one place where such a large ship canal as we have described could possibly be built.

The routes suggested for ship canals are:

Looking at the less cost of transportation to Montreal, it has, naturally enough, been thought by some persons that if the Welland and St. Lawrence Canals could be deepened to twenty feet, and their locks enlarged to the capacity of the St. Mary's Falls Canal, and if the present small canals connecting Lake Champlain on the north with the St. Lawrence, and on the south with the Hudson, could also be made ship canals, this would be the true solution of the problem.

The distance from Chicago to New York is 1,670 miles, of which 175 miles would be artificial navigation. Twenty feet would not answer, and to make these canals twenty-five feet deep would require many miles of under-water rock excavation in the St. Lawrence and in Lake Champlain. The Welland, St. Lawrence and Champlain Canals would have to be entirely rebuilt; but the most serious difficulty would be want of water.

There is a summit between Lake Champlain and the Hudson of fifty-four feet, and the topography of the country would prevent cutting deep enough to feed the Champlain Canal from Lake Champlain. The necessary amount of water for navigation could only be supplied by constructing vast storage reservoirs sufficient to hold the whole rainfall of the Eastern Adirondacks, and cutting off the water from many manufacturing interests now supplied by it.

The cost of a ship canal (one twenty feet deep), including the enlargement of the Canadian canals, which would have to be done by the Dominion government, is estimated by E. L. Corthell, civil engineer, a very high authority, at a total of $102,000,000, without damages for diversion of water. To make it twenty-five feet deep would be impracticable on account of cost. Moreover, in case of war, the Canadian end of this route could be shut by Canada, while their own canals would remain open and give access for warships to the upper lakes. Thus, from a military point of view, it is undesirable; while commercially, we shall show later that it is not as economical for transportation as a less expensive route.

Plans for improving the Erie Canal were suggested by Mr. Sweet, state engineer, in his report to the legislature of New York ten years ago. He says:

There are two methods of improving the Erie Canal, and, in my opinion, only two worthy of consideration.

The first is to increase its depth one or two feet by such deepening of the channel and raising of the banks as are consistent with maintaining the integrity of its present structures, and to lengthen the locks to facilitate the use of steam by permitting boats to be locked in pairs. This system of improvement would give the best attainable result for the boats now in use and to the consort syst m of ste m towage for their movement.

The second method is to enlarge it to such an extent as to make it available for the steamers navigating the lakes—a class of vessels of large tonnage and moderate power and speed, which are rapidly displacing all other merchant marine for freight traffic on the lakes and on the ocean.

In a paper read before the American Society of Civil Engineers in 1886 he proposed to enlarge the whole Erie Canal to eighteen feet in depth, increase the size of its locks and prism for lake vessels, and remove the droop so as to feed the whole from Lake Erie. His rough estimate was $150,000,000.

It may be confidently stated that the increase in the dimensions of lake steamers during the last ten years has been so great that a canal eighteen feet deep would be of no use. It would not compete with the first-suggested plan of deepening the canal to nine feet and trans-shipping into steam fleets. This we shall show by figures.

If any ship canal at all is to be built, it must be not less than twenty-five feet deep. It appears to the writer that a more favorable route would be via Oswego, Lake Ontario, and a 25-foot ship canal, twenty-six miles long, around Niagara Falls. Possibly Oneida Lake, twenty-five miles long, would form part of the route. Such a scheme would still require moderate enlargement of the Erie Canal from Utica to Buffalo, and removal of the droop, as the new canal would have to be fed from Lake Erie.

The distance from Chicago to New York would be about the same as by way of Buffalo. There would be 230 miles of artificial navigation, as against 350 by the Erie Canal.

The cost of either of these schemes would be very great, certainly very far in excess of the sum named by Mr. Sweet. Both schemes would require turning the Mohawk River and its narrow valley into a series of lakes, and moving the New York Central and West Shore railroads, besides many dams, factories, and villages. Careful surveys should be made to ascertain the cost of both of these routes.

The present Erie Canal, though nominally seven feet, is less in some places. Navigation is now carried on by horse boats running in pairs, and by steam tugs towing three or four boats after them. These boats are of about 250 tons capacity, and that of the two-horse boats is 500 tons. That of the steam tows, including the tugboat, about 900. They average two and a half miles an hour while in motion, and, including lockages, run through from Buffalo to New York in nine days, and, including twelve days in port, make seven trips per season. The low cost of steam towing has brought down rates, so that the horse boats make very little money.

The people of the State of New York will vote on November 1 on the question of deepening the canals to nine feet, and lengthening the few remaining short locks to admit of two boats at once. All the locks on the Erie Canal are double, so that boats can pass each other without delay.

An experiment will soon be tried to ascertain the practicability of electric towing. If successful, it will be a great help to the owners of horse boats who have not capital to invest in steam tugs. Every man can hitch his boat to the electric trolley, paying so much per day for its use.

Another experiment, due to the energy of citizens of Cleveland, has just been tried of sending a fleet of tugs, each drawing five steel barges from Cleveland to Buffalo, and thence through the Erie Canal to New York. Owing to the shallow depth of the canal, no better time was made than at present.

But if the canal were uniformly deepened to nine feet, and the remaining thirty-two locks doubled in length, a fleet of five barges could go from Cleveland to New York in six or seven days. Better organization would reduce the time spent in port, so that nine trips could be made in a season. With seven and a half feet draught, 1,500 tons could be carried. The effect would be to greatly lessen the cost of transportation, as will be seen.

A comparative statement has been prepared giving the cost of transportation by the present Erie Canal, improved canals, and by several proposed ship canals.

The figures upon which it is based, will be found in detail in the appendix to this paper. These have been got from the valuable report of John Bogart, state engineer of New York in 1891, from data as to lake boats, furnished by W. J. Babcock, manager of the Chicago Shipbuilding Company, and from data as to the Cleveland steel barges for which I am indebted to C. E. Wheeler, manager of that line.

In order to arrive at the cost, we are obliged to make an estimate of the probable receipts in both directions. The assumption in all cases is that vessels and barges carry full cargoes of grain going east, and two-thirds full of merchandise going west.

This makes the rates somewhat less than actual rates, when allowance has to be made for the contingencies of short cargoes. As the rule applies to all alike, the comparison is a fair one.

The routes are, in all cases, from Chicago to New York.

No. 1.—Large steamers on lakes and one tug with three wooden barges on present Erie Canal, including cost of elevating at Buffalo and trimming. Cost per bushel, 4¾ cents.

No. 2.—Large steamers on lakes, Chicago to Cleveland, elevating and trimming at Cleveland, with fleets of one tug and five steel barges on Erie Canal deepened to nine feet. Cost per bushel, 2¾ cents.

No. 3.—Large steamers, Chicago to Oswego, passing through Niagara Falls ship canal twenty-five feet deep, trans-shipment at Oswego, including elevating and trimming, into fleets of tug and five steel barges on Oswego and Erie Canal deepened to nine feet. Cost per bushel, 3 cents.

No. 4.—Large steamers, Chicago to New York, passing through Niagara Falls, Oswego and Erie ship canals, all twenty-five feet deep. Cost per bushel, 2 35-100 cents.

No. 5.—Large steamers, Chicago to New York, passing through Welland, St. Lawrence and Champlain ship canals deepened to twenty feet; 4½ cents. Or if twenty-five feet deep, 3 cents.*

No. 6.—Erie Canal enlarged to eighteen feet deep, as proposed by Mr.

*[NOTE.—As it is barely possible to improve the Champlain route to twenty feet, it is thought proper to give the cost by this route for that depth, and as an illustration of the value of depth, to also give the cost if twenty-five feet deep.]

Sweet, steamers carrying 5,000 net tons on sixteen feet draught, cost 6 cents per bushel, Chicago to New York, or more than cost at present.

No. 7.—Erie Canal deepened to nine feet. Fleets of one tug and four steel barges. Cost, Chicago to New York, 4 cents.

The application of better methods of loading and unloading, on the Erie Canal would lessen the number of days in port, and increase the number of annual trips.

The speed with which it is now done is marvelous. Mr. Babcock says: "The steamer Victory unloaded 3,900 tons of ore in ten hours. Coal cargoes of 5,000 to 6,000 tons are loaded from pockets in two or three hours, by machinery in ten hours, and unloaded in about two days.

"Grain cargoes are spouted in two or three hours, and unloaded in six to eight.

"Package freight, in conveniently arranged boats, with first class hoisting machinery, has been handled at the rate of 300 tons per hour."

Western forwarders know how to handle their end of the route, and if New York wants to keep the other end she must go and do likewise.

CONCLUSIONS.

Ship canals on the Canadian and Lake Champlain routes are not needed either from a commercial or a military point of view.

The enlargement of the whole Erie Canal into a ship canal would be very expensive and of less commercial value than the Oswego and Niagara Falls route.

Public opinion should concentrate itself upon the following things:

First—Immediate improvement of the Erie and Oswego Canals, upon which a vote is soon to be taken.

Second—Construction of a ship canal not less than twenty-five feet deep around the Falls of Niagara.

Third—Surveying the Oswego and Albany route to see if such a canal can be built within practicable limits of cost.

Fourth—If fleets of steel barges can be built and insured so as to run both on the canal and on the lakes, the cost of transportation by them would be less than by a ship canal.

APPENDIX TO MR CLARKE'S PAPER—COST OF TRANSPORTATION.

Chicago to Buffalo, large steamers, loaded to 18 feet, carrying 6,000 tons:

No. 1—Description:

Distance from Chicago to Buffalo, 870 miles; speed per hour, 13 miles; time one way, 67 hours; round trip, 134 hours, or 5½ days. Time in ports—At Chicago, 3 days; at Detroit, 1 day; at Toledo, 1 day; at Cleveland, 1 day; at Buffalo, 3 days; total in ports, 9½ days; total for round trip, 15 days; for season of 225 days, 15 trips of 15 days each. Cost of running 225 days, at $250 per day, $56,250; depreciation, repairs, insurance and other expenses, $43,750; interest of 10 per cent. on $200,000, $20,000; cost per season, $120,000. Estimated Receipts per Trip—Full cargoes east, 6,000 tons, equaling 200,000 bushels, at 1¼c. per bushel, $2,500; two-thirds cargoes west, 4,000 tons of merchandise, at $1.50 per ton, $6,000; total receipts round trip, $8,500; 15 trips at $8,500 each, $127,500; calculated rate per bushel, 1¼c.; actual rate, 1¼c. to 2c.

With Erie Canal 7 feet deep—Description:

Fleets of 1 tug of 180 tons and 3 barges of 250 tons each, or 930 tons in all. Distance from Buffalo to New York, 493 miles; speed per hour, 2½ miles; running time per trip, 200 hours; 72 lockages, 20 hours; actual time per trip, 220 hours; time per round trip, 440 hours or 18 days; actual time in port, 12 days; total time for round trip, 30 days. In the season of 7 months 7 trips can be made, which is the average at present. Erie Canal—Running expenses, 7 months, $5,300; repairs, depreciation and winter storage, $2,100; interest on $18,500 at 10 per cent., $1,850; total, $9,250. Assumed Receipts per Trip—East, 930 tons, or 31,000 bushels grain at 2⅓c. per bushel, $723; west, two-thirds of a load of merchandise, 600 tons, at $1 per ton, $600; receipts, round trip, $1,323; receipts for season, or 7 trips, $9,261. Total cost from Chicago to New York: Chicago to Buffalo, as per No. 1, 1¼c.; elevator at Buffalo, ⅞c. per bushel, .875c.; canal transportation, 2.333c.; trimming, etc., .275c.; total, 4.73c. per bushel; actual rates, 5@7c.

No. 2—Large steamers on lakes, Chicago to Cleveland, elevating and trimming at Cleveland into fleets of 1 tug and 5 steel barges on Erie Canal deepened to 9 feet, etc. Capacity, 7½ feet draught, is 1,500 tons. Distance Cleveland to Buffalo, 174 miles; speed per hour, 6 miles; time, 29 hours. Distance Buffalo to Albany, 350 miles; speed in motion, 4 miles per hour; time, 87½ hours; all locks lengthened for two boats; time of lockages, 15.5 hours. Albany to New York, 143 miles; speed, 6 miles per hour; time, 24 hours; total running time, 156 hours; round trip, 312 hours, or 13 days; time in port, 12 days; total time, round trip, 25 days, giving 8 round trips per season of 210 days.

Expenses—Ten per cent. interest on cost of fleet worth $40,000, $4,000; 210 days' running expenses at $30 per day, $6,300; insurance and all other expenses, $7,700; total expenses per season, $18,000.

Estimated Receipts—Full cargoes of grain going east, 1,500 tons, or 50,000 bushels, at 1½c. per bushel, $750; two-thirds of a cargo of merchandise going west, 1,000 tons, at $1.50 per ton, $1,500; total receipts one round trip, $2,250; total receipts 8 round trips, $18,000. Cleveland to New York, 1½c. per bushel.

Cost of carrying grain from Chicago to Cleveland in large boats, including cost of transferring, should not exceed 1¼ cents per bushel, making total cost per bushel from Chicago to New York by this route, 2¾ cents, on the above supposition as to size of cargoes.

No. 3.—Large steamers, 7,000 tons burden, loaded to 20 feet, Chicago to Oswego, passing through Niagara Falls Ship Canal, 25 feet deep; transshipment at Oswego (including elevators, trimming) into fleets of 1 tug and 5 steel barges on Oswego and Erie Canals, deepened to 9 feet. Distance, Chicago to Buffalo, 870 miles; speed per hour, 13 miles; time 67 hours. Niagara Canal, 26 miles; speed per hour, 7 miles; time, 4 hours; ten lockages, at one-half hour each, 5 hours. Lake Ontario, 120 miles; speed per hour, 13 miles; time, 9 hours; total running time, 85 hours; round trip, 170 hours, or 7 days; in port 10 days; total, 17 days; making a total of 13 trips in a season of 220 days. Expenses nearly the same as No. 1—$122,000.

Assumed Receipts—233,000 bushels grains at 1¼ cents per bushel, $2,912; two-thirds of a cargo going west, 4,666 tons, at $1.50 per ton, $7,000; total receipts, round trip, $9,912; giving $128,852 for season of 13 round trips. Cost per bushel, 1¼ cents.

Oswego Canal, 38 miles; Erie Canal, 166 miles; total, 204 miles; speed per hour, 4 miles; time 51 hours; lockages 26, at a half hour each, 13 hours. Hudson River, 193 miles; speed, per hour, 6 miles; time, 24 hours; total running time, 88 hours; round trip, 176 hours, or 7 days and 8 hours; time in port, 7 days 16 hours; total, 15 days, giving 14 round trips per season.

Assumed Receipts—50,000 bushels at three-quarters of a cent per bushel, $375 going east; 1,000 tons merchandise at $1 per ton, $1,000, going west; total round trip, $1,375; for 14 round trips, $17,500. Expenses same as No. 2. Total cost, Chicago to New York—Chicago to Oswego 1.25c.; elevator, .875c.; trimming, etc., .275c.; canal, Oswego to New York, .75c.; total cost per bushel, 3.15c. Rates for elevators would probably be reduced by competion between Buffalo and Oswego, so that we may call the cost 3 cents.

No. 4.—Large steamers carrying 7,000 tons on 20 feet draught, from Chicago to New York, passing through Niagara Falls, Oswego and Erie Ship canals, all 25 feet deep. Distance by lakes and rivers, Chicago to Buffalo, 870 miles; Lake Ontario, 120 miles; Hudson River, 143 miles; total distance, 1,133 miles; at 13 miles per hour the time is 87 hours. Canals—Niagara, 26 miles; Oswego, 38 miles; Erie, 166 miles; total, 230 miles; at 7 miles per hour the time is 33 hours Lockages—Niagara, 10; Oswego, 6; Erie, 20; total, 36; at half an hour each, 18 hours; total time, 138 hours; round trip, 276 hours, or 11½ days; in port, 13 days; total time, round trip, 24½ days; giving 8½ round trips in a season of 210 days.

Estimated Receipts—Going east, 233,000 bushels at 2 35-100c. per bushel, $5,490; going west, 4,666 tons merchandise, at $2 per ton, $9,332; total, round trip, $14,822; for 8½ round trips, $125,987. Cost, Chicago to New York, 2 35-100c. per bushel. This is 66 6-10c. per net ton for a distance of 1,363 miles, or about ½ of 1 mill per ton per mile. This is less than the cost of conveying freight on long sea voyages in vessels of 28 feet draught. In view of this, what becomes of the proposal to send ocean vessels to the upper lakes?

No. 5.—Steamers loaded to 18 feet, 6,000 tons burden, passing from Chicago to New York through improved Welland, St. Lawrence, and Champlain canals, 20 feet deep. Distance from Chicago to foot of Lake St. Francis, on the St. Lawrence, including lakes, 1,024 miles; speed per hour, 13 miles; time, 78 hours. St. Lawrence River, 161 miles; speed per hour, 10 miles; time, 16 hours. Welland and St. Lawrence Canals, 70 miles; speed per hour, 4 miles; time, 17.5 hours; lockages, 53; at half-hour each, 26.5 hours; total, 136 hours. Caughnawaga Canal, 38 miles; speed per hour, 4 miles; time, 9.5 hours. Richelieu River, 24 miles; Lake Champlain, 112 miles, or 136 miles in all; speed per hour, 13 miles; total, 10.5 hours. Champlain Canal, 67 miles; speed, 4 miles an hour; time, 17 hours; lockages, 12; at half-hour each, 6 hours. Hudson River, 143 miles; speed per hour, 13 miles; time, 11 hours; total running time, 54 hours; grand total, 190 hours; round trip, 380 hours, or, say, 16 days; time in port, 13 days; round trip, 29 days, or 7 trips per year.

Assumed expenses, as per No. 1, $120,000. Assumed Receipts—200,000 bushels, at 4½c. per bushel, $9,000; 4,000 tons merchandise, at $2 per ton, $8,000; total, round trip, $17,000; total, 7 trips, $119,000. If these canals could be made 25 feet deep, boats of 7,000 tons could then make 8 trips per season, and move at 6 miles per hour instead of 4. This would reduce the cost of carrying grain east to New York to 3 cents per bushel. Total distance, 1,639 miles, of which 175 miles would be artificial navigation.

No. 6 (Erie Canal enlarged to 18 feet deep)—Large steamers, carrying 5,000 tons on 16 feet draught. Distance, Chicago to Buffalo, lakes, 870 miles; Hudson River, 143 miles; total, 1,013 miles, at 13 miles an hour; time, 78 hours. Canal, 350 miles; speed per hour, 4 miles; time, 87.5 hours; lockages, 72; reduced to 50, at half-hour each, 25 hours; total time in motion, 190.5 hours; round trip, 381 hours, or 16 days; time in port, 13 days; total 29 days, or 7 round trips per season of 210 days. Yearly expenses reduced to $112,000.

Estimated Receipts—East, 5,000 tons or 166,500 bushels, at 6c., $10,000; west, two-thirds of a cargo, 3,333 tons general merchandise, at $2 per ton, $6,666; total, $16,666 per trip; 7 trips, $116,620. Cost per bushel, 6c., as against 2.35c. on a 25-foot navigation via Oswego, showing the great value of depth of water as allowing larger cargoes and greater speed.

No. 7 (Erie Canal deepened to 9 feet.)—Fleets of one tug boat and four steel barges 180x17½, loaded to 7½ feet draft; capacity, 2,400 tons. The time would be as follows: Lakes and rivers, 1,013 miles, at 6 miles an hour, 169 hours. Canal, 350 miles, at 4 miles an hour, 87.5 hours; 20 days 15.5 hours. Total in motion, 272 hours; both ways, 544 hours, or 23 days. Time in port 13 days, or 26 days per round trip, allowing of 6 round trips per season. Expenses, on same basis as before estimated, $24,000. Estimated receipts, cargo now carried 2,400 tons in four barges: Full, east, 80,000 bushels at 2c., $1,600; two-thirds, west, 1,600 tons freight at $2, $3,200; $4,800 per trip; six round trips is $28,800. Cost of conveying a bushel of grain from Chicago to New York, 2c. a bushel.

SUGGESTIONS AS TO MR. CLARKE'S PAPER BY MR. FLOWER.

Mr. Flower: My relation to this program and to the topics it embraces, and especially to Mr. Clarke, is of a very peculiar and delicate nature. I have solicited nearly all of these persons to make the effort and expense of preparing technical papers for our convention. We had to have them. I have prepared most of those papers for the printer and read the proof on them—analyzed their contents far in advance of everybody else. I feel, therefore, that I occupy in a certain sense the position of host to the authors and their papers, which precludes me from entering fairly into any controversy over their contents.

As previously stated, Mr. Clarke is unable to be here in his own defense, being prostrated in New York by the extreme heat. But, owing to the high standing which he occupies, and the great weight which his utterances would be likely to carry, I can hardly refrain from calling attention to at least some features of this paper, though I may not discuss them. In the first place he omits to take Buffalo into consideration with her large elevator and terminal charges in computing the cost of transportation to New York. I may say he almost utterly ignores Buffalo and the great toll that she has always levied on western products, in his consideration of the enlarged Erie canal as an alleged sufficient outlet to the sea.

Next, he says that small barges can afford cheaper transport than big steamships and at the same time in his note to No. 5 of his statements, proves that a 25-foot channel could carry wheat at 3 cents while by a 20-foot channel the cost would be 4½ cents. I am compelled to leave it to others to say whether the entire fabric of his argument in that direction is not thus destroyed by his own illustrations in favor of our notion of a deep channel from the lakes to the ocean.

In making his computations for barge traffic from Cleveland, instead of Buffalo, to New York, he mentions no elevator charges at the former city and omits the fact also that Cleveland is without elevators to carry on the enormous business now done at Buffalo and which must be an incident and expense of any point of adequate transshipment.

In his conclusions he says that no canals are needed beyond enlarging the Erie canal to get goods to New York. This raises the same presumption that I felt compelled to excuse in the letter by Mr. Balch, of the New York Produce exchange, namely, that all New York cares for is to lay her hands on the products of the west and secure her tolls and commissions, regardless of whether or not the producer shall ever have a cent of return. I know he does not mean to do this, and I ask all of you to agree with me in that view; but no one can deny that that construction may be put upon his conclusion. We all wish to get to the seaboard, of course, but Mr. Clarke's paper fails to take into consideration the vast amount of traffic which is not destined for New York but other seaboard ports, and for points beyond the ocean. How there can be any saving in breaking, transferring and wasting its bulk several times is a mystery to me.

I will call attention to the fact that I have known grain to be carried from my city of Superior 1,000 miles to Buffalo for practically one-half of the tolls taken by the Buffalo elevator pool. I can not find this fact mentioned in any of Mr. Clarke's numerous calculations. But I think it improper for myself to go further. I will ask Mr. Cooley, who does not occupy the same relation that I do toward Mr. Clarke's paper, to carry forward the discussion, calling his attention, as I do so, to one very remarkable matter which in this essay is assumed to be proven, to-wit, that transport on the lakes is cheaper than that on the ocean, from which we may conclude that with an adequate outlet to the Atlantic, lake craft would be enabled to go forth and drive salt water freighters out of business.

DISCUSSION OF MR. CLARKE'S PAPER BY MR. COOLEY.

Mr. Cooley: I think that we all appreciate Mr. Flower's delicate position, as I am sure I feel the force of his remarks in reference to the omissions in Mr. Clarke's paper. Although unprepared to do justice to the subject I am forced to relieve him.

Mr. Clarke's paper, like many writings, is most interesting in the postscripts, or the matter appended.

In comparing rates, he allows ⅞ cent per bushel for elevating grain at Buffalo and Oswego and omits it at Cleveland; he presents figures to show cost of handling cargoes in connection with a 9-foot Erie canal by transfer at Cleveland and Oswego and omits the comparison for Buffalo; the canal-boat rate from Cleveland is assumed to be double that from Oswego, but including terminal charges, the Oswego rate is made the highest; the Welland and St. Lawrence canals to the foot of Lake St Francis are given as 70 miles when the actual length is about 50 miles; the time of lake vessels in port is stated at 9½ to 13 days, or about double that actually occuring in through movement, as all marine men are aware; he assumes that a fleet of canal-boats adapted to the improved Erie canal can make through trips to Chicago and discount the rate of large lake vessels by ship-canal to New York; finally, he figures that lake vessels by Oswego ship-canal will carry cargoes between Chicago and New York, on a draught of 20 feet, for less than the ocean rate on long sea voyages in vessels of a draught of 28 feet.

Mr. Clarke has undertaken to prove too much or too little, and his figures will not stand the test of analysis nor are they verified by experience. There are too many assumptions, seemingly biased in the direction of maintaining the competence of a 9-foot ditch to do the traffic of the west. A part of the confusion arises from the charge assumed on west-bound freights, and computing results solely on grain rates; and a part through that very troublesome matter of transfer from vessels to canal boats. If the charges both ways were compared through an adequate ship-route and through the 9-foot canal with tranfers, the results would be decidedly different.

Has Mr. Clarke studied the ocean rate on grain from the Pacific coast around Cape Horn sufficiently to justify his assumption as to ocean rates? If his conclusion is correct, then it demonstrates that lake vessels and lake methods of handling business can more than compete on the high seas, as Mr. Flower points out, a matter of some importance in view of the fact that half the steamship tonnage of the United States in hulls of over 1,000 tons is owned on the lakes. On the other hand, what becomes of Mr. Oldham's conclusion (and he is conceded to be good authority) that the sea-type of vessel is cheaper to build and operate, even on the lakes?

Take again, the idea of towing canal boats in shoe-strings between Buffalo and Chicago; they must indeed be staunch craft and much more expensive than figured to meet exigencies of weather. I have had some experience with lake conditions, having been in every considerable blow on Lake Michigan during one season in a small tug, for the purpose of measuring currents due to winds. I have seen waves 7 to 9 feet between trough and crest arise in a few hours and, on one occasion, of 14 feet in half that number of hours. A fleet of canal boats would have hard work to live long enough to reach port in a storm like that.

The question of shoe-string towing has been argued for 30 years to my knowledge, originally in connection with the proposed systems of canals by the St. Lawrence and Lake Champlain to Montreal and New York, and within the past six years it has been ably presented by John Goodwin on behalf of the Pittsburgh and Lake Erie ship-canal. It should be apparent, however, and this is borne out by the actual practice, that a given capacity in a single hull is cheaper to build and operate than in several hulls. The size of hull may be limited by canal-lock or harbor conditions, but outside of this, it is determined mainly by length of route, facility in obtaining cargoes and the requirements or market at the point of delivery, consignments being often based on the consumption and distribution capacity at the receiving end.

If Mr. Clarke will take the transfer charges at Buffalo and New York he will find that they aggregate more than 2 cents per bushel. Grain has been carried many times through the lakes from Duluth, Superior and Chicago, during the last five years, for less than the Buffalo elevator charge—Mr. Flower says for about one-half, which I presume is true—and the canal charge has also been less than the total transfers at Buffalo and New York, and further: of the through rate from Duluth and Chicago to Liverpool, over half has been collected in the state of New York.

In other words, one-tenth of the distance has made half the tariff.

This state of things, with some variation, has been going on for a generation, notwithstanding agitation, public howling and legislation Are we now to be led to believe that when the 7-foot ditch is changed into a 9-foot ditch vast economies in transportation are to be effected and elevator and transfer men reformed to such a degree that transportation between Chicago and New York will be therein effected cheaper than in hulls carrying 7,000 to 10,000 tons, as a proper ship-route should contemplate? If so, like Mr. Flower, I am mystified.

We can all agree that a 9-foot canal is better than 7-foot ones and that, doubtless, many economies may be effected in handling boats and cargoes; but, nevertheless this in no sense answers the purpose except as a temporary expedient. All experience shows a steady growth in the size of hulls for economical transportation. Gen. O. M. Poe* said to me in 1891 that he had long since stopped setting limits to the growth of lake commerce or the depths that might be demanded, and any thing was justified in its interest which you could induce people to believe in, and he expressed regret at his inability to have the Soo lock as deep as he had originally proposed.

On the other hand, Mr. Clarke reaches some conclusions which I can endorse, namely, that an 18-foot ship-canal from Buffalo is not justifiable; that ship-routes must go into Lake Ontario and that the canals should be 25 feet deep for a draught of 20 feet.

It will take exhaustive surveys, especially on the Mohawk route, to determine what may be feasible. In my opinion, the enormous cost and much of the difficulty in projecting a ship-route have come from certain rigid ideas in regard to prism, locks, water supply and vested rights. I can conceive plans of treatment, either by the Mohawk or Champlain route, in which the matter of depth will not be a limiting factor and will subordiate itself to a progressive treatment to all future demands if a little head work is done at the outset.

The west is going to the sea without paying tribute at any toll gate. Mr. Clarke ought to know that. The question of cost is entirely subordinate to the results.

When we consider that the lakes are carrying 25 per cent. of the ton-mileage of all the railways of the United States, and that the Vanderbilt system alone, which scarcely ramifies over a territory as great as that immediately bordering the lakes to say

*NOTE—In charge of lake improvements. He died since the convention adjourned.

nothing of that more remotely influenced, represents a capital account of $600,000,000, what shall we say can be afforded for proper marine routes? We can believe that with their development, the equivalent of the difference in rail and water rates on the total movement each year would exceed the entire cost.

Lake interests are now practically developed on the four upper lakes on maximum routes of 900 to 1,000 miles. Suppose you add Lake Ontario, the St. Lawrence and Lake Champlain which are equivalent to two new lakes, with a maximum route of 1,400 to 1,500 miles—an addition to navigable area, length of route and direct territory of 50 per cent.?

May we not believe that the ton-mileage would then increase more than 50 per cent. on account, both of longer routes and more territory, and would this not be a justifiable work, even though an impassable mountain chain existed beyond to close forever access to the sea by the St. Lawrence and the Hudson?

Again, take the interior of New York, itself: There are possibilities reaching southward toward the anthracite region and the seaboard in that direction, well worthy of consideration, and which can form parts of and be adjuncts to a Mohawk route, the possibilities of which have hardly dawned on its special advocates!

The west is fortunate in that the question of route and seaboard terminus, provided we reach the marketing points, is entirely subordinate to the desire for an adequate outlet, and our views as to what should be done do not depend on what may be feasible by a particular line or the loss of tolls at a particular point.

It is rather a question of what route has the largest capabilities for present and future development and will at the same time satisfy traffic conditions. To that question I am unable to join Mr. Clarke and give a definite answer further than to say that the inquiry narrows down to the Mohawk and Champlain routes via the Hudson, so far as concerns the American seaboard. The Canadian route is too clearly defined to require discussion.

REPORT OF COMMITTEE ON RESOLUTIONS.

President Howland resumed the chair and announced that the committee on resolutions had arrived at a general expression which, it was hoped, would convey the sense of the convention. We will hear from Mr. Cooley, chairman of the committee.

Mr. Cooley: It seems to the chairman of the committee that this platform voices, substantially, the sense of this convention in regard to the subject of a deep channel to the sea, and the encouragement of proper means thereto. That is the theory upon which the committee worked; and I believe the committee wisely determined that all matters not strictly germane to that should be presented, if at all, separately to this convention, and stand upon their own merits. I will read the platform:

FUNDAMENTAL PLATFORM.

Recognizing the supreme utility of deep waterways through the great lakes and thence to the sea, and reaffirming in full the platform adopted at the organizing convention held in Toronto in 1894, the International Deep Waterways association, in first convention assembled, declares as follows:

1. That the public welfare demands the deepest practical channels between the several lakes and to the seaboard to enable vessels of the most economical type to pass between lake ports, or between the lakes and the seaboard, or to foreign waters, without the necessity of transshipment;

2. That the said requirements call for a least depth of twenty-one feet in all channels and the building of all permanent structures for a navigable depth of twenty-six feet or more in order that the watercourses may be progressively and economically deepened to the ultimate necessities of traffic;

3. That the prompt action of the congress of the United States and the government of the Dominion of Canada providing for a joint commission to investigate and report upon the establishment and maintenance of deep water between the great lakes and the sea, conformably to the resolution adopted at Toronto in 1894, is a matter of congratulation, and that in view of the extended scope and great importance of the subjects to be examined by the said commission, this convention urges that the most liberal provision be made for the necessary expenses;

4. That broadening the channels through the connecting shallows between Lakes Erie and Huron, and Lakes Huron and Superior, as recommended by lake carriers, is urgently demanded by the interests of commerce, and is in line with the progressive development of a great trunk water route;

5. That the international interest in the great fresh-water seas of the American continent and in the ship-routes joining them to the ocean, is recognized, and that the use of their waters and the control of their levels are proper subjects for international regulation;

6. That pending the development of the best deep channel or channels to the ocean, the promised early completion by the Canadian government of the St. Lawrence canals—if possible with lengthened locks—will result in marked benefit to international commerce and the producers of the interior; likewise, that the movement in the state of New York toward lessening the cost of transportation to tidewater by improving the Erie canal, which must have a permanent value, is noted with satisfaction;

7. That with respect to the several resolutions offered concerning local canal projects, all enterprises designed to extend marine commerce through lateral routes, tributary to the great lakes system, should be encouraged;

8. That special and renewed attention is called to the desirability of establishing a permanent international court, as set forth in the organizing convention in Toronto, in 1894.

On motion of Col. Gridley the report of the committee on resolutions was unanimously adopted.

BROADER CHANNELS RESOLUTIONS.

Mr. Livingstone: We would like the endorsement of this great convention to go to congress this winter and ask for an appropriation to remove three serious impediments in the way of a deep waterway: first, the Limekiln crossing at the lower end of the Detroit river; second, the St. Clair flats channel; third, the Hay lake channel.

In any deep waterway to the sea these three impediments have to be removed. It is a long step in the direction of the object for which this convention is called together. The lake carriers want to go to congress this winter, and say: gentlemen, three things are imperative, and we want these three things. In the meantime the great object we are seeking to accomplish, will come along, and before you have that accomplished we will have these impediments out of the way.

We are in imminent danger every day of vessels being sunk. Only a few weeks ago three lives were lost in collision. The entire commerce is liable to be blocked at any time. There is a gentleman here from Superior who thoroughly understands Hay lake channel. I understand it fairly well. No one will question the feasibility of increasing that channel to 500 feet. In this connection I ask leave to offer a resolution:

WHEREAS, All the cuts and improvements in the St. Mary's river are of the width of 300 feet; and,

WHEREAS, There is at the St. Clair flats a single canal or channel of 300 feet width for accommodation of all through traffic to and from Lake Superior and Lake Michigan and the lower lakes; and,

WHEREAS, At the dangerous and difficult passage known as the Limekiln crossing, which has to accommodate almost the entire commerce of the great lakes, there is a channel through rock with a width of 440 feet, with sharp turns at either entrance and a strong current; and,

WHEREAS, The phenomenal increase in number, size and capacity of lake vessels, and the growing custom of towing enormous consorts with long tow-lines, already overtax the capacity of those channels and render their navigation extremely hazardous, which hazard increases yearly; and,

WHEREAS, Serious accidents occur, which block these passages and are liable at any time to suspend the entire navigation through them; therefore,

Resolved, That the present proportion of the traffic and its rapid increase render it imperative for reasonably safe navigation that these channels be enlarged—those of the St. Mary's river to at least 500 feet; the Limekiln crossing to at least 600 feet, and that of the St. Clair Flats canal to 600 feet by the addition of a 300-foot passage alongside its present westerly pier. This convention urges that the governments take up these works and carry them to completion at the earliest possible moment.

Mr. Flower: I move the adoption of the resolution.

Mr. Cooley: I second the motion.

Carried unanimously.

Col. E. C. Gridley: I beg leave to offer a resolution:

Resolved, That while we fully recognize the great importance of carrying out the drainage canal enterprise at Chicago, to the general shipping interests of the North American continent, and while we are desirous of encouraging all improvements tending to cheapen transportation by water in all territory tributary to the great lakes; yet, in view of the report of the board of engineers appointed by the war department of the United States government, and of the printed opinions of many other eminent engineers upon this subject, we urge upon the joint commission of the government of Great Britain and the government of the United States, and also upon the department of each government which is charged with the duty of supervising and controlling water transportation routes, the vital importance of the maintenance of the present lake levels.

Seconded by S. A. Thompson.

Judge Powers: I move to lay this resolution upon the table. With all due courtesy to the gentleman who has offered it, I desire to express the reasons which actuate me in making this motion. This, with many collateral questions, was before the committee on resolutions, and after an extended discussion it was the unanimous voice of the committee that we had no jurisdiction over the question raised by the resolution of our friend from Duluth. The scope of the resolution is to reflect upon the city of Chicago for its action in proposing to divert the waters of Lake Michigan from the purposes for which they are now used. It is very plain that it is a question for the two governments to consider. This association is engaged in the single object of building a deep waterway from the great lakes to the ocean. We have no more effective friends in this enterprise than the gentlemen from Chicago, notably the chairman of the committee on resolutions, who has done more to give this association life and vitality than all the rest of us on the outside put together. (Applause.) I hope our friend from Duluth will find it agreeable to withdraw his resolution.

Mr. McGuirk: I desire to state that my friend, Col. Gridley, is mistaken if he thinks this is a Chicago matter alone. The Mississippi valley is vitally interested in the construction of the Chicago ship canal, and the mighty enterprise taken hold of by Chicago is approved by the entire Mississippi valley. This diversion of waters being an international matter, this convention should not adopt the resolution.

Mr. Harris: If it hadn't been that during the last three years the rain-fall has been one-quarter less than in previous years, making the lakes very low, this question would not have been thought of at all.

Mr. Fisher: We know the fact that the government of the United States is dealing with this very question now. We can not, therefore, fear for one moment that the level of the lakes will be in jeopardy because of the non-action of the government.

Mr. Drake: I believe that the question can be safely left to our respective governments. The matter will be watched so closely that steps will be taken to guard against any diminution of the depth of our channels. I don't believe this resolution will harm Chicago, and I don't believe it will have any particular weight if it is adopted. I might have been understood yesterday as being opposed to the drainage canal. I want to place myself clearly before this convention as not in opposition to that great enterprise. At the same time I don't see any objection to adopting this resolution.

Col. Gridley: I desire to say that there is no man on the floor of this convention who would be more reluctant than myself to place any obstacle in the progress of the city of Chicago. No man on this floor admires more than I do the gigantic enterprise that has prompted an expenditure of $30,000,000. I offer this resolution with the best of motives, feeling that we can not shirk this question honorably, and that we must deal with it manfully.

I do not wish to say that they shall stop this work at Chicago, but that this convention shall call the attention of the lawful authorities to counteract, if necessary, the effects of the drainage canal, and to maintain, in some way, the present lake levels. That does not antagonize Chicago, nor anybody else.

President Howland: Shall the resolution lie on the table? Those of that mind will please say "aye."

Motion [illegible] the resolution lie on the table adopted.

THE UNITED STATES HYDROGRAPHIC SERVICE.

Luther Allen, of Cleveland: I desire to offer to this convention a resolution in regard to the hydrographic service which concerns us so deeply in all the cities on the lakes:

WHEREAS, The hydrographic service of the United States navy department has, since its extension to the inland lakes, resulted in great benefit to navigators and the merchant marine;

Resolved, That we heartily approve and endorse the United States hydrographic service as an invaluable source of information, tending to promote the safe navigation of the great lakes; and, *Resolved*, That this association respectfully urges upon the navy department and the congress of the United States the further extension of that service, and the establishment of branch offices at all important ports.

Mr. Conmee, of Port Arthur: I wish that could be made to include Canada.

Mr. Allen: I myself wish so, too. I desire to say that we are greatly indebted to the improved service for the very valuable aids which it has been to navigation. While it is practically new, it has already become a source of information that has been of great value to the merchant marine generally. We are largely indebted to Lieutenant Blow and to Commander Sigsbee of the United States navy for the extension of the service, which has been of such incalculable value, and we should show our appreciation of it.

The resolution was unanimously adopted.

President Howland: I think we would all be glad to hear from Lieutenant George P. Blow, who has had charge of that service, which is so important to the dwellers on the lakes.

Lieutenant George P. Blow, U. S. N.: I would be very much pleased to describe our service, because it is something of which the country can be justly proud. The idea is entirely cooperative. Captains of vessels and others coming into port, having discovered anything pertaining to navigation, report the same to our office, and the government notices these things and publishes them freely.

We do not confine ourselves to any country or language which, of course, will be comforting to my enterprising friend, Mr. Conmee. This department has thirteen branches situated in the principal cities of the Atlantic sea-coast, the Gulf of Mexico, and the Pacific ocean and recently on the lakes in Chicago and Cleveland. The one in Chicago was the first experiment, and rose out of the wreck of the world's fair as part of the exhibit. The one in Cleveland was established through the enterprise of the Cleveland chamber of commerce, realizing the importance of this work. In securing the necessary appropriation they gave us office rent free.

I am very glad to hear Mr. Allen say that this service has been of great importance to cities on the lakes. If the public want this service extended, they must appeal to congress for it. There have been pressing recommends to have it established at the five principal ports: Duluth, Superior, Sault Ste. Marie, and Detroit, and at Buffalo, which is the foot of navigation; and at Ogdensburgh which is the connecting link between fresh and salt water in this country.

These cities have, through their chambers of commerce and their municipal bodies, petitioned congress for offices, and we hope that congress will appropriate the necessary sum of money required to establish these offices, feeling certain that they will pay for themselves in the first six years.

I feel much pleased that this matter has come before such an assembly as this. The best way to understand the work of this office is to visit it, and visitors are always welcome, and we take great pleasure in explaining to them the work of the system. The great benefit to the citizens at large is in the time service.

STATE AND PROVINCIAL OFFICERS.

President Howland: The provincial and states presidents have not been announced.

Mr. McGuirk: A few nominations have been made as follows: Pennsylvania—George A. Kelley, Pittsburgh; Iowa—Charles Francis, Davenport; Vermont—Granville G. Benedict, Burlington; Wisconsin—Capt. W. H. Wolf, Milwaukee; Michigan—William Livingstone, Detroit; Illinois—O. A. Thorpe, Chicago; New York—John A. C. Wright, Rochester; Ontario—John Brown, Toronto.

The remaining offices of all kinds will be filled by the executive board.

FINAL ADJOURNMENT.

President Howland: I have now to make, before closing this most successful convention, quite a characteristic announcement. You all have noticed, I am sure, that although two of the very amplest topics on our program were treated by the veteran war-horses of this association and, in fact, of the entire deep-water movement—Mr. Vice-President Cooley and Mr. Executive Secretary Flower—the authors have, except when practically forced out, very modestly occupied none of the time or attention of this gathering. The generous idea was to afford as much time as possible to the fresher recruits and to the delegates who have so kindly attended, to take p[illegible] in the discussions. I therefore announce that the valuable papers by Mr. Flower and Mr. Cooley will not be read but will form the closing chapter in the volume of our official proceedings.

I think this ends the work of the convention, unless some gentleman has some further business. I think we may congratulate ourselves on the conclusion of the laborious but very pleasant and fruitful session of this first convention of our association. I desire, personally, and on behalf of the association, to thank all the delegates who have so kindly given us their attention from day to day, and the prestige they have lent to the gathering by their distinguished presence as representatives of so many governments and interests and organizations. I think that we part better friends and wiser men than we met; and we look forward to meeting one another next year with added members.

Cities desiring to secure the next convention will hand invitations to the executive board.

The convention stands adjourned sine die.

Basis for Co-operation Between the United States and Canada in Canal Construction and Maintenance.

FRANK ABIAL FLOWER,
Superior, Wisconsin.

We may learn in a general way from an examination of the treaties that subsist and have subsisted between the United States and Great Britain, that there are absolutely no reasons save the ascertained infeasibility of the enterprise, why the American republic should not co-operate or enter into a perpetual arrangement with Canada for the improvement, control and use of waterways practically common to both, including the permanent regulation of their levels, thus giving to each what neither could have without the help of the other and with mutually lessened expense and enlarged benefits.

On November 30, 1782, the "Provisional Treaty of Peace," was signed by the representatives of the two countries, opening with the following, a passage full of genuine christianity and statesmanship:

WHEREAS, Reciprocal advantages and mutual convenience are found by experience to form the only permanent foundation of peace and friendship between states. It is therefore agreed to form the articles of the proposed treaty on such principals of liberal equity and reciprocity as that partial advantages (those seeds of discord) being excluded, such a beneficial and satisfactory intercourse between the two countries may be established as to promise and secure to both perpetual peace and harmony.

Strangely enough, this first attempt at treaty-making between the two now mightiest of all nations, opening with a profound statement of international comity and good sense, was practically ignored and repudiated, more especial'y, perhaps, by Great Britain. But things most enduring and valuable are slowest not only to mature but to germinate. Therefore, those who have been struggling with the present enterprise, seeing clearly the two nations most interested coming together like old friends to bring it to fruition, believe that the living spirit and essence of that grand, century-old paragraph are now here to temper all future international intercourse and to weld friendly relations into security and permanence.

The second treaty, called the "Definitive Treaty of Peace," was concluded on September 3, 1783. It recognized the colonies to be "free, sovereign and independent" but otherwise contained no reference to any save military, fishery and boundary matters except that Article VIII declared: "The navigation of the river Mississippi, from its source to the ocean, shall forever remain free and open to the subjects of Great Britain and to the citizens of the United States."

We shall presently see that the term "forever" did not in this treaty continue forever.

The next, the "Treaty of Amity, Commerce and Navigation," signed on November 19, 1794, is the most broad and interesting of all the early conventions between the two countries. It left very little outside of religion and African slavery untouched. Practically, freedom of commerce and navigation in the waters of both countries was granted to the inhabitants of each, subject to local laws and regulations to be executed without discrimination. But, it said: "The river Mississippi shall, however, according to the treaty of peace, be entirely open to both parties."

It has been stated that at that time many in England supposed the Mississippi extended from the Gulf of Mexico to Hudson's bay. There were, however, some doubts concerning the matter, and the manner of settling these doubts throws light on how the present problem may be handled diplomatically, according to precedent and very ancient precedent, too. Article IV provided that it being "uncertain whether the river Mississippi extends so far to the northward as to be intersected by a line to be drawn due west from the Lake of the Woods, * * * it is agreed that measures shall be taken in concert, between His Majesty's government in America and the government of the United States, for making a joint survey of the said river from one degree of latitude below the falls of St. Anthony to the principal source or sources of said river; and also of the parts adjacent thereto."

Article V provided for making a joint examination and survey to determine which stream was meant by the "River St. Croix" designated in the original treaty of peace to form the eastern boundary of Maine.

Article VIII provided the manner of paying the expenses of making these surveys and examinations. The commissioners were to be paid "as agreed between the parties" and "all other expenses defrayed jointly by the parties."

Thus, more than a century ago we find Great Britain and the United States working and spending money together exactly as will be necessary before the permanent work of an international waterway can be undertaken, viz: a complete survey and examination, at joint expense, of all the waters, channels, canals, locks, works and routes in both countries forming or likely to form, a part of the grand international watercourse from the great lakes to the sea.

But the treaty of 1794 was claimed to have been set aside by the war of 1812. The American minister, John Quincy Adams, contended that the treaty had not been set aside, but was such an instrument as would continue in full force and effect until ended according to its own terms. Lord Bathurst, the British negotiator, refused to accede to this view, saying in conclusion: "Great Britain knows of no exception to the rule that all treaties are put at an end to by a subsequent war between the same parties."

Mr. Adams was obliged to concede this point or abandon others; and so Great Britain lost her free rights and privileges in the Mississippi and has never regained them.

But it is not improper to observe that this great treaty as well as its predecessor, was set aside only in part after all. The several states were not restored as colonies to Great Britain; the American fortresses were not reinvested; the boundaries fixed by treaty remained, and remain to this day, notwithstanding the entire document was declared by Great Britain to be dead and set aside, and the United States minister was compelled by force of circumstances to acquiesce in this decision.

However, treaties which are not inherently perpetual may be made so by their own terms, as we may see later.

Several treaties have subsisted and now subsist between Great Britain, and the United States for the control of the great lakes and other waters we are now considering. The stipulation of 1817 restricts the number of armed vessels on the said waters as follows:

On Lake Ontario to one vessel not exceeding 100 tons burthen and armed with an 18-pound cannon. On the upper lakes to two vessels not exceeding like burthen each, and armed with like force, and on the waters of Lake Champlain to one vessel not exceeding like burthen and armed with like force.

The stipulation contains a clause giving either party power to terminate the agreement after six months' notice to the other.

The Clayton-Bulwer convention of April 19, 1850, is a genuine, and for our purposes, an important canal treaty. Its vital paragraphs agree that forever neither country shall acquire or maintain any exclusive control over any canal through Central America from the Atlantic to the Pacific ocean, directly or indirectly, for itself or for others; never acquire any colonies or territory adjacent thereto; never violate or neglect to defend the complete neutrality of said canal, and finally:

Vessels of the United States or Great Britain traversing the said canal shall, in case of war between the contracting parties, be exempted from blockade, detention or capture by either of the belligerants; and this provision shall extend to such distance from the two ends of the said canal as may hereafter be found expedient to establish.

Here we have, almost a half century old, the very essence of the model for a treaty between the two countries for the projection, construction, use and control of a far greater watercourse—one more eternally beneficial to civilization and to the welfare of the nations directly interested.

But to our friends, the Canadians, the treaty of all treaties is that of June 5, 1854, now dead. It gave to our neighbors free trade in 28 classifications of articles and free navigation of Lake Michigan. To both parties it gave more extended fishing privileges and to the United States "the right to navigate the river St. Lawrence and the canals in Canada used as the means of communicating between the great lakes and the Atlantic ocean with their vessels, boats and crafts as fully and freely as the subjects of Her Britannic Majesty * * * ."

This convention was to remain in force ten years and thereafter could be terminated by either party by giving one year's notice. At the end of eleven years it was terminated on the notice of the United States, against the wishes of Canada, and all attempts to renew it have been unavailing. On this point an interesting statement from the book by James Fisher, Q C., M. P. P., entitled "Our Highways to the Sea," is as follows:

In 1854 one of the conditions on which the United States entered into the treaty of reciprocity with Canada, was the opening of the St. Lawrence river and the canals to the citizens of the United States as freely as they were enjoyed by the Canadians themselves. But the canals were not then of sufficient capacity to satisfy the needs of American commerce and Washington diplomacy was in after years directed to securing from Canada an undertaking to deepen them. The importance attached by our neighbors to the bringing about of such a result is indicated by a circumstance which happened in 1864. The reciprocity treaty was to continue in force ten years, and thereafter until the expiry of twelve months after either government had given the other notice to determine it. It was understood that congress was certain in 1864 to give such notice. But the government then in power in Canada had a paragraph inserted in the Queen's speech at the opening of the session, indicating an intention to inaugurate a liberal canal policy. This announcement so far influenced western members of congress that that body was persuaded to withhold the notice, and the treaty of 1854, in consequence, continued in force a year longer than would otherwise have been possible.

In 1865-6 negotiations for a new treaty were carried on by the coalition government formed to bring about confederation. Again one of the conditions demanded by the United States was the enlargement of the canals, and the use of the same as well as of the St. Lawrence river on equal terms with the Canadians; but the negotiations were fruitless. In 1869 70 they were once more renewed on the same lines, Canada's aim being to secure reciprocity while that of the United States was mainly to secure a good waterway to the sea. Again the negotiations failed. In 1871 took place the negotiations which resulted in the famous Washington treaty of that year, by which the free use of the St. Lawrence was granted and forever assured to the citizens of the United States. Once more Britain yielded the benefit of the canals to our neighbors. * * * During the negotiations the Americans declared that unless the Welland canal should be enlarged so as to accommodate the then course of trade, they would not be disposed to make any concessions.

It fell to the lot of the late Hon. George Brown in 1874, conjointly with Sir Edward Thornton, to enter into fresh negotiations without the advantage of being able to offer the navigation of the St. Lawrence as a *quid pro quo.* His efforts were successful to the extent that a draft treaty was agreed upon by the commissioners, only to be rejected, however, by the American senate.

The draft treaty provided for the enlargement of the Welland and St. Lawrence canals. From Mr. Brown's statement of the negotiations it would appear that from the outset this was demanded by the American commissioners. These facts indicate that the Americans attached the very greatest importance to the question of deepening the Canadian canals.

To secure an adequate outlet to the sea is the interpretation of the words with which Mr. Fisher closes his statement.

The very comprehensive treaty of May 8, 1871, referred to in the foregoing extract, popularly known as the "Treaty of Washington," except that Articles XVIII to XXV, both inclusive, and Articles XXX and XXXII were terminated by the United States in 1885, is the main convention governing the commerce, waters, bonding privileges, canals, etc., between the United States and Canada. Its greatest provision is the following, which, by its own terms, is to remain in force for all time:

ARTICLE XXVI.—The navigation of the river St. Lawrence, ascending and descending, * * * from, to and into the sea, SHALL FOREVER REMAIN FREE AND OPEN for the purposes of commerce to the citizens of the United States, subject to any laws and regulations of Great Britain, or of the Dominion of Canada, not inconsistent with such privilege of free navigation.

This vast privilege is to go on forever. In the text of the treaty there is no provision for bringing it to an end.

In return for it the rivers Yukon, Stikine and Porcupine, in Alaska, are made forever free to the subjects of Great Britain—perhaps to enable Her Majesty to go ice-boating to the North Pole; though, of course, there is dust of gold in the bars and beds of those rivers.

If not germane to this discussion, it is interesting to note that the people of the United States, without the free use of the St. Lawrence, were in the position of the Russians before they made the great Volga river the literal mother of their empire by the war against Sweden, which gained for its connecting canals an outlet to the Baltic, and by the conflict which resulted in capturing the hostile Afghan country at the mouth of that wonderful stream—navigable for more than 2,300 miles; draining about 1,400,000 square miles of the richest territory, and carrying a flotilla of over 4,000 craft.

And this St. Lawrence privilege, of untold ultimate value, dedicated to our use forever, was secured without exhausting the material resources that may have to be drawn upon hereafter in the field of diplomacy.

"Partial advantages, those seeds of discord," mentioned in the opening paragraph of the first treaty between the two countries, were not wholly eliminated by the practical operation of the treaty of Washington. Thus:

ARTICLE XXVII.—The government of Her Britannic Majesty engages to urge upon the government of the Dominion of Canada to secure to the citizens of the United States the use of the Welland, St. Lawrence and other canals in the Dominion, on terms of equality with the inhabitants of the Dominion, and the government of the United States engages that the subjects of Her Britannic Majesty shall enjoy the use of the St. Clair flats canal on terms of equality with the inhabitants of the United States, and further engages to urge upon the state governments to secure to the subjects of Her Britannic Majesty, the use of the several state canals connected with the navigation of the lakes or rivers traversed by or contiguous to the boundary line between the possessions of the high contracting parties, on terms of equality with the inhabitants of the United States.

Canada granted the use of all her canals to the United States in accordance with the letter and spirit of this article, but did not receive what she expected in return. Canadian craft did not secure full reciprocal advantages in the state canals tributary to the great lakes, although the Dominion authorities protested several times against the unequal outcome. The reply and excuse to the Canadians was that the Federal government of the United States had no control over state canals and no way to compel states owning canals to obey fairly and fully the terms of the treaty.

Article XXVIII provides that "The navigation of Lake Michigan shall also, for the term of years mentioned in Article XXXIII of this treaty, be free and open for the purposes of commerce to the subjects of Her Britannic Majesty, subject to any laws and regulations of the United States or of the states bordering thereon not inconsistent with such privilege of free navigation."

Thus, while the United States has forever a free right and privilege to navigate the river St. Lawrence and the canals of Canada, British subjects may be deprived of reciprocal privileges on Lake Michigan two years after the United States shall have thought fit to give notice to that effect; and they are shut out of the free use of certain state canals of the United States which they supposed the treaty guaranteed to them.

These "partial advantages" are mentioned to show that the United States has a valid reason for fairness and liberality toward Canada in future arrangements for canal construction, use and control.

Without having examined any of the lesser treaties and stipulations between the United States and Great Britain, we have gone far enough to know that the enlargement of the canals, locks and works leading from the great lakes to the sea and their joint use by the two countries have been subjects several times of international diplomacy. Therefore nothing remains that is at all new in the entire matter proposed, except to provide an equitable financial basis for surveys, construction, maintenance, management and disposing of the cost of works already constructed by either country that may be available or necessary as permanent parts of the grand, international enterprise.

The probabilities of war, sometimes interposed as objections to establishing cooperative arrangements with Canada, are hardly worth serious consideration.

A nation can not restrict the growth of trade and commerce, or retard the progress of its people, or stunt the development of its great natural resources because other nations exist with which possibly, somewhere in the endlessness of the future, it may be at war.

The beautiful and historic Danube river, in the heart of Europe, was improved and is controlled by a co-operative arrangement among seven interested powers, with benefit to all and menace to none. Indeed, this arrangement, which has extended over a period of forty years, is so original, so much like that which must be ultimately entered into by the United States and Canada, and resulted in such an increasing benefit to the people of Europe, that a careful study of it is recommended to jingoists on both sides of the line. Johnson's outline of the arrangement is as follows:

"Regulation of the Danube," Volume II: Placing the river under the protection of international law in accordance with the terms of the Peace of Paris (1856). Its navigation was made free to the ships of all nations, and a joint commission, composed of representatives from the seven signatory powers, and known as the European Commission of the Danube, was appointed to prevent the violation of its neutrality and to promote works of improvement along its lower course. Successive treaties have continued this commission, guaranteeing the permanent neutrality of all improvements that it shall make, and granting it various sovereign powers over the river below Isakcha, such as the collection of taxes to pay for the expenses of the works undertaken. The riparian powers are represented in another commission, also permanent, whose primary object has been to remove obstruction in the Iron Gate, for which purpose they have the right to collect a tax from vessels navigating the river. The Austrian government changed the course of the Danube opposite Vienna by confining its current to a straight, deep channel along a well-constructed quay. A large area of land was reclaimed for agricultural purposes, and a fine water-front secured. The work was begun in 1869, under a commission, completed in 1881, and cost not less than 32,000,000 gulden, equal to about $16,000,000.

A more critical and suggestive account, especially for diplomats and masters of trade and commerce, will be found in Millett's "The Danube." Extracts from pages 280-7 are made, and all who think that war is preferable to peace arrangements are asked to study them over carefully every Sunday morning until convinced that "peace hath her victories no less renowned than war:"

The navigation of the Danube from Galatz to the mouth is controlled and regulated by an international commission, which was called into existence by the importance of the commerce with the corn-producing countries along the lower river * * *.

* * * Russia took possession of this region after the capture of Ismail, in the early part of the century, and, in order to help commerce at home, put various restrictions on the Danube trade, which almost annihilated it for a time. The adoption of free trade by England naturally stimulated the export business in the corn-producing countries of the Danube, and great pressure was brought to bear to induce Russia to remove the hampering restrictions of the navigation of the river.

International disputes arising from this cause finally culminated in the Crimean war, and it was not without reason, therefore, that the treaties of peace contained articles intended to place the navigation of the river in control of the countries most interested in the corn supply. One clause of the treaty created a riverian commission, whose duty was to regulate the general navigation of the river, and another clause established a European commission of the Danube, "to clear the mouths of the river, as well as the neighboring parts of the sea, from the sand and other impediments which obstruct them."

The first of these commissions found its task impossible on account of the conflicting interests of the small countries along the river, and has never done anything, although it is still recognized diplomatically.

The powers represented in the active commission are Great Britain, Austro-Hungary, France, Germany, Italy, Roumania, Russia and Turkey.

Owing to a misunderstanding of the nature of the work to be done, the commission was established for a term of only two years. This period was extended at various times, and at last it was settled by the treaty of 1878 that the functions of this body should continue until it should be dissolved by the powers.

It has been constantly at work since its first meeting in 1856. A few statistics will give an idea of the effect on English trade of the improvements to navigation brought about by the commission. Before 1847 from three to fifty-two English vessels entered the Danube annually. Between 1847 and 1860, 264 English ships entered the river, representing a net tonnage of 509,723. Between 1861 and 1889 these numbers were raised to 12,363 and 9,842,260, respectively. In 1861, 214 English sailing-vessels and 35 steamers came to the port of Sulina: and in 1889, 842 steamers and not a single sailing vessel. In 1890 the total number of vessels of all nationalities entering the Danube was 1,519, including many steamers of 1,400 to 1,600 tons.

The commission began in 1860 to collect tolls to maintain improvements, and in that year the revenue was 256,583 francs. In 1889 this sum was increased to 1,348,552 francs. British ships have paid from 71 to 87 per cent. of the whole dues levied during the past ten years * * *.

* * * In general terms, the work of the commission has consisted in the construction of groynes and revetments, straightening the river banks, shortening the channel by cuttings, and dredging the shallow places. The whole delta has been surveyed, and accurate maps made. A great part of the Sulina arm has been canalized, and the channel deepened

from eight feet at extreme low water to over 16 feet, or to 20½ feet at average low water.

Under the direction of Sir Charles A. Hartley, the consulting engineer of the commission, and the able supervision of Mr. Charles Kuhl, since 1872 the resident engineer, the improvements are carried on with constant regularity and great energy, and every year the navigation of the Sulina branch becomes less difficult and dangerous. Vessels of 2,000 tons may now steam up as far as Braila with perfect safety * * * . The headquarters of the commission are at Sulina, on the Black Sea.

We also have seen Russia put one-third of the entire cost* of that vast enterprise into the Baltic or North German canal, recently opened with imperial splendor, every foot of which is on German soil. Russia and Germany have not been over-friendly nations and their frontiers are darkened by almost a million armed men.

If warlike nations, like those mentioned, join in canal construction, control and use under the circumstances stated, it is absurd to suppose that friendly powers like Canada and the United States can not co-operate upon a mutually satisfactory and beneficial basis for the improvement and use of waters wholly within the territory of neither, but practically common to both; and a solemn discussion of the contrary view is even more absurd.

The diplomatic necessities for the co-operative arrangement under discussion, illustrated by the single incident of the 90 per cent. rebate of tolls on St. Lawrence traffic granted by Canada in 1892, which operated as a discrimination against United States shipping, and resulted in President Harrison's retaliatory proclamation of that year, require no discussion. They are self-evident. Likewise that of impounding waters and controlling levels.

Neither does the question of permanency require discussion. Treaties may be as enduring as governments. An arrangement that is mutually satisfactory and profitable to both parties will perpetuate itself under almost any difficulties we can conceive. Commercial bonds are stronger than the mere paragraphs of treaties; but where treaty provisions and trade interests are in unison, there inevitably must be practically perpetual security.

Thus we see that the question of diplomacy was long ago shorn of all its difficulties, both in domestic and European examples. So, if it were known what the people of the two countries would agree to, the matter of drafting a perpetual, satisfactory treaty could be accomplished in a single day.

A free discussion of the differences that would arise during the present state of public sentiment, in attempting to formulate such a treaty, may be considered injudicious in many quarters. It can do no harm, however, to state the substance of the probable differences.

In the first place, sentiment is less controllable, less reasonable, than any other element in national character. There is what the newspapers call a strong "jingo" sentiment in both countries. Formerly, it was more pronounced in Canada, but commercial necessities will ultimately dominate almost everything, and now it is more common and more emphatic in the United States. The essence of it is an apparently unreasoning

*NOTE.—United States Consular Reports, No. 175, p. 604.

opposition in either country to any close or friendly relation, for any purpose whatever, with the other. Those who harbor such feelings are constantly making mental preparations for war. They talk bigly of military tactics, and never cease explaining, on this side how the Americans can whip the British, and in Canada how the English navy could raze American seaport cities.

This sentiment is not confined to individuals, is not heard simply on the hustings, in the pulpit and in our club-rooms; but finds permanent record in the columns of many newspapers and magazines.

For defense, those who entertain the war theory point to the fact that in the past Great Britain has been engaged in scores of military conflicts, and has twice measured strength with the United States.

It would be utterly impossible at present to qualify or modify this spirit of jingoism in either country. Whatever, therefore, shall be done of a co-operative nature will have to be accomplished not with the aid, but in spite of jingoism.

But it is possible to carry out the central idea of this association, making the great lakes of the utmost feasible utility to commerce and affording an ample outlet to the ocean, without ignoring the peculiar instincts of those who are certain of another conflict between the United States and Great Britain. It would be impracticable to try to go into the details of how that might be done; but the suggestion of a beginning may lead to such a wide discussion of the great subject as will ultimately crystalize public sentiment in some proper direction.

For instance: Canada has nothing further, as Mr. Fisher suggested in his book, to lay at the feet of the United States. She has given up the St. Lawrence forever; she has the bosom of no vast sea like Lake Michigan, exclusively her own, to offer; she has no Mississippi to be opened; she has only the hospitality of a small population in a narrow settlement to extend to American manufacturers.

If, then, engineers should discover that the most practicable deep-water route from the great lakes to New York is by way of Lake Champlain, it would be feasible to work out an international or boundary water-course in which each nation would control its own shores and each have an independent outlet to the sea. It may be necessary in order to accomplish this, for Canada to grant commercial or absolute right of way through territory south of the St. Lawrence and west of Coteau Landing in return for navigating Lake Michigan and present and future great lakes canals.

Mutual arrangements are certainly possible for the improvement of all channels common to both countries and the construction of new works for common use. Such a plan would give an international ship-route from the head of Lake Superior and the head of Lake Michigan almost to Montreal, and thence each country would have an independent course of its own to tide-water—the Canadians down the St. Lawrence and the Americans up Lake Champlain and down the Hudson—and the interior two free, ample connections with the markets of the world.

In case such an arrangement were made, it would probably fall to the United States to improve the entire great lakes—including a channel around Niagara Falls and the enlargement of the St. Lawrence river eastward to the point of parting—and to the Canadians the task of improving the St. Lawrence below the parting point; although in equity, if granted proper concessions, the entire bill might be paid by the United States.

It might not be considered proper to go further into the discussion of this subject. But if we may not discuss the principles involved, we shall undoubtedly be allowed to interest ourselves with outlining a probable method of procedure for international co-operation in the matters under consideration. It could be somewhat as follows:

1. An international commission to report jointly upon the feasibility and desirability of the enterprise. [That is now provided for by the Vilas amendment to the sundry civil bill of March 3, 1895, to which the Canadian government has made reciprocal response].

2. If the preliminary report of this commision should be favorable, sufficient power and money would probably be granted to the same body for making actual topographical surveys, estimates and collateral investigations, the report thereof to be accompanied by general recommendations as to routes, probable cost, method of further procedure and use and government of the proposed enterprise.

3. Following, commissioners would be appointed to negotiate a perpetual treaty defining substantially the permanent basis for the entire co-operative arrangement.

4. In appropriate terms and elaboration such a treaty would have to provide for

(a). An International Marine Board, to have executive charge of the entire project.

(b). Perhaps an International Court to hear and determine by rules of law all contests arising between the persons and interests of the two countries.

(c). What waters and existing works should fall under joint control for mutually free use.

(d). Appraisal of and method of settling for existing improvements in either country available as part of the international route.

(e). Ratio of cost of construction, maintenance and management to be borne by either country.

(f). Method of payment--whether in cash, or bonds, or both.

(g). Method of construction—whether by continuous contract, on government account, or otherwise.

(h). Proportion of membership of permanent Marine Board to be appointed from either country.

(i). Proportion of officers and employes on permanent works to be appointed from either country.

(j). Whether locks should be free; if not, rates of tolls to be collected for their use.

(k). Codification and consolidation of marine rules and regulations as well as charts of the waters coming under the terms of the treaty.

(l). Bringing lights, buoys, range marks, fog horns, channel spars, storm signals, etc., under common control.

(m). Impounding and diverting waters and controlling levels of the great lakes system.

(n). Recasting the basis of dividing costs, charges, ratio of employes, etc., perhaps every five years in accordance with the changing ratio of population or commerce, or both, between the two high contracting parties.

When we come to examine the financial basis for any co-operative arrangement between the two countries, even on the most imperfect information, we develop some decidedly interesting, if not startling, conditions. For instance, exact and officially estimated figures produce the following:

	United States.	Canada.	Total.	U. S. percentage.	Canada percentage.
Population—1895....	69,000,000	4,850,000	73,850,000	$93\frac{4}{7}$	$6\frac{3}{7}$
Federal debt..........	$1,850,000,000	$246,820,000	$2,021,820.000	$86\frac{2}{3}$	$13\frac{1}{3}$
State debts............	250,000,000	62,645,000	312,645,000	$87\frac{1}{5}$	$12\frac{1}{5}$
Great lakes tonnage	....	....	....	94	6
Great lakes com'erce	....	....	....	96	4
Average for the United States......	....	....	....	$91\frac{1}{5}$	....
Average for Dominion of Canada......	....	....	....	....	$9\frac{1}{5}$

Ratio (praclically) 9 for United States 1 for Canada.

By the above conglomerate exhibit it appears that if the entire cost of a broad, deep ship channel from the great lakes to the ocean should prove to be $100,000,000, Canada's share, without offset or countercharge, would be less than $10,000,000. This establishes practically the ratio between the two countries to govern the number of employes and appointees to come from each, and the portion of the cost of maintainance to be charged to each, at one to nine—that is to say, ten for Canada and ninety for the United States.

A final digest of the financial subject might modify the ratio in several respects, especially if the past should be made a part of the future For instance, Gen. O. M. Poe, in charge of the upper lakes works, furnishes a detailed statement (*) showing that up to September 1, 1895, the entire amount, including cost of maintainance and operation, expended on all the

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* NOTE—An extract from Gen. Poe's statement is thus:

St. Mary's River and St. Mary's Falls Canal (1855 and 1881)	$ 2,626,124
Improving St. Mary's River under present project to Sept. 1, 1895	2,968,476
Improving Hay Lake Channel to Sept. 1, 1895	1,848,821
Improving Detroit River to Sept. 1, 1895	708,001
Improving St. Clair Flats Canal, Mich., to Sept. 1, 1895	760,223
Ship Channel connecting waters of the Great Lakes between Chicago, Superior and Buffalo to Sept. 1. 1895	1,424,194
Total	$10,335,839

It has cost for operating and care of canals as follows:

St. Mary's Falls Canal to Sept. 1, 1895	573,337
St. Clair Flats Canal to Sept. 1, 1895	69,824
Total for operating, etc	643,161
Aggregate	$10,979,000

works of the United States for improving the great lakes from Chicago and Superior to Buffalo, is $10,979,000, or less than 15 cents per capita. The Dominion of Canada has expended on her Welland canal and other waters (including of course the new lock at Sault Ste. Marie) to make from the great lakes to the ocean a route useable upon equal terms by the citizens of both countries—the United States, it is known, having no such outlet—the plump sum of $62,000,000,* or over $12 per capita—an astonishing appropriation!

So, while there are more than ten times, on an average, the resources, population, tonnage, commerce and financial ability in the United States, the Dominion of Canada has expended in opening a channel free alike to both countries to the sea, a sum six times greater than that appropriated by the United States.

This, without any offset or countercharge, would still further reduce, if not entirely wipe out, the ratio of Canada's share to be paid for future improvements.

But, of course, many of these works, like some projected by the United States, would be unavailable as portions of the grand international route to the ocean, and would therefore be excluded from any basis chosen for future expenditures.

It may be stated in the rough, however, in case of an international agreement to improve common watercourses, that the United States would have to expend something like $800,000,000 before reaching a stage where she would be placed upon an equal footing—population, commerce, tonnage, taxable valuation and collateral things considered—with Canada.

While a few of the foregoing statements are merely tentative, all of them taken together certainly bring us to a point where there is ample opportunity for the most comprehensive reflection.

*NOTE.—I have, through the politeness of the Dominion Minister of Railways and Canals, the following official statement showing the expenditures by the Imperial Government and the Canadian Government upon the construction, renewals and maintenance of the Sault Ste. Marie, Welland and St. Lawrence canals, and that portion of the St. Lawrence river between canals and below Montreal, up to June 30, 1895:

CANAL.	On Capital Account.	Surveys and Renewals chargeable to Income.	Maintenance and Repairs.
Sault Ste. Marie	$ 3,256,510 00	$ 950 00	$ 3,432 00
Welland	23,764,070 00	359,730 00	4,138,756 00
Williamsburgh	3,438,941 00	7,164 00	406,035 00
Cornwall	5,498,720 00	81,748 00	701,384 00
Beauharnois	1,611,690 00	177,826 00	182,052 00
Soulanges	1,737,986 00	....	....
Lachine	9,855,720 00	229,105 00	1,761,829 00
St. Lawrence River Canals	966,146 00	98,378 00	... .
Deepening the St. Lawrence between Quebec and Montreal	3,518,650 00	....	....
Total	$53,648,433 00	$95',901 00	$7,193,488 00
Grand Total	.. ..	....	$61,796,822 00

Ultimate Development of Interior Water Transportation.

LYMAN E. COOLEY, C. E.,
Chicago.

I.

Nature's forces, backward through endless time, stratified against the upheavals and warpings of the shrinking earth the successive pages of geologic record; shaped the great outlines and moulded the faces of continents; determined where the waters should gather together and fashion channels to the sea; where the ice-cap, expanding resistlessly southward in glacial lobes, should carve, score and grind; engraved the valleys and filled the estuaries with alluvial deltas; milled, transported and sorted the drift-soils which gird the earth in temperate climes. Civilization dawns on the alluvium and rises to its zenith on the drift.

How nature wrought, her methods and the manner of their application, defines the great features of a continent, endlessly varying in consistent detail. The coast lines, the parallel folds of two mountain systems, the great trough from the Gulf to the Arctic sea, rising northward one thousand feet in one thousand miles and descending northward again to the sea in a second thousand miles; the primordial Laurentian continent, flanked south and west by the wide plateau in which are bosomed the lake depressions, compassed about by the gentler rock-folds and the drift-hills; the glacial passes and outlets carved across the borders of the lake regions and southward across the summits of the northland slopes; the eroded valleys heading in the declivities of either mountain system and seeking the lowest line in meanders through the convolutions, terraces and plains of the trough bottom—all this is a continental hieroglyph, interpreting the genesis of the past and eloquent of the present. Where the waters are, where they have been and where they may be again, condition strictly the possibilities of the future in their service to man.

Man calls to his aid machines and structures in endless variety, climbs the hills and pierces the summits, still conditioned by the main features of topography and even again oblivious; but all are artificial, out of accord with nature's methods, toll-gatherers absorbing wealth in maintenance and operation, passing quickly away in neglect and disuse. He can build otherwise, subordinate to his service the great features along the lines of nature's past efforts and in harmony with her methods; make works that persist in usefulness as a natural creation until the face of continents shall change and man himself shall not be there to protest.

Conditions of climate, affecting man and his habitations and the waters in their utility, have barred the northern end of the continental trough, and yet this may not be wholly so. The lake plateau and its descents eastward, with singular felicity, extends the possibilities to the Atlantic seaboard and invites intercourse with foreign lands.

Southward through the Mississippi valley from the head of Lake Michigan, late in geologic time, failed the lake outflow by a narrow margin only. Different epochs in glacial development, at higher levels, carved other water passes to tributary valleys; to the upper Mississippi via the St. Croix from the head of Lake Superior and by the Fox-Wisconsin from Green Bay; to the lower Ohio via the Maumee-Wabash from Lake Erie, and again to the upper Ohio via the Grand-Mahoning near Warren. Still eastward and directly to the sea, glacial waters spilled down the Susquehannah via the central lakes of New York, and later found outlet through the Hudson via the Mohawk and the St. Lawrence-Champlain from Lake Ontario. There is the great pass from the northland via the Red-Minnesota through Lakes Traverse and Stone and subordinate to all are others of collateral value.

To restore the ancient outlet at Chicago in its course to the sea, to improve the modern outlet through the St. Lawrence and develop the southern valleys via the Hudson to the Atlantic, comprehends the largest possibilities. The old water-passes furnish sites reaching the great valleys, from the Red River of the North and the big bend of the Missouri in the Dakotas around to New England, by routes to the sea more or less devious, passing in circuits the regions milled by glacial forces and favored by climate—a system of laterals in connection with the fluvial system, of loops and cut-offs, that will extend the benefits of a continental trunk waterway to the arable and productive territory of the continent, its fields, forests and mines.

II.

Tribes hemmed in and protected by natural barriers, fixed in abode and forming a national character, growing strong and expanding to the sea, there to blossom and mature the fruits of civilization in intercourse with the known world: this is the history of many ancient peoples. The old land and water cross-roads, the Bosphorus, held the flickering light of the past through the universal night to illumine the beginnings of the present. Around the coasts, up the rivers and across the portages, the spirit of trade and adventure pioneers anew human intercourse and its fruits and along these lines spies out the mysteries of new continents. Commercial necessities bring the canal lock, and the water-trails and portages grow into transportation systems.

That the great instrument of civilization, the highway, was the province of the state, was recognized in ancient government and was wisely foreseen by the fathers, and so the rivers and harbors were made forever free and the canal was provided from the public purse, during the first half-century of the republic. The steamboat did not sufficiently antedate the locomotive to make its impression on canal development, and the more nimble servant caught the rising spirit of progress and until recently satisfied its foresight as to the public needs. In contravention of original policies, mass conservatism and skepticism relegated through franchises, the new development to bold and speculative minds, until to day the all-prevading transportation function ministers to private gain, a universal tribute-gatherer beyond the dreams of absolute monarchy, a means of taxation practically without representation and contrary to the principles established for civilized constitutions by the great contest of a century ago.

The canal system of the fathers has passed, is reminiscent of the public inertia toward new conceptions. The tremendous material progress of the half-century has developed steam craft on ocean, lake and river, has made machines and methods of work, until the possibilities of to-day are beyond the vagaries of a generation ago, and the end is not yet. It becomes feasible to connect lakes and rivers through the old water-passes on a scale commensurate with all the capabilities of these natural waters, to make routes and systems out of water-courses now detached, local and inconsequential.

The railway is best adapted to the quick and detailed traffic of the country, while the function of the waterway has largely changed to a cargo carrier between traffic centers, and this is the logic of its development. To move cheaply the great bulk products, the food for populations and the fuels, the materials for structures and for industries, is to relieve the railway of the duties of forwarder of the low-grade traffic moved on little or no margin, and leave to it the high-grade traffic in finished products and the more profitable function of a gatherer and distributor.

The great lakes, inadequately improved and on seven months of navigation, are carrying some 25 per cent of the ton mileage of the railways of the United States; and yet in the territory of the lakes and their seaboard connections, a minor fraction of the country north of the Potomac and Ohio and north and east of the Missouri, is comprised one-half the railway mileage and over 70 per cent. of the freight movement. In this region, the lake movement is some 36 per cent. of the rail and the average ton by water moves five times as far. To add the water movement through the seaboard connections, the coastwise and the river traffic, would increase largely the proportion, but statistics are wanting. Considering the prosperity of this region and the financial condition of the railways, is more eloquent testimony needed as to the complementary functions of water and rail transportation and their mutual necessity for the common welfare?

The Federal government has expended on the waterways and harbors of this territory $126,000,000, part of which is maintenance rather than capital, while state expenditure on works of present utility will scarcely add half as much more, the aggregate being only 3 per cent. of the railway capitalization. Yet the freight movement by water is considerably over half that by rail and over one-third the total, notwithstanding water routes are largely in a state of nature, the improvements entirely inadequate and the artificial links antiquated, necessitating transshipment on through business.

Were the waterways developed as a system between commercial points so that cargoes could go to final destination as freely as by rail, the freight movement by water would be multiplied. The country at large ultimately pays the cost, whether the transportation is provided through franchises or by direct taxation. Having put six thousand millions in railway facilities in the lake-seaboard territory, how much can be afforded for a waterway system, adequate to a larger movement, involving little for maintenance and operation, so contributing new elements of commerce that the railway gains out of the enhanced prosperity?

III.

People gather in cities to transact commerce and engage in industries, and to these all occupations are collateral. With the development of transportation facilities and the application of the great inventions, city growth has been enormously stimulated at the expense of rural populations, the village and the small town. Cities are essentially traffic-centers, places where commodities are gatherd in warehouses or changed into more useful products, points of concentration for distribution or forwarding. Where these functions can be most cheaply performed are cities growing most rapidly.

Facilities for transportation make great cities possible and the railway stimulates city growth on navigable waters. In 1890, 30 per cent. of the population of the United States were gathered in cities of 8,000 inhabitants and upward, and of this population, 22 per cent. were inland, or away from waters that are habitually navigated although half of the inland cities were on waters that have been considered worthy of improvement by the appropriation bill. The inland cities are essentially small, 217 in number out of a total of 448, only 13 of them having a population of 50,000 and upwards. A few of the larger have an interstate character, while others are mining or waterpower cities; the great number, however, are local to limited regions of territory.

The great lessons are taught in the distribution of the waterway cities, aggregating some 78 per cent. of the population gathered in cities.

If an inside ship route were to be made between Norfolk and Boston, through the several bays, tideways and sounds, by three short canals, the Chesapeake and Delaware, the Delaware and Raritan, and the Cape Cod (two actually existing on a small scale and the third projected) it would pass by 31.7 per cent. of the city population of the United States, or 44.5 per cent. of the population of the waterway cities. Such a route would be some 600 miles long, with less than 60 miles of canals and would connect directly four-fifths of the tidewater city population of the nation. It would save long detours in an enormous coasting trade and in proportion to the length of canal involved, would be the greatest traffic route of the continent.

A water route up the Hudson through the Mohawk and Champlain valleys to and through the several great lakes would reach 18.5 per cent of the city population, or 23.7 per cent. of that of the waterway cities. Such a route finds its natural tide-water extensions in the inner coast line southerly to Norfolk and easterly to Boston, and taken as a whole, it reaches 53 2 per cent. of the city population or 68.2 per cent. of that in waterway cities. Surely this is a tremendous result to be accomplished by one water route, without considering its relation to foreign commerce.

The route of the lakes and gulf waterway via the Illinois and Mississippi rivers passes 5 per cent. of the city population, and the return via the Gulf and Atlantic coast, 1.8 per cent. additional. The entire circuit, including the inner-coast line, aggregates 60 per cent. of the city population, or 77 per cent. of that of the waterway cities. Two loops in this circuit, one from Lake Erie to the headwaters of the Ohio and joining the lakes and gulf waterway at Cairo, the other from Lake Superior to the headwaters of the Mississippi and joining the main circuit above St. Louis, will add 9.1 per cent. and raise the aggregate to 69.1 per cent. of the total city population or 88.5 per cent. of that in waterway cities.

On the remaining Atlantic and gulf coasts are 1.8 per cent. of the city population and 3 per cent are on the Pacific coast, which the Nicaragua canal will make part of

NOTE—Of the city population, 0.6 per cent. are on short tributaries of the lake system, 0.6 per cent. on tributary rivers of the Atlantic and Gulf coast, and 0.2 per cent. on tributary rivers of the Pacific coast, and these are included in the totals.

the system. The remaining waterway population is 2.6 per cent. on the Missouri and 1.5 per cent. on tributaries of the Mississippi and Ohio.

One arterial route through the continent, two loops and an isthmus canal, join in one system of circuits 74 per cent. of the city population, leaving only 4 per cent. on interior tributaries. To utilize all the great passes and the valleys leading therefrom which invite waterway development, is to put 90 per cent. of the city population on circuit routes, reach the arable areas of the continent and the forest and mineral resources

Cities, commerce, industries—all are along the trail of the waters—on routes carved by the forces of the past, which determine the present and condition the future.

IV.

France, since 1876, recognizes in her policy the complementary functions of water and rail transportation. With an area equal to the combined areas of Illinois, Indiana, Michigan and Wisconsin, and a population four times as great, she has in use 8,000 mile of canals and improved rivers, or 38 per cent. of her railway mileage. Large sums are being expended in unifying the system on a minimum standard for prism and locks, so that water-freights may move throughout France without breaking bulk, and although the revision is far from complete, the good effects are seen in an increased ton-mileage of 62 per cent. for the ten years previous to 1891, a ratio five times as great as that for the railway system. The total water movement is one third of that by rail and the number of tons is equal to that handled in the maritime trade. The minimum standard for locks permits a boat carrying a cargo of 330 net tons, though larger locks are in use on routes where conditions warrant.

The physical situation in these four states favors a waterway system of equal or greater extent, but its economic justification is doubtful, even with the growth to ultimate population. Transportation conditions largely determine city location and growth in this country while in older countries, modern facilities must adjust themselves to the existing regime. Here present and prospective railway rates are much less, the resources and commodities for exchange are in larger fields and more widely separated and the routes are longer. All this invites greater concentration at traffic centers and larger carriers, which means larger tributary areas and fewer cargo routes. The waterway system of France is unquestionably beneficent under the conditions there obtaining and is significant of what should develop on a more comprehensive scale with population growth on this continent.

The competence of a waterway system turns on the minimum capacity of boat which shall be adopted as a standard. Nearly twenty years ago, John G. Stevens and John B. Jervis, veteran authorities on canal and railway economics, looking to the logical outcome of railway development, fixed the minimum capacity of the steamboat in competition, at 600 to 800 tons. Reviewing this question in 1888, the writer fixed the limit at 1,000 tons of cargo.

It is evident that in a competitive business, the railway can, for a time at least, move freight at train expenses, without drawing on the treasury, and the boat must be able to meet this condition or go out of business. The train of 1,000 tons assumes the best possible permanent way, the highest development of motive power and larger carloads and is the limit toward which the best trunk lines will approach rather than a measure of probable train loads. The 1,000-ton boat can run for the train expenses on a somewhat longer route, as will usually obtain in water carriage, and it represents a less investment than the train. In competition long continued, the railway must meet maintenance and fixed charges. Without analyzing conditions further, it is apparent that if the boat is in position to meet the extreme of railway competition set forth, it can carry well under the railway charge when all the proper elements of cost are included. It is also apparent that if the boat is not in this position, the water route constitutes a mere menace, affecting rail rates temporarily and spasmodically, without increasing materially the commercial movement or developing new resources of traffic.

The minimum boat must move in free water at 10 to 12 miles per hour and half as fast in restricted channels; it demands quick acting locks of high lift, and it should be capable of navigating canals, lakes and rivers, and carry cargoes on routes from points of origin to destination in the interior and coasting trade. It will be longer in proportion to beam than the old canal boat and may navigate canals with a consort working tandem; as a fleet of barges it may be towed in shoe-strings through lakes and sounds, or rafted together and pushed through the rivers. Recent studies show how the minimum boat may be increased to 1,200 to 1,500 tons capacity according to model without augmenting materially the cost of canals, structures and improvements, and this capacity provides a safer margin in competitive traffic.

The maximum limit when not restricted by navigable depths, is determined by depths of harbors, terminal facilities, ability to obtain cargoes, market and distributing capacity at destination, length of route, and the forwarding business presents elements of traffic differing from routes to ultimate destination. When navigable facilities permit and the traffic demands large cargoes, the single hull is cheapest in first cost, in maintenance and in operation; though conditions may often obtain when barges from minimum prisms may be worked in tows on larger waters.

Between the minimum boat and the craft of ultimate economy, physical conditions will permit routes of intermediate capacity and the efficiency of a waterway system will be thus promoted, provided certain standards are obtained rather than a mere variety based on requirements purely local.

V.

Physical conditions clearly define the modern waterway along natural routes, through the estuaries, sounds, rivers and lakes, and over the great passes that mark the ancient outlets and water courses. More obscurely, but none the less surely, the centers of population have defined themselves along the same lines, lines so laid out as to join remote areas in the exchange of diverse products due to climate and soil and to mineral development.

The common welfare demands that distance shall be eliminated in the exchange of the elemental raw materials, which lie at the basis of human activities; that they be moved in bulk at low cost; that the food, fuel, ores, building materials and products for manufacture shall assemble as though produced in one locality as nearly as may be, that the transportation tax be reduced to a minimum.

The normal function of the waterway is to handle these great bulk movements in primary products. It may handle, too, the bulk exchanges in goods and finished wares; but the railway is the better servitor for the high-class products, and can command a somewhat better rate, and it will usually do the short haul business except where a species of ferry or forwarding trade is involved. In gathering up and distributing throughout the country and in handling valuable freight, it will dominate.

The great waterway of ultimate economy now practicable is through the several great lakes and by the St. Lawrence to the sea, and by the Champlain and Mohawk routes and the Hudson river to the seaboard cities along the inner coast route from Norfolk to Boston. The entire series of works are to be regarded as parts of one project, designed to serve over half the city population and freight movement of the continent.

Of only less importance is the waterway between the great lakes and the gulf, the partial restoration of the ancient outlet via the Illinois and Mississippi rivers through the only practicable pass at lake level, an artery passing through the heart of fertile areas scarcely in the spring-time of development and gathering in all the tributaries between the mountain systems. It is now practicable to develop it for fleets of barges taking in one tow all that single hulls can carry through the eastern seaboard route, or not less than 10,000 tons of cargo, and for such craft as is suited to nearly all the harbors and the trade of the coasts and islands of the gulf and Carribean, and passing through these lake expanses to the Nicaragua canal, it finds a commercial outlet in the Pacific. In engineering, this route is capable of ultimate development to all the requirements of navigation, but in producing such a result, the statesmanship of two nations must be broad enough to make any use demanded of the great lakes.

The great circuit through the core of the continent, joining all waterways and coasts in one system, may well form the basis of a continental policy, and yet subordinate routes as loops on the main circuit are pre-eminently justified. A route from Lake Erie and down the Ohio, of the largest practicable capacity, virtually skirts the foot of the Allegheny mountains along three states and reaches fuel supplies necessary to the northwest and to reduce its ore products. A route from Lake Superior and down the Mississippi, margins the region of grain production. On the great circuit, the two loops and the coasts, service is then given to over 72 per cent. out of 78 per cent. of city population in waterway cities.

Still other loops demand consideration. The one from Lake Ontario leading southward through central New York by the lakes and their southern divides to the Susquehannah and Chesapeake bay, passes alongside the anthracite fields of Pennsylvania. From the southerly bend of the Tenessee leads a pass to the headwaters of the rivers of Alabama and to Mobile bay, skirting the great mineral regions of the south. From the head of Lake Erie by the Maumee-Wabash divide to the head of Lake Michigan and down the Wabash to the Ohio and again from Green bay by the Fox-Wisconsin divide to the Mississippi, nature invites development. The great glacial outlet by Lakes Stone and Traverse and the valley of the Minnesota and the Red River of the North, is the natural commercial outlet of the Canadian northwest, and a river and lake system of untold extent; and again it may be feasible to reach the westerly bend of the Missouri through the Dakotas; and possibly by a route from the Missouri to the gulf through eastern Kansas, Indian territory and Texas, join in circuits the western tributaries of the Mississippi. The productive area of the continent may be still further grid-ironed by feasible routes when demanded by commerce, and there will still remain series of useful tributaries which cannot be closed in loops and circuits.

It is sufficient to know that the physical conditions invite a radical development, to which engineering and financial resources are entirely adequate, working an economic revolution beneficent to every occupation in life.

VI.

Nature has laid out the North American continent for a homogeneous people; has thrown up the mineral wealth in parallel ridges flanking either coast and laid down the resources of soil between, under climatic variations passing through the temperate from frigid to torrid lands; has provided all the diversity of products and defined the routes by which they are to be assembled, exchanged and distributed; has planned the continent for the greatest civilization on the largest scale; has not fenced off separate fields of human activity as in the other divisions of the earth.

She has left barriers along her routes hardly sufficient to defer their removal until the spirit of man rises to the level of his opportunities, until he has so far apprehended nature as to apply her methods in harmony with her purposes, developing features of mother earth that shall persist as though they had always been so completed.

Simplicity and permanence avoid perpetual drains of wealth for renewals, maintenance and operation, the chief elements of cost in artificial systems, reducing the traffic tax to the elements of equipment and movement. To attain this is a heritage against all time, a contribution to fundamental resources, an investment not measureable by the rules of value.

Wise policy considers the continental problem as a whole. Long since, commercial necessities brought about unification of gauges in the railway system and the highest efficiency in a waterway system demands the same requirements, not a single gauge alone, but a standard minimum and multiples thereof. Possibilities should be determined in advance, and how they may be comprehended in the whole, the present achievement contenting itself within the resources and commercial necessities, but forming part of a progressive development to a final end. All over this land, works are designed on local conditions and immediate necessities, are expedients to be thrown away or to disbar a proper solution, when they could as well have formed part of an ultimate purpose and been silent and persistent petitioners for its consummation.

Responsible despots of old loved their peoples and sou ht their welfare. So men to-day, understanding nature in her moods and masters of her forces, love things as they find them and labor in their application to the betterment of human kind. Continental possibilities are before us. Like a lower type of life, a great organism is developing with nervous system awry, with capillaries, veins and rudimentary arteries doing duty for circulation, with congestion here, debilitation elsewhere, and a general feeling of malaise. To perfect the arterial system is to develop the highest type of organic life.

To do those things which nature invites and the perfect organism demands, to assemble the food and the raw materials under a favoring clime almost as waters run, makes an industrial situation not possible elsewhere on earth, and a civilization may mature such as the ages have not seen and which shall dominate the world. So reads the great continental hieroglyph, interpreting the forces of the past.

DISTRIBUTION OF CITY POPULATION OF THE UNITED STATES.

Cities of 8,000 and over—Census of 1890.

Localities and Class.		Population.	Number.	Percentage.
Inner Coast Route.	New York and vicinity	2,882,594	15	15.6
	Remaining cities	3,523,821	45	19.1
	Total	6,406,415	60	34.7
Hudson river, Champlain and Mohawk valleys		548,904	20	3.0
Great lakes		2,748 280	30	14.9
Great lakes tributaries		107,007	4	0.6
Desplaines and Illinois rivers		89,678	4	0.5
Mississippi river below Illinois river		828,043	9	4.5
Atlantic and Gulf coast—New York to Miss. riv		217,821	9	1.2
Atlantic and Gulf coast tributaries		110,585	5	0.6
North Atlantic—east of Boston		290,298	16	1.6
West Gulf—south of Mississippi river		56,641	2	0.3
Pacific coast		510,763	8	2.8
Pacific coast tributaries		40,810	2	0.2
Ohio river		1,115,779	23	6.1
Upper Mississippi above Illinois river		530,099	14	2.9
Tributaries of Ohio river		208,623	7	1.1
Tributaries of upper Mississippi river		37,345	3	0.2
Missouri river		484,767	11	2.6
Arkansas and Red rivers		59,116	4	0.3
Waterway cities: Total		14,390,974	231	78.00
Inland cities, over 50,000 inhabitants		957,268	13	5.2
Inland cities, under 50,000 inhabitants		3,094,913	204	16.8
Inland cities: Total		4,052,181	217	22.0
City population: Grand total		18,443,155	448	100

NOTE.—The above exhibit exceeds the census returns by 158,770, due to treating the metropolitan centers as units and including suburban population.

Reception and Luncheon—*Speeches.*

For the reception and luncheon tendered by the Maritime Board of the Cleveland chamber of commerce on Thursday evening, Harvey D. Goulder was chosen toastmaster and the following reception committee appointed:

Luther Allen,
C. E. Benham,
C. C. Bolton,
M. A. Bradley,
Harvey H. Brown,
D. B. Chambers,
W. C. Cole,
James Corrigan,
John B. Cowle,
Loftus Cuddy,
H. G. Dalton,
J. H. Farley,
William M. Fitch,
Harvey D. Goulder,
C. A. Grasselli,
C. E. Grover,
D. R. Hanna,
H. M. Hanna,
L. C. Hanna,
M. A. Hanna,
George E. Hartnell,
James H. Hoyt,
L. F. Loree,
H. F. Lyman,
D. C. McIntyre,
Price McKinney,
William S. Mack,
Samuel Mather,
W. G. Mather,
Philip J. Minch,
John Mitchell,
R. C. Moody,
John W. Moore,
W. P. Murray,
T. F. Newman,
D. Z. Norton,
H. B. Nye,
C. E. Gowen,
E. W. Oglebay,
J. R. Oldham,
J. H. Palmer,
J. F. Pankhurst,
James Pickands,
E. C. Pope,
George L. Quayle,
W. D. Rees,
R. R. Rhodes,
A. C. Saunders,
Daniel Shurmer,
Jared A. Smith,
W. B. Stockman,
John Tod,
C. H. Tucker,
Robert Wallace,
J. W. Walton,
George Warner,
H. J. Webb,
Charles E. Wheeler,
W. J. White,
Thomas Wilson,
Francis J. Wing,
J. M. Worthington,
A. T. Anderson,
W. J. Akers,
B. D. Annewalt,
F. H. Baer,
S. K. Barstow,
Arthur Bradley,
Oliver K. Brooks,
F. F. Bruce,
Howard H. Burgess,
T. W. Burnham,
E. G. Caskey,
J. E. Cheesman,
W. A. Comstock,
J. C. Chandler,
X. X. Crum,
C. A. Davidson,
J. J. Davis,
P. W. Ditto,
C. L. Douglass,
Leopold Einstein,
A. G. Frisbie,
H. A. Fuller,
Willard Fuller,
R. C. Gaensslen,
T. H. Geer,
N A. Gilbert,
H. H. Hackman,
W. A. Harshaw,
John Jaster,
W. D. Kearfott,
O. G. Kent,
D. E. McLean,
H. F. McNutt,
M. A. Marks,
W. B. Maxson,
J. A. Melcher,
L. I. Metcalf,
Daniel Myers,
P. C. O'Brien,
L. A. Osborn,
H. H. Poppleton,
Jotham Potter,
E. P. Roberts,
C. A. Seltzer,
Fred T. Sholes,
J. J. Sullivan,
Fred P. Thomas,
L. N. Weber,
A. C. Yesinger,
F. F. Hickox,
Geo. W. Gardner,
H. B. Burrows.

A reciprocal committee was selected by the convention as follows:

J. Enoch Thompson, Toronto, chairman for Canada;
Hon. Thomas B. Mills, West Superior, chairman for United States;
Richard R. Dobell, Quebec;

T. R. Wright, Port Huron;
Lieut. George P. Blow, U. S. N.;
Thomas Monro, C. E., Coteau Landing;
Denison B. Smith, Toledo;
Frank E. Wyman, Duluth;
Capt. J. S. Dunham, Chicago;
Col. Jared A. Smith, U. S. A.;
Hon. H. W. Seymour, Sault Ste. Marie;
Gen. Edward C. O'Brien, New York;
Hon. H. Henry Powers, M. C., Morrisville, Vt.;
Joe M. Chapple, Ashland, Wis.;
Thomas H. Canfield, Burlington, Vt.;
George A. Kelley, Pittsburgh;
William Livingstone, Detroit.

The chamber of commerce, rooms where the reception was held, were beautifully decorated with flowers in unique marine designs, and the Stars and Stripes and the Union Jack intertwined indicated complete harmony of action and reciprocity of sentiment.

H. D. Goulder, chairman and toastmaster, opened ceremonies by calling upon Mr. Wilson M. Day, president of the chamber of commerce.

Mr. Day: Voicing for a moment the expression of the 1,100 members of the Cleveland chamber of commerce, I will make my speech in four words: "Welcome; adieu; come again." (Applause.)

The Toastmaster: The gentlemen will now have the pleasure of listening to Mr. Towne, member of congress, from Duluth.

Charles A. Towne: It is a sincere pleasure to be able in this way to acknowledge—although in no sense is it possible for us entirely to get even—the hospitality that has been so generously extended to us by the people of Cleveland, and the opportunities that your arrangements have afforded us to become acquainted with each other, and especially to become instructed upon the great question which has been the subject of deliberation by this body. I, for one, desire to express my deep appreciation of the opportunity that has been afforded to me—confessedly quite ignorant upon many branches of the subject discussed by this body—to come into contact with men so fully informed and with so free a disposition to impart that information.

One thing that has particularly interested me has been the spirit of harmony manifested between the representatives of the two great branches of the same people, whose deliberations have been coincident during this meeting. I am a great deal of an

American. I believe in my own country against the world. But after the Stars and Stripes, if there were any flag under which I should wish to enlist for any purpose, it would be the Union Jack. All that we hold dear in our institutions, and all that has made it possible for this people to become what it is, has been the traditions of self-governed and law-observing ancestors. From the English constitution we have our rules of law, to which we render obedience. These things, which are our common heritage, have made possible the development of both peoples. I believe in the future dominance over all the world of the representatives of the grand old Anglo-Saxon race, and this convention is a step in that direction.

The Toastmaster: I know you will have pleasure in listening to a few words from Mr. Howland, of Toronto, the president of the International Deep Waterways asssociation.

Mr. Howland: I have great pleasure in being invited to express in a few words the very great appreciation we feel for the handsome and kindly reception by the citizens of Cleveland, and particularly by those to whom we are indebted for the favors of yesterday, this evening and to-morrow. I came to Cleveland with the expectations, which I ventured to express on the first opening day, that we would find it a delightful city, a hospitable city, an intelligent city, a city of great industries. Some of our members have been enjoying one of these features, some another. I must confess, so far, I have not indulged my anticipation of a run out Euclid avenue. I hope to enjoy that to-morrow under the auspices of our kind host.

Let me say one word for the enjoyment and pleasure I have had in Cleveland, the recollection of which I shall carry back with me, and the story of which I hope to use for the edification of those at home and elsewhere, and that is a visit to the hydrographic office of the navy in this city. Nothing has impressed me more of the times in which we live, and the country in which you live, and types of character and the systems that are being developed, than the half-hour I spent in that department under the kindly offices of Lieut. Blow and Ensign Cole, where a collection of scientific information is being made, to be used for the protection of life and property throughout the whole world.

I saw there that a degree of science was being brought to bear by which it was possible for the ingenious and scientific members of that staff to tell on request where an accident to the sails of a ship happened in the midst of the wide, trackless ocean; to tell where the salvage ship should go out and find remains of the derelict. That is a magnificent tribute to the possibility of science and to this country of yours.

The fact that that information is distributed full and free of access to every nationality and to every sailor in the wide world who may want it, is a specimen of the high order of our modern liberality.

When I consider that that really is conducted by the American government through the agency of the navy department, I think it is one of the most remarkable signs of the times any one can have brought to his notice. We all hear of turning swords into plowshares; but when we turn all the great machinery of the navy department from the business of spreading desolation and destruction on sea and shore to the purposes of preserving life and property for friend and possible foe, for all humankind, we perceive the dawn of the reign of human brotherhood of which we have been told.

I wish to carry away that recollection, with the highest estimate we have all formed upon former occasions, and feel now, for the gentleman who was kind enough to exhibit it to us, Capt. Blow; and with the greatest respect for your United States navy and for the departments under its control.

We in Canada have been glad to unite with the representatives from the broad prairies and from these great lake cities of yours in this common work for our common advantage. We have embodied frankly and in all sincerity a union of the symbols of the two nations in the seal which we have adopted for this International Deep Waterways association. We have the stars and the cluster of maple leaves in harmonious combination. The constellation of stars looks down with all their luster undiminished and the seven maple leaves are looking up very humbly to those stars; but they belong to another world. The stars are admired by the maple; the maple looks up to them, but it is not ambitious; it does not wish to be wrapped up among the stars. Although the maple is full of admiration, it does not wish to call any of those stars down to rest in its bosom. I thank you once more for your kind reception and for your kind treatment of myself personally.

The Toastmaster: We will now be favored by our friend Mr. McGuirk.

A. P. McGuirk: I appreciate very deeply the honor conferred upon me in being called upon to speak on this occasion. I am very glad of an opportunity to tender in some degree the thanks of this convention for the many kindnesses which have been showered upon us in this city. I think Cleveland is one of the beautiful cities of the continent, and I think her people are most hospitable. Ohio is a great state. If there is anything an Ohio man wants, he will go and get it, if he can, and he can get most anything he wants.

We are extremely interested in this great movement inaugurated in Toronto a year ago, and greatly strengthened here; and I am sure it will go on to a splendid achievement.

I appreciate in the fullest sense this convention, because it has considered the great question of commerce in the broadest and most kindly spirit. No unkind word has been said during these proceedings on the floor of this convention. We can return to our homes believing that this movement is inaugurated for great good. I love this sort of entertainment. You should come to the great state of Iowa, to her broad prairies; we will give you all the good things we can, between now and then, save up. We trust some day we shall invite this convention to Davenport and give you a ride on the beautiful Mississippi, and show you some of the achievements and prospects of the mighty west.

[Here the chamber of commerce quartet rendered a selection.]

The Toastmaster: That anthem reminds me of my friend Gridley, of Duluth. I will call him next.

Col. Gridley: Mr. Toastmaster, and gentlemen of the convention: I cannot help recognizing in this great movement which we are called here to deliberate and pass upon, the condition of the two great countries involved. To express my individual idea I cannot do better than to acknowledge the very delicate, and in a sense feminine—I mean feminine in the idea of refinement—sentiment that was expressed by the gentleman representative of Canada. I can not help thinking that we are really in the position of a great big Uncle Sam on one side, and a young, attractive, blooming and in every way lovely daughter of the Dominion on the other side. It is a love scene. I would encourage the old gentleman to dress in his best garb, and to put on his best blooms, and his best smile, and to make himself as attractive as possible. We are one family, and in this International Deep Waterways association I cannot help seeing the greatest future possibilities.

The Toastmaster: We all know that the "Flower" of the now powerful International Deep Waterways association is the very brilliant, able and active executive secretary, who comes from the upper end of Lake Superior. We will now be favored with some remarks by Mr. Flower, of West Superior. (Applause.)

Mr. Flower: Out of the materials developed by our association and its international gatherings a picture of the future has been forming in my mind which I——

[At this point Toastmaster Goulder touched a button and the chamber of commerce quartet, arose and sang, with deep and sonorous rythm, Mr. Flower's Deep-Water Hymn* to the air of "Rocked in the Cradle of the Deep."

The Toastmaster: The quartet has taken a mean advantage of Mr. Flower. I believe we would all be glad to hear from him further. (Applause).

Mr. Flower: If I may write the songs of an International Deep Waterways convention, I care not who sits up all night to make its platforms. (Applause.)

The Toastmaster: We would like to hear Mr. Burton, member of congress from this district, from whom we expect great things.

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*NOTE—

A DEEP-WATER HYMN.

The King who gave these sea-lakes vast
For man's great use, all time to last,
Carved on the earth-crust His decree
To ope' their channels to the sea
And stretch to inland field and mine
The endless highway of the brine.
Direct from Cleveland we shall sleep,
Rocked in a channel to the deep;
And from Superior, too, we'll sweep,
Rocked in a channel to the deep—
Rocked in a channel to the deep.

O, blind and puny gropes the man
Who can not see God's mighty plan
To bring the western harvest-feast
By shipways free to hung'ring east,
And thus His grand design complete
To tap the realm of bread and meat.
Safe from Chicago we shall sleep,
Rocked in a channel to the deep;
Aye, from all lake ports we shall sweep,
Rocked in a channel to the deep—
Rocked in a channel to the deep.

—Frank Abial Flower.

Theo. E. Burton: I must confess that I am not thoroughly informed upon the subject under discussion. I have not had the pleasure of attending the previous sessions of this convention, but my impressions are decidedly favorable to the opening of a deep waterway to the ocean by the concurrent action of the United States and Canada. Along the boundary line between these countries, or near to it, nature has furnished ample channels for most of the way to the Atlantic. The characteristic feature of this waterway is that, except for occasional obstacles afforded by shoals, rapids, or falls, it is equal to any of the channels of commerce in the world. Instead of attempting for hundreds of miles to dig across the land where there are no natural water courses, and a supply of water must be stored in reservoirs, is it not far better for us to select the course which nature has mapped out for us, overcoming the obstacles afforded by rapids or falls by constructing canals around them?

Many have advocated a waterway exclusively under the control of one country or the other. While I have the utmost respect for the patriotic sentiment which favors this view, it is rendered impossible by conditions already existing. Essential portions of the channel are on the boundary line between the United States and Canada, and must be used indiscriminately by the ships of each country. Does the pilot who sails along the Detroit and St. Clair rivers stop to consider whether his boat is speeding along in Canadian waters or waters of the United States? Nor is the argument of obstruction in case of war entitled to any greater respect. An old smooth-bore gun, well located, could stop the enormous traffic of these great lakes.

Again, this is an era in which the greatest triumphs are those of peace. We can not afford to indulge in any jingo sentiment against Canada or Great Britain. We say this, not because we are cowardly, but because we are brave, for we believe if once we took up the sword we could defeat, yes destroy, the proudest military nation on the face of the globe.

In the future development of the material resources of the United States and Canada, I believe there is no improvement more important than that which would give to this great inland territory a way to the ocean, so that its ships can carry its products to other portions of the new world and to the old world as well. Certainly, these great inland seas are here for some purpose, and the opportunities for navigation afforded by them can not be properly utilized without communication with the outside world.

As a representative of the city of Cleveland, I wish to express, not alone for myself, but also for the community, our thanks to those who have come to us from other states and from Canada to deliberate upon the great subject under consideration. They have added to our understanding of this project, and our interest in its success. We hope their reward may be great, and that before many years have passed they may be known as the early advocates of a great project, which at one time seemed little more than a dream, but which aided by their efforts became a settled reality, and one of the world's greatest monuments of commercial progress.

The Toastmaster: I know we will take pleasure in hearing from Mr. Fisher, of Winnipeg.

Mr. Fisher: I take great pleasure in being at this convention. From the moment it was announced that the convention was to be in Cleveland, I was determined to be here, and to let nothing keep me from coming. Now that I have been here, I would regret exceedingly, if anything had prevented me from coming, because having taken part and having met the delegates from various parts of the country and the good people of Cleveland, I feel it has been good for us to meet in this gathering. It enlarges our ideas and our knowledge of each other, removes predjudices, and makes us better friends.

I venture to say that, apart from the United Kingdom of Great Britain and Ireland, there is only one country that buys more from this people of the United States than Canada. We are sorry we do not sell as much to you as we did a few years ago; but we still sell a good deal to you. I am inclined to think that a citizen of your own state has harmed us a great deal with a certain measure, the effect of which was, perhaps, that you do not buy as many of our horses and sheep and other articles that we have to sell.

I have a great idea of having the closest reciprocity of the commercial relations between these two great countries. I am glad to know so much more of the people on this side, and of the resources and conditions of this country than I did before.

I live in a young province in the far northwest, where we have the making of a great country. I think that Mr. Thompson said this afternoon that he had ambition to be what that great son of Ohio had been in his lifetime.

The Toastmaster: Did that Ohio man get the whole country?

Mr. Fisher: He is after it now. It was the Hon. Jas. W. Taylor who was connected with our country from its very earliest days. He went to the far northwest in the early '50's, before we knew anything about that country. He made a study of it, so that he was named Saskatchewan Taylor, because no one could tell so much of the grandeur of the Saskatchewan country as Taylor himself. I was honored with his personal friendship. There was no man ever lived in our country who did more to impress upon our people the desirability of having good water connection with the east than that good son of Ohio.

I agree with your congressman here that the true solution of the question is for these two nations to unite together as good neighbors in making the waterways that have been given them from heaven for their joint use. We must agree upon terms upon which we will make our highways. I thank you, gentlemen, for calling upon me to say these few words, and I sincerely hope, and have great confidence, that in a few years we will see the solution of the great problem which we are helping in our humble way to carry forward. (Applause.)

The Toastmaster: We will now hear from Captain Dunham.

Captain Dunham responded with a pantomime address of two minutes, at the end of which he ejaculated: "The least."*

The Toastmaster: We will now hear from Mr. Conmee, of Port Arthur.

Mr. Conmee: I am very glad to be here. I do not know of any enterprise in which any citizen of this or any other country could engage that is more praiseworthy than the object we have in view. I hope that our efforts will be crowned with success. I trust that the success may come at an early day.

We must keep in view the single object of a deep waterway. I look forward to great developments in the way of waterways, not only in the sense of a trunk line, but in various lines in new sections. The time will come when we shall take vessels in at the Pacific and send them out at the Atlantic. We have a

*NOTE—A prize had been offered "to the speaker who within the two-minute limit for addresses should say the least." It went to Captain Dunham.

"pacific" object in view, and I hope we will pursue that object until crowned with success, because it will bring prosperity to the communities in which we live.

A gentleman said here this evening that he is a great deal of an American. I profess to be a great deal of a Canadian. I must meet him half-way. I think I am free to say that if there is any flag for which I would fight, apart from the Union Jack, it would be the Stars and Stripes.

I have carried arms under that flag. (Immense applause.) I was a volunteer in your late civil war, having enlisted in the city of Rochester and belonged to the 8th New York infantry.

I want to tell you that in Canada we have to-day a republic, just as you are a republic. We make our own laws. We govern ourselves. We are no more dependent upon Great Britain commercially or politically than you are dependent upon Great Britain. We tax Great Britain just as we tax you; indeed, we tax her a little more. If you look at our tariff, you will find it is favorable to this American republic. We believe there is no desire in Canada at the present moment for any change, and we believe we can work out our destiny. We are an independent people, and we have national aspirations.

I do not quite agree with our international president that the marriage which exists is going to exist for all time. When the time comes for a change, and come it will, we shall have nobler aspirations than those of annexation. We shall take our place as one of the independent nations among the peoples of the earth.

What is a necessity to the commerce of our two nations? It is one great channel from our western shores of navigation to the seaboard, in order that our shipping may pass out free. The barriers that now restrict trade and commercial interchange between these two great peoples I would be glad to see leveled, and Canada and the United States progressing side by side upon equal terms.

The Toastmaster: We will now hear from Mr. Joe M. Chapple, of Ashland, Wis.

Mr. Chapple: I suppose I am called upon as one of the primary class, being a very young delegate; yet, gentlemen, I want to tell you that this convention has been to me an education in this project that can not be equalled. The first night I arrived I sat up until my eyes grew heavy devouring the literature of this convention. I was reminded of a story about Lincoln. When McClellan captured a large number of cattle in Virginia he telegraphed to the president: "Have captured 6,000 head of cattle. What shall I do with them?"

I was much in the same predicament. I had this mass of literature; what should I do with it? The answer came back from Washington, from good, genial Old Abe: "Milk them."

Then, as I listened to the strains of the voices when they sang Mr. Flower's Deep-Water Hymn, closing with that soft piano and the bass growling down deep and deeper, I wondered whether we were not going to have even more than a 26-foot channel.

This occasion has been to me a patriotic inspiration. The time has come when the educational phase of this question has been accomplished. The proceedings of this convention ought to and I think will become an editorial text-book. To me, being in the newspaper business, it will become a mine of information from which to draw for years to come I shall return to my home, inspired as I never have been with this subject. We are united with Cleveland, in bonds of iron. Do you think we are interested in this project? Technicalities have been, in a measure, cleared away, and now I believe that the time is near—and he may ridicule it who will—the time has come for sentiment. Was ever anything accomplished without sentiment? Before congress can aid us in this matter we must create and establish public sentiment. What are the flags all nations love so well? Nothing but sentiment. I am a sentimentalist.

I believe if the co-operation of the newspapers was cultivated more in this country, it would not be many years before this object would be accomplished. There is no such word as "fail," in the great international dictionary. (Applause.)

A year ago I was upon a boat going down the Manchester canal from Liverpool. There were vessels of seven nations lying at the docks—products going to all parts of the globe from Manchester. That $75,000,000 canal—who raised the money for it? I heard on the omnibus that the barmaids and widows of Manchester were stockholders in the Manchester canal. If that is a fact, with 75,000,000 people in these countries and with our energy and enterprise, does the required ocean outlet seem like an impossible and insurmountable object? Never. I believe, as I believe I am standing here, that the next decade will see the deep waterways project an accomplished fact. (Applause.)

The Toastmaster: We have Mr. Crocker, of Minneapolis, and we should be glad to hear from him.

Mr. Crocker: If I had my way to-night I would like to go on a high enough hill of thought, into a clear enough air of judgment for calm, clear, broad consideration of all that is involved. I would try to keep myself so far from the influence that lessens the judgment of man and checks his action, that we might take up this subject and accomplish it. I can not help wishing that every thought might point in this direction, and that we might dispossess ourselves of everything which makes friction and creates digression, and direct our efforts to this one end.

The Toastmaster: We will be glad to hear from Mr. Snyder.

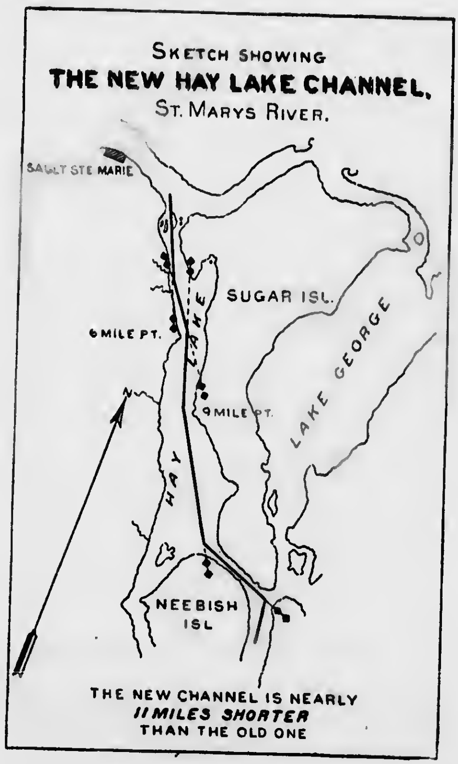
Col. F. B. Snyder: The hour is too late for me to trespass more than a very short time. I want to tell you a little story. There has been so much said during the past week about the great and beautiful, and growing west and northwest, I want to illustrate it. There was a farmer out west who planted corn; and the rain came and the sun shone upon it and it grew tall and stately. It ripened and it was so tall, he could not see whether it was ripe or not, so he took his little boy and had him climb up the stalk. The boy climbed up the stalk, and while the farmer was waiting for him to come down he became troubled. A stranger coming along said: "My friend, why are you distressed and troubled?" "Why," said he, "I sent my little boy up to the corn to see if it was ripe, and I am afraid the corn will grow up faster than the boy can climb down."

In the same line of thought, permit me just one idea at this time. When Minnesota was made a territory, and the state university was built there, a few years passed and the crash of 1857 came and in 1863 the governor of the state recommended to the legislature that the university be sold to pay its debts. On that day a citizen, one of the most valiant men, the Hon. John S. Pillsbury, went and paid its accumulated bonds to Selah Chamberlain, and the university was cleared of that debt. That man proposed to the legislature that he, with two others, would assume the burden of the university of Minnesota, if the legislature would allow them their right to lift it out of debt. These two men did it, and to-day the university of Minnesota has 2,200 students, and ranks second only to the university of Michigan among the great state institutions in this country.

I notice this great deep-water movement making the same progress.

After a delightful interchange of personal greetings and the luncheon, the function closed at 11 o'clock.

On Thursday the members of the convention were given an opportunity to drive about the progressive and attractive city of Cleveland.



Resolutions Submitted to Committee but not Adopted.

By James Fisher, Winnipeg:

Resolved, That it is a matter of the most heart-felt gratification to the convention that such prompt provision was made by the congress of the United States and the government of Canada for the appointment of a joint commission to inquire into the whole question of deep water communication between the great lakes and the sea, conformably to the suggestion of our platform. And we venture to urge upon the respective federal authorities the prime importance of giving to the commission full power, and the requisite means, to make all necessary surveys and estimates, to the end that it may be enabled to report upon the cost and advantage of different routes and as to the desirability of deepening in any cases the present channels or of constructing new ones.

By D. B. Smith, Toledo, O.:

Resolved, That we favor all efforts tending to improve the waterways of this country and especially the route from Toledo to the Ohio river at Cincinnati.

By James Fisher, Winnipeg:

Resolved, That the extension of a system of canals from the head of the great lakes to the upper waters of the Mississippi and to the valley of the Red river would be the means of greatly stimulating the development of the northwest, and would largely add to the commerce of the lakes; and that the time has come when a systematic examination should be made into the question of the feasibility and cost of such undertakings by the governments of the two nations.

By S. A. Thompson, Duluth:

Resolved, That the interests of lake commerce call for the earliest improvement of that route to tidewater which can be deepened for the least cost and in the least time.

Resolved, That this convention desires to secure the best route regardless of all local interests.

Resolved, That in order to select such a route full studies of all routes are needed, and that the influence of this convention shall be used in both the United States and in Canada to have their respective governments at once cause detailed examinations and final estimates of cost to be made of all the routes by which deep water may be made from the lakes to tidewater. Each government dealing with the portion lying in its own territory, and causing all the estimates to be made on a common basis, so that comparison of their relative merits may be made at the next annual meeting of this convention.

By Mr. Orr, Buffalo:

Resolved, That this convention observes with satisfaction that in the state of New York there is a movement on foot looking to an enlargement of the Erie canal with a view to increasing its capacity and lessening the cost of transportation to tidewater.

By George H. Anderson and George A. Kelley, Pittsburgh:

Resolved, That this convention recognizes the importance and commercial benefits that will result from the construction of water highways connecting Lake Erie and the Ohio river with the fuel producing districts of western Pennsylvania, Ohio and West Virginia.

Resolved, That the proposed water-routes connecting the ore and fuel districts are necessary to the greatest possible economy in our manufacturing industries and in a reduced cost in the fuel supply of the great lakes from the ore fields of Lake Superior to the fuel fields of the states aforesaid, all of which are essential to the enlargement and supremacy of American manufacturing.

Resolved, That this reduced cost in manufactured products in the territory bordering on the great lakes will result in a greater power of competition for the world's markets through the proposed waterways to the ocean; and pursuant thereto, we recommend the construction of as large waterways to the Ohio river as nature will admit and the character and volume of commerce will justify, and we also recommend the legislatures of Pennsylvania, Ohio and West Virginia to consider favorably all legislation tending to promote and assist in the establishment of waterways within their borders.

By Hon. Campbell W. Adams, Utica:

WHEREAS, The people of the state of New York are this year to vote on the question of spending $9,000,000 for the improvement of her free canals, so as to cheapen transportation and facilitate commerce;

Resolved, That it is the sense of this convention that New York is deserving of encouragement in the proposed improvement of her canals, and that we endorse and hope for the adoption of the bill providing for such improvement.

By Col. T. P. Roberts, Pittsburgh:

Resolved, That this convention heartily endorses the movement inaugurated by citizens of Pennsylvania looking to the connection of the Ohio river with Lake Erie, and that the legislatures of the three states interested are hereby recommended to favor such movement by appropriate legislation.

By D. B. Smith, Toledo:

Resolved, That we hereby invoke the aid of the congress of the United States, by the passage of a joint resolution requesting the secretary of war to order accurate and reliable surveys of the various routes for a ship-canal from Lake Erie to tidewater that have been under consideration by the public mind, each of which shall carry a depth of 26 feet, and which routes may be identified as follows; viz., from the Niagara river by way of Oswego to the Hudson river; from the Niagara river by the way of Lake St. Francis and Lake Champlain to the Hudson river; from Buffalo by way of the Erie canal and Troy to New York. And also the cost of enlarging the Canadian system of canals from Lake Erie to Montreal, and that an appropriation of $250,000 be made to cover the expense of such surveys.

APPENDIX.

Words of Encouragement.

Resolutions indorsing the work of the International Deep Waterways association were adopted in many localities throughout the country, but three only were formally transmitted, as follows:

By Alderman Drew:

Resolved, That the city council of the city of Minneapolis heartily endorses the efforts now being made by the International Deep Waterways association for better transportation facilities by water to the seashore. That this council fully appreciates the benefits which will result to all the northwest, and especially to Minneapolis, its metropolis, upon the completion of the proposed improvements. That this council approves the convention which has been called to consider this important question, at Cleveland, on September 24, 25 and 26, and believes that as a result of the deliberations of that body much progress will be made toward the accomplishment of the ends sought. This council further pledges its earnest co-operation on all measures of a public nature which will strengthen and support the international association in bringing to a speedy and successful close the plans and projects for which it is organized.

Passed September 10, 1895.

FRED B. SNYDER, *President of the Council.*

Approved September 12, 1895.

ROBT. PRATT, *Mayor.*

Attest: CHAS. F. HANEY, *City Clerk.*

By the Burlington (Vt.) Board of Trade:

WHEREAS, The construction and completion of several transcontinental railroads between the waters of the great lakes and those of the Pacific ocean has opened up a territory vast in extent, an empire in itself—whose inestimable and inexhaustible resources are being rapidly developed, thereby producing an immense amount of tonnage, concentrating at various points on the upper lakes for shipment to eastern markets; and,

WHEREAS, The present modes of transportation are being severely taxed in exchanging the products of the farm, the forest and the mine between the producers of the west, and the consumers of the east, and it is evident that it will become absolutely necessary at no distant day to have increased facilities and new avenues of communication between different parts of the country; and,

WHEREAS, The International Deep Waterways association has called a convention to meet at Cleveland on the 24th, 25th and 26th of September, to take into consideration a system of improvement of the waters of the lakes, by which sea-going vessels may pass from the ocean to ports on these waters; and,

WHEREAS, An invitation has been sent to this board to join in these deliberations by sending delegates thereto; therefore,

Resolved, That in the opinion of this board the time has arrived for the serious consideration of this subject and that it is the province of wise statesmanship on the part of the United States government to take measures for the improvement of the waters between the upper lakes and the Atlantic ocean, upon a scale which shall be adequate to accommodate the rapidly increasing trade and commerce of the country for years to come.

Resolved, That the board of trade of the city of Burlington, Vt., hereby cordially approves the proposed objects of this convention, and realizing the importance of this matter to the business interests, especially of Burlington, Vt., in particular, and to New England in general, do hereby accept the invitation of the International Deep Waterways association to be present at said convention.

Resolved, That William J. Van Patten, G. G. Benedict, Thomas H. Canfield, B. B. Smalley and L. B. Lord with D. W. Robinson, H. W. Allen, C. W. Brownell, C. P. Smith and Horatio Hickok as alternates, be appointed delegates to represent this board at said convention and they be urgently requested to attend and present to the convention the expression of this board that it is desirable for the interests of New England and the valley of Lake Champlain, as well as for that of New York city, that as a part of the system of inrovement, a canal should be constructed between the St. Lawrence river and Lake Champlain and between Lake Champlain and the Hudson river.

By the Commercial Club of Mankato, Minnesota:

Resolved, That the Commercial club of Mankato, Minn., fully appreciates the benefits which will accrue to the general business interests of the northwest from the successful termination of the plans and projects of the International Deep Waterways association; that we heartily endorse their work and pledge our earnest co-operation in all measures of a public nature which will assist and strengthen the said association, and that we accept the invitation to be represented at the convention of the association to be held at Cleveland, Ohio, September 24, 25 and 26, and trust that the deliberations of that body may result in much progress toward developing and strengthening plans for better transportation facilities by water to the seaboard.

C. L. ALLEMAN,
J. B. OGLE,
H. A. PATTERSON,
S. J. WRIGHT,
C. H. HIGGS,
Committee.

Sept. 23, 1895.

International Deep-Water Legislation.

A Pioneer Deep-Water Bill.—On Feb. 8, 1892, John Lind, congressman from Minnesota, presented the following "joint resolution to promote the improvement of the waterway from the head of Lake Superior by way of the Welland and St. Lawrence canals and St. Lawrence river to the sea:"

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That the president of the United States be, and he is hereby, requested to invite negotiations with the government of the Dominion of Canada to secure the speedy improvement of the Welland and St. Lawrence canals and the St. Lawrence river so as to make them conform in depth and navigability, so far as practicable, to the standard adopted by the government of the United States for the improvements now in progress within the United States for the waters connecting the great lakes; and to that end the president is hereby authorized, if he deems expedient, to appoint three commissioners to negotiate on behalf of the United States with the representatives of the government of the Dominion of Canada the terms and conditions of any agreement which may be entered into between the two governments in pursuance of any proposition submitted in that behalf by the government of the Dominion of Canada.

Favorable Report.—Mr. Lind, from the committee on interstate and foreign commerce, submitted the following report to accompany the foregoing:

The committee on interstate and foreign commerce, to whom was referred the joint resolution (H. Res. 11) to promote the improvement of the waterway from the head of Lake Superior, by way of the Welland and St. Lawrence canals and St. Lawrence river, to the sea, respectfully report:

The value and extent of the commerce of the great lakes has been so frequently commented upon in this body of late years that it is not deemed necessary to quote figures and statistics to demonstrate its importance. Forming, as they do, the boundary line, in part, of eight of the larger states, the great lakes furnish a highway for the interchange of the productions of those commonwealths that has no parallel in any other country. Thus far the traffic upon them has been confined almost wholly to the trade with Canada and the internal commerce between the states. The recent development of the untold resources of the great northwest has, however, made the productions of that region not only a vital part of our internal commerce, but the leading factor of our foreign trade. To facilitate the internal commerce, by affording better facilities in the way of improved harbors, lights, and deepening the canals, congress has not hesitated to vote appropriations by millions. Its action in this behalf has met the approval of the country.

Your committee believes that it is now equally important to facilitate and take the proper steps to secure a deep water outlet for the foreign commerce originating in the states bordering on and tributary to these waters.

Public interest in this subject is evidenced by the action of conventions and commercial bodies, as well as by the several propositions submitted to congress, looking to the opening of adequate waterways between the lakes and the ocean. The impracticability of deepening or improving the Erie canal so as to admit the passage of ocean-going crafts seems to be admitted on all sides. But it is claimed, however, by persons who are competent to express opinions on the subject, that it is feasible to construct a canal from Oswego to the Hudson of sufficient size and depth to furnish deep-water passage from the lakes to the sea. That this may be true, and that the work may be undertaken, if practicable, is earnestly hoped for by all who are interested in the development of our means of communication. It stands admitted, however, that this project, in connection with the proposed Niagara canal, would require decades for its execution and an amount of money variously estimated from $40,000,000 to $100,000,000.

Pending the consideration of this plan, and its execution if adopted, it seems to your committee that the great interests under consideration should be served by other available means if such are at hand or within our reach. Nature has provided an outlet by means of the St. Lawrence river which needs but comparatively little improvement to make the great lakes as available to the commerce of the world as they now are to the internal commerce of the United States and of Canada. On the practicability of the St. Lawrence route for that purpose we quote from a letter to this committee, written by Col. O. M. Poe, in charge of the construction of the new canal at Sault Ste. Marie, in response to a reference of this resolution to the war department, as follows:

> The Welland and St. Lawrence canals undoubtedly occupy the most favorable, and therefore, the best line of water communication between the lakes and the ocean. A deep waterway can be opened by their route at less cost than by any other, and there can be no question as to its advantages in an engineering point of view. * * * So far as communication between the lakes and the countries beyond the Atlantic is concerned, every argument favors the proposition of this bill.

Our neighbors on the north have already improved this natural outlet by the construction of the Welland canal between Lakes Erie and Ontario, and the series of shorter canals along the St. Lawrence. These canals cover the entire distance where canals are required between Lake Erie and the sea. Their aggregate length is only seventy miles, while the Erie canal is 363 miles long.

In pursuance of plans adopted by the Canadian government for uniformity in depth the Welland has been deepened to 14 feet, and the work is in progress on the other canals with the prospect of completion within three years if the necessary appropriations are made. The magnitude and importance of the work already done is made evident by the fact that the steamer Wetmore, carrying some 80,000 bushels of wheat, went through from Superior to Liverpool last season by lightering her cargo in passing down that portion of the St. Lawrence river at which the canals have not yet been deepened. This trip, though largely experimental, proved remunerative to the owners of the vessel. The rate paid to Liverpool was 9½ cents per bushel, exclusive of the charge for transshipment to lighter the vessel, which was 3 cents per bushel.

This demonstrates that, with the completion of the improvements now in progress, steamers of the size and capacity of the Wetmore can be dispatched from points on the great lakes to any port in the world, provided we can use the canals in common with the Canadians. If the canals were further deepened so as to correspond with the new "Soo" canal, Milwaukee, Chicago, Cleveland and Buffalo would enjoy all the advantages of seaboard cities with reference to foreign trade.

Your committee, therefore, recommend the passage of the joint resolution.

The Baldwin Bill.—M. R. Baldwin, a congressman from Minnesota, introduced the following bill "For locating and constructing a ship canal from the great lakes to the Atlantic ocean:"

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the secretary of war be, and he hereby is, authorized and directed to cause to be made accurate surveys, examinations, and final estimates of cost of construction of a ship-canal by the most practicable route from the great lakes to the Atlantic ocean, of sufficient capacity to transport the tonnage of the lakes to the sea, and that the sum of one hundred thousand dollars, or so much thereof as may be necessary therefor, be, and the same is, appropriated to defray the expenses of such survey and estimates.

SEC. 2. That for carrying out the provisions of this act the president shall appoint a commission of five, a majority of whom shall be civil or military engineers, whose duty it shall be to examine and select the most feasible route for said canal or canals and estimate the cost thereof and to make report of the same. Said commission shall also be authorized to enter into negotiations with Canada for such rights and privileges as may be found necessary in the event of such canal being located in part through any Canadian territory.

SEC. 3. That said canal shall be constructed, owned, managed and operated by the government of the United States, subject to such joint ownership and control by the Canadian government as may be found necessary for any part of said canal that may be located and constructed through Canadian territory: Provided, That such part of said canal as may be constructed in Canada shall be subject to such joint ownership and control by the government of Canada and the government of the United States as may be agreed upon by treaty between these countries.

SEC. 4. That for the purpose of constructing said canal under the provisions of this act, and providing the necessary money therefor, the secretary of the treasury is authorized and directed to issue, from time to time, as may be required, the bonds of the United States in an amount equal to the cost of construction of said canal or canals, in denominations of twenty-five dollars, fifty dollars, one hundred dollars, and one thousand dollars, drawing interest at the rate of two per centum per annum and payable at the option of the government, on the demand of the holder, at any time after the expiration of twenty years from the date of issue.

The First Deep-Water Law.*—On February 8, 1895, Wm. F. Vilas, United States senator for Wisconsin, introduced the following "Joint resolution authorizing a preliminary inquiry concerning deep waterways between the ocean and the great lakes, and providing commissioners therefor:"

Resolved, by the Senate and House of Representatives of the United States of America in Congress Assembled, That the president of the United States is authorized to appoint, immediately after the passage of this joint resolution, three persons, who shall have power to meet and confer with any similar committee which may be appointed by the government of Great Britian, or the Dominion of Canada, and who shall make inquiry and report whether it is feasible to build such canals as shall enable vessels engaged in ocean commerce to pass to and fro between the great lakes and the Atlantic ocean, with an adequate and controllable supply of water for continual use; where such canals can be most conveniently located, and the probable cost of the same, with estimates in detail; and if any part of the same should be built in the territory of Canada, what regulations or treaty arrangements will be necessary between the United States and Great Britain to preserve the free use of such canals to the people of this country at all times; and all necessary facts and considerations relating to the construction and future use of deep-water channels between the great lakes and the Atlantic ocean. The persons so appointed shall serve without compensation in any form, but they shall be paid their actual traveling and other necessary expenses, not exceeding in all $10,000, for which purpose the said sum of $10,000, or so much thereof as may be necessary, is hereby appropriated.

The president may, in his discretion, detail as one of such persons an officer of the U. S. Navy or of the army.

Mr. Wise's Favorable Report.—On February 15, 1895, Mr. Wise from the committee on interstate and foreign commerce, submitted the following report to accompany the foregoing:

The committee on interstate and foreign commerce, to whom was referred the joint resolution (S. R. 130) authorizing a preliminary inquiry concerning deep waterways between the ocean and great lakes, and providing commissioners therefor, after considering the same beg leave to submit the following report:

This resolution offers a practical way to enter upon a work that must commend itself to the house as being of the greatest national importance. The union of the great lakes with the seaboard by a deep waterway—one that will carry ocean-going vessels—has for years been the subject of discussion in conventions called especially for that purpose, and in the public press, and its importance in cheapening the cost of transportation between the interior of the country and the seaboard would be so far-reaching as to affect favorably every portion of the country.

Statistics of lake transportation show that since the deepening of the channel between Buffalo, Chicago and Superior-Duluth the cost of carriage by water over such route is on the average only one-ninth of the cost of carrying the same freight by rail. This saving in transportation charges by reason of the lake service amounts in round numbers to $150,000,000 annually, and your committee believe that if such service can be extended to the seaboard that sum would be very largely increased.

Your committee, therefore, recommend the passage of the joint resolution.

*NOTE—Approved and became a law on March 2, 1895. See U. S. Pub. Doc. 122, page 44.

State Deep-Water Legislation.

The Illinois Bill.*—SECTION 1. *Be it enacted by the People of the State of Illinois, represented in the General Assembly,* That it is hereby declared to be the policy of the State of Illinois to procure, as soon as practicable, the construction of a trunk waterway through the state from Lake Michigan via the Desplaines and Illinois rivers, to the Mississippi river, of such dimensions and capacity as to form a homogeneous part of a through route from the Atlantic seaboard via the great lakes to the Gulf of Mexico; and it is hereby declared to be the further policy of the said state to determine such a system of lateral and subsidiary waterways as shall be permitted by topographical and hydrographical conditions, in order that the state may, by appropriate legislation, fully conserve the public interests in said system, to the end that the same may be developed with the growth in resources and population, as public necessities shall demand. And in furtherance of the policy herein set forth, the governor is authorized to appoint, by and with the advice and consent of the senate, a commissioner of waterways, who shall be a civil engineer of recognized standing and ability on waterway questions; said commissioner to report to the next general assembly of Illinois such data and conclusions, with estimates, diagrams and maps in illustration thereof as may be germane to the subject, and said report shall be accompanied by recommendations in regard to the means to be employed in carrying out any project that may be matured, and the draft of any legislation that may be desirable.

SEC. 2. In projecting said trunk waterway, the commissioner shall consider the sanitary and ship-canal of Chicago, and the connection of the same with Lake Michigan, in relation to its uses as a harbor for lake shipping; also for ocean vessels, in accordance with such plans, for connecting the lakes with the Atlantic, as may be projected by the commissioners of the United States, and said commissioner is authorized to co-operate with the United States commission and obtain any necssary data bearing upon said project for ocean navigation. And from said sanitary and ship-canal of Chicago to the Mississippi river, said trunk waterway shall be projected of such capacity as will accommodate boats of a draught of not less than fourteen feet, and be adequate to the largest Mississippi steamboats and to a fleet or tow of barges carrying not less than ten thousand net tons of freight; and said project shall be so designed as to permit future increase of depth whenever warranted by the demands of traffic and the public resources; and said project shall be considered in relation to the navigable stages of the Mississippi, the improvements now under way and the possible future development.

SEC. 3. Said commissioner is authorized to procure all necessary data, documents, reports, maps and charts, and to that end he shall have access to any such material collected or prepared by any sanitary district, and may take copies thereof, and is authorized to call upon any public officer or any corporation organized under the laws of this state, for any information relative to the subject matter of this act that he may require, it being the intent to collect and utilize existing information, as far as the same may be available, for the purposes of this investigation; and he may promote projects consistent with the purposes of this act by attending waterway conventions and congresses, by co-operating with commissioners and officials charged with similar objects in other states, by the exchange of pertinent information, by the publication and distribution of statistical and other information of current interest and by exhibits of diagrams and maps, and said commissioner is authorized to receive contributions of assistance and moneys from individuals and public bodies and to apply the same in his discretion and as he may be authorized by the party or parties contributing the same.

SEC. 4. For the purpose of carrying out the intent of this act there is hereby appropriated from any moneys not otherwise appropriated, the sum of twenty-five thou-

*NOTE—Passed the senate with but four dissenting votes, and the assembly with but one dissenting vote, and was vetoed by Governor Altgeld, June 26, 1895, after the legislature had adjourned so that it could not be passed over his head.

sand dollars ($25,000), or so much thereof as may be necessary, the same to be disbursed by the commissioner of waterways, in the employment of assistants, procuring data, publication of reports and in traveling and other necessary expenses, of which a detailed account shall be returned on vouchers subject to the approval of the governor: *Provided* that said commissioner shall be entitled to receive as compensation to be paid out of the sum above appropriated for his services, the sum of five hundred dollars ($500) per month for twenty-two months, beginning July 1, 1895. The commissioner of waterways shall have his office in the city of Chicago, or at such other point as will best suit the convenience of his work, and in his absence he may depute some suitable person to act for him. He shall make a quarterly report to the governor, briefly setting forth the work in progress and an exhibit of expenditures therefor, and he may append to said report a statement of work done and expenditures incurred and paid through assistance and contributions from sources other than those provided in this act, and he shall file copies of all matter issued or published in the progress of investigation.

The final report of the commissioner of waterways shall be submitted to the general assembly through the governor, on or before March 1, 1897.

The First State Deep-Water Law.—*The people of the state of Wisconsin, represented in senate and assembly do enact as follows:* SECTION 1. The governor is hereby authorized and instructed to appoint by and with the advice and consent of the senate, a suitable person by reason of learning and experience in that direction to represent the state of Wisconsin in all matters relative to deepening and improving the great lakes channels and their outlets; to be a delegate of the state in such deep channels conventions; to appear at Washington and elsewhere when directed by the governor, and to gather statistics and information upon the entire subject as set forth herein* and make full report thereon to the governor.

SEC. 2. The said person so appointed shall be known as the deep channels commissioner of Wisconsin and shall be provided with necessary stationery, postage and printing. For his compensation he shall receive the sum of $150 per month and his actual and necessary traveling expenses while engaged in the performance of his duties, stated under oath and approved by the secretary of state; provided, that all salary and compensation of said deep channels commissioner shall cease at the end of two years from the date of the first appointment hereunder.

Approved April 19, 1895.

Miscellaneous Deep-Water Literature.

Hon. Wm. W. Bates,† Ex-Commissioner of the Bureau of Navigation: It has cost the country something to improve our lake navigation, but it has cost the farmers of the great northwest an hundred-fold in the lower prices for their products because lake vessels could not be built large enough to do their work economically. And in behalf of my brother shipbuilders I will make this assertion: There is nowhere in the world a higher skill or better judgment in proportioning and modelling vessels to carry great loads on light draught of water than on these lakes; and this has been the case for forty years past. It is not their fault in the least degree that lake transportation cost too much for so many years. It is the fault alone of a mistaken idea of the expenditure of public money.

Deep-water navigation through the lakes and to the sea is an improvement of national importance and utility. As such it deserves popular consideration.

But there is another view in which the national interest appears. A deep waterway through and from the lakes to the sea would remove an obstruction now preventing the enterprising and energetic people of this region from the application of their resources in building and running vessels in the foreign trade. The shipbuilding and freight-carrying business of these lakes, if not already, soon will be, overdone, and the

*NOTE—The preamble set forth fully all the purposes of the bill.
†NOTE—At Detroit Convention, Dec. 17, 1891.

whole country would be benefited if this pent-up power could find a new field for life and activity. New blood in the ocean transportation business is badly needed. I know of no place whence it could be obtained so well as from these lakes. Here we have the courage, the skill and the energy that have made the west the foremost business section of the United States. Here is where the young men of the nation have had a chance and have shown to the world what that means in a free republic. Here is the place to build ships for a foreign trade, to own them and to run them from our elevators and our warehouse docks to and from all parts of the world. Deep-water navigation between the sea and these lakes, through our own territory, confined to our own flag as it should be, would go far towards the solution of the shipping problem. It would immensely increase our naval power and raise our national rank. It would vastly enlarge and fortify our commercial credit. It would assure always a favorable balance of foreign trade. It would give the young men of our country another chance. They would go forth to the sea and devise new methods of doing the business of the world. Their enterprises and successes would be cheap to our nation at the cost of the improvements necessary to be made.

By sending our exports to market in our own ships we would receive for the service the ten, fifteen or twenty per cent. of their value now added for freight, but which is now earned and received by foreign shipping. The work of the foreign ships brings us into debt abroad, whereas, the work of our own marine would keep us out of debt and keep our gold at home. Here is a simple problem that will illustrate the functions of a ship employed in foreign traffic:

There is a cargo in New York and another in Liverpool, each valued at $100,000. Freight is the same both ways. An American steamer takes our cargo to Liverpool, and a British ship brings the British cargo to New York. We build, equip, man, provision, insure and run our own vessel, and the British do the like by theirs. We do the banking, commission and insurance on our own cargo, and the British do the same for theirs. There is a fair exchange of goods and of services, and the balance of trade is even between the two countries.

Now suppose that a British steamer carries both cargoes. The freight is equivalent to 20 per cent. of value in each case. The banking, insurance and other expenses are 5 per cent. Then the British account will stand:

One cargo	$100,000
Freight on two cargoes	40,000
Insurance, etc., two cargoes	10,000
Total British credit	$150,000

The American account will stand:

One cargo	$100,000
Adverse balance of trade	50,000
Amount of credit and debt	$150,000

From these transactions it is easily seen that an adverse balance of foreign trade may be due, and in our case is really due, whenever it occurs, not to a lack of exports made abroad, but to a want of shipping of our own to carry what we send. We are actually paying to foreign shipping every year a sum as large as that collected at the customs houses. The only fear of our own commercial men is the export of gold to balance our foreign trade. If we had transportation in proportion to exportation the work of our marine would keep our gold at home. We would not need to fear a silver currency then. We would then have safety in our foreign trade; and foreign trade enough to satisfy us all.

Hon. Albert Fink:* You are aware that when the rates are reduced between Chicago and New York on account of the opening of the canal, this reduction applies not only to Chicago, but to all interior cities (St. Louis, Indianapolis, Cincinnati) as well as to New York. If that was not the rule the result would be that the roads running, say from St. Louis, Indianapolis and Cincinnati to Chicago, would carry the freight to Chicago, from which point low rates would take it to the east, and leave the direct road from the interior points to the seaboard without business. Hence, whenever the rates

*Note—Letter to Senator Windom.

are reduced on account of the opening of navigation from Chicago and lake ports, the same reduction is made to all interior cities, not only to New York, where the canal runs, but to Philadelphia and Baltimore. Although the latter cities have no direct water-route communication with the west, yet they receive the benefit, as far as railroad rates are concerned, the same as if a canal were running from the lakes direct to these cities.

The same in regard to the west-bound business. * * * so that it may be said that all rail rates are kept in check by water transportation.

J. J. Hill,* President of Great Northern Railway: The matter of transportation is one of the greatest and most vital importance to all the people, next to the cultivation of the land. It is certainly of more importance than any other single subject that affects the nation or the nation's welfare, or the well-being of the people of the nation. I would like to call earnestly the attention of the delegates to the importance of deep water navigation. The first nine or ten years of my residence in the state of Minnesota was passed in connection with the navigation of the Mississippi river. The Mississippi river, a noble stream, has served her time and her day, but I fear—as an old Mississippi river steamboat man, I say it with sorrow—I fear the Mississippi river clock has struck twelve, never to strike again. (Applause.) No, there is not depth enough of water—the rain does not fall in sufficient quantities to make it. If we could lath and plaster the bottom of the river and hold the water, possibly we might improve it from St. Paul to St. Louis, but if we look over the river and harbor appropriations we see a list of sums of money that represent the taxes collected from the people of the country, and I think I am safe in saying that one-third of the entire sum might as well be appropriated and given to King Kalakua to enable him to attend the Paris Exposition. (Laughter and applause.) Take, for instance, the old Minnesota river. I have traveled on a steamboat from St. Paul to Yellow Medicine in a week or ten days. I did not miss the time, because it was pleasant. But, gentlemen, we cannot afford the time. Take the Red River of the North. I made a great deal of money in a small way on the Red River of the North with steamboats; but that time is gone. I believe I own all the steamboats on that river, and I will give the entire number for less than one-half of the annual appropriation. I speak, gentlemen, from my own knowledge. I think one-third of the appropriation might as well have been thrown away. It seems a pity that the money could not have been expended where it would have done the most good. If that money could have been expended to deepen those channels where a steamer can carry a cargo of 3,000 tons at twelve or fourteen miles an hour, and do it at an expense on the boat and on the shore of $175 per day; if the channel from Chicago to Buffalo and from here to Buffalo were deepened to full 18 feet of navigable water, I think I would have the courage to build a 5,000-ton boat that could carry at one-half the present rate charged. I may be sanguine about these questions, but I think after I have had time to consider a subject carefully I am always sanguine, and I never was more sanguine about anything in my life than about that which we must have if we enter into competition with the markets of the world—and we do. All our western produce is sold at prices fixed by Mark Lane. Am I not right, Mr. President? [Answer, "Yes, sir."] The surplus we have to sell establishes the price on the balance, and we are interested to the extent of the distance we have to carry it in finding cheap means of transportation. There is not a question in my mind that the cheapest transportation that can be furnished in any way is through a good steamer and deep water upon which to run her. There was a time when we had a foreign commerce, when our flag floated on every sea and in every port, and our merchant ships were second to none in the world. Now, at this time the fact stares us plainly in the face, no matter how it is brought about, it is here and present with us, that we have not any ocean trade to speak of. We are driven behind the ramparts of our own territorial boundaries, and we have a commission every week or two traveling about the country to see if there is not some way to be devised in which the transportation between our states from one state to another can be preserved to the American systems as against some colonial lines over in Canada. That is what we are doing. Our commerce, our transportation to-day, if I may use the simile, stands chained and manacled by the laws.

*Note—At Superior (Wis.) Deep Waterways Convention, August 6, 1889.

There was a time when American enterprise could reasonably sit down and expect the fruit of its own labor and its own energy and work. But temporarily that time is gone. I hope the time will be very temporary and very short. (Applause.) If this convention, and it covers the waterways of the country, will urge upon the general government the expenditure of a reasonable sum of money to give us deep water from the head of these lakes, you will, as I have said before, deserve the thanks of every man in this country, east, west, north and south. I do not wish to ignore or to forget the value of the improvement of the rivers; I do not by any means want to relegate them to the bone yard. They do not deserve to go there. The Mississippi from Cairo to New Orleans can and will do some business; but as far as the great transportation problem of this country is concerned I believe it is true, considering the difference in time, that a first-rate steamer can carry freight from the head of this lake for less money than it can float down the Mississippi on a raft. This question of transportation is important to the country at large; it is so great that it will make itself felt. It must be fairly considered and treated, or the country at large will suffer just as the interests within it suffer.

Hon. Ignatius Donnelly:* There is no greater geographical fact in the world than that for all practical purposes the Atlantic ocean penetrates to the heart of this country, and terminates very near where we are now assembled. (Applause.) And I think that, big as are the brains of our western people, and there are none larger on earth (laughter and applause), and illuminated as they have been by the lights of such extraordinary progress, even the largest intellects do not completely grasp the full meaning of that tremendous geographical fact. I could not help thinking all this the other day, when looking at a map of Europe, and noticing how the Mediterranean sea penetrated far into the depths of that great continent—for practically Europe, Asia and Africa are one continent—I remember how, in the ancient world, all the vast civilization centered around that great body of water, until Plato, surnamed The Broad, from his broad view of things, used this broad expression: "The nations are gathered around the Mediterranean like frogs around a pond." And when you look at that map, and consider the glories of Tyre and Sidon, the great nations of the Phœnician world, Alexandria, and the great nations of another epoch, Rome and mighty Carthage further down the coast of that region; and when you remember that the great growth, extraordinary power and wealth of those marvellous communities were sustained by a region that will not for one instant compare with this continent—for back of them were the great deserts of Arabia and Africa, the rocky peaks and soil of Phœnicia or Palestine, the rainless country where nothing could be raised without irrigation; and when you consider that into the heart of this continent of America penetrates a body of water greater in its shore lines than the water of the Mediterranean—penetrates not into deserts, but into lands of unexampled richness—for the valley of the Nile for agricultural purposes extends but five and one-half miles in average width (we could stow it in any one county of Minnesota or Wisconsin,)—and when you think that those nations, under such disadvantages, rose to such magnificence and power in that ancient world, to what must this country not come in the great hereafter? Here we have millions of square miles of fertile land, and here to-day, going out into our western country, is a commission appointed by the senate of the United States, that proposes to reclaim by irrigation a large part of that two-fifths of the wild land of our country which cannot be made practically valuable without irrigation. Why, my friends, we are only upon the threshold of things, and men will look back in the future and laugh at our exaltation and pride, and at the statistics of which we boast to-day.

I made a prophecy the other day, which I think will be realized, although none of us will live to see it, that before the end of the twentieth century there will be grouped around the head of this lake great cities perhaps under one municipal government, that will contain 10,000,000 of inhabitants. The London Times said the other day: "The child is now born that will see the United States with 200,000,000 of people." Why, what is that? Why, in eleven years, at our past ratio of growth, we will touch the mighty sum total of 100,000,000 of people, and nine-tenths of those here will live to see it. And what will the future give?

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*NOTE—At Superior (Wis.) Deep Waterways Convention, August 6, 1889.

What geographical fact will stand out so conspicuously as that mighty waterway in whose interest you are assembled here to-day? There is an ancient tradition that the mouth of the Mediterranean was once cut off from the ocean by a line of rocks and sand, and that some highly civilized pre-historic nation opened the waterway which now exists in front of the rocks of Gibraltar. We are now assembled to assist in opening in the same way the Mediterranean of this continent, this American continent, and we should never rest until the government has completed such improvements that ships of the largest burden can load at these docks and sail without breaking bulk until they touch the ports of England and Europe. (Great applause.)

Gen. Edward C. O'Brien, President New York Dock Commission: To realize their topographical advantages to the eastward the Canadians are spending, as I have said, $83,500,000 to perfect a deep-water route from Lake Superior to the Canadian seaboard.

From Liverpool to New York is 3,040 miles. From Liverpool to Montreal is 2,790 miles. From New York to Duluth (via railroad to Buffalo) is 1,437 miles, and via the Erie canal, 1,517 miles. From Montreal to Duluth, via the St. Lawrence, is 1,354 miles. From Liverpool to Duluth, via Montreal and the St. Lawrence, is 4,144 miles, which will shortly be unbroken deep-water navigation. From Liverpool to Duluth, via New York, is 4,477 miles, or 4,557 miles, according as the route be via the New York Central railroad or the Erie canal to Buffalo. Montreal is 250 miles nearer Liverpool than New York is, and 83 or 163 miles nearer Duluth. From Liverpool to Duluth the route, via Montreal, is 3?3 or 413 miles shorter than the route via New York.

Let us translate these distances into dollars and cents and see what commercial advantages the Canadians will realize on the completion of the great eighty-three-and-a-half-million-dollar water route from the great lakes to the seaboard. Let us compare the relative costs of taking a ton of freight from Duluth to New York and from Duluth to Montreal.

On the lakes and the St. Lawrence we can, without serious error, assume freights to average 1 mill per ton per mile, and on the Erie canal 3 mills per ton per mile. Five hundred and twenty miles of barge transportation at 3 mills equals $1.56, and 997 miles of steamship transportation at 1 mill equals $1, making transportation to New York cost $2.56, to which must be added 47 cents, port, commission, and transshipment costs at Buffalo, making the total freight from Duluth to New York equal to $3.03 a ton.

Via the St. Lawrence to Montreal the items of cost will be: 1,355 miles at 1 mill, equal to $1.35; twenty-six hours' detention in the locks, equal to 26 cents; tolls 10 cents, making the total freight cost from Duluth to Montreal $1 71 a ton.

It will be seen that the natural and artificial advantages of Canada's location and her deep waterway to the sea will give Montreal an advantage over New York of $1.32 a ton, or 35⅓ mills a bushel on all freight received from the great lakes.

In view of the profound statesmanship exhibited by our neighbors, what has our own government done to meet the situation, and by providing a cheap deep-water route reaching the seaboard at an American port, to keep the trade and sympathies of our people within our own borders?

Our government has done nothing! Absolutely nothing! It has expended upward of $40,000,000 in general and local improvements on the great lakes, of which sum $14,158,223 is to be the total cost of the 20-foot channels connecting Lakes Erie, Huron, Superior and Michigan.

These improvements are most important, both specifically and as parts of a grand general scheme to provide deep navigation from Chicago to New York. They have proved most important to our internal commerce, and of the highest value to the people whose commodities are transported over them.

But in default of provision made by our own government by which the vast commerce of these waters can cheaply reach the sea at an American port, that commerce will go to those foreign ports which it can reach cheaply; that is to say, the vast commerce originating in our interior states will go to Canadian seaports, and Canada, by her foresight will reap the advantages of the expenditures made by our own government.

The state of New York is an empire in itself. Our state is more populous and many times wealthier than Canada. What has our great state of New York done to preserve to our own cities the trade which is now ours?

Absolutely nothing! We look at our Erie canal, with its 7 feet of water, and its 72 locks and lose ourselves in admiring its greatness. It has played a great part in the history of the state and of the nation. But boats carrying 250 tons on 7 feet of water, at a speed averaging 3 miles an hour, can not compete with boats carrying 2,750 tons, at a speed of 12 miles an hour.

It must be borne in mind that Canada has not realized the advantages of her great expenditure, because her canal system is not complete. The strength of a chain is the strength of its weakest link; the capacity of a navigation system is measured at its point of least capacity. The weak link in the Canadian water route is the Beauharnois canal, with only 9 feet of water.

But this weak link will soon be replaced by a strong one, namely, the Soulanges canal, with 14 feet of water over the lock sills and 17 feet in the stretches. This canal will be finished within two years, and then the Canadian 14-foot system will be in full working order from Lake Superior to Montreal. There will be no weak link in the chain then, and we will feel the pinch.

The Canadians are also considering the introduction of very high, quick-acting lifts in their canals. They have chartered a company which proposes to make the descent from Lake Erie to Lake Ontario with two lifts, each 160 feet, in lieu of the twenty-five locks now in use, and to descend the total difference in altitude between Lake Erie and Montreal harbor with only six lifts, in lieu of the fifty-three now in use.

Thus will be effected a saving in time between Lake Erie and Montreal of at least twenty hours, which, translated into cents, means a saving of 20 cents per ton, or over $\frac{1}{2}$ a cent a bushel on Canadian commerce, and a handicap of that amount on our commerce.

It is also the avowed intention of the Canadian government to make the St. Lawrence river and canals free, thus reducing the cost of freight to Montreal 10 cents per ton, or 2$\frac{2}{3}$ mills per bushel. The struggle for supremacy in the carrying trade within this continent will begin in earnest when Canada opens the Soulanges canal.

The city and the state of New York have a greater interest at stake than any other city or state in the Union. The United States customs district of New York collected during the fiscal year ended June 30, 1893, nearly 70 per cent. of the total duty collected on imported merchandise of the United States, and here also was shipped over 40 per cent. of our total exports for the same year.

New York has 28$\frac{7}{10}$ per cent. of the total tonnage, 38 per cent. of the Atlantic and Gulf coast tonnage, 23 per cent. of the lake tonnage, 27$\frac{7}{10}$ per cent. of the total steam tonnage, 46$\frac{5}{8}$ per cent. of the steam tonnage on the Atlantic and Gulf coast, and 19$\frac{1}{3}$ per cent. of the steam tonnage on the lakes. New York has 3$\frac{1}{6}$ times as much tonnage as Michigan, more tonnage than floats on the great lakes, and almost as much as any other four states.

This ascendancy in shipping is due to the great advantages of the port of New York and the reasonably cheap rail and canal transportation between New York and the great lakes. It is threatened by the improvements now being completed by the Canadians, whose port of Montreal will, in 1897, have 30 feet of water, be fully protected from the ice shoves, and can be equipped with the most modern facilities for handling freight.

In order to meet the requirements of American commerce, we must have the best possible internal connections and the cheapest possible freight rates between the great lakes and New York City, and to get such freight rates we must have adequate waterways between the Hudson and the great lakes.

The people of New York seem to be less alive to the needs of commerce than any other people. They have been indifferent alike to the activities displayed by other people and to their own future.

Statistics of Marine Commerce on the Great Lakes.

COMPILED BY L. E. COOLEY, C. E.,
Chicago.

SUEZ CANAL.

(Traffic through.)

The Suez canal was opened in 1869, and 1870 was the first full traffic year.

Year.	No. of Ships.	Net Tonnage.	Year.	No. of Ships.	Net Tonnage.
1870......	486	436,600	1883......	3307	5,775,861
1871......	765	761,467	1884......	3284	5,871,500
1872......	1082	1,160,743	1885......	3624	6,335,752
1873......	1173	1,367,767	1886......	3100	5,767,655
1874......	1264	1,631,650	1887......	3137	5,903,024
1875......	1494	2,009,984	1888......	3440	6,640,834
1876......	1457	2,096,771	1889......	3325	6,800,854
1877......	1663	2,351,447	1890......	3389	6,853,637
1878.....	1593	2,269,678	1891......	4206	8,699,020
1879......	1477	2,263,332	1892......	3559	7,712,028
1880......	2026	3,057,421	1893......	3341	7,659,068
1881......	2727	4,136,779	1894.....	3352	8,039,105
1882......	3198	5,074,808			

COMMERCE OF ST. MARY'S FALLS CANAL.

Year.	No. of Days Open.	No. of Passages.	Registered Tonnage.	Actual Freight Net Tons.	Remarks.
1855......	....				
1856......	209	....	106,296	....	Opened
1857......	206	....	101,458	....	June 18.
1858.....	217	....	180,820	....	Locks 12 feet of
1859......	210	....	219,819	....	water.
1860.....	200	....	352,642	....	
1861......	196	....	403,657	....	
1862	215	....	278,639	....	
1863......	211	....	359,612	....	
1864......	217	....	507,434	....	
1865	217	1,411	571,438	....	
1866......	213	997	409,062	....	
1867	214	1,006	458,530	....	
1868......	216	1,305	556,899	....	
1869......	210	1,155	432,563	....	
1870......	217	1,338	524,885	....	
1871......	206	1,828	690,826	....	Lake Superior
1872......	200	1,637	752,101	....	and Northern
1873......	198	2,004	914,735	....	Pacific period.
1874......	205	2,517	1,204,446	....	
1875......	205	1,734	1,070,857	....	
1876......	203	2,033	1,259,534	....	
1877......	213	2,417	1,541,676	....	
1878......	240	2,451	1,439,216	....	
1879......	216	2,567	1,667,136	....	
1880......	201	3,121	1,677,071	....	
1881......	213	3,503	1,734,890	....	
1882	227	4,004	2,092,757	1,567,741	New lock
1883......	224	4,774	2,468,088	2,029,521	opened for
1884......	232	4,315	2,042,259	2,267,105	16 feet.
1885......	211	5,689	2,997,837	2,874,557	
1886	224	5,380	3,035,937	3,256,628	
1887......	216	7,424	4,219,397	4,527,759	
1888......	212	9,355	4,897,598	5,494,649	
1889......	234	7,803	5,130,659	6,411,423	
1890......	228	9,579	7,221,935	7,516,022	
1891......	225	10,557	8,454,435	9,041,213	
1892......	233	10,191	8,400,685	8,888,759	
1893......	219	12,580	10,647,203	11,214,333	
1894......	234	12,008	8,949,754	10,796,572	
		14,491	13,110,366	13,196,860	

Average period of navigation, May 1 to December 1, equal to 215 days.

ST. MARY'S FALLS CANAL TRAFFIC—VALUE AND COST.

Year.	No. of Tons Net.	Value of Freight.	Average Distance Carried (miles).	Cost per Ton Mile (mills).	Proportion in Canadian Vessels.
1887	5,494,649	$79,031,757	811.4	2.3	7 per cent.
1888	6,411,423	82,056,019	806.4	1.5	6 " "
1889	7,516,022	83,732,527	790.4	1.5	4 " "
1890	9,041,213	102,214,948	797.2	1.3	3½ " "
1891	8,888,759	128,178,208	820.4	1.35	4 " "
1892	11,214,333	135,117,267	822.4	1.31	3 3/10 " "
1893	10,796,572	145,436,957	831.9	1.10	4 1/10 " "
1894	13,195,860	143,114,502	828.1	.99	3½ " "

TON-MILEAGE ST. MARY'S FALLS CANAL—COMPARISON WITH ALL RAILWAYS OF THE UNITED STATES.

Year.	By Water for the Season.	By Rail for Year Ending June 30.	Per Cent.
1890	7,207,299,415	76,207,047,298	9.4
1891	7,292,462,269	81,073,784,021	9.0
1892	9,232,773,938	88,241,050,225	10.4
1893	8,980,310,240	93,588,111,833	9.5
1894	10,927,871,324	80,335,104,702	13.6
Total five years	43,630,717,186	419,445,098,079	10.4

NOTE—The number of tons carried one mile by all the railways of the state of Illinois for the year ending June 30, 1894, was 6,050,197,710 at an average rate of 9.38 mills per ton-mile.

FREIGHT RATES FOR WATER TRANSPORTATION TO AND FROM LAKE SUPERIOR.

Items.	Designat'n	1887	1888	1889	1890	1891	1892	1893	1894
Coal	Net tons	$0 90	$0 70	$0 47	$0 45	$0 43	$0 41	$0 40	$0 40
Flour	Barrels	29	17½	18	13	15	16½	17	14
Wheat	Bushels	......	03½	04	03	01⅛	03⅛	02⅛	02⅛
Grain	"	07	......	03¼	02	03½	03¾	02¾	02¾
Corn	"	......	04⅓	......	03	......	......	......	......
Mfg'd Iron	Net tons	2 35	1 80	2 10	1 34	2 50	2 15	2 00	90
Pig Iron	"	......	1 30	1 45	1 35	1 17	1 23	1 30	1 15
Salt	Barrels	18	16	18	15	18	15	12	12
Copper	Net tons	2 60	2 35	2 25	2 88	2 00	1 40	1 75	1 95
Iron Ore	"	1 75	1 28	1 14	1 10	98	1 00	80	70
Lumber	M. ft. B. M.	4 00	2 80	2 70	2 38	2 70	2 95	2 35	1 90
Silver Ore	Net tons	3 00	1 90	1 90	2 25	2 25	2 25	2 25	2 25
Building Stone	"	1 15	2 05	2 02	2 00	2 00	1 67	1 36	1 28
Uncls'd fr'ght	"	4 00	3 00	3 00	2 75	3 58	3 60	3 00	2 75

NOTE—From traffic statement of Sault canal.

WATER AND RAIL RATES IN MILLS PER TON-MILE.

YEAR.	FREIGHT MOVEMENT.		WHEAT.	
	Rail, Eighteen Trunk Lines.	Water, To and from Lake Superior.	Rail, Chicago to New York.	Water, Duluth to Buffalo.
1887	9.7	2.3	......	......
1888	9.2	1.5	4.8	1.4
1889	9.2	1.5	5.0	1.5
1890	8.8	1.3	4.8	1.1
1891	8.7	1.35	5.0	1.7
1892	8.0	1.31	4.7	1.3
1893	......	1.10	4.9	1.0
1894	......	0.99	......	0.9

DETROIT RIVER—(COMMERCE PASSING) EXCLUSIVE OF CANADIAN VESSELS AND TRAFFIC IN COLLECTION DISTRICT OF DETROIT.

Year.	No. of Vessels.	Registered Tonnage.	Crossing by Railway.*	
			Cars.	Tons.
1881	35,888	17,572,240	....	....
1882	35,199	17,872,182	....	....
1883	40,385	17,695,174		
1884	36,742	18,045,949	257,267	3,087,204
1885	34,921	16,777,826	263,628	3,163,536
1886	38,261	18,968,065	294,518	3,534,216
1887	38,125	18,864,250	266,336	3,196,032
1888	31,004	19,099,060	285,661	3,427,932
1889	32,415	19,646,000	260,973	3,311,676
1890	35,640	21,684,000	273,960	3,287,520
1891	34,251	22,160,000	330,898	3,971,776
1892	33,860	24,785,000	320,129	3,842,248
1893	33,165	23,091,889	318,366	3,820,382
			304,941	3,659,292

*Note—Twelve tons per car.

ACTUAL TONS OF FREIGHT—(STAPLE PRODUCTS ONLY).

By census ....for 1889, 19,717,860.
Report Chief Engineer, U. S. A., " 1891, 23,209,619.
" " " " " 1892, 26,553,819.
" " " " " 1893, 23,091,899.

CLEARANCES AT ALL LAKE PORTS.

Year.	Number.	Registered Tons.	Remarks.
1891	55,896	32,483,444	Entrances would double foregoing figures.
1892	60,340	37,402,916	
1893	51,649	34,571,208	

TOTAL RECEIPTS AND SHIPMENTS ON THE GREAT LAKES FOR THE CENSUS YEAR 1889 AT UNITED STATES PORTS.

Lake.	Net Tons.	Percentage.
Michigan	18,571,258	36.27
Superior	7,925,930	15.48
Huron	3,373,807	6.59
Erie	19,343,875	37.78
Ontario	1,256,947	2.45
St. Lawrence river	731,289	1.43
Total	51,203,106	100.00

Average trip .... 566 miles.
Ton-mileage 15,518,360,000
Ton-mileage of railways of the United States.. 68,727,223,146

Ton-mileage by water of great lakes equals 22.6 per cent. of the railways of the United States.

LAKE SHIPMENTS FOR 1890.*

Iron ore	9,133,963	net tons.
Flour, grain and mill products	4,846,450	" "
Forest products	7,885,000	" "
Coal	6,751,931	" "
Salt, stone and copper	766,000	" "
All other shipments	3,920,000	" "
Total	33,303,324	" "
Valued at $15.00 per ton	$499,549,860.	

Average trip assumed at 556 miles, as in 1889. Ton-mileage, 18,849,681,384.

Ton-mileage of the railways of the United States for the year ending June 30, 1890, 76,207,047,298.

Ton-mileage by water of great lakes equals 24.7 per cent. of that of the railways of the United States.

The iron ore shipment from Lake Superior district by all rail in 1890 was 848,377 gross tons. The Lake Superior output is estimated at 65 per cent. of the total ore product of the United States.

The railways of New York carried to tidewater in 1890 3,045,302 net tons of grain and flour.

*Note—By W. Livingstone, now president of the Lake Carriers' Association.

LAKE FLEET—JUNE 30, 1894.

Class.	Number.	Gross Tonnage.
Steam Vessels	1,731	843,239 65
Sailing Vessels	1,139	302,985.31
Canal Boats	386	41,961.25
Barges	85	39,214.72
Total	3,341	1,227,400.93

The number of steam vessels registering 1,000 tons and upward was 359, with a gross tonnage of 634,467.84. The number of vessels of this class owned in all other parts of the United States is 316, with a tonnage of 642,642.50, so that half of the best steamship tonnage in the United States is owned on the lakes.

NEW TONNAGE.

The tonnage built on the lakes was, for the following years ending June 30:

Year.	Number.	Tonnage.
1890	218	108,515.00
1891	204	111,856.45
1892	169	45,168.98
1893	175	99,271.24
1894	106	41,984.26
Total	872	406,976.28

On December 31, 1894, 29 vessels were under contract, with a capacity in gross tons of 43,850, and a valuation of $2,870,500.

On December 31, 1893, the number under contract was 28 vessels with a capacity of 26,400 gross tons, and a valuation of $2,538,500.

The new tonnage built for the four years ended 1890, was as follows:

Year.	Western Rivers.	Seaboard.	Lakes.	Total.
1887	10,901	83,001	56,488	150,450
1888	11,859	105,125	101,103	218,087
1889	12,202	111,852	107,080	231,134
1890	16,506	169,091	108,526	294,123
Total	51,468	469,129	373,197	893,794

THE VESSEL TONNAGE IN 1890.

	Sail.		Steam.		Total Tons
	Number.	Tons.	Number.	Tons.	
Atlantic and Gulf	13,049	1,542,118	2,800	817,108	2,359,226
Pacific	843	238,638	551	183,779	422,417
Lakes	1,272	328,655	1,527	652,022	981,577
Western Rivers	....	....	1,087	205,276	205,276
Total	15,164	2,109,411	5,965	1,859,085	3,768,496

HUDSON RIVER TRAFFIC FOR 1889.

Tonnage of all shipping points	15,033,300
Coming to and leaving tidewater by canals	3,592,437
Total tonnage	18,582,596
Value of above tonnage	$185,733,094

The indications from known data are that the aggregate ton-mileage of Canadian commerce about the great lakes and on the St. Lawrence river, the commerce of Lake Champlain and the Richelieu river, the New York canals and the Hudson river, is not less than 7 per cent. of the ton-mileage by the railways of the United States. If this is correct, and the data are far from complete, then the great lakes and tributary waters and their seaboard connections carried 30 per cent. of the ton-mileage of the railways in the year 1889.

WELLAND CANAL* TRAFFIC.

Year.	Total Movement Tons.	Between United States Ports.	Year.	Total Movement Tons.	Between United States Ports.
1870......	1,274,818	....	1887......	779,918	340,501
1875......	1,142,853	....	1888......	878,800	434,751
1880......	896,122	....	1889......	1,085,273	563,584
1881.....	798,809	194,173	1890......	1,016,166	533,957
1882......	608,929	282,806	1891.....	....	556,800
1883......	880,957	432,611	1892......	955,554	541,065
1884.	....	407,079	1893......	1,294,823	631,667
1885......	....	384,599	1894......	....	....
1886......	....	484,478			

*NOTE—The canal was opened in 1885 for vessels drawing 12 feet of water and in May, 1887, for vessels drawing 14 feet.

AVERAGE DAILY RATE ON GRAIN, CHICAGO TO BUFFALO.

Year.	Wheat.	Year.	Wheat.
1878......................	3.1 cents.	1887.........	4.1 cents.
1879......................	4.7 "	1888......................	3.7 "
1880......................	5.7 "	1889	2.5 "
1881.	3.2 "	1890......................	1.9 "
1882......................	2.5 "	1891..............	2.5 "
1883.....	3.5 "	1892......................	2.2 "
1884......................	2.1 "	1893...	1.8 "
1885.........	2.0 "	1894......................	1.3 "
1886......................	3.6 "	Average, 17 years	2.9 "

Handling charge to vessels on grain $3.50 to $4.00 per 1,000 bushels.

AVERAGE RULING OF LAKE RATES, HARD COAL, FROM BUFFALO.

Year.	Chicago.	Superior-Duluth.	Toledo.
1885.........................	$0 71	$0 52	......
1886.........................	87	62	......
1887.........................	1 05	70	$0 35
1888.........................	86	65	41
1889.........................	52	41	27
1890.........................	62	43	33
1891..	56	29	25
1892.........................	59	43	27
1893..............	49	29	28
1894.........	46	25	25
Average, 10 years..	$0 67	$0 46	$0 30

Milwaukee rate usually same as Chicago. Detroit rate about same as Toledo.

Coal of all kinds shipped in net tons and handled without charge to vessels.

Soft coal to Milwaukee runs about the same as the hard coal rate; to Superior and Duluth 9 cents above the hard coal rate.

EAST-BOUND FREIGHT OUT OF CHICAGO DURING SEASON OF NAVIGATION.*

Season.	Total Net Tons.	All Rail.	Lake.	Per Cent by Lake.
1891...........	4,269,934	1,560,850	2,705,084	56.4
1892...........	5,197,194	2,145,180	3,052,014	58.7
1893...........	5,033,750	1,846,128	3,187,622	63.3

*NOTE—Marine Review.

Effect of Depth Upon Artificial Waterways.*

BY THOMAS C. CLARKE, M. AM. SOC. C. E.,
New York.

In examining the question of deep waterways between the lakes of this country and the ocean, the author has collected some facts of a general engineering interest, which he now presents to the society. The question of first cost, the interest on which is represented by tolls, will be disregarded, and the inquiries will be confined to ascertaining the cost of transportation alone, taking the case of the upper lakes and Erie canal between Chicago and New York as an example.

To ascertain the cost of transportation on this system these data are necessary:

First—The number of trips which steamers and barges can make during the season of navigation. This depends upon the possible speed in artificial waterways. The number of trips per season also depends upon some other matters which do not affect this discussion; such as the number and character of the locks, the length of detention in port, etc.

Second—The yearly cost of operating and maintaining large steamers, also of steam-towed barges.

Third—The receipts per trip must be equal to the amount of annual expenses divided by the number of trips, to prevent loss. For the sake of comparison the amount of receipts per trip will be equally divided between the receipts from grain going east, and merchandise going west. The cost of carrying grain will be ascertained by multiplying the number of bushels carried per trip by a rate which will make up a half of the expenses per trip. Such rate will always be a little less than the actual rates, as shippers must provide for the contingencies of light cargoes. As the rule is equally applied to all the conditions of depth, the comparison will be a fair one.

Transportation between Lakes Superior, Michigan and Erie costs less now than transportation by long ocean voyages; as the vessels have full cargoes both ways of grain, coal, ore, lumber and merchandise. They do a local business in addition to the through business, which is not possible on the ocean. Hence, people say, "If we could only get a ship canal so that lake vessels could go to New York without breaking bulk, the economy of transportation would be extended nearly 500 miles farther." It really means not only a ship canal, but a ship canal of such dimensions that the expensive ship shall not be detained too long while passing through it.

The conditions will now be examined. All of these are known except that of the depth of water under the keel of the ship, necessary to enable her to move at the required speed. If the question were simply one of resistance it could be solved mathematically, but there are other things to take into account. The Suez canal when opened was 27 feet deep, and vessels loaded to 25 feet draught are able to pass through at the rate of 4½ miles an hour. If they try to move faster, the currents of water passing under their bottom to replace that driven away by the screw, cause them to lose steerage way, and the ship takes a shear, runs her nose into the bank and stops not only herself, but other vessels. Greater width would help. The Suez canal is now being dredged 5 feet deeper and widened. It is hoped that speed can be increased to 6 or 7 miles an hour when the canal is deepened to 32.5 feet.

As a type of a lake freighter, the new steamer Victory will be taken. She is 380 feet long by 48 feet beam, and carries a cargo of 4,000 net tons at 14 feet draught; 5,000 tons at 16 feet, 6,000 tons at 18 feet, and 7,000 tons at 20 feet. Her economical rate of speed on the lakes in deep water is 13 miles an hour.

The depth of lake harbors now contemplated by the United States government is 20 feet. No port but South Chicago has 18 feet, the rest having not much over 16 feet.

Half an hour will be allowed for lockages in a ship canal, and the same for a fleet of barges. Thirteen days will be assumed as the time of detention in port in all cases.

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*NOTE.—Paper read by T. C. Clarke before the American Society of Civil Engineers at New York, October 16, 1895.

This time seems long, but is necessary in order to do a local business and get full cargoes. Better organization and machinery for handling freight would shorten this time.

SHIP CANALS.

I. Erie canal deepened to 18 feet to admit steamers carrying 5,000 tons on 16 feet draught. Distance: Chicago to Buffalo, by lakes, 8[illegible]0 miles; Hudson river, 143 miles; total, 1,013 miles. At 13 miles an hour; time, 78 hours. Canal, 350 miles; speed per hour, 4 miles; time, 87.5 hours. Lockages, 72 reduced to 50, at one-half hour each, 25 hours. Total time in motion, 190½ hours. Round trip, 381 hours, or 16 days. Time in port, 13 days. Total round trip, 29 days, or seven trips per season of seven months.

ESTIMATED EXPENSES.—210 days at $250	$52,500
Insurance and other expenses	43,950
Interest, 10 per cent. on cost, $200,000	20,000
Total	$116,450

ESTIMATED RECEIPTS PER TRIP.—One-seventh of $116,460 is $16,635, half of which is $8,318. The ship carries 5,000 tons on 16 feet draught, equal to 166,500 bushels of wheat, the rate on which would be 5 cents; this would be $8,355 on 166,500 bushels.

II. Erie canal deepened to 25 feet, to admit steamers carrying 7,000 tons burden. Speed increased in canal possibly to 7 miles an hour. Distance: lakes and rivers, 1,013 miles, at 13 miles an hour, 78 hours. Canal, 350 miles; at 7 miles an hour, 50 hours. Lockages, 25 hours. Total 153 hours; round trip, 13 days. Time in port, 13 days, or 26 days, eight trips per season.

ESTIMATED EXPENSES.—Allowing for extra coal, $120,000.

ESTIMATED RECEIPTS PER TRIP GOING EAST.—One-eighth of $120,000 is $15,000, and one-half of that is $7,500. Ship carries 7,000 tons or 233,000 bushels, which, at 3.22 cents per bushel, makes $7,500, Chicago to New York.

BARGE CANALS.

Cost by lakes to Buffalo and by present Erie canal, 7 feet deep.

III. The present cost of conveying grain from Chicago to Buffalo is	1.25 cents.
Elevating and trimming cargo at Buffalo	1.15 "
Canal to New York	2.33 "
Chicago to New York	4.73 "

Actual rates from 4¾ to 7 cents.

IV. Cost by lakes to Buffalo and by Erie canal deepened to 9 feet. Fleets of one tug and five steel barges loaded to 7½ feet draught. Cargo, 1,500 tons.

Erie canal, 350 miles. Speed, in motion, 4 miles an hour. Time, 87½ hours. Lockages, all locks lengthened for two boats, 15½ hours. Hudson river, 143 miles; speed, 6 miles an hour; time, 24 hours. Time in motion, 127 hours. Round trip, 254 hours, or 10.6 days; time in port, 12 days; total, 22.6 days round trip. Number of trips in 210 days, nine.

ESTIMATED EXPENSES.—Two hundred and ten days, running expenses at $30, $6,300; insurance and other expenses, $7,700; interest on cost, 10 per cent. on $40,000, $4,000. Total expenses, $18,000.

ESTIMATED RECEIPTS.—Full cargoes grain going east, 50,000 bushels at 2 cents is $1,000; going west, 1,000 tons at $1.00, $1,000. Total, $2,000 by nine trips, is $18,000. Total cost of conveying wheat from Chicago to New York via Buffalo and Erie canal, when deepened to 9 feet, is:

Chicago to Buffalo		[illegible] cents.
Elevating	.875 cent.	
Trimming	.275 "	1.15
Transportation (canal)		[illegible] "
Total		[illegible] cents.

An examination of the cost in the third and fourth cases shows that one of the heaviest charges is the 1.15 cents per bushel due to transshipment. Hence the loud cry for ship canals.

V. Is it not possible that less expensive machinery can do the business on lake and canal? If the insurance companies will insure a fleet of five steel barges 90 x 17½ feet and loaded to 6 feet, from Buffalo to Cleveland, 174 miles, would they not insure a fleet of four steel barges 180 x 17½ feet, loaded to 7½ feet draft, from Buffalo to Chicago? Such a fleet could pass the Erie canal deepened to 9 feet and with its few short locks lengthened.

The time would be as follows: Lakes and river, 1,013 miles at 6 miles an hour, 169 hours; canal, 350 miles at 4 miles an hour, 87.5 hours; lockages, 15.5 hours; total in motion, 272 hours x 2 = 544 hours or 23 days. Time in port, 13 days, or 36 days per round trip, allowing six round trips per season.

Expenses calculated on same basis as before, estimated at $24,000, to cover larger mileage and more coal used.

ESTIMATED RECEIPTS.—One-sixth of $24,000 is $4,000, and one-half is $2,000. They carry 2,400 tons, or 80,000 bushels, and the rate should be 2½ cents, to make $2,000.

It seems to the author that the proper thing is for the people of New York to vote for the 9-foot enlargement; and the fleets of barges running on both lakes and canal must follow. The profit would be so great that a very high rate of insurance could be paid.

SUMMARY OF COST OF TRANSPORTATION, CHICAGO TO NEW YORK.

I.	Ship canal 18 feet deep, no transshipment..........	5 cents.
II.	" 25 " " "	3.22 "
III.	Barge canal and lakes, 7 feet deep, including transshipment....................................	4.73 "
IV.	Barge canal and lakes, 9 feet deep, including transshipment.	4.40 "
V.	Barge canal and lakes, no transshipment................	2.5 "

The object of this paper, besides the usual one of exciting friendly discussion, is to call the attention of the profession to what seems to be proved in the foregoing, that a ship-canal ought to be not less than 25 feet deep, if it be intended to pass large lake vessels; and that a slight enlargement of the Erie canal may allow fleets of steel barges to run from New York to Chicago, and transport freight at less rates than large lake vessels could do in a 25-foot ship-canal, even if it were used free of tolls. If this be true, why are ship-canals wanted? In the judgment of the author, there is but one such canal needed; a ship-canal around Niagara Falls on our own territory, allowing upper lake vessels to reach Lake Ontario ports, and there tranship by rail or canal to New York.

Effect of Depth Upon Artificial Waterways.*

CHAUNCEY N. DUTTON, C. E.,
Washington, D. C.

I must express my deep appreciation of the courtesy of your invitation to join in the discussion of the paper just read by the distinguished engineer on "The Effect of Depth Upon Artificial Waterways."

I will not at this point question the accuracy of the estimates of the cost of operating vessels, upon which the author bases his conclusions, but will try to show that they are capable of a wholly different application, and when so applied will lead to exactly opposite results.

Neither will I take issue with his implied condemnation of the Erie and Oswego routes for ship-canals, nor with his conclusion that a ship-canal should be 25 feet in depth. I do not propose, however, in discussing the project of a ship-canal from the great lakes to the seaboard, to limit the range of thought to the narrow field, the grain carried by the Erie canal.

More than 9,000,000 tons of vegetable food are carried from the lakes to the sea; the Erie canal does not carry one-tenth of it. Seventy to seventy-five million tons of through freight are carried on the routes paralleling the future continental highway. The Erie canal carries about one-thirtieth of it.

The ship-canal must be powerful enough, as a means of transportation, to compete with those carriers which have proved stronger than the Erie canal.

*NOTE—Reply to paper read by T. C. Clarke before the American Society of Civil Engineers at New York, October 16, 1895.

It will not be a competitor with the state canals; it will be a feeder to them, filling them up with local distributing business, which they can do cheaply and profitably. It may relieve them of a part of the through business for which they are ill-adapted, because it can do it cheaper, as I will prove by Mr. Clarke's own figures, and also by reliable data.

The paper in question has little relation to the subject matter of its title, being rather a series of statements relating to the cost of carrying wheat from Chicago to New York in ships and barges.

That these statements in their most important particulars are erroneous and wholly at variance with fact, I will prove, as follows, first recapitulating Mr. Clarke's statements:

No. 1. That in a vessel carrying 5,000 tons on 16 feet the cost will be 5 cents per bushel.

This estimate is too high, as I will prove by authentic statements of the present cost of conducting transportation in cargoes of 2,000 to 2,500 tons, and a reliable estimate for a vessel carrying 4,725 tons on 16 feet, in addition to 265 tons of fuel.

No. 2. That in a vessel carrying 7,000 tons on 20 feet draught the cost will be 3.22 cents per bushels.

This statement is two and one-half times too much, as I will prove by an analysis of the author's own figures, corrected in some particulars to agree with the present performance of steamships on the lakes, and a reliable estimate for such a vessel.

No. 3. Erie canal as it now exists, 4.73 cents per bushel.

No. 4. Steamship on lakes and fleet of steel barges 7½ feet draught, 17½ feet wide, 93 feet long, via improved Erie canal, 4.4 cents per bushel.

I might pass these estimates without comment as an allowable special plea in favor of this particular route and method of transportation—but I prefer to draw attention to the fact that it is proposed to fit the Erie canal locks with improved gates, which will add 12 per cent. to the tonnage of the barges using it: that the draught in the locks is to be 8 feet, instead of 7½ feet; and that it can be deduced from Mr. Clarke's second estimate that wheat can be carried from Chicago to Buffalo for ¾ of a cent, instead of 1¼ cents, as he states. By making these corrections he could have made a showing for the Erie canal some 20 per cent. more favorable than he has. As a compensating error, however, he has assumed that barges can be towed at an average speed of 4 miles an hour in the Erie canal.

No. 5. That in a hypothetical steel barge, 7½ feet draught, 17½ feet beam, 180 feet long, towed from Chicago to New York via lakes and Erie canal, the cost will be 2.5 cents.

This estimate is wholly wrong and the assumptions on which it is based are false, as I shall forthwith prove.

A moment's consideration will show that his hypothetical barge 180 feet long, 17½ feet wide, 7½ feet draught and presumably about 11 feet deep, could not, as he assumes, have the same weight, cost, carrying capacity, and expenses per foot of length as the real 90-foot barge of equal width and draught, but that on the contrary, her weight and cost would increase nearly as the square of her length, and therefore his hypothetical 180-foot barge would weigh and cost nearly four times as much as the real 90-foot barge, because assuming the wave-action in a seaway to be equal on both, the weight would be nearly as the square of the length, as in beams. She would be twice as long, and weigh nearly twice as much per foot of length, making her nearly four times as heavy.

The actual 90-foot barge weighs about 75 tons.

To settle this question beyond controversy, I obtained an approximate estimate of the weight, cost and carrying capacity of such a barge, from one of the largest and most successful ship-building concerns in the country. Their chief engineer states that "roughly speaking, the weight would be about 280 tons, the cost $22,000 complete ready for sea, and the carrying capacity about 360 tons, instead of 600 as Mr. Clarke estimates. Such a barge would be of no service whatever if it were built."

Such a barge never has been built, and never will be; and if it were built, it could not be towed, singly or in fleets, around the short curves in the Erie canal at the rate of four miles an hour; in fleets, not at all; and singly, possibly at the rate of one mile in four hours, by two tugs, one to pull her nose off, and the other to pull her stern off, at every curve.

That such a barge is not available for the lake traffic is clearly proved by the history of navigation on the Canadian canals. For nearly a generation there has been an open waterway with 9 feet least draught and only 54 locks, the smallest 45 by 220 feet, big enough for two of the hypothetical barges to lie in, and used by barges of much more advantageous proportions than he assumes.

Did the St. Lawrence barges ever engage in trade across Lake Ontario and through the Welland canal? No. They are shut out of the lake traffic by steamers of 1,650 tons capacity, less than one-fourth the size of the Victory, by vessels which cannot earn a living west of Port Colborne. This effectually disposes of his fifth estimate, that for the hypothetical barge.

The tenacious hold of the barge idea is surprising in view of the facts. Surely, had there been any such economies in barges as has been claimed, every shipyard on the lakes would be building them. But do we find any such state of things? On the contrary, the one yard dedicated to barge construction is now building as many ships as barges.

Let us now consider the author's second estimate, for a 7,000-ton vessel drawing 20 feet.

He states the operating expenses of the Victory at \$250 per day, and her interest and other fixed expenses at \$67,500 per year. The per diem ratio of these expenses he makes $\frac{1}{210}$th, basing it on a short season of lake navigation. He forgets that when the Victory can get to the sea, she will not go back to winter in the lakes. She will put in surface condensers and engage in the coasting or foreign trade during the winter months, and the per diem ratio of her fixed expenses will shrink from $\frac{1}{210}$th to $\frac{1}{365}$th, or from \$321.43 to \$184.93 per day, her total daily cost shrinking from \$571.43 to \$434.93, as the immediate result of making the ocean accessible to her. This alone reduces his estimate 24 per cent., or from 3.22 cents to 2.45 cents per bushel.

This invalidates his whole argument. But we will go a little further. He figures on a route from Chicago to New York, 1,363 miles long, with 350 miles of canal, and 50 locks. That is the Erie canal route. A much better route will be via the St. Lawrence and Lake Champlain, 1,570 miles long from Chicago to New York, with at first only 90 miles of canal, and finally only 75 miles, and only 5 locks.

Applying his basis of speed to this route, 1,480 miles of open water at 13 miles per hour equals 113.85 hours; 90 miles of canal at 7 miles per hour equals 12.85 hours; and 5 locks at 24 minutes per lock equals 2 hours, a total of 128.7 hours, equals 5 days, 8 hours, 42 minutes, steaming time from Chicago to New York. Mr. Clarke estimates her time via the Erie route at 153 hours—24 hours, 18 minutes longer than the St. Lawrence route, longer in the ratio of 100 to 84. Here is a further reduction of 16 per cent. in one item—the actual steaming time.

Mr. Clarke bases his estimate on the supposition that the ship would be tied up in port 13 days each trip. We know that under favorable circumstances, at Chicago, West Superior or Duluth, she would discharge and receive her cargoes and clear the port within 12 hours of the time she entered. From the late Hon. George H. Ely's admirable pamphlet, "The Great Lakes of North America," we learn that the ship Manola was in port an average of only 37 hours, 36 minutes, per trip during the entire season, her trips averaging 1,686 miles. This on the lakes. Mr. Clarke's assumption therefore means that when in New York the ship would tie up 11½ or 12½ days, as against a half a day to a day and a half in the lake ports.

It is a violent wrench to one's business instinct to assume any such thing. If New York does not provide good terminal facilities, other people will come and build them as they came and built the elevated and cable roads, and many other things. But facilities for rapid loading and unloading now exist here for such cargoes as are in sufficient quantities to warrant them. It is a weekly occurrence that great ocean steamships are entered and cleared within three days; and it has been done within two days.

But suppose the terminal facilities do not exist. Would a ship tie up here 11½ or 12½ days when in that time she could carry her cargo to Europe, earning 4¾ to 6 cents a bushel; or could coast from Halifax to Galveston; or make a round trip to the West Indies; or run light to Chicago or Duluth and bring back another cargo?

What the ship will actually do on Mr. Clarke's basis of speed and cost is this: She will steam 1,480 miles in open water in 113.85 hours; 90 miles of canal in 12.85 hours, and pass 5 locks in 2 hours, a total of 128.7 hours; and will lose at the outside 37.6 hours in loading and unloading; a total per trip of 166.3 hours.

Mr. Clarke's bas's makes her cost $434.93 per day, equal to $18.12 per hour, and the cost per trip between Chicago and New York $3,013.36, equal to 43 cents per ton, equal to 1.29 cents per bushel, only a trifle more than the present cost of breaking bulk at Buffalo, and 40 per cent. of Mr. Clarke's estimate.

We now see why the western shippers want to ship through, and avoid breaking bulk, and why they demand ship-canals.

It is because it will save them 3.11 cents per bushel, equal to $1.161 per long ton on the cost of transportation, in steel bargos steam towed via a future 9-foot Erie canal, according to Mr. Clarke's fourth estimate.

This is on the supposition that the ship finds it more profitable to discharge here than to carry her cargo elsewhere, and finds a return cargo, which might be anthracite coal, sugar, building stone, bricks, ore, lumber, asphalt, or package freight. If she found no cargo here, she could run light to Kingston for anthracite; or to Fishkill, Troy, or Burlington, for building stone, marble, or package freight from New England; or to Lake Champlain for ore; or to Quebec for fish or iron sand; or to Oswego for anthracite: or to Buffalo or Cleveland for bituminous coal or coke. At the very worse, supposing she had to return light every other trip, she could run light to Chicago or Duluth for eastbound freight, in which case her account would stand: Eastbound trip and detentions, as aforesaid, 166.3 hours; one-half of westbound trip, 64.35 hours, a total of 230.65 hours, at $18.12 per hour, equal to $1,179.3[illegible], equal to 59.7 cents per ton, equal to 1.6 cent per bushel—less than half of Mr. Clarke's estimate.

This is the most unfavorable showing that can be made. New York is one of the three first-class ports of the American continent, and can provide return cargoes nine trips out of ten. Even were New York unable ever to provide a return cargo, and the port sealed so that the ship could not get out to find cargoes elsewhere, and were there no intermediate ports, and the eastbound freight had to bear the expenses of the round trip, the cost would only be 76.4 cents per ton, equal to 2.05 cents per bushel, less than two-thirds his estimate, and less than half the cost in steel barges via a 9-foot Erie canal.

Thus far I have used the author's own assumptions, properly applied, to disprove his own conclusions. I shall now endeavor to prove that his assumed costs are not founded on fact, and to establish, as nearly as possible, the actual cost of operating ships of various sizes and of conducting transportation in them under various conditions. For the figures hereafter presented, I am indebted to the courtesy of correspondents familiar with the subject.

As such statements might seriously affect important business interests, I will merely present conclusions in summary form; but my data may be verified by the personal inspection of the author of the paper and the officers of this society to attest their genuineness and reliability.

I will first call your attention to the published balance sheet of the Minnesota Steamship Company's ship Manola for the season 1890, which, so far as I know, is the only authoritative statement of the kind which has ever been published. For it we are indebted to the public spirit of the late Hon. George H. Ely of Cleveland, your delegate to the Fifth International Congress on Inland Navigation, held at Paris in 1892.

The Manola is 292 feet 5½ inches on the keel, 308 feet 5½ inches over all, 40 feet breadth, 24 feet 6 inches molded depth, 2,000 horse power, and could carry fully laden about 3,500 tons. In 1890 she was in commission 222 days, in port 47 days, steamed 175 days, made 30 trips of 1,686 miles each, equal to 50,584 miles, equal to 2[illegible] miles per day, her speed being, laden, 11.85 miles; light, 12.72; average, 12.25 miles per hour. Her fuel consumption was 5,528 tons, worth $14,427.14. She burned per hour 209 pounds when light, 226 pounds when loaded, and averaged 218 pounds, equal to 1½ ounces per ton mile. She carried 71,170.69 tons; equal to 2,295¾ tons per trip on 14.7 to 14.9 feet of water. She loaded in 7½ hours, and unloaded in 12½ hours.

She earned gross $93,738.25, net $38,624.05; her expenses being $55,114.20, equal to 58.79 per cent. of her gross earnings.

Carrying 2,295¾ tons, less than one-third the capacity of the ship we are considering, she cost $2[illegible].26 per day, including insurance, but not amortization, and earned net

$173.98 per day, out of which she paid amortization and a very handsome profit to her owners.

You will observe that she cost daily only $1.74 less than Mr. Clarke's estimate of the running expenses of the Victory and that the ratio of operating expenses to amortization and profits was as 100 to 70, and she was thought to do nobly. Mr. Clarke's assumed ratio is as 100 to 129, a difference of 59 per cent.

These figures are introduced for the purpose of checking the approximate correctness of those to follow.

I will now invite your attention to a summary statement of the actual cost of conducting transportation the current season up to Oct. 1, in a large fleet of lake steamships, which are a fair average of the large lake freighters. In the statement furnished me some of the calculations were based on gross tons, and some on net tons. I have reduced them all to gross tons for better comparison with the statement of the Manola.

GREEN BAY PORTS TO LAKE ERIE PORTS.

Water.	Average Cargo. Gross tons.	Cents.
15 feet 4 inches. Ore and return light	2,515.43	44.09
15 feet 4 inches. Ore down	2,546.36	36.28
Coal up	1,869.54	29.56
Average cargo	2,207.93	Average..33.43

SUPERIOR-DULUTH TO LAKE ERIE PORTS.

	Average Cargo. Gross tons.	Cents.
[illegible] feet 2 inches. Ore and return light	2,136.73	64.51
[illegible] feet 2 inches. Ore down	2,009.17	44.45
[illegible] back	1,934.21	35.08
Average cargo	1,971.69	Av. cost..39 86

To the above must be added 4 cents per ton for painting, winter laying up, and fitting out expenses, which would make the cost between Superior-Duluth and Lake Erie ports as follows on 14 feet 2 inches of water:

	Average Cargo Gross tons.	Cents.
Vessel returning light	2,136.73	68.51
Vessel carrying ore down	2,009.17	48.85
And coal back	1,934.21	39.08
Average cargo	1,971.69	Av. cost..43.86

Average cost of carrying one ton per round trip, 87.72 cents.

The statement of the Manola gives the cost per ton of freight carried an average of 1,686 miles, as 77.4 cents, the draught being 14 feet 7 inches to 14 feet 9 inches, and the cargo 2,296 tons. The vessels in this fleet average within one foot of the length of the Manola and three inches wider. The comparison of the figures 77.4 cents per ton per trip by the Manola and 87.72 cents per round trip by this fleet is not fair to the fleet, because from the length of the Manola's voyage it is evident that she touched at intermediate ports, probably loading down as deep as she could in Lake Superior and then running to Green Bay to complete her cargo.

I will endeavor to apply corrections to the figures for the fleet to make comparisons with the Manola more just. It cost the Manola 22.6 cents per ton to handle cargo; at the present time the charge for unloading is 15 cents per ton and for trimming 2½ cents, making a total of 17½ cents.

If from the figures for the fleet we take 17½ cents as above and deduct from the remainder 10¼ per cent. to compensate for her being twice in port and loaded and unloaded as against once for the Manola, we shall arrive at figures which admit of an approximately correct comparison. This gives us a cost of 62.85 cents per ton for a trip, equal to twice the distance from Cleveland to Duluth, which would be approximately equal to the length of the Manola's trips.

It will be remembered that the average size of the fleet steamer is practically the same as the Manola, but the Manola had the advantage of 5 to 7 inches of water, which enabled her to carry 325 tons additional cargo. Again correcting the figures for the fleet steamer we find that with this additional draught of water she could have carried her cargo for 56.44 cents instead of 62.85 cents. The lack of from 5 to 7 inches of water added 6.41 cents to the cost of carrying cargoes a distance approximately 1,650 miles.

The vessel's performance on this voyage may without considerable error be assumed as equal with her performance on a voyage from Duluth to New York; because if the detentions between Cleveland and Duluth be equated with those between Cleveland and New York the equated distances, east and west, will be substantially equal.

Therefore the cost of conducting transportation between Duluth and New York in a vessel carrying 2,300 tons on 15 feet of water would be 56.44 cents per long ton, or 1.51 cents per bushel. The fleet steamer's round trip performance, without corrections as above, is 87.72 cents per long ton or 2.35 cents per bushel. To these must be added interest and amortization. The net earnings of the Manola per season of 222 days were 70 per cent. of her operating expenses. Had she been in commission 365 days and earned the same sum of money, the percentage would have been 42⅝. Adding this percentage to the figures given above we have 2.15 corrected rate and 3.83 uncorrected for the remunerative freight rate in a vessel carrying 2,300 long tons on 15 feet of water.

Through the courtesy of a friend who is the executive officer of a great shipyard I am able to give you some further light upon the effect of depth.

The following are the data with reference to a ship which is to be 432 feet over all, 412 feet keel, 48 beam, 28 feet depth. It is to be a very heavily constructed, staunchly built hull, good not only for the present, but if kept off the rocks and out of collisions, good for several generations:

DEAD WEIGHT CAPACITY.*

At 14 feet	6 inches	draft	4180	net tons.
" 15	" 0	"	"	4450	"	"
" 15	" 6	"	"	4672	"	"
" 16	" 0	"	"	4990	"	"
" 16	" 6	"	"	5264	"	"
" 17	" 0	"	"	5539	"	"
" 17	" 6	"	"	5815	"	"
" 18	" 0	"	"	6180	"	"
" 18	" 6	"	"	6385	"	"
" 19	" 0	"	"	6680	"	"

It will be observed that this ship is considerably larger than the Victory. If she were loaded to 20 feet, which is 1 foot more than her builders have calculated upon, she would carry 7,265 tons. In view of the greater dimensions of this ship it is doubtful if the Victory can carry 7,000 tons.

The cost of the ship will be about $250,000. She will have 3,000 horse power. Her operating expenses will be about $175 per day or $7.29 per hour.

Her fixed yearly expense will be about:

Amortization and interest 12½ per cent. equal to	$31,250
Repairs, painting, etc.,	2,750
Total	$34,000

Allowing fifteen days for laying up, this is at the rate of $97.14 per day or $4.05 per hour.

At the same rate of speed, etc., as heretofore assumed for the 7,000-ton ship, assuming this ship laden to 20 feet and carrying 265 tons of fuel, her performance between Chicago and New York will be:

1. Assuming full return cargoes:

Conducting transportation	17.32c.	per net ton, equal	0.52c.	per bu.
Amortization, etc.	9.622	" " " "	0.289	"
Handling cargoes	17.5	" " " "	0.525	"
Total	44.45c.		1.334	

*Note—Net tons including 150 tons fuel.

2. **Assuming one-half return cargoes:**

Conducting transportation	23.95c.	per net ton, equal	0 72c.	per bu.
Amortization, etc	13.33	" " " "	0 4	"
Handling cargoes	17.50	" " " "	0.525	"
Total	54.75		1.645	

3. **Returning light:**

Conducting transportation	30.725c.	per net ton equal	0.92c	per bu.
Amortization, etc	17.06	" " " "	0.51	"
Handling cargoes	17.5	" " " "	0 525	"
Total	65.285		1 955	

I give the flat cost of transportation separately in order to show that in a life and death competition the big ship is invincible.

The effect of the depth of water upon the cost of carriage is very great in such ships. One inch means, at full draught, 49 tons or .68 per cent, and averages 46 tons, or ⅝ per cent. One foot means 8$\frac{4}{10}$ per cent., and 5 feet 6 inches means 44.7 per cent.

At 16 feet draught the vessel will carry 4,990 tons, or allowing 265 tons of coal, 4,725 tons of cargo. The cost would be:

Full return cargoes:

Conducting transportation	25.66c	per net ton, equal	0.77c.	per bu.
Amortization, etc	14.25	" " " "	0.43	"
Handling cargoes	17.5	" " " "	0.525	"
Total	57.41		1.720	

Half return cargoes.

Conducting transportation	35.49c.	per net ton, equal	1.06c.	per bu.
Amortization, etc	19.75	" " " "	0.59	"
Handling cargoes	17.50	" " " "	0.525	"
Total	72.74		2.175	

Returning light:

Conducting transportation	45.52c.	per net ton, equal	1.37c.	per bu.
Amorization, etc	25.28	" " " "	0.76	"
Handling cargoes	17.50	" " " "	0.525	"
Total	98.30		2.055	

These figures include vessel insurance, but not cargo insurance, which runs 25 cents to 30 cents per $100 Chicago to Buffalo, and of course varies per ton proportionately to the value.

We have seen that according to the basis assumed by Mr. Clarke a ton of freight can be carried from Chicago to New York in a 7,000-ton ship for 43 cents; and according to the data here presented for 44.44 cents. No other means of transportation can approach this for cheapness; and it is evident that if the ship canal be a private enterprise, remunerative tolls can be paid without raising freight costs to the point where competition would even begin.

The economy of carriage will take effect not only on grain, but also on all other commodities, effecting similar savings upon the present rail rates which have ruled this summer for carload lots from Buffalo to New York, per long ton as follows:

Upon articles in class 1, $7.28—many kinds of package freights and small fruits.

Upon articles in class 2, $6.16—wool, hops, canned goods, butter, eggs, dressed hogs, green hides, etc.

Upon articles in class 3, $5.04—cheese, paints, and many kinds of boxed and barrelled merchandise.

Upon articles in class 4, $3.36—dry hides, baled; rope, vegetables, heavy boxed and barrelled goods which will stand rough treatment, and certain kinds of castings and metal goods.

Upon articles in class 5, $2.80—lumber, salt, hay, green fruit, grease, candles, glue, lard, molasses, stove castings, hollow ware, wall finish, peas, potatoes, seeds, etc.

Upon articles in class 6, $2.24—starch, sal soda, rice in boxes, green coffee in bags, beans, etc.

Upon flour, etc.,—$1.12.

Upon live stock as follows, per long ton: horses—$6.72; sheep and hogs—$3.92; cattle—$3.70.

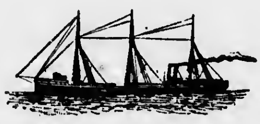
The greatest percentage of saving in the cost of transportation will be on dressed meats, which now pay $10.08 per long ton from Chicago to New York, and are carried exclusively by rail. As this business is now conducted the carcasses are first cooled for thirty days at Chicago and then shipped in refrigerator cars which are re-iced four or five times.

When large steamships can steam between the two ports the freshly killed carcasses can be loaded into a ship having a cold storage plant and cooled while in transit, the cost of cooling and transportation being little, if any greater, than the cost of cooling alone at Chicago, because the expenses of the ship would be little if any greater per unit of capacity than those of the warehouse at Chicago.

The figures are from the latest official publications of the United States government. There is a tendency in the articles to slip from one class into another on different roads, which makes exactness of statement impossible without a more searching analysis than I have had time to make.

It must be borne in mind that over 95 per cent. of the freight moved pays these or higher rates, and that to attempt to limit the question to the small movement over the Erie canal is to lose sight of the true significance to the west of a ship canal to the sea.

But the western people do not get their minds side-tracked in any such way. They realize that economy in transportation is their only salvation; that a ship canal to the sea will pay them its entire cost in a single season. Hence the momentum of the movement of which the Cleveland convention is a recent illustration and which has now assumed such proportions that no human power can stay it until the barrier is broken down that pens in the great heart of this great continent.



Rivers of the Mississippi Valley.

REPORT ON TRANSPORTATION BUSINESS IN THE UNITED STATES, ELEVENTH CENSUS, 1890.

Extracts from *Letter of Transmittal* by Supt. Robt. P. Porter: The figures of this report are quite interesting and in some respects unexpected. They show, for instance, that the fleet of the Mississippi valley consisted of 1,114 steamers with a tonnage of 210,772 tons, * * * and 6,339 unrigged crafts, with a tonnage of 3,182,608 tons, * * * the real value of the Mississippi fleet to be $21,907,150. The unrigged fleet was used almost entirely in the transportation of freight, the towed freight amounting to 19,059,542 tons out of a total of 29,405,046 tons. The figures of towed freight are not only interesting in themselves, but taken in connection with other statistics of a comparative nature, they show from first to last that there has been a steady decrease in the freight carrying steamer fleet, with a more than corresponding increase of the use of freight carrying barges. This decrease in the number of the Mississippi valley steamers must not, however, be regarded as an indication of a waning industry, but rather, when taken in connection with the increased number and value of the unrigged, as a proof that the new methods of transportation are yearly growing in the extent of their adoption.

No better example of this changing method of transportation can be found than that which is presented in some of the tables of comparative statistics of this report. One of them, for instance, which gives the statistics for 1880 and 1889, shows that there were registered in the ports of the Mississippi valley in 1880, 1,198 steamers, which had a tonnage of 251,793 tons, while in 1889 the registered steamers numbered 1,114 with a tonnage of 210,772, an increase of eighty-four steamers and of 41,021 tonnage tons. On the other hand, it will be found that while in 1880, the unrigged craft of the valley numbered 3,854, with a tonnage of 909,824 tons, the unrigged in 1889 had risen to 6,339, with a tonnage of 3,183,608, an increased number of 2,485 and an increased tonnage of 2,272,784 tons.

Extract from page 18—*Increase of Towed Freight:* This relation of cause and effect is seen to be consistently carried out in the fifth comparative table (table 24), showing the comparative freight movement in 1880 and 1889. On the steamers in the first mentioned year, there were transported 13,557,884 tons of freight while in 1889 the actual transportation of freight by steamers was but 10 345,504 tons, a decrease of 3,212,380 tons. But while the business of the freight steamer has decreased, it will be seen that the towed freight has very materially gone up, the figures for 1880 being 5,388,638 tons, while in 1889, they had risen to 19,059,542 tons, an increase of 13,670,904 tons of towed freight. The decreased steamer-carried freight will of course diminish this gain, but even when the 3,212,380 tons decrease in steamer freight is taken from the 13,670,904 tons of towed freight there remains a net increase of 10,458,524 tons of freight moved on the rivers of the Mississippi valley in 1889 over the total of 1880, although it is but proper to state here, that this increase would probably suffer a diminution, if the barge movement for 1880 had been as fully reported as it has been for 1889. On the other hand, it must be understood that 1889 was what is known as a poor year, nearly all of the rivers having suffered from low waters.

The passenger business has kept up much more steadily than it had been imagined would be the case, and it will be seen that in both the "ferry" and "regular" divisions of the passenger returns, the ratio of increased travel has run very steadily with that of population.

Extract from page 27—*Condensed Results:* The tranportation of the fluvial system of the whole valley has received such accessions * * * that the freight movement for 1889 stands at 28,293,140 tons against a freight movement of 18,946,522 tons for 1880, an increase for the decade of 9,346,618 tons.

Extracts from page 26: In a series of resolutions passed by the board of directors of the Merchant's exchange of St. Louis in 1890, it was stated that with the improvement of that portion of the Mississippi below the metropolis of Missouri, the increase of exports via. the gulf has kept steady pace, and that from very small beginnings in 1872, they had increased yearly until in 1889 nearly 20 per cent. of the entire exports of corn from the United States was by this route.

Remark: The reports of St. Louis Merchants' exchange give the average Liverpool rate via. New Orleans at 50 per cent. less than via. New York.

Extract from page 24—*Navigable and Utilized Waters:* The total navigable mileage of the valley was 15,410, of which 14,266 was reported on as having been used for purposes of transportation. Many of the unemployed 1,114 miles were probably unnavigable during 1889 because of the prevailing low water, to which reference has already been made, while it is also quite within the possibilities that many of the miles of sub-tributaries were merged within the mileage of the larger streams without being individualized.

ROUTE TO THE GULF OF MEXICO.

Chicago, June 27, 1895.

Charles T. Bogardis, Springfield, Ill.—Dear Senator: In respect to the veto of the waterway bill, it occurs to me on reflection, that the governor's view of the constitution is most strange. If I understand aright, he contends that it would be improper to investigate any subject or determine a policy thereon, if the carrying out of the thing by the state was in itself contrary to the constitution. In other words, private parties could bring matters to the attention of the legislature, with a view to constitutional amendment or referendum, about which the state would be denied the privilege of inquiry.

All this proceeds on the theory that the subject matter of the bill necessarily contemplates state action and appropriations for a waterway when, as a matter of fact, other and alternative solutions are feasible.

Without following the constitutional point further, some facts in regard to the real basis of the governor's constitutional objections may not be amiss:

No complete estimates have been made of the cost of extending the Chicago ship-canal from Lockport down the hill some eight miles to Lake Joliet, and down a declivity of some 76 feet. It is assumed that this work will cost some $1,000,000 per mile after the site has been procured and the sanitary district has done thereon what is necessary for its own purposes, or a total of about $8,000,000.

From Lake Joliet to Utica is a distance of about fifty-five miles. This portion of the river is of level reaches or reaches of moderate declivity, and broken by several rock-bound rapids, dropping through a total height of about 64 feet. A provisional project has been worked out for this portion of the river on a basis of 14 feet, with fleet locks 90 feet wide and 750 feet long, the estimated cost being $10,000,000.

The entire estimated cost, therefore, from the end of the sanitary and ship-canal at Lockport to the head of the alluvial river at Utica will be some $18,000,000, providing for a fleet navigation of 14 feet and descending to a level 140 feet below the level of Lake Michigan.

A proper utilization of the water power from the Chicago canal will develop 100,000 net horse power within this distance of 63 miles. Over this section of the river an estimate was made in 1891, on a basis of 14 feet, by Capt. W. L. Marshall, of the corps of engineers, U. S. A. His total was about $28,000,000: but in this distance he located some 16 locks, and in order to avoid overflows, indulged in very heavy rock excavation. His prices for rock were also more than double those now being paid by the sanitary district of Chicago and his prices for earth and hard-pan excavation were considerably higher.

The present project avoids much rock excavation, reduces the number of locks to 5, and the prices to those actually paid under contracts on the sanitary canal, which are believed to be sufficient to cover the necessities of the work although this project does not as yet profess to be a final one or the estimates to be entirely conclusive.

From the head of the alluvial valley at Utica to the Mississippi river, some 40 miles above St. Louis, is a distance of about 227 miles with a low water declivity of only 30 feet or an average of about ⅛ of a foot per mile. It is proposed to remove the 4 locks and dams built by the state and the United States at Henry, Copperas Creek, La Grange and Kampsville, and dredge the stream so as to give an available boating depth of 14 feet of water when supplied with the volume of water from Lake Michigan.

This volume of water is some sixteen times the extreme low water volume at La Salle, and about ten times the low water volume at Beardstown. In securing a channel, it is proposed to dredge for a width of not less than 300 feet, with side slopes such as will be stable under the ordinary conditions of the river.

It is estimated that 66,320,000 cubic yards will require removal, and this can be done cheaply by hydraulic dredges and placed upon the banks or in the lagoons at a distance of a mile, if necessary, at a very low cost, the developments in this class of work having been very great in the last five years.

It is assumed that $7,000,000 will be ample to cover contingencies on this kind of work, and would be sufficient to secure the removal of 100,000,000 cubic yards, if found necessary. Dredging operations through Lake St. Peter, in the St. Lawrence, with old fashioned machines and conditions hardly as favorable, have been prosecuted for years at a cost inside of five cents per yard.

Taking these figures as sufficient, we find the entire cost of carrying 14 feet of water from the end of the sanitary canal to the Mississippi river, a distance of 290 miles, to be $25,000,000. Upon the Mississippi river, the government is committed to a project of 10 feet at extreme low water, from St. Louis to the sea, and the officials exhibit a gratifying confidence in the ultimate success of their plans for this work, and the last congress appropriated therefor some $12,000,000.

We may assume that the minimum of 10 feet is feasible, and with the river improved to this extent, vessels of 14 feet draught will be able to pass through the Mississippi river for more months in the year than northern lakes and rivers are open. In other words, the low water period, running from 14 down to 10 feet, will be less in duration than the period of ice in northern waters.

Under present conditions of the Mississippi, it is found profitable to build a class of merchant steamers, capable of drawing 9 to 10½ feet, and this class of boats, run as the Anchor line from St. Louis to New Orleans, the Model barge line, from St. Louis to the sea, are adapted to drawing 9 feet. These draughts represent the available boating depth for sufficient length of time to be profitable. At one time there existed on the river two boats, the Jim Howard and the Grand Republic, which drew 12 to 14 feet, but with the changes of transportation facilities, it was found that the steamboats were less adapted to the traffic, and are decreasing in number, while the barges are increasing rapidly, so that the average tonnage and transportation movement show a steady increase.

As to the cost of improving the Mississippi river from St. Louis to the sea, no definite figures are available and I am not aware that any complete estimates have been made; but we may be sure, judging by the history of

France and Prussia, that these streams will be developed to their full capacity and the efforts will not cease as the country grows in population and resources.

It is surely wise to design any works proposed in the state of Illinois on the basis of what is contemplated as ultimate boating depth on the Mississippi, and surely it is not too much to expect that with a connection with the great lakes, a depth of 14 feet will be extremely desirable and useful.

L. E. COOLEY.

P. S.—The carrying out of a proper project on the lower Illinois would reclaim some 300,000 to 400,000 acres of bottom lands. These, together with the water-power would add $40,000,000 to the resources of the state. The project would be defensible if no Mississippi river existed. The fact that there are in this river and tributaries over 14,000 miles of water actually navigable in the census year, and which will ultimately be developed to their fullest extent, reinforces the project beyond measure. L. E. C.

GENERAL TRANSPORTATION OBSERVATIONS.

CHICAGO, August 28, 1895.

Hiram M. Chittenden, 1st Lieutenant Corps of Engineers, U. S. A., Columbus, Ohio.—Dear Sir: The answer to your letter of July 18, has been deferred awaiting some compilations which I now see I will be unable to make for some time to come.

I send you a type-written copy of some marine statistics compiled for the Chicago board of trade. I presume you have all this information in more available form.

In a brief on the lakes and gulf waterway, appendices Nos. 10 and 11, will be found a discussion bearing upon the economy of canal vs. railway movement. The relative value of the facts has not materially changed since 1888.

I also send a "Blue Book" and refer you to part IV, where matters of collateral interest are discussed.

The journal of the association of engineering societies for 1891 contains discussions on deep water to the seaboard, in which much interesting matter is collected. You can probably get access to this in the library of the Cleveland society of engineers.

I also send as of current interest a discussion on lake level effects.

I regret that all this is not strictly to the point, but only of value by way of suggestion. The best exhibit on lake transportation is General Poe's tables for the Soo canal. The census report on lake transportation gives ton-mileage and is good. The papers before the water commerce congress at Chicago are valuable, and contain one by Vivian, the statistician on transportation for the census. Address William Watson, 107 Marlborough street, (Back Bay), Boston.

A few observations may not be amiss: The reduction in water rates is more than keeping pace with that by rail.

The old-fashioned canal is passing out of use. River commerce is changing to a barge movement over long distances, the coasting trade and the palace steamboat passing out. These changes color the popular impression against waterways in general, and until the nature of these changes is finally determined, no proper criteria can be had. I do not think the waterway system of France for boats of 300 tons would be warranted in this country where freight rates by rail are scarcely half. The Erie canal enlarged as now proposed can at best only prolong its life as an actual freight carrier.

The last time I looked the matter up, the Chicago boats, carrying a majority of our east-bound tonnage, received about one-third of the through rate to the seaboard, the rail from Lake Erie points taking two-thirds. The lake distance is double the rail distance, or the ton-mile rate one-fourth on through shipment in quantity. Again, the average rate on Illinois railways is reported at nine mills while the commerce through the

Soo last year averaged less than one mill, which is a fair comparison of all classes of traffic on land and water.

In round numbers the ton-miles of the state of Illinois last year was about one-fourth that for the entire lake system and the freight charge more than double, allowing a ratio of over eight to one for general traffic.

On special commodities special rates are made. Mineral traffic by rail is down to three and four mills. Coal rates from Erie to Michigan and Superior points usually range from 35 to 50 cents per ton for routes of 700 to 1,000 miles, or about one-half mill. Chicago and Buffalo grain, one-third to two-thirds mills.

Ohio river coal goes from Pittsburgh to New Orleans at 60 cents to $1.00 for 2,000 miles, or say at one-third to one-half a mill.

So many factors enter, especially the one of terminal charge and cargo units, that it is difficult to value new conditions due to new routes. Considering the methods in vogue by rail, except on freight and special traffic, the water route is usually more prompt, as cargoes go at once to destination.

There are, however, some anomalies. We have here on our little canal boats of 140 tons carrying on a stone trade of about three-fourths million tons per annum on a 25-mile route, three and four boats in one tow, and the railways do not even attempt to compete. The traffic is, however, quite constant and regular, and there is no winter business.

I regard waterway development as the work of the next 25 years and as necessary to the proper development of the country, but it is apparent that under the present and prospective conditions, that development must be along lines quite at variance with our traditions.

I regret that I have been unable to furnish you such matter as I expect to bring together within the coming year. Yours very truly,

L. E. COOLEY.

Official Report on Lake Levels.

In November, 1891, the chief of engineers, U. S. A., at the request of the secretary of the American Society of Civil Engineers (who had been asked by the chief engineer of the Montreal harbor commission of Canada to suggest the subject), ordered a set of observations made to determine the amount of water flowing down the Niagara river. The time was especially propitious, as the water was then very low.

The results of these measurements were somewhat unexpected, and they were repeated in May, 1892. The second set corroborated the first, and the whole formed the subject of a report to the chief of engineers, which appeared in his annual report of 1893, pages 4, 364 and following. But, as the subject was important, the *Engineering News* anticipated the appearance of the official report by publishing in its issue of March 2, 1893, this report, with the permission of the chief of engineers. This publication was the first ever made in which, as a result of careful measurements, a relation between the level of the lakes and their outflow, or discharge, had been established and given to the public. Prior determination of this discharge had not attempted to detect this relation, and nothing more than a general determination of a season's work had been published. In all plans for the Chicago drainage canal, the early measurements had been taken, and those studying the subject chose such isolated figures as suited them best

The report of 1892, being so late in appearance, long after the drainage canal was put under construction, escaped the notice of many who are interested in navigation for two reasons. Some were too busy to see anything, unless specially brought to their notice. Others thought the whole matter already fully canvassed, and settled. It is true there is nothing showing that the consent of congress had been asked for this enterprise; certain that the subject had not been treated as an interstate affair, to say nothing of its being an international affair. The United States has always been slow to move; with its many sleeping rights, it has for many years been loth to exercise them. Not till 1888 did it begin to exercise positive legislation over its navigable waters in order to preserve them for all its citizens. Each river and harbor bill since then is found to have sections strengthening the hands of those who wish to keep the waterways open and in good order, for all classes of navigators. Not till 1890 had any prohibitive clauses been enacted into laws forbidding, for example, the destruction of channels by improper dumpings. Saw mills went their own unchecked way every year, clogging up the streams. Railways bridged all smaller streams, in the states, without interference from the United States. Many other features can be quoted. But it is sufficient to say that all that is now changed. The adopted policy is to defend, as well as improve, all water courses, now navigable, or probably navigable in the reasonably close future. Waterways are under the charge of the United States, and there is no likelihood of their being abandoned for some time to come.

With this an established fact it is impossible to think that United States supervision shall not be extended to the Chicago drainage canal in due time. Under whatever law built, and for whatever purpose constructed, just so soon as it is shown that that canal affects, or becomes a part of, the system of navigable waterways of the United States, some supervision or control of it must follow. When boats use it for harbor purposes; when its waters add to the Illinois river, or take from the lakes, they alter natural conditions, and the matter rises for consideration under national authority.

The water levels of the great lakes are very delicate. Storms, barometric changes, rainfall, even tidal changes, are felt. Records show at Buffalo no less than thirteen feet as a total possible change, between the lowest and the highest gauge readings. Each lake is a basin. The water is constantly pouring in from not only one, but several inlets. The overflow, however, is now always out of the one outlet provided for that purpose; the second one, formerly at Chicago, has been plugged up.

As in our basins, when the water rises enough to take two, three or more of the small holes to carry it off, it is always to be noted that those holes are always carrying that surplus off; they do not wait until the water has time to pass from one end to the other. In the same channel the head alone governs the rate of outflow, and that head is measured by the gauge-reading at the outlet. The supply of water in the lake, the net supply, allowing for evaporation, is the sole cause of the outflow. That supply depends solely upon rainfall, but the lake, when it receives more than it has been receiving, must discharge more; when it has less, there is less to run out. If the outlet be dug down, or new ones made, the water runs off faster than it ran off before.

The outflow is instantly affected by a changed inflow, provided there is enough such to increase or reduce the head. If we have a rainfall of 1 inch over the lake area (and such are not uncommon events), there is a head of 1 inch to run off. But if there are two outlets to run out of, instead of one, this inch must run off sooner than through the one. If the new outlet should reduce the levels of Lakes Michigan and Huron about 6 inches, this effect will be produced in full in about two years; it is not then a question of many years, as some suppose.

We may feel very sure, therefore that in this question two points are certain: 1. The drainage canal is not solely a state affair, but a national one. 2. The tapping the lakes must affect their levels. But it is said, first, that the changes in levels do not concern shippers, and then that, at most, the effects will be trifling.

If one watched carefully the course pursued by shippers one would see that, as a rule, each vessel carries all that it can take, and get out of its port or into that it intends to reach. Vessel owners and managers are very shrewd, watchful men; they know what they can safely carry, allowing for storms and short detentions arising from passing causes; they average pr[illegible]ell the practicable depths, and carry all the channels will stand. They are as c[illegible]rsant as are theorists about the effects of storms, but they keep good watch on ruling depths. Now, should it be certain that these average depths were reduced 3 inches, or 6 inches, they must load accordingly. And not only the large boats, but also the small ones using the small harbors that the large ones cannot go into. All must lose the 3 or 6 inches as it may be; and not for one or more trips, but for all trips, and for all time; a diminution of capacity is not a single tax, but a continuous one. A vessel that, when light, draws 6 feet and loaded 12 feet, must lose 3 inches out of 72, say 4 per cent. in capacity, each loading; a vessel drawing 12 feet light and 20 feet loaded would lose somewhat over 3 per cent. in capacity at each and every loading.

Should the loss of levels be 6 inches instead of 3 inches, then these figures become doubled. Will the loss be 6 inches or will it be 3 inches? This is an important question, and we have only the Niagara river discharge observations from which to answer it. These cover a range of about 1.8 feet. There were scattering observations outside these limits, but the mass of results was secured between gauge readings, mean lake level, the highest, and 1.85 feet. The "smooth curve" as published enables us to note the fall of 0.53 feet on the gauge per 10,000 cubic feet per second for the first foot of fall and 0.4[illegible] feet for the whole.

These observations, especially at the lower readings, are erratic, and indicate a need for more measurements, especially at these levels. This lower portion of the gauge should be studied and additional observations made, and the board is a unit in suggesting the importance of a series of gaugings of the St. Clair river at the present time for this purpose, and to furnish additional knowledge of the relation between gauge readings and discharge. The subject is of such general bearing upon the navigation of the lakes that it demands careful treatment and full data. The Niagara data do not show how much Lakes Huron and Michigan would be lowered, even if 0.53 feet were the net loss to Lake Erie. The opinion expressed by Mr. Johnston that the effect on the two upper lakes would be some 15 per cent. greater than upon Erie would seem to point to a probable loss of, say, 0.61 feet. This possible loss of 7 inches certainly is important enough to justify careful measurements of the discharge through the St. Clair. It is true that the law as it stands, and the intention of the trustees, contemplate the abstraction of only 300,000 cubic feet under present conditions; but after the canal is open measurements would not be so instructive, and we must assume that ultimately the entire [illegible],000 cubic feet per minute will be drawn from Lake Michigan, as required by the state law.

The abstraction of 10,000 cubic feet of water per second from Lake Michigan will lower the levels of all the lakes of the system except Lake Superior, and reduce the navigable capacities of all harbors and shallows throughout the system to an extent that may be determined, if at all, by actual measurements only. Under the laws of the United States these changes in capacity cannot be made without federal authority, and to enable the executive officers of the United States to act advisedly in the matter it is necessary, in the opinion of the board, not only that these measurements be taken, but that the money cost of restoring the navigable depths in channels and harbors be carefully estimated.

In this connection the board submits, without expression of opinion, an estimate prepared by Mr. Charles H. Keep, secretary of the Lake Carriers' association, of the commercial losses in carrying capacity of the lake fleet, should a reduction be made in lake levels of 1, 3 or 6 inches.

The board notices that the same peculiarity exhibited by the Niagara discharge curve is pointed out by Mr. Johnston as existing in the Morris, Ill., and south branch Chicago river curves.

The board also notes Mr. Johnston's conclusions that—

> Applying the reasoning to the St. Clair and Detroit rivers, then the value $Q' - Q$ may be taken from the diagrams illustrating the tables before described, the only uncertainty being as to the value of a. Suppose a to be unity, and the mean depth 20 feet. Then $Q' - Q$ will equal something greater than 20,000 cubic feet per second.

This practically corresponds with the deductions made from the Niagara river observations.

So many uncertainties arise in the application of hydraulic formulas that the only way to ascertain the approximate discharge of these streams is to measure them for periods long enough to eliminate accidental fluctuations and to cover all stages.

While the navigable capacity of all harbors and channels on the great lakes below St. Mary's falls will be injuriously affected by a diminution in depth, the navigability of the inner harbor of Chicago will be diminished also by the introduction of a current therein, which, in the present condition of the river, even with the minimum flow of 5,000 cubic feet per second, or 300,000 cubic feet per minute, is entirely inadmissible. The estimates of the effect of the drainage canal upon this harbor should also consider this element.

The board of trustees have not yet determined upon a plan of treatment of this navigable channel, and their plans may be such as may improve, impair or destroy its utility as a navigable river.

All of which is respectfully submitted.

O. M. Poe, Col. Corps of Engineers, Bvt. Brig.-Gen., U. S. A.
E. H. Ruffner, Major of Engineers, U. S. A.
W. L. Marshall, Major, Corps of Engineers.

Lake Level Effects on Account of the Sanitary Canal of Chicago.*

A BRIEF BY L. E. COOLEY, C. E.
Chicago, Illinois.

STATEMENT—The Sanitary Canal of Chicago is now in process of construction under the authority of a law passed by the general assembly of Illinois in 1889. This work is to be opened in 1896 or at the latest in 1897. The ultimate capacity of this channel is to be not less than 10,000 cubic feet per second when the lake is at Chicago datum (the low water of 1847) which is 4.7 feet below the high water of 1838 as established at Milwaukee. The law permits the channel to be developed through the earth sections on the basis of a capacity of 5,000 cubic feet per second, provided that the same is enlarged with the growth of population to the ultimate capacity set forth, viz: 10,000 cubic feet per second, said ultimate capacity being sufficient, in the view of the law, to so dilute the sewage of 3,000,000 people as to maintain a sanitary condition throughout the channel and in the streams into which the same is to discharge—the Desplaines and Illinois rivers.

Under the law a sanitary district has been organized with original powers of taxation and indebtedness, governed by a board of nine (9) trustees, elected by popular suffrage, and under the authority of this board the work authorized is being prosecuted.

The work as now laid out provides for a main channel, which begins at a junction with the Chicago river, or rather the south branch thereof, in the southwest quarter of the city, at a point 5.8 miles from Lake Michigan, by the course of the river, and extends to the vicinity of Lockport, a distance of 28.05 miles from the point of beginning, where the water is to be discharged into the Desplaines river, and such work done along the bed thereof, for a distance of 7.1 miles, as is necessary to conduct the outflow safely through the city of Joliet.

For 7.8 miles out from Chicago the channel is being constructed with a present capacity of 5,000 cubic feet per second, the future enlargement being simply a matter of dredging through comparatively easy material. The 20.25 miles in the Desplaines valley is through glacial drift of the most difficult character and through rock, and this part of the work is being carried out on the ultimate basis of capacity. The standard dimensions as adopted are, for 14.9 miles through the rock cut, 160 feet wide at bottom and 162 feet at the top, with a declivity of one foot in 20,000 feet; and in the earth and drift for a distance of 13.15 miles, 202 feet wide at bottom and 290 feet at the water line when the channel in carrying 22 feet of water, with a declivity of one foot in 40,000 feet, excepting, however, the 7.8 miles at the Chicago end, previously mentioned, which are being constructed with a width 92 feet narrower than the standard earth section.

The bottom of the channel, at its junction with the Chicago river, is actually 24.45 feet below datum, and at the Lockport end 30.1 feet, the total theoretical declivity being 5.65 feet. The capacity is figured on a depth of 22 feet on a conservative basis, so as to make sure of meeting any requirements of the inspectors who are independent agents of the state. It will be noticed tnat an allowance of 2.45 feet is made in the grade at the Chicago end in order to surely meet any solution that may be demanded through a connection with Lake Michigan in order to feed this channel to its full capacity. These additional works have not been provided for, nor have plans for the same been matured. Should these works be carried out on a liberal basis, the depth in the main channel will be increased two feet at low water.

It is proposed to open these works on the minimum capacity provided by law (as-

*NOTE.—Prepared for Harvey D. Goulder, attorney of the Lake Carriers' Association and submitted to him in Nov., 1894.

sumed at not less than 5,000 cubic feet per second, but actually 20,000 cubic feet per minute for each 100,000 of population), and it is presumed that considerable work will be required in the Chicago river to pass the minimum volume without injury to navigation. Extensive works of a radical nature will be necessary to provide the ultimate volume, viz: 10,000 cubic feet per second, and several years will be required for their full development.

The volume flowing in this channel will be regulated by controlling works at the lower end at Lockport, and by these means the discharge may be fixed and controlled at any amount, or entirely stopped at pleasure.

Aside from its sanitary utility, the channel is to be regarded as the most costly part of a waterway from Lake Michigan to the Mississippi, and as a useful extension of the harbor of Chicago for vessels of deep draught, and these objects were contemplated as important incidents of the work and were fully expressed as the policy of the state when the law was passed.

TECHNICAL CONSIDERATION—All investigations have proceeded on the basis of 10,000 cubic feet per second, and the ultimate effect on lake levels of diminishing the volume passing through the several outlets and connecting channels of the lake system by this amount. The effect of any lesser volume will be in direct proportion to the effect produced by 10,000 cubic feet; in other words, 5,000 cubic feet will produce one-half the result.

In all these inquiries the lake system is to be regarded simply as a great river, subject to fluctuations the same as any stream, according to the supply of water draining thereto. It has annually its high water period and its corresponding low water period, and in some years this low water drops much lower than others, and again, in a series of years the high waters reach a limit much higher than others, all depending upon the annual precipitation and whether rain or snowfall are deficient or excessive, and also on successions of dry and wet seasons. The range of these fluctuations is much limited over the season of normal rivers on account of the reservoir action of the enormous lake expanses and, also, on account of their great water surfaces, evaporations, wind and other effects are important. It is assumed, however, that whatever in any degree affects one of the lakes in its water supply, will likewise in some degree affect all the others below it, depending on the area, local water supply, and the conditions of the outlet in each case. For instance, the St. Clair river runs at a higher elevation when carrying a volume of 230,000 cubic feet per second than when carrying a volume of 10,000 feet less, or 220,000 cubic feet per second, the same as any other stream, and the level in Lakes Huron and Michigan is determined by the elevation of the water in the St. Clair river. In the same manner is the level of Lake Erie determined by the volume passing through the Niagara river and the local outlet conditions in the vicinity of Buffalo and Black Rock; and that of Ontario by the volume of the St. Lawrence and the conditions at the head of the Galops rapids below Ogdensburg. Normally, the effect should be less down the stream on account of its increasing volume; in other words, the volume of the St. Clair river is diminished by a larger ratio than is that of the Niagara or St. Lawrence.

In the investigations heretofore made, the mean discharge of the St. Clair river has been taken at 225,000 cubic feet per second, and of the Niagara river at 265,000 cubic feet per second*. These figures are based on the best available information collected by the lake survey. Assuming these figures to be correct the abstraction of 10,000 cubic feet per second will diminish the mean outflow in the St. Clair river by nearly 4½ per cent. and in the Niagara river by about 3¾ per cent. On lines of reasoning obvious to those unacquainted with hydraulic principles it is apparent that the ruling depth in the rivers at mean level cannot be lessened by an amount greater than these percentages. Applying hydraulic principles the effect will be only a fraction of that indicated by the reduction in volume.

The writer had the honor to lay the foundation of the present project in a report drafted for a committee of the Citizens' association of Chicago in 1885, which was adopted by said association as the basis of promotion. His professional experience has lain along the lines of river hydraulics and naturally the first matter to consider was the effect on lake levels of so bold a project, and this he satisfied himself of before the

*NOTE.—On the authority of L. Y. Schermerhorn, for many years assistant engineer under Col. Roberts, and republished by Chas. Crosman, of Milwaukee, in his chart of lake fluctuations.

proposition was even suggested. In 1886-7 the matter was considered by the drainage and water supply commission, an engineering organization officially constituted to determine a plan for sewage disposal, and this commission also satisfied itself upon the subject before committing itself to the project. In January, 1888, the matter having been publicly raised, the writer discussed the question publicly for the first time in a brief, entitled "The Lakes and Gulf Waterway," now out of print.*

Later in 1888-9 the matter was discussed at great length before the Western Society of Engineers by several well known hydraulic engineers, and the discussions were published in the Journal of the Association of Engineering Societies in March, 1889.†

The discussion before the Western Society of Engineers may be considered as exhaustive, so far as the data existing at that time is concerned, and very little original information has been collected since. It was fully recognized that the data was inadequate for a positive determination, and the matter was approached by the several writers from various hydraulic standpoints, and the conclusions reached are to be regarded as setting limits rather than a specific amount. The concurrence of opinion was, however, most remarkable, and the actual results deduced varied between 0.2 feet and 0.4 feet, as the probable effect of removing 10,000 cubic feet per second through a new outlet. The effect at low water would be somewhat greater and at high water somewhat less than at mean stage.

In 1891-2 some measurements were made of the discharge of the Niagara river opposite Black Rock. These observations indicate that the mean discharge of this river has been taken too high. They cover an inconsiderable range of lake fluctuations, there being but one low water observation and none much above the medium stage. These observations seem to indicate at and near low water an effect of about 0.3 feet. At medium and high stages the conclusion has been drawn that the effect would be greater. As such deduction is at utter variance with all experience in hydraulics any conclusions from these observations must await further measurements made at extreme low water and also the necessary measurements at high lake, when, no doubt, the observations made will be found to indicate normal variations. These observations are printed in the report of the chief of engineers, U. S. A., 1893, page 4,364. The official report ventures its inferences with proper caution, considering their singular character.

In a paper read before the Western Society of Engineers in October last, Mr. T. T. Johnston, first assistant chief engineer of the sanitary district, concludes that no supposable condition could make the effect as great as 0.5 feet. Mr. Johnston approaches the matter largely on the basis of analogy with our large western rivers, in the investigation of which he spent several years of professional life.

All data and opinions up to this time seem to point to the conclusion that between low water and high water and over a range of 4 feet, there is a variation in discharge of over 100,000 cubic feet per second, and that to lower lake levels by 0.4 feet would take over 10,000 cubic feet per second. For the purpose of discussion the effect may be assumed at 0.3 feet until determined by actual observations of the most painstaking character.

That there are many reasons for making these observations, in order to ascertain the effect of the deepened channels, of ship canal and water power schemes, and also for scientific purposes, is evident. When the facts are properly ascertained and valued the effects of any given cause will reduce to a question of plain demonstration rather than of speculation.

Discussion—The question at issue is a very sober one, the interests concerned are many and important, and conclusions are to be arrived at candidly and without distortion. If great public purposes may be attained without substantial injury to important interest, no objection should lie; and again, if injury is to occur, objection should content itself in providing the proper remedy.

It is assumed that any injury attaches to the effects produced at or near low water when the available depths for navigation are least.

It will be contended that the effects on the interests of navigation are immaterial,

*Note.—Three editions were published aggregating 15,000 copies.

†Note.—Reprinted as a special edition of 5,000 and issued by the Citizen's association of Chicago. In this discussion the matter included in the brief upon the Lakes and Gulf Waterway was republished

and further, if they be not so considered that the remedy may be easily applied. It is proposed to develop the several considerations which bear upon the question:

1. The Detroit river has been deepened at the Limekiln crossing from an original depth of 13 feet to 21 feet; the St. Clair flats from 9½ feet to 16 feet; with work now in progress for 20 feet; work is in progress at the head of the St. Clair river, at the entrance of the Detroit river, and both above and below the Limekilns for 20 and 21 feet. The Ste. Mary's river had an original depth of 9½ feet, which was increased to 16 feet, and work is in progress both above and below the rapids for 20 and 21 feet. The Niagara river is having its barrier reef at the outlet of Lake Erie cut down to 21 feet to extend deep water down to Tonawanda. The Canadians deepened the reef at the head of the Galops rapids below Ogdensburg from 10 to 16 feet.

All these changes in outlet conditions necessarily have affected and will affect lake levels and some of them doubtless by sensible amounts that may be greater or less than that produced by the decrease in volume of water due to the new outlet at Chicago. This question has never been raised except in relation to the Canadian improvement at the Galops rapids, and in that case was dismissed as immaterial after a learned technical discussion. (See report of chief of engineers, U. S A., 1882, page 2,470, *et seq.*)

It may be said with confidence that had the question not been raised in conjunction with the Chicago sanitary canal all lake interests would have been equally oblivious to any injury that may follow. In other words, the effects are so obscure and ill-defined as to make their practical detection impossible by the ordinary commercial agencies.

2. If it were not known from technical considerations that lake levels were to be changed by 0.3 foot (assuming that amount to be correct), it would be practically impossible to determine the fact by any measurements that can be made, or observations on lake levels continued for a century, and for the following reasons:

a. The mean annual fluctuations between the high water of late spring and early summer, and the low water of late autumn and winter is, for Lakes Michigan and Huron 1.34 feet; Lake Superior 1.2 feet; Lake Erie 1 55 feet; Lake Ontario 2.07 feet. These fluctuations vary greatly in different years.

b. The fluctuation over long periods is from 4 to 5 feet, as from the high water of 1838 to the low water of 1847, a range of 4.7 feet for Lakes Michigan and Huron, and still more to the low water of 1891-2. These fluctuations are irregular as to period, but usually pass over a range of three to four feet every five to seven years.

c. Every change of the wind produces effects from a few tenths to extremes of several feet, depending on velocity and direction.

d. Rapid changes of barometric pressure produce sensible effects. A high barometer on Lake Michigan and a low barometer on Lake Huron can easily shift large volumes of water through the straits of Mackinaw and make a difference of level of one foot between the two lakes, and there are observations indicating such a result. A high barometer on Lake Huron and a low one on Lake Erie will increase the discharge through the St. Clair and Detroit rivers, and possibly the discharge of the Niagara river may be varied from this cause.

e. There are periodic fluctuations occurring at short intervals of less than one hour, even in the calmest weather. Automatic tide gauges show these fluctuations at all times, frequently of several tenths of a foot, and they are known on many occasions to have much exceeded one foot.

f. The difference in evaporation, one year with another, may easily exceed the volume to be abstracted. Ten thousand cubic feet per second would remove from the combined surfaces of Lakes Huron and Michigan in one year 2.97 inches of water, and this is only one-half the difference in evaporation for the years 1867 and 1868, as reported by the lake survey.

g. The excess of water required to mature a corn crop over that required to mature a crop of small grain throughout the water-sheds of Lakes Huron and Michigan would supply the sanitary canal of Chicago for several years.

Without raising additional points, supposing that observations for twenty years after the sanitary canal is opened, are compared with observations for twenty years previous, and it is found that the mean level during that period has stood 0.3 foot lower, would the evidence be conclusive? Might there not be changes in climatic conditions? May not the habitations of the watershed change conditions of drainage and absorption? May there not be carelessness in gauge readers and changes in reference bench marks in forty years? Are not the outlets and shallows undergoing changes and improvements? Finally, take the records of fluctuations since 1838, nearly sixty years, and consider them carefully; are we not prepared to believe that the next twenty years will show a higher mean lake surface than the last twenty, even after allowing 0.3 foot?

If the normal changes in lake surfaces are so large and various as to obscure a specific change relatively small in amount, so that a vessel owner is obliged to employ experts and make critical scientific examinations through a series of years to ascertain if he be injured, we may relegate the matter, for practical purposes, to the purely scientific field. Under practical conditions, are vessel owners loading vessels to margins of 0.3 foot, or do they even work as close as that in ship canals where water level conditions are under control within close limits?

3. Any changes that have been made in lake levels heretofore, have been the results of deeper channels, to which harbors and shipping had to conform, so it became a matter of no moment to any vessel interest and could at most have curtailed subsequent development by a very small amount. Any effect due to the sanitary canal of Chicago will occur on the eve of the opening of the new channels through the connecting shallows, and is not of importance to interests that are vested on present depths, and at most can effect prospective interests in this degree—that they will develop on a basis of 19.7 feet and 20.7 feet, rather than 20 and 21 feet. If lake interests are to look forward to a progressive deepening of the connecting channels in the future as in the past, and an ultimate project to the high seas of not less than 26 feet, then the matter may be dismissed, as the movement for still larger depths will take effect before vessel interests have generally exhausted the provisions that are now being made.

4. Assuming that the effect will be material, the remedy therefor is to be considered. In a discussion in the Marine Review of September 7, 1893, Gen. O. M. Poe, in charge of the work through the connecting shallows of the lakes, in reply to an article by Mr. G. Y. Wisner, civil engineer, advocating the control of the level of Lake Erie by means of a dam at the head of the Niagara river, pointed out the cheap character of the work required to secure greater depths, should they be found expedient.

Aside from the works already provided for in connection with the new channel at Sault Ste. Marie, the cost of securing a navigable depth of 20 feet, is less than \$4,000,000, or inside of \$1,000,000 for each foot in excess of 16 feet, the ruling depth for many years past. Future increase in depth will doubtless be more expensive as the quantities of material will probably increase faster than the cost will diminish on account of improved methods.

It is sufficient here to point out that the navigable depth may be readily increased, and at inconsiderable cost as measured by the benefits. Conceding the extreme effect of the sanitary canal, it will add to the cost of deeper channels in the future not over 1 per cent. of the ultimate investment in the Chicago enterprise. This will be offset many times when that enterprise is completed so as to be suitable for a harbor for lake shipping without cost to the general government, to say nothing of the advantage to all lake interests that will ultimately result through a navigable connection with the Mississippi valley.

5. In the Detroit Free Press of January 8 and 11, 1889, appeared two interesting communications upon the effect of the proposed water power canal at Sault Ste. Marie on the level of Lake Superior. This canal proposed to take out some 10 per cent. of the volume flowing over the rapids, and it was contended that the level of Lake Superior would be reduced thereby nearly six inches, diminishing by that much the depths of the United States canal and the approaches thereto.

Gen. O. M. Poe, in his reply, deprecates any alarm to the interests of navigation, and, admitting for the sake of argument the effect alleged, says: "A simple, easy and inexpensive way of remedying the evils which the writer of the article seems to fear would be to reduce the cross-section of the river by building a spur dam at the head of the rapids, thus intercepting an area equal to or even considerably less than the cross-section of the water-power canal;" and again that it "surely would not require a construction of any great magnitude or cost, nor would it tax the ability and resources of the engineer to an overwhelming degree."

The same methods can be applied to the St. Clair, Detroit and Niagara rivers. It will be objected that local increase of velocity will thereby be occasioned, detrimental to the interest of navigation, but this will probably not be considered a serious matter by the official mind in view of the dyke built in connection with the deep channel through the Middle Neebish for the evident purpose of counteracting any effect which this new channel may have in lowering the water level in the Ste. Mary's river above, and at the Soo.

Without passing on the quality of this solution, it is sufficient to say that any ill effects can be met by narrowing the outlet channels, an adjustant that nature itself might provide in the course of time as it meets all abnormal disturbances of the balance of its forces.

6. A favorite project of the writer, which he has developed on former occasions, is to fully control the outflow of Lake Superior by work on the Sault Ste. Marie rapids, for the purpose of permitting a much larger supply of water to be taken from the lakes at Chicago for the purpose of improving the low water navigation of the Mississippi river.

The high water period in Lake Superior is later than in the lakes below, and the water therefrom comes in on top and behind to swell and prolong the high water stage. Suppose that the flow from Lake Superior is restrained during the spring and, early summer, and is allowed to come out later in the season and during the winter. It is apparent that high water on the lower lakes will be restricted and the lower stages better maintained. It is estimated that by thus controlling the outflow of Lake Superior it would be feasible to remove three or four times the volume provided for in the sanitary canal, or 30,000 to 40,000 cubic feet per second, without impairing low water stages or the minimum depths available for navigation.

If this proposition is feasible from a technical standpoint, then sufficient control of Lake Superior to correct any effect that may be occasioned by the abstraction of 10,000 cubic feet per second, presents no engineering difficulties of a serious character.

7. It has been proposed to control the level of Lake Erie by a dam across the Niagara river. Such a project has been seriously advocated for some time by G. Y. Wisner, civil engineer, of Detroit, and the proposition was presented to the Toronto Deep Waterways convention in September last by the Cleveland delegation and be[illegible] endorsed by the assembly. The arguments advanced are to improve the depth[illegible] Limekilns and vicinity and in the lake near the mouth of the Detroit river, and [illegible] the harbors of Lake Erie and the approaches thereto. This project has been advocated entirely independent and apart from any considerations based on the effect of the sanitary canal of Chicago.

The project has great merit and hardly needs more than a clear statement of what it is proposed to do to commend itself. If any such project is to be carried out it effectually disposes of the Chicago question, for it will be feasible to control an additional depth on Lake Erie several times any effect that can be assigned to the Chicago enterprise.

8. The movement for ocean navigation into the lakes that is now beginning to crystalize, and the sentiment for which was voiced by the international convention at Toronto in September last, is one which will excite a deep and growing interest throughout all the region tributary to our lake-board and is likely to grow in force more rapidly than any one realizes who has not made a deep study of the economic factors and the engineering possibilities. When such a movement materializes into engineering forms our lake problems will be looked at from a very different standpoint and the matter of controlling lake levels and meeting such problems as that at Chicago will take on a more purely incidental character.

9. The introduction of high powered vessels of deep draught to carry large cargoes with speed will bring to the mind of practical navigators a question which has not heretofore appealed to them on draughts of 16 feet, and that is the necessity of wider channels and ample clearance beneath the keel. It will be found difficult to handle vessels in a crowded stream with only one or two feet beneath the keel and under the influence of varying currents and winds, and that no considerable speed can be made under such conditions. It has been stated that the great Atlantic liners are unable to make their best time in less than 1,000 feet of water, and every one acquainted with western river navigation is familiar with the effect of an attempt at speed when the depth is small in proportion to the draught of boats. The interests of

lake navigation to-day are certainly sufficient to justify channels of 24 to 26 feet, even though the harbors should be limited to 20 feet, and should an ultimate depth of 26 feet be the future policy, the connecting channels should be deepened to 30 feet and upwards. If any such development is to be the logical outcome of growing lake interests, the effect of the Chicago sanitary canal sinks into insignificance.

CONCLUSIONS—We may conclude as follows:

1. That the data are insufficient to reach a conclusion as to the specific effect and that the information available indicates limits not less than 0.2 foot and not exceeding 0.4 foot, between which the final determination will lie.

2. That the magnitude and character of lake fluctuations are such that if the effects were unknown from purely scientific observations and measurements and technical analysis they would never be discerned or appreciated; in other words, lake phenomena are so active and of such amplitude that results relatively small are entirely masked.

3. That conceding any effect that may be claimed, several remedies are feasible therefor, any one of which can be applied at a cost relatively small as compared to the cost of the sanitary canal of Chicago, and that the expense of such application will be a small part of the benefits which lake interests will ultimately derive through that work.

4. That the future of lake interests and their seaboard connections will demand a radical deepening of the shallows of connecting channels and a control of lake levels, so that the interest in the question raised will reduce to a technical discussion in hydraulics.

5. That a careful remeasurement of the outflow of the several lakes under all conditions is desirable as the only final arbiter of any lingering doubts, and also for the more important purpose of projecting future works of a radical character and valuing the effects thereof.

The discussion has proceeded on the basis of the effect of 10,000 cubic feet per second. It is proper to call attention to the fact that it is proposed to open the channel in 1896 or 1897 on the basis of 5,000 cubic feet per second, and that extensive improvements of a radical character must be made before the channel can be utilized to the full capacity ultimately contemplated, and that several years will elapse before these are fully consummated. The time will, therefore, be ample to make exact determinations and without prejudice to any material interest.

There is submitted as part of this brief a reprint of a discussion before the Western Society of Engineers, entitled, "Levels of the Lakes as affected by the proposed Lakes and Gulf Waterway;" also a map on a scale of two inches per mile, showing the location of the sanitary canal of Chicago, with profile and cross-sections thereof; also a popular description of the work in progress, prepared by the chief engineer of the sanitary district.

This discussion is not to be regarded as the official expression of the board of trustees, but rather as the individual view of one of the trustees, who was the first chief engineer of the district, and a promoter of the enterprise from its inception.

ADDENDA.—The foregoing brief, prepared for Mr. Harvey D. Goulder, attorney for the Lake Carriers' association, in November last, should be emphasized along the line of the amount of clearance beneath the keel, as particular stress has recently been laid on the value of small changes in depth.

The recent fleet that is built to utilize the new channels of 20 and 21 feet is actually moulded for a draught of 18 feet, and this will be substantially the maximum loaded draught. The reason is obvious: Large vessels must have some clearance in order to navigate with any freedom and safety, and two or three feet is a small enough margin for safety, considering the obstructions that may lie along the bottom, as sunken logs, and boulders carried in by the ice; and also, for the reason that lake fluctuations are too erratic to make a closer margin safe. Under these considerations the value of a minor change of level, such as may be produced by the sanitary and ship-canal of Chicago becomes, a matter of relatively small consequence through the deepened connecting channels of the several lakes.

The same conclusions apply to the harbors, only in less degree. The larger harbors will surely be deepened to meet the requirements of the new fleet. Considering dredging methods on the practical side a small fraction of a foot partakes of a paper discrimination of little moment outside the office. The smaller harbors, frequented by boats of light draught, engaged in the lumber and coasting trade, are so much under the influence of beach movement and other deposits that it is a wise navigator indeed who can tell within a few inches how much water he can carry on successive trips.

The only practical rule followed is to go safe, and the margin of safety is not measurable by the limits assigned to the effect of the Chicago canal. If it be admitted that the working draught of vessels will be affected at all, the matter is surely one incapable of practical valuation on the financial side. It belongs to the indefinite realm, like rain, dew, fog, sunshine, temperature, evaporation, etc., small margins which are incapable of valuation in relation to material affairs, and the most that can be said is that certain tendencies make for good, while others make for bad, and that all effects are relative. In summing up the questions, positive and negative results must be considered, and a balance struck with reference to the common welfare.

Unquestionably the entire Chicago enterprise is prejudiced by the pessimis to talk against the ship canal and navigation idea. As long as the idea of a scheme of national benefit, through the connection of the lake region with the Mississippi valley, was held out as a realizable project of the early future, the people bordering the lakes were willing to resolve their doubts in regard to lake levels in Chicago's favor, as were also the people along the Illinois and Mississippi rivers, willing to wave their doubts on the sanitary side.

The reaction against this idea is one of the most ephemeral character, and such as occurs periodically in the history of all great enterprises. The people of the state at large are almost unanimously in favor of the carrying out of the waterway idea on the broadest possible lines, and have fully expressed their policy in this regard through the general assembly in the "act to promote the construction of waterways," passed June 14, 1895, in the following language: *

It is hereby declared to be the policy of the state of Illinois to procure, as soon as practicable, the construction of a trunk waterway through the state from Lake Michigan via the Desplaines and Illinois rivers to the Mississippi river of such dimensions and capacity as to form a homogeneous part of a through route from the Atlantic seaboard to the Gulf of Mexico.

This policy represents also the views of a large majority of the people of this city, and there is little question but what matters in connection with the Chicago enterprise will shape themselves along these lines in the near future, and further, that the state will enforce the broad view in due season.

I assume that Chicago must sooner or later meet the issue, not only on the side of the lakes, but also on the side of the Mississippi valley, both on lake level and sanitary effects. She will have but one valid defense, and that is along the lines which sees Chicago's greatest good in the good of the state and nation.

TECHNICAL BRIEF BY THOMAS T. JOHNSTON, C. E.

This discussion has been precipitated by the existing controversies as to the effect the main drainage channel of Chicago will permanently have on the levels of the great lakes, excepting, of course, Lake Superior. This channel will form a new outlet from the lakes similar to that by way of the St. Lawrence river, though of lesser magnitude. It has been held by various authorities, that the effect will be to permanently lower the level of the lakes all the way from two to twenty-four inches, and in a corresponding degree injure the harbors of the lakes for the improvement of which many millions of dollars have been expended. A lowering of a few inches, say not exceeding four or five inches, will not generally be considered of great moment. The present purpose is to discuss the subject from a physical rather than a financial point of view.

There are a number of causes in the process of development, the influence of which is to permanently lower the level of the lakes, some of which are of immediate importance. The drainage channel, a work of national importance in a commercial sense, has been given more prominence than any other. Those interested in the Niagara water-power, a purely private enterprise, contemplate its influence with fear, but say nothing about the influence their own works tend to exert. Members of the corps of engineers, U. S. A., have publicly asserted that its influence would be bad. A gravity canal from Huron to Erie is among the possibilities and water power schemes are afloat to utilize

*NOTE—Vetoed by the governor on June 26, after the adjournment of the general assembly.

the fall from Superior to Huron. The manner in which these causes lower the levels is of two kinds, the one by diminishing the flow through the channels connecting the lakes and the other by destroying the conditions that cause one lake to be higher than another.

The practicability of permanently raising or lowering the lake levels is forcibly suggested by the changes of levels constantly in process due to natural causes. The lakes rise and fall just as a river does and for the same reasons, though not in a manner so intensely manifest, and the corresponding changes of level are those only of prime importance since the changes endure through months and even years at a time. All other changes of level are of a very temporary nature and endure only a few minutes or a few days at most. Waves may be ignored entirely. Under the influence of certain storms the whole mass of water in a lake may, for a limited time, be set to rocking back and forth, the water surface at the one side of the lake rising a foot or two while a corresponding depression is taking place at the opposite side, the process reversing after ten or fifteen minutes, the rise being displaced by a depression and vice versa. Lunar tides probably exist, though in so small a degree as not to be distinguishable. Varying barometric pressure on different parts of a lake may have influence but for a short time only. All these changes of short duration may, however, be neglected in comparison with the changes due to the varying quantities of water delivered by tributaries, either on the surface or subterranean. In the spring of the year rainfall is plentiful, the tributary streams are in flood and the lakes rise. The reverse takes place in the fall. It happens sometimes, if evaporation may be supposed to be a constant, that more water flows into a lake in the course of a year than flows out, with the result that the lake is at a higher level at the end of the year than at the beginning. This process has been known to recur through a period of years, the level of the lake being raised a few inches year after year, and then a reverse process would have existence for a few years. A chart was prepared by Mr. Charles C. Crossman, of Milwaukee, in 1891, which records these changes of lake levels for a long series of years for each of the great lakes. They are so arranged that the variation of rainfall may be compared with the variation of lake level. They are based on average elevation of water surface for each month during the period covered. They are reproduced here as diagram No. 1, and need no further explanation. A similar chart, covering a longer series of years, and prepared by Gen. O. M. Poe, corps of engineers, U. S. A., forms diagram No. 2, but it applies to Lakes Huron and Michigan only, these two lakes being at the same level. Particular attention is invited to these charts.

Diagram No. 3 is a profile of the lakes from Duluth to the head of the St. Lawrence river, showing Lake Superior about 20 feet higher than Lakes Michigan and Huron, the latter lakes being at the same level because the channel connecting them is so large. Lake Erie is about 9 feet lower than Lake Huron, and 360 feet higher than Lake Ontario.

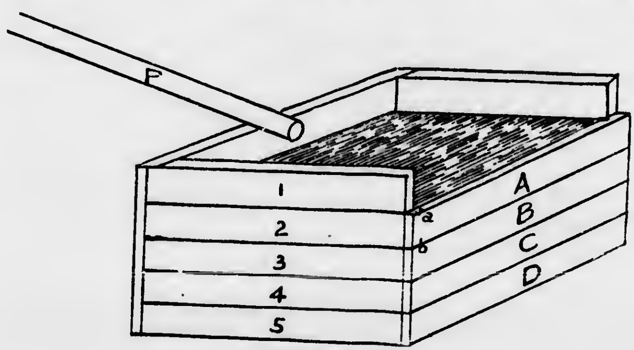


Diagram No. 4.

The Niagara Falls are between Ontario and Erie, with a fall of 160 feet. If the fall was 1,600 feet instead of 160 it would make no difference with the level or outflow of Lake Erie. In other words, the presence or absence of Lake Ontario can not affect the level or outflow of Lake Erie. Similarly, the presence or absence of Lakes Huron and Michigan would have no effect on the levels or outflow of Lake Superior. The Sault Ste. Marie rapids are, in this connection, the parallel of the Niagara Falls and intervene to effect the same result. There is not a sheer fall over the rapids, but the fall or slope over them is at the rate of about 20 feet per mile. They have a length of 3,500 feet, width of 2,300 feet and mean depth of between 2 and 3 feet. It follows that the drainage canal of Chicago cannot in any way affect the levels or outflow from Lake Superior. Lakes Michigan, Huron, Erie, Ontario and the connecting rivers are concerned.

It may be well to state the fundamental and the simple principles on which the direct treatment of the question is to be based. Diagram No. 4 represents a receptacle for water in the same sense that, in algebra, *X* represents any quantity. While the diagram shows a simple box, with the sides formed of the planks or boards marked 1, 2, 3, etc., and *A*, *B*, etc., still all that is to be said of it applies equally well to any receptacle for water having a great depth or insensible velocity of water in it, be that receptacle a reservoir, lake, tank or pond, etc., etc. The removal of the plank or barrier *A* will result, after a time, in lowering the water level to the top edge of plank *B*, at which elevation it would stay. The same result would happen if the barriers 1 and 2 were removed instead of *A*. The removal of the barrier results in a definite and permanent lowering of the water surface. Suppose water to flow into the receptacle through the pipe *P*, just as water flows into Lake Huron through the St. Mary's river. If the quantity of flow be constant, a constant depth of water on the top edge of plank *A* will result. Now, if the barriers *A*, or 1 and 2 be removed, as in the first instance, then the level of water in the receptacle will, after a time, find a permanent elevation over the top edge of *B* just as it had over the top of *A*. Similarly, if the flow through the pipe be variable. The variable inflow would result in variable depths on *A* and variable levels in the receptacle, and the removal of the barrier *A* would simply result in a repetition of all these variations at a level a fixed and constant distance lower than occurred before the removal of the barrier; and that distance would be a constant, no matter what the shape or nature of the barrier removed, provided always that the depth of water in the receptacle be great or be not sensibly changed.

The barrier restrains outflow from the receptacle, and the removal of it simply results, after a time, in a fixed lowering of the water surface or lake level, variation of inflow or outflow being what it may. This may be regarded as a principle.

Diagram No. 5 serves to develop the matter to a conclusion.

DIAGRAM No. 5.

The inflow through the pipe and the outflow over *A* are represented. Neglect the outflow through the hole *H* for the present. It will further simplify the illustration to consider *A* to be a weir of great length compared with the depth of water on it. Let the inflow be variable, as is the inflow to the several lakes. Variable flow will take place over A and variable depth will have existence thereon. The flow of water over the weir A may be computed by the familiar formula $Q = C h^{\frac{3}{2}}.l.$ in which Q is the discharge or flow in cubic feet per second, h the bend or depth over the weir, l its length and $C = 3.3$ more or less.

Diagram No. 6 following represents the formula graphically for a weir of given length.

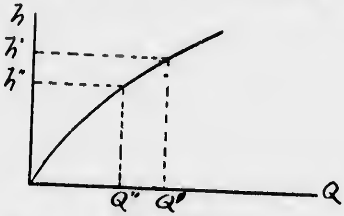


DIAGRAM No. 6.

h' is the head corresponding to the flow Q' and l $''$ is the lowering of head corresponding to a change in discharge amounting to Q'' $'$. Returning now to the water receptacle, and note the outflow through the hole H. his outflow is caused by the removal of the barrier which formerly restrained water from flowing through the hole. Conceive the size of H to be so regulated that the outflow through it be constant, then it will permanently diminish the flow over A by a constant amount—say $Q'-Q''$, and the corresponding permanent lowering of the water level in the receptacle will be $h'-h''$. The absolute magnitude of $h'-h''$ will depend on the magnitude of Q', being smaller as Q' is greater. This is readily seen on examination of diagram No. 6, above.

The hole H finds its parallel in the Chicago drainage canal and the plank A in Niagara Falls or Niagara river or in the St. Clair and Detroit rivers.

The curve in diagram No. 6 is based on the flow over a weir and may be called the discharge curve of a weir. The numerical values determining the curve depend on the values assigned to l and C in the weir formula. Its discussion has set forth all the principles involved in the determination under discussion.

The reservoir, instead of having a weir for a barrier, may have a rectangular channel of indefinite length. The variation of flow through the channel may be represented by a curve similar to that of a weir. The weir is so well understood that there can be no question as to the form of curve showing the variation of discharge over it. The same can not be said of channels, and it is proper to discuss the form the curve may have. Before doing this it will be well to discuss analytically the change of depth that will take place in a channel when a given change of discharge or flow has taken place.

Suppose the barrier restraining and regulating outflow from a reservoir be a rectangular channel of uniform cross section and indefinite length, as indicated in diagram No. 7 in longitudinal section.

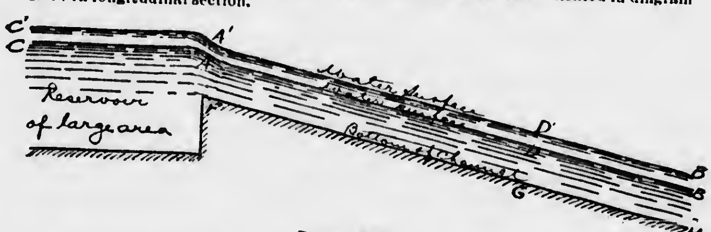


DIAGRAM No. 7.

The inflow and outflow must be the same. At one time let it be such that the water surface is at $C\ A\ B$. At another time let it be such that the water surface is at $C'\ A'\ B'$. The difference on these two occasions is $Q'-Q$, which may have such magnitude that

$D\,D'$ is one (1) foot. $C\,C'$ will be larger than $D\,D'$ by the head due to the difference in velocity in the channel on the two occasions.

It can be demonstrated that, so long as the depth of $D\,G = B\,H$ is constant that the value of $Q'-Q$ for a given value of Q will be essentially constant, no matter how wide the channel may be or what its slope may be; provided only that the width be in excess of say 500 feet and depth greater than say five feet, or less than, say, sixty feet.

The Kutter formula is generally accepted as stating correctly the variation of slope, hydraulic radius and velocity in uniform rectangular channels, and other channels of uniform cross-section, provided the size be not too great or too small. This formula certainly satisfies all authentic experimental data in such channels with satisfactory concordance. If a diagram (diagram No. 8) be made in which ordinates be logarithm of hydraulic radius (log. r) and abscissæ the (log. $v-\frac{1}{2}$ log s) logarithm of velocity minus one-half the logarithm of slope,* the Kutter formula may be represented, as shown, graphically thereon, one line for each value of "n" in the formula, if s in the coefficient be constant or neglected, or one additional line as shown, for each volume of s should it be considered. Any other formula between the variables v, r and s may be represented on the diagram; also some one point on the diagram corresponds to the observed values of the variables in any particular experimental measurement of flow.

The equation of any straight line on the diagram is of the form $v = Cr^a s^{\frac{1}{2}}$.*

An examination of the diagram (No. 8) shows that, when the hydraulic radius exceeds, say, four (4) feet, and is not to vary more than one (1) foot, then in the case of any given channel the hydraulic formula may be written in the form $v = Cr^a s^{\frac{1}{2}}$ as well as in the form used by Kutter. The results of the two formulæ will essentially agree. If the other formula be cast aside, it may likewise be said, as far as experimental data supports any formula that within the variation of one (1) foot in depth, the formula $v = Cr^a s^{\frac{1}{2}}$ satisfies the experimental data.

The formula being $v = Cr^a s^{\frac{1}{2}}$ the following results: Referring to the diagram No 7 the slopes of $D'\,B'$ and $D\,B$ are necessarily the same.

Let v, r, A (area), and Q refer to the one condition of flow and v', r', A' and Q' to the other: s, C, and a refer to both.

$$s^{\frac{1}{2}} = \frac{v}{Cr^a} = \frac{v'}{Cr'^a}$$

$$v' = \frac{vr'^a}{r^a}$$

$$\therefore Q' = A'v' = A'\frac{v.r'^a}{r^a}$$

$$v = \frac{Q}{A}$$

$$\therefore Q' = Q\frac{A'.r'^a}{A.r^a}$$

$$\therefore Q' - Q = Q\frac{A'.r'^a}{A.r^a} - Q$$

$$= Q\left\{\frac{A'.r'^a}{A.r^a} - 1\right\}$$

---

*Note—$v = C.r^a.s^{\frac{1}{2}}$

$\therefore$ log. v = log. C + a log. r + $\frac{1}{2}$ log. s

log. v − $\frac{1}{2}$ log. s = a log. r + log. C

C and a are constants, log. v, long s and log. r are variable and the usually observed quantities to be correlated.

It is therefore demonstrated that the value of $Q'-Q$ is independent of the slope of the channel may have or the value C may have, it being understood that whatever the slope may be, it is constant.

It is not evident from the formula that $Q'-Q$ for a given value of Q is essentially a constant for differing widths of channel but the tables to follow will demonstrate the fact.

The diagram No. 8 does not definitely fix the value of "a", the exponent of r, but enables limits to be placed thereon. For purposes of illustration lines are drawn on the diagram, as indicated, representing the formula when "a" is both ½ (as in the Chezy formula), and unity (1). It appears that, in case of any particular channel, its value must exceed ½, the limitations as to size of channel hitherto stated being still contemplated.

Tables, as follows, have been prepared, with "a" equal to both ½ and unity (1); and for widths ranging from 500 to 6,000 feet; depths (d') varying from 5 to 50 feet; and Q' equal to 225,000 cubic feet per second. Diagrams Nos. 9 and 10 show the results of the tables graphically.

The first table (table A) is based on a rectangular cross-section and is shown graphically on diagram No. 9.

The second table (table B) is based on an arc of a circle for bottom of cross-section and is shown graphically on diagram No. 10. Q is made equal to 225,000 because the mean value of discharge in the St. Clair river is believed to be about that magnitude.

Diagrams 11 and 12 show graphically the coefficients of Q in the formula for both rectangular and circular arc cross-sections.

The results for both forms of cross-sections are practically the same. This being the case, it follows that the value of $Q'-Q$ for a given value of Q depends solely on the mean depth of any section and has the same value regardless of the shape of the cross-section, except that it is larger for rougher than for smooth sections in such measure as the value of "a" is increased, as shown on the diagrams.

Given, a channel of varying width and varying shape of cross-section but let its mean depth from section to section be constant. Then whatever its slope may be, or whatever the widths may be, the value of $Q'-Q$ for a given value of Q will be the same, and the absolute value of that magnitude will depend simply on the value of "a." This conclusion is based on the showing of the logarithmic diagram No. 8 by which it was proved that the formula $v = Cr^a s^{\frac{1}{2}}$ would with sufficient correctness represent the variation of these variables while any change of one foot, more or less, was made in depth.

It will be observed that the value of $Q'-Q$ for a given value of Q is essentially constant in the case of any particular channel, without regard to width or slope, and that its magnitude is larger as "a" is given larger values.

It is to be observed that the value of $Q'-Q$ will be larger or less as the following conditions obtain:

Larger as the ratio $\frac{r'}{r}$ increases. Suppose a channel of width "w'" and area A' b, bounded in one instance with vertical sides and horizontal bottom, and in the other instance by an arc of a circle. In the latter case the value of $Q'-Q$ will be slightly less.

Larger as the sides of the channel are rougher and more irregular, for it will be seen on diagram No. 8 that the value of "a" in the formula will be nearer unity (1) as the channel is rougher and more irregular. It is not improbable that in a wide boulder bound channel, of shallow depth, its value may, for some range in value of r, be larger than unity (1.)

Larger, if by any chance the slope in the channel (illustrated further on) should be larger for Q' than for Q.

Less, if by any chance the slope in the channel should be less for Q' than for Q.

The foundation for expanding this discussion so as to apply to irregular channels leading from the reservoir has been laid.

TABLE A.—*Exponent of r=c=½.*

W. WIDTH	VALUE OF $Q'-Q$ FOR A CHANGE IN DEPTH FROM 5′ to 4′	10′ to 9′	15′ to 14′	20′ to 19′	25′ to 24′	30′ to 29′	35′ to 34′	40′ to 39′	45′ to 44′	50′ to 49′
500	88830	38016	24061	17544	13733	11315	9585	8306	7319	6536
1000	89136	38265	24290	17761	13979	11514	9779	8493	7500	6712
1500	89239	38330	24369	17837	14053	11586	9849	8561	7567	6778
2000	89291	38392	24409	17876	14091	11623	9886	8597	7603	6813
3000	89343	38433	24450	17915	14130	11660	9923	8638	7639	6848
4000	89369	38457	24471	11935	14149	11679	9941	8652	7657	6866
6000	89396	38479	24491	17955	14168	11699	9960	8671	7675	6885
Exponent of r=a=1.										
500	125184	51674	32316	23355	18252	14925	12593	10870	9546	8496
1000	125366	52233	32789	23828	18676	15231	12984	11248	9911	8851
1500	126097	52412	32953	23984	18826	15476	13126	11387	10048	8985
2000	126213	52503	33037	24063	18902	15550	13200	11459	10118	9054
3000	126329	52587	33120	24143	18981	15627	13275	11533	10191	9126
4000	126387	52639	33163	24184	19020	15666	13313	11570	10228	9163
6000	126446	52686	33205	24225	19060	15705	13351	11608	10266	9201

TABLE B.—*Exponent of r=a=½.*

SURFACE WIDTH. W.	VALUE OF $Q'-Q$ FOR A CHANGE IN DEPTH FROM 5′ to 4′	10′ to 9′	15′ to 14′	20′ to 19′	25′ to 24′	30′ to 29′	35′ to 34′	40′ to 39′	45′ to 44′	50′ to 49′
500										
1000			19543			9873				
1500										
2000			19532			9875				
3000			19481			9871				
4000			19474			9866				
5000			19494			9859				
Exponent of r=a=1.										
500										
1000			24212			12278				
1500										
2000			24190			12289				
3000			24100			12283				
4000			24075			12274				
5000			24134			12265				

DIAGRAM NO. 9

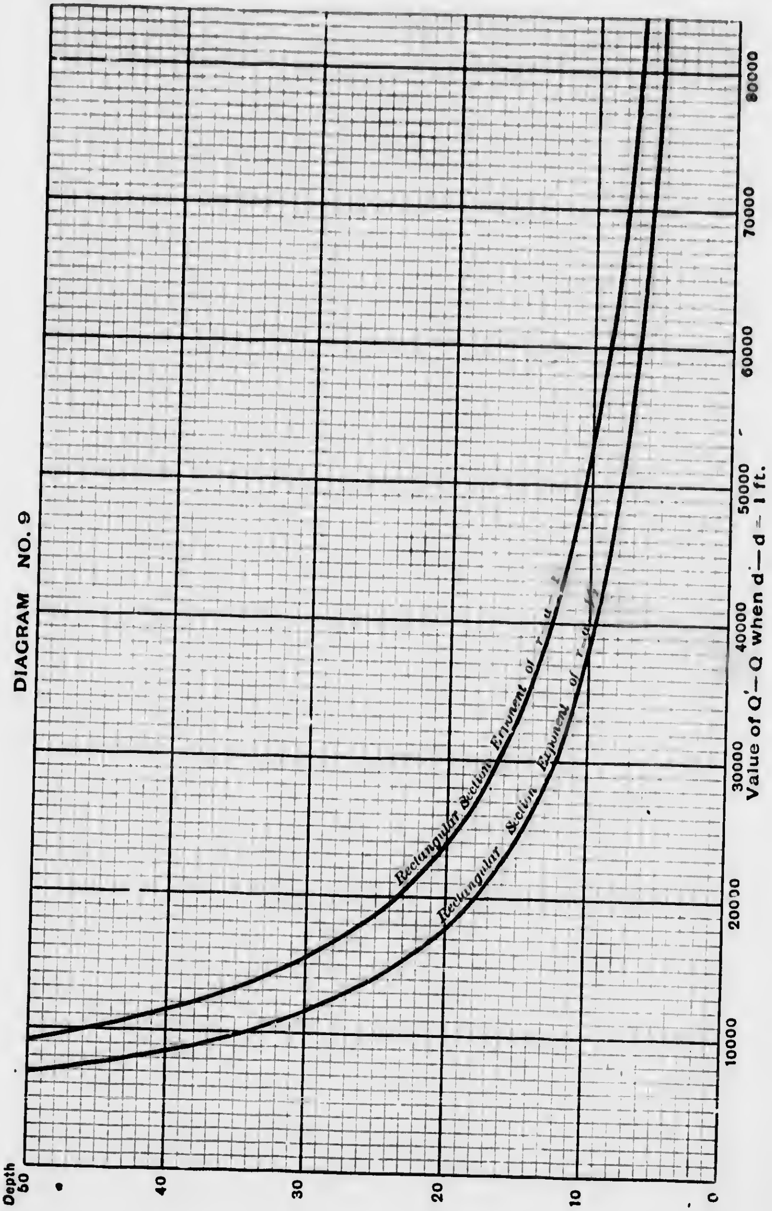

Depth
50
40
30
20
10
0
10000
20000
30000
40000
50000
60000
70000
80000
Value of Q'—Q when d'—d = 1 ft.
Rectangular Section Exponent of
Rectangular Section Exponent of

DIAGRAM NO. 10.

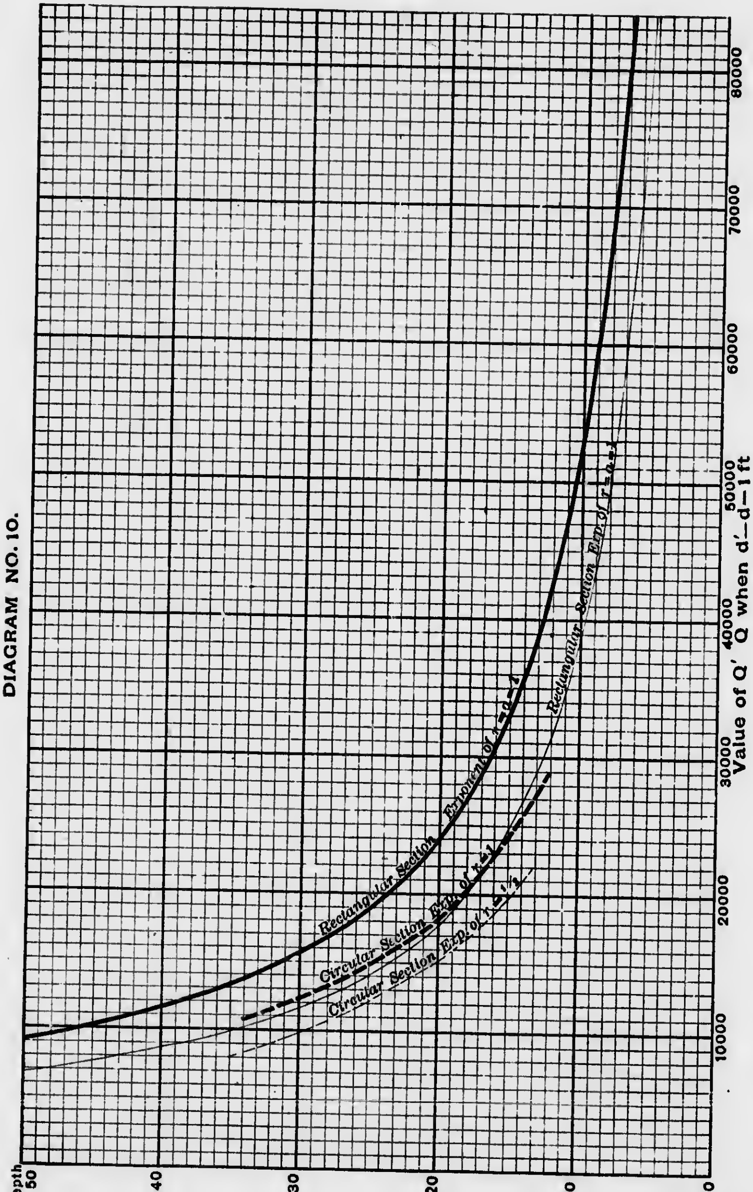


DIAGRAM NO. 11

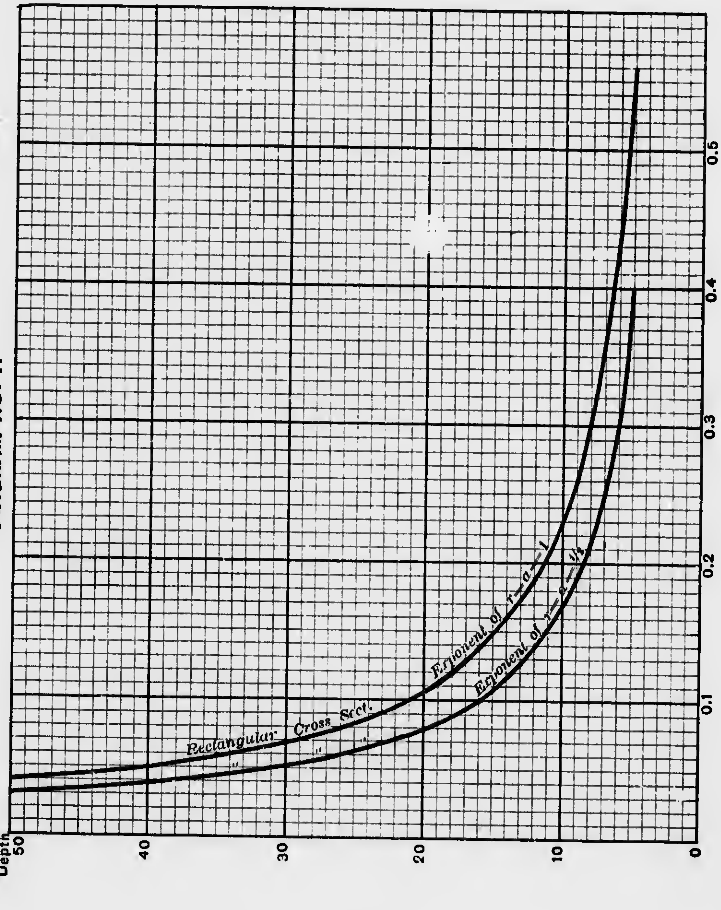
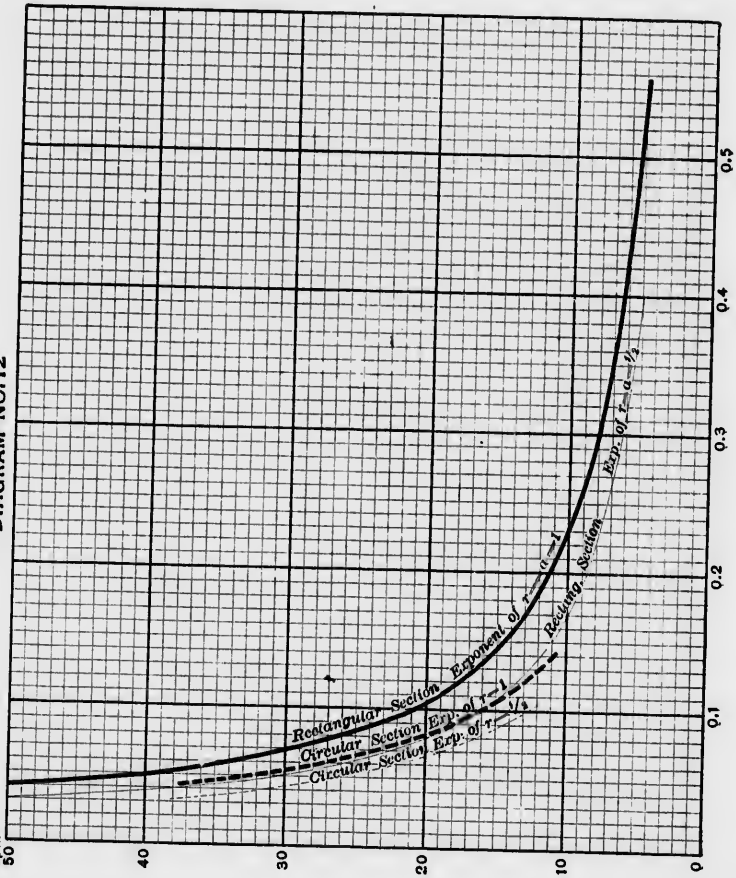


DIAGRAM NO. 12



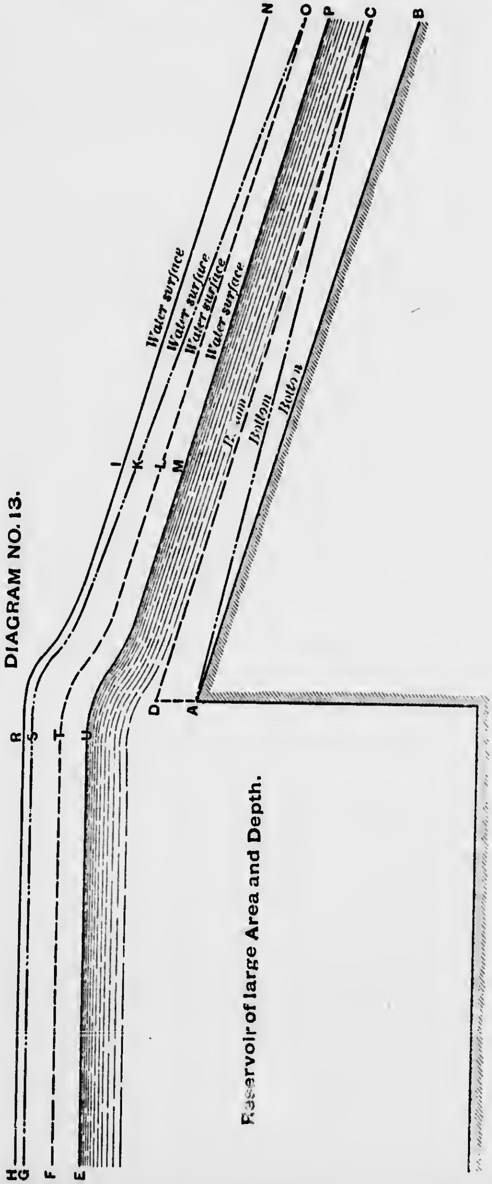


DIAGRAM NO. 13.
Reservoir of large Area and Depth.
Water surface
Water surface
Water surface
Water surface
Bottom
Bottom
Bottom
A
B
C
D
E
F
G
H
I
K
L
M
N
O
P
R
S
T
U

First—Consider a uniform rectangular channel with bottom *A B* and water surface *M P* and depth *P B* (diagram 13) of any width.

Second—A uniform rectangular channel with bottom *D C* and its width so adjusted that its water surface will also be *M P*.

Third—Suppose the inflow and outflow from the reservoir to be increased by a stated amount, 10,000 cubic feet per second, for instance. Then, from inspection of the tables, it is evident that the water surface in the more shallow channel will be raised to *L O*, a lesser amount than will be the case for the deeper channel, the water surface for which will be *I N*.

Fourth—Suppose now that the outlet channel to have its bottom as shown by *A C* and, proceeding from the reservoir, to have increasing width equal at the head of the channel to the width under the head "first" above, and a width at *O* equal to the width under the head "second" above. The tendency at the extremities of the channel will be as flow increases, to cause differing elevations of water surface to the end that the slope will take some shape as illustrated by *K O*. That is, a steeper slope will obtain in the channel which will in turn reduce the water surface from *R* to *S*. In other words, the change of water surface in the reservoir will be less than would be the case if the deeper channel of uniform cross-section had existence. Proceeding from Lake Huron to Lake Erie a channel having this general cross-section actually exists.

It is evident that for any reservoir having an outlet of diminishing hydraulic radius, proceeding from the reservoir, the value of $Q' - Q$ for a given value of Q will have larger values at and near the head of the outlet than would be the case with a uniform rectangular channel having the larger hydraulic radius.

It is also evident that all these tendencies would exist if the channel, under the heads "first" and "second" were of irregular width, excepting that, in general, the irregularities would tend to increase "a" in the formula and correspondingly increase the value of $Q' - Q$ that would have existence.

The conclusion is that the value of $Q' - Q$ increases above the values in the tables in a channel having increasing slopes and diminishes in a channel having diminishing slopes. The percentage of increase or decrease of velocity and discharge will be approximately one-half (½) the percentage of increase or decrease of slope.

What has been said for a rectangular channel applies equally well to any form of channel. Mean depth, slope and the value of "a" are the ruling quantities, as already shown.

Consider a channel the mean depth of which varies from section to section, but in some such manner as indicated on the following diagram, No. 14:

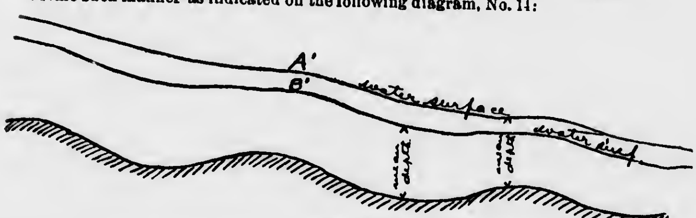


DIAGRAM No. 14.

Let the water surface rise from B' to A'. Suppose the total fall of water surface to remain unchanged. Then the value of $Q' - Q$ must be that corresponding to some mean depth intermediate between the maximum and minimum. The average mean depth—the volume of the water prism divided by the area of its surface—may be taken as the proper one. Applying the reasoning to the St. Clair and Detroit rivers, then the value of $Q' - Q$ may be taken from the diagrams illustrating the tables before described, the only uncertainty being as to the value of "a." Suppose "a" to be unity and the mean depth 20 feet. Then $Q' - Q$, will equal something greater than 20,000 cubic feet per second.

This analytical discussion is believed to be in the proper line for a determination of the matter in hand, but should be supplemented by more complete data for the preparation of which there is not now sufficient time. It has been developed far enough, however, to dissipate the wild ideas that the Chicago drainage canal will, when flowing 10,000 cubic feet per second, lower the lakes anything like a foot. Considered in connection with the Niagara discharge observations, the change of level for this flow is narrowed to less than half a foot, and the change due to 5,000 cubic feet per second to less than three inches.

This discussion also serves to demonstrate certain features of the discharge curves in the rivers connecting the lakes, as elsewhere stated.

The form of discharge curve in an open channel may now be discussed. The case of a rectangular channel of indefinite length may be considered first. Slope therein is necessarily a constant. Width of channel may, as previously, be between limits 500 and 6,000 feet, and depth between 5 and 60 feet.

Slope being constant, the logarithmic diagram (No. 8) shows that the equation $v = Cr^a s^{\frac{1}{2}}$ will apply to the channel, though "a" may be variable. "s" being constant it makes no difference whether its exponent should be one thing or another, providing it be constant. In channels of the size considered, the equation for area is practically $A = C'r$, since r essentially equals mean depth. The equation for discharge may therefore be written—

$Q = ACr^a s^{\frac{1}{2}} = CC' r^{a+1} s^{\frac{1}{2}}$. Or, since slope is constant, $Q = Kr^{a+1}$, K being a constant and equal to $CC's^{\frac{1}{2}}$. This equation for discharge is similar to that for a weir and has a form as shown on diagram No. 15:

It is to be noted that this curve is convex toward the axis of D. The reverse is the case with the discharge curve of the south branch of the Chicago river measured in 1892. The increase of depth is simply increase of fall of water surface in four miles of river from Bridgeport to Lake street, the hydraulic radius varying comparatively little. See diagram No. 16.

The value of $Q'-Q$ increases with depth.

Assume that "a" in one instance equals ½ and in another instance unity (1), then the curves for the two cases will be illustrated on diagram No. 17:

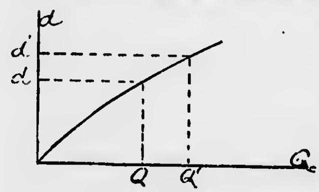


Diagram No. 15.

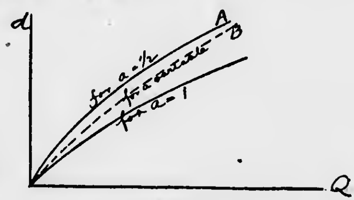


Diagram No. 17.

Should the value of "a" be variable and diminish gradually from 1 to ½, the curve will be as shown, and it is easy to see how it will be if the value of "a" increases from ½ to 1. Experiment indicates, however, that "a" will always be a diminishing quantity as depth increases. (See Ganguillet & Kutter collection of experimental data, translated by Hering.)

In any event, $Q'-Q$ must always be an increasing quantity (slope being constant) as d increases, unless "a" $= 0$ or a minus quantity, the former value being absurd and the latter contrary to any experience in channels as well defined as those connecting the lakes.

The above has been applied to a rectangular channel, but the previous discussion of $Q'-Q$ shows that it will apply to any channel where mean depth is constant.

Consider next the case shown on diagram No. 14, where the channel has variable mean depth and variable width, but constant total fall of water surface. The curves would be of the same form as for channels of uniform depth and cross-section, but the origin of discharge would not correspond to the zero of depth. The equation would be of the form $Q = Cf(r^{a+1})$.

Note—d = mean depth and for all practical purposes may be used instead of r.

The preceding discussion has shown the form of discharge curve for any shape of channel, providing slope be constant. Should slope increase as the water rises, the discharge at the greater depth will be greater than would be the case with constant slope. If it be true that slope (s) should have exponent ½ in the formula, then if r be constant and s alone vary, the form of curve will be as in diagram No. 18:

This, as already stated, is similar to the curve for south branch of Chicago river, diagram No. 16, referred to above, which bears out the conclusion that the exponent of s should be essentially ½.

On diagram No. 19, two curves are shown, the one for varying s and the other for constant s.

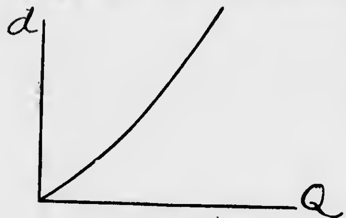


DIAGRAM No. 18.

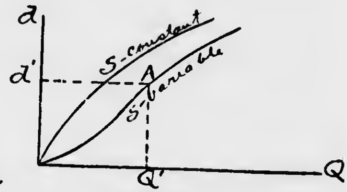


DIAGRAM No. 19.

NOTE—$Q = K s^{\frac{1}{2}}$
K = constant = $C A r^{a}$

The former is illustrated by the discharge curves in the Desplaines river at Riverside and the Illinois river at Morris, diagrams No. 20 and No. 21, that part of the Morris curve determined below overflow being considered.

It is clear that the form of curve may be more or less sinuous, but that, unless slope diminishes, the discharge must increase as depth increases, though, if slope increases at a suitable rate the discharge may likewise increase at a diminishing rate. Such is the mechanical and experimental conclusion.

There is one phase of experimental discharge curves worthy of mention and illustrated to a certain degree by the Morris curve, diagram No. 21. After overflow took place the discharge in the main river increased at a diminished rate, though the total discharge of the river increased at an increasing rate. Similar results have been obtained at various points in the Mississippi and its tributaries as shown by reports of the chief of engineers, U. S. A. It is highly probable that in such cases, while the depth is increasing from the point of overflow to high water level, the value of "a", may be negative, but there is no experience to indicate that such would be the case in the rivers connecting the lakes, while a change of four or five feet in depth took place. In the case of the Morris curve it is highly probable that the variation in question was due to varying slope.

The direct treatment of the problem in hand depends, of course, on the discharge curve in the rivers connecting the lakes, unless the analytical method herein described may be considered a direct method.

The only data promising an approximation to such a curve are those obtained in 1890-91 in the Niagara river under the direction of Maj. Ruffner, corps of engineers, U. S. A. These are fully described in the report of the chief of engineers, U. S. A., for 1893, page 4364. Diagram No 22, accompanying shows them graphically, the gauge (which is the same as depth) being ordinates, and the discharge (Q) being abscissæ. Major Ruffner's report indicates that slope increases with depth within the range of depth covered by the observations, which accounts for the apparent convexity of the curve toward the axis of discharge, as is the case for the south branch of the Chicago river (diagram No. 16). However, as in the case of the Morris curve (diagram No. 21) this convexity is not necessarily represented by a parabolic curve.

It may be noted that the observations made in Niagara river, which were all below mean lake level, give no clue whatever as to the form or shape of the curve above mean lake level. This is more evident after considering diagram No. 19.

Quite a number of curves may be drawn on the diagram indicating the mean discharge of given depths, one of which is as shown. This curve indicates what is highly probable and in conformity with the increasing slope, viz.: That at low stages of Lake Erie, the change of level for a change of outflow amounting to 10,000 cubic feet per second is about three inches, or one and one-half (1½) inches for the amount which will, for some years at least, be taken by the Chicago drainage canal. At mid-stage of the lake it appears that the change of level will be somewhat more, but the change is not of so much consequence at the higher as at the lower stages.

The changes of level in the river, however, are somewhat less than in the lake at Buffalo, on account of the increasing slope. Essentially simultaneous gauge readings at Buffalo and in the river where the flow was measured are reported by Major Ruffner. They are shown on diagram No. 23. There are evidently several accidental observations in the lot, which being ignored, permits the establishment of the line *A B* which expresses the relation between the changes of level in the river at Buffalo. Numerically, the level of the lake changes 25 per cent. more than the level of the river where the flow was measured. This gauge relation is, as shown, a straight line, which conforms to experience elsewhere.

The change of level probable in Lake Erie is fixed by the Niagara river. The charts showing variation in lake levels (diagrams Nos. 1 and 2) indicate that the rise and fall of Lakes Huron and Erie are about the same and, therefore, that a given change of flow through the connecting rivers will produce the same change of level in both lakes, except in so far as the flow through Niagara river is larger than the flow through the Detroit river. That is, the change of level in Lakes Huron and Michigan for a given change of flow will be 15 per cent., more or less, greater than the change in Lake Erie.

An Existing Outlet to the Sea.*

ALEXANDER R. SMITH, EDITOR SEABOARD,
New York.

Cheap transportation is an irresistible commercial magnet. For 3,000 miles of unbroken coast line such a magnet extends along the southern boundaries of the great lakes. The enormous trade of our central, western and northwestern states is steadily drawn lakeward by the magnetic attraction of cheap transportation. Cheap transportation not only attracts traffic—it creates it. Its vacuum draws the wind of trade steadily in its wake, and the freedom of lake transportation is a potential element in reducing its cost.

INCREASED LAKE COMMERCE.—Where 40,000,000 of tons of freight are now moved on the great lakes, at an average rate of $1 a ton, as soon as your lake ports are deepened to conform to your deepened channel, 60,000,000 tons of freight will be carried for $40,000,000, for I believe that the increased facilities of lake navigation will augment the traffic 50 per cent., by reducing the cost of its transportation 33 per cent.

NEW YORK DEEPLY INTERESTED.—The people of the state of New York are intensely interested in this development. The great port of New York watches the growth of lake commerce with ever-increasing satisfaction, and contributes, willingly, to everything that will increase its volume and reduce its expense. Constant progress and improvement in the one case hastens, and in the other cheapens the cost of, transportation. New York as a state, and New York as a port, have prodigiously benefited by this wonderful and incomparable growth of lake commerce. It is not sentiment, but the immutable law of trade, that enables New York to benefit by the existence and expansion of lake traffic. The Erie canal first contributed to the commercial supremacy of the state of New York. Why? Simply because it connected 1,500 miles of lake navigation with the illimitable oceans. Do not imagine, therefore, that a single citizen of New York, who has even the vaguest knowledge of commerce, is indifferent of the value of it to himself or the state.

What the great lakes are as a magnet to draw the traffic of the heart of the continent toward them, the Erie canal is in attracting to it the lake commerce destined for tidewater. Cheap transportation is the magnet in both cases. Free navigation supplements this advantage. inspires public confidence, induces trade development, suggests improvement in facilities of transportation, and reduces charges. New York state, and so many of its successful citizens, have gained so much from lake commercial development, and the necessities of its transportation, that not for a moment should it be thought that they are hostile to anything that shall in the least degree increase its volume. The development of lake commerce has successfully engaged the attention of great men of affairs all along the line of the chain of lakes, and brought to their aid the purse of the nation with a lavishness of munificence that is the truest national economy. So, too, the development of commerce within the state of New York has been under the direction of the keenest minds within the state, although more largely in the line of constructing and equipping the most successful trunk railroads in the world. The absolute control and domination of their systems, impossible in the free competition of waterways, assured larger personal profits in railroad traffic. Yet, the canal itself has been the prime factor in the successful development of these railroads, which, it is the boast of their managers, offer the cheapest railroad transportation in the world, because of canal competition at every point. The competing canal induces merchants to send their goods by the way of the port of New York and Buffalo, because the existence of rivalry will induce the cheapest possible rates. It is essentially the canal that has been the magnet which has attracted to New York her vast commerce, and upon which her prosperity unquestionably rests. Take away the canal, and the magnetic attraction which has drawn commerce will have become lost. Gradually the commercial emi-

*NOTE—Not printed in advance, according to rules of the executive board, hence published in the Appendix.

nence of New York will be undermined, inevitably its commerce will become diverted, higher rates will follow upon diminished traffic, and in the end the commerce, the population and the wealth of New York will not exceed her great rival sisters. New York's great point of superiority commercially is its canal to the great lakes.

How New Yorkers Feel.—These are facts inground in the minds of the commercial men of New York. These are facts which cause the great majority of the citizens of our state to hold the canals in such affection. These are facts which, thirteen years ago, induced the people to abolish tolls upon the canals, by a majority of over 322,000. These same facts make the people jealous of their canals, and their own control of them, so that they have repeatedly and emphatically declared in their constitutions that the "canals shall not be leased, sold or otherwise disposed of, but shall remain the property and under the control of the state, forever." So, we have the best of reason to believe the people will willingly maintain their own canals. Had we doubt of this the vote of the people, at the last election, in giving a majority of 115,342 for a separate amendment to the constitution authorizing the legislature to improve the canals, would have renewed our confidence in the people, because that majority was greater by over 32,000 than was cast for any other amendment. More singular yet, is the fact that one of the great parties, the members of which voted almost solidly against all of the 33 amendments because of partisan hostility to some of them, have, by their acts long shown that it is a party that can be depended upon to favor the canals at almost all times. It will favor them this year. That constitutional amendment authorized the improvement of the canals, by the legislature, according to three financial plans, to wit: The appropriation of funds from the treasury, or by equitable annual tax, or by bonding the state. The first two methods did not require a submission of the question again to the people, but the third did, if the amount of the bonds exceeded $1,000,000. It fell to those who had urged the constitutional convention to present the canal improvement amendment to suggest the scope of the bill that would carry into effect the expressed wishes of the people. Almost involuntarily, and entirely unanimously, they agreed upon a bill which proposes to bond the state for $9,000,000, for an improvement that has been mooted for twenty years, and was in effect, first suggested by Samuel J. Tilden, when governor of the state of New York, and taken up and ever since advocated by Horatio Seymour, Jr. This improvement consists in taking a foot from the bottom and placing a foot on the banks of the Erie and Oswego canals, and the deepening of the Champlain to seven feet, uniformly. It was the only plan of improvement advocated before the constitutional convention. Estimates furnished by the state superintendent of public works, and the engineer and surveyor, placed the cost of the proposed improvement at between $8,000,000 and $9,000,000, and for that reason the amount of the bonds to be issued was fixed in the bill at $9,000,000.

New York and a Ship-Canal.—It must not be supposed that the gentlemen urging canal improvement all these years were unfamiliar with the agitation for deep waterways, or that the interests of the state being so entirely dependent upon its commerce and the preservation of its waterways that afforded it cheap transportation, they failed to give most earnest and thorough consideration to every phase of that question. Had they found that such a canal would best serve the people of the state, would they not have urged it, would they not have endeavored to convince the people of the necessity for it, and the facts fitting, would they not have carried through a project for the construction of a ship-canal? Certainly they would. Actually, they were unconvinced. Not alone were they appalled by the colossal cost of such a canal, but the physical difficulties presented seem unsurmountable. Yet, beyond and above all this, they could not see where either New York or the nation would be the gainer by such a construction. They have yet to see where its construction will cheapen transportation. They have yet to learn where the funds can be obtained for its construction. They have never yet been informed how the physical difficulties can be overcome. But yet, if it is in the power of delegates to this convention to point out where transportation will be cheapened, or where and when the money can be obtained, or how the work can be accomplished, and how the water can be obtained, they will welcome and work for the construction of such a canal. Even then, however, there must need be such a vigorous agitation, support will be so difficult t[illegible], the removal of obstructions to accomplishment will be so tedious, the time co[illegible]ed will be so long before the construction will have become completed, that, as public spirited citizens, as men upon whom the responsibility now rests for conserving the commercial preeminence of the state, they will feel compelled to do their utmost to secure the adoption of the bill now before the people of New York for the proposed moderate form of improvement that has been urged.

BARGE CANALS ACROSS WISCONSIN, MINNESOTA AND THE DAKOTAS.—Gentlemen are delegates to this convention who are keen for a reduction of charges on the cost of carrying grain from the great fields of the northwest to the seaboard. We are told that the divide between the lakes and the Mississippi is but about fifty feet high. They know that it would not be costly to construct a barge-canal from the head of Lake Superior to the Dakotas, to the Red River of the North, over the border to Lake Winnipeg, and through the 2,000 miles of free navigation through the great Saskatchewan river, thus canalizing a territory that would open to almost immediate navigation an enormously fertile grain country: Yet this is a subject that may well engage the attention of an International Deep Waterways convention. If the leaders of public movements in that far region turn their eyes upon their immediate surroundings and note conditions with the same keenness of vision that they can see afar, do they not see that they could thus effect reductions in the cost of transporting grain to the seaboard, from beyond the great lakes infinitely larger than any possible reductions a ship-canal from the lakes to the sea will afford? May I not, with the extremest diffidence, suggest to the gentlemen who come here from Minnesota and Wisconsin, from the Dakotas, and from Manitoba, the wisdom and expediency of saving the 20 cents a bushel now required to get their grain to a lake point, before showing such anxiety to save a phantom fraction of a cent a bushel in getting it from Buffalo to New York? When the great grain empire stretching back of Lake Superior, and of Lake Michigan, too, northerly and westerly, has constructed barge-canals connecting the great navigable rivers with the lakes, and has cheapened the transportation of grain from 20 to 2 cents a bushel, as New York has done by the construction of the Erie canal, across the 500 miles that intervene between the great lakes and the sea, will it not be time then, if a fraction of a cent may yet be saved by the construction of a ship-canal at a cost of hundreds of millions of dollars across New York, to agitate its construction? I honestly think so, and I commend these suggestions in all sincerity, to the gentlemen representing those illimitable regions, as worthy their most serious consideration. We, of New York, would very greatly like to see grain carried from the Dakotas, western Wisconsin and Minnesota, and from Manitoba, to Duluth and Superior, as cheaply as we now see it carried from Superior and Duluth to New York. When the vast stretch of empire just indicated will have cheapened the carriage of grain to 5 cents a bushel for 1,500 miles of navigation beyond the western end of Lake Superior, its representatives may, I think, with far greater assurances of success, suggest the construction of a ship-canal from the lakes to the sea, to reduce the present rate of 5 cents a bushel from the head of Lake Superior to New York to a possible 4 cents a bushel for 1,500 miles of navigation to the sea.

LAKE STEAMSHIP DEVELOPMENT.—The grand development in the construction and size of lake steamships long ago won my unstinted admiration. The hustling get-thereness which characterizes the live business men who are becoming opulent along the shores of these great lakes through the cheapening and consequent increase in the transportation upon them, has been a theme which I have loved to dwell upon in addressing the more staid, infinitely slower, and too self-satisfied people of the seaboard. I shall attempt to tell you nothing of the rates you obtain and the trips made during a season of navigation with your magnificent freighters. You know all that. You may not, however, be so well informed concerning the vessels navigating the Erie canal, nor the rates they obtain now, nor what is contemplated in the immediate future. And I am here more particularly to tell you about that.

WHAT NEW YORK IS DOING.—This convention is called, I understand, to discuss the necessity of a deep waterway between the lakes and the Atlantic. Through the courtesy of your officers, I have been honored with an invitation to be present and participate in it, and I gladly and promptly accepted that invitation. We have in New York state a temporary organization known as the executive canal committee. It represents all of the leading commercial associations in the state on canal matters. Its membership is made up from those great permanent organizations, for the purpose of harmonious and united action. It has been in existence for about eighteen months, during which time its efforts have secured the adoption of a canal improvement amendment to the constitution, the preparation of a bill for such improvement, its passage through the legislature and approval by Governor Morton, and the committee is now engaged in presenting to the voters of the state, who will pass upon it at the next election, reasons for its adoption. It happens to be my very good fortune to be secretary of that committee, and in charge of its campaign, under the direction of a sub-committee. For these reasons, I am here to talk to you about our canals—principally the Erie.

THE ERIE CANAL WILL ACCOMMODATE LAKE TRAFFIC.—Whether a nine-foot Erie canal will come up to your wishes or ideal, I presume, depends altogether upon the efficiency and cheapness with which it will accommodate lake commerce. We, of New York, believe that it will fully do that. I shall attempt to present some facts for your consideration that will prove this, and I feel sure that you will not, at least, be any less interested in a great artificial waterway which has existed for seventy years, and which it is proposed to improve, than you will be interested in waterways which exist only in the brains of their projectors, but which it is proposed to construct.

THE PRESENT ERIE CANAL AND PROPOSED IMPROVEMENT.—The Erie canal is 352 miles in length, begins at Buffalo, and ends at Albany, thus connecting Lake Erie with the Hudson river. It has cost about $50,000,000 to construct. It is 70 feet wide on the surface, 56 feet wide on the bottom, and supposedly 7 feet deep. Its locks are 110 feet long, 18 feet wide and 7 feet deep over miter sills. There are 72 of these locks. In several places two are close together, and at Lockport there are five, and between Cohoes and Troy, there are a series of 16. All of the locks are double—one alongside of the other, so, in truth, one might say that there are 144 locks. They are always spoken of as 72. Forty of these 72 locks are lengthened, that is to say, 220 feet long, in which two boats are put through at one lockage. The bill now before the people provides for the lengthening of the unlengthened locks. The present state engineer and surveyor has stated that he can, with a pair of modern steel lift-locks, supplant the 16 locks at Cohoes, and that he can at Lockport displace the five present locks with a pair of steel lift-locks. A bill appropriating $100,000 was passed by the last legislature to build a pair of steel lift-locks at Rexford Flats, on the Erie canal, to displace two pairs of short locks. All of these proposed steel lift-locks will accommodate a double boat at one lockage. Another improvement contemplated by the present state engineer and surveyor is the substitution of steel gates, on rollers, in place of the present wooden swing gates, and, by other trifling changes in the locks, to gain twelve feet. That is to say, these last mentioned improvements will permit the building of canal boats about twelve feet longer than at present, which, in a pair of double boats, will mean an increase in their carrying capacity of about eighty tons.

TO ACCOMMODATE 12,000,000 TONS OF FREIGHT.—All of these improvements will doubtless be made concurrently with the proposed deepening of the Erie canal, and in three or four years, at most, we are promised the completion of the work. I have not stated to you one impracticable thing, but have shown you the present condition of the Erie canal, which last year accommodated a traffic of 3,000,000 tons, and which, improved, will have a maximum capacity at least four times greater than that carried last year.

WHY NOT EXAMINE INTO THE IMPROVED ERIE CANAL'S CAPACITY.—Perhaps these are dry details. But they are practical details, remember, not conjectural details, and on that ground I ask your indulgence. I feel sure that if the eminent gentlemen attending this convention—engineers, ship builders, ship owners, grain growers and other commercial and shipping men—would but examine into the proposed improvements, and the future possibilities of the Erie canal, with but a tithe of the scrutiny with which plans and projects of a colossal ship canal, or canals, are examined, you would all find much to repay you. The probability that we will be able to offer the cheapest possible route to the sea at the completion of the pending improvements, should command for this great canal your most profound study. If the eminent talent so freely at the disposal of this convention should make such a study and investigation of our proposed and pending improvements, they could give you, at a subsequent convention, much very valuable information which my lack of technical knowledge precludes me from imparting. And, however alluring and inspiring the pictures which orators will paint upon your minds concerning the grandeur and greatness of a ship canal to the sea, let me again impress upon you the fact that the most public spirited and talented men within the State of New York, technical and commercial, who have studied the canal system, and canal needs, and canal possibilities, are unanimously agreed that the 9-foot Erie will accomplish all in the way of accommodating commerce seeking an outlet to the sea, that will be required for many, many years to come. In short, that the proposed improvement will bring the existing canals up to all the present or prospective demands of commerce by affording it the cheapest and freest transportation.

Boats now Navigating the Erie Canal.—At the present time the boats that navigate the Erie canal are of wood, 98 feet long, 17 feet 11 inches in width, and with a molded depth of about 10 feet. They cost from $2,500 to $3,000, and carry grain for upwards of twelve years, many lasting for sixteen and twenty years in that trade, after which, for many years longer, well cared for, they are used in the transportation of rough freight, such as coal, lumber, cement, etc. A pair of these boats now carries 480 tons, or 16,000 bushels of wheat, on a draft of six feet. They are manned by five men, and towed by six mules. Then, there are steam canal boats, which cost from $7,000 to $8,000 each, that push one boat ahead, fastened to them as are the double boats, and they tow two behind, fastened together. Other steam canal boats tow five of these canal boats, which are called consorts. The average number of trips made by a double header is six, and by a steam fleet, seven. Eight trips are not infrequently made by these fleets, and the maximum number of trips is nine, but, as stated, the average is seven. And that will be the basis of my calculations.

Trips and Traffic Now.—The present year will do to illustrate the operation of the Erie canal, bearing in mind that if the down rates are low, the up rates are high, and are thus pretty nearly balanced. We may use a fleet of six canal boats, including a steamer, for the purposes of this illustration:

Fleet carries down, per trip, 46,000 bushels wheat.
Fleet carries down in seven trips 322,000 bushels wheat.
Fleet carries up, per trip, 850 tons freight.
Fleet carries up in seven trips 5,950 tons freight.
Rate on wheat, 2 cents per bushel. Fleet earns $6,440.
Rate on up freight, 60 cents per ton. Fleet earns $3,570.
Gross earnings of fleet, in season of navigation, $10,010.

What Improvement Will Accomplish.—When the Erie canal is deepened to nine feet, this fleet will be able to load a foot deeper, and make three more trips in a season of navigation—some say twelve trips, all told. With two feet of water under the bottom, where now there is scarcely as many inches, half of the distance, it cannot be doubted that boats will travel faster, in fact at double the present two miles an hour rate of speed. It will cost no more for coal to travel twice as fast with two feet of water under the bottom, nor as much, as is now required. In fact, the expense of navigation will not be increased appreciably, even should the trips be doubled, in a season. We will assume the most moderate estimate, however, of ten trips in a season. I will now show you at what rates of freight this fleet could earn just as much as now, and at no additional expense:

Fleet will carry down, per trip, 58,000 bushels wheat.
Fleet will carry down, in ten trips, 580,000 bushels wheat.
Fleet will carry up, per trip, 1,150 tons freight.
Fleet will carry up, in ten trips, 11,500 tons.
Rate on wheat, 1⅛ cents a bushel, fleet earns $6,525.
Rate on up freight, 30 cents a ton, fleet earns $3,450.
Gross earnings of fleet, in season of navigation, $9,975, or $35 less than the same fleet earns now.

Increased Traffic Means Cheaper Transportation.—It will be your privilege, gentlemen, to figure on [illegible] much below the above last quoted rates, based on an improved canal, ships will be able to carry freight [illegible] ship canal. Some may say that the ship will save the cent a bushel now required to pay transshipment at Buffalo. But the answer to that is that competition will force the Buffalo people to reduce their rates to probably an eighth of a cent a bushel, and a fair profit can be earned on that, with an increased traffic. Others may pooh pooh at the idea of only making ten trips in a season of navigation, and declare that the ship will make a round trip to New York from Buffalo, as quickly as she can from Duluth to Buffalo, or in ten days' time. If that claim is made in behalf of the ship, travelling through the canal loaded to its maximum depth, or nearly to it, it must be admitted that the canal barge, with 10 or 15 feet of water under her bottom, will be able to travel two or three times as fast as the ship, and so make more trips than the ship. If a ship can make 10 trips through the canal in 100 days, then the canal barges will be able to make at least 20 trips through the canal in 210 days of navigation. And when you concede at least that to the canal boats, you must cut the rates last quoted in two again, so that the canal boat will carry wheat for five-eighths of a cent a bushel, and up-freight for 15 cents a ton, and earn as large profits as are now possible at 2 cents a bushel and 60 cents a ton on up-freights in seven trips.

PROFIT ON FREIGHTS AT 15 CENTS A TON.—If gentlemen can figure out a use for a ship canal for canal barges to compete at five-eighths of a cent a bushel and 15 cents a ton, against ships, in navigating it, it will be interesting to see their figures. I leave it to unbiased men, and these, it is to be presumed, will be in congress, and to whom will be submitted the proposition to spend $200,000,000 to $500,000,000* for a ship canal, from the lakes to the sea, whether it would be worth while to construct such a canal, to effect such a saving as I have shown will be provided in a 9-foot Erie canal.

I hazard nothing, in asserting that, with the canal business in the hands of large companies, with solicitors out looking for freight in all of the great manufacturing cities, as the railroads have, under the moderate improvement that is on the eve of commencement, it requires no strength of imagination to foresee that a canal fleet will be able to make ten day trips regularly, or at least twenty in a season, and without any further deepening than 9 feet. Or, that the 9-foot Erie will be able to carry, with the fleet of boats now navigating it, under business-like management, four times what it now carries, or approximately, 12,000,000 tons of freight at an average of 15 cents a ton, a distance of 500 miles.

TOLLS NECESSARY TO PAY INTEREST ON INVESTMENT.—Assuming your ship-canal to cost $200,000,000—the lowest estimate that is put forward for a 26-foot ship canal—and a traffic of 12,000,000 tons would need to bear a toll of 66⅔ cents a ton to pay interest on the investment, to say nothing of the cost of maintenance. Even should the traffic of such a canal double, or approximate to 24,000,000 tons, the toll would need to be 33⅓ cents a ton to pay interest on the investment at 4 per cent. Your experience at the Soo canal will enable you to judge whether you could lock through a ship canal a traffic exceeding 12,000,000 tons. If you required double locks to accommodate such a traffic —and would you not?—how much would that add to the cost of your ship canal? How much would it add to the amount that you would need to raise annually, to pay interest on the investment, by tolls? Remember that the canals which it is proposed to improve in New York state, paid into the state treasury $34,000,000† more than they cost, up to the time tolls were abolished, and that this surplus, if put at interest, would have yielded a revenue sufficient to forever maintain these canals, without costing the people‡ a dollar. Surely, it is not proposed that a ship canal, to cost from $200,000,000 to $500,000,000 shall be made a free gift to commerce, that the money shall be sunk, forever, without hope or even interest on it, much less a return of the principal?§

FIGURES TO PONDER OVER.—Consider for a moment that the interest on the investment of $200,000,000 for the construction of a ship canal, if at 4 per cent. would pay for the transportation of 60,000,000 tons of merchandise from Buffalo to New York, through the Erie canal improved to 9 feet, should such or duplicates of it carry it. And the interest on an expenditure of $500,000,000 would pay for the transportation of 133,333,333 tons of merchandise carried over competing 9-foot barge canals.

FIFTY CENTS A TON TOLLS VS. 15 CENTS A TON FREIGHT RATE.—If the entire 40,000,000 tons of freight now moved on these lakes were to use the ship canal, and its locks and width were of a size to accommodate it, at a conservative estimate of $500,000,000* for the cost of its construction, interest at 4 per cent. obtained from tolls would require a levy of fifty cents on every ton that used it—a toll three times higher than the freight could be moved for through competing 9-foot canals with 7-foot barges.

If the government were able to effect a loan of $500,000,000 even at 3 per cent. interest, it would probably take a hundred years to pay off the bonds in, and it would be interesting to obtain an actuary's figures of the amount that it would be necessary to raise, annually, to pay interest and provide a sinking fund to wipe out the debt even in a hundred years. Certainly it would be so colossal a sum that the people would be a long time consenting to submit to it throughout their own and the lifetimes of their great grandchildren.

NEW YORK'S CONSERVATIVE BUT SUFFICIENT IMPROVEMENT.—The people of New York, containing one-tenth the population, and probably one-fifth the wealth of the union, are willing to spend $9,000,000,† wisely, economically, conservatively, and, they believe, sufficiently, for the needs of commerce requiring an outlet from the lakes to the sea, and if, in the course of a half a century, the improved canal should be found inadequate, an expenditure of another $9,000,000 or so for additional improvements might be justified.

*NOTE—There is no such estimate or proposition from friends of ample channels.

†Wrung from western producers in the form of tolls; so that the west paid the New Yorkers for their canal and gave them $34,000,000 besides.

‡By "people" Mr. Smith means the New York traders. The millions of producers in the west, who really paid for the Erie canal, are not "people."

§Who is paying interest on or returning the principal of the millions spent by congress on New York harbor?—F. A. F.

Toronto Deep Waterways Convention.

September 17, 18, 19 and 20, 1894.

MONDAY, SEPTEMBER 17—AFTERNOON SESSION.

The convention met informally in the Council Chamber at 3 P. M., Monday. The delegates presented their credentials and were introduced to Mayor Kennedy and Alderman J. Enoch Thompson, Chairman of the Joint City Council and Citizens' Committee on Deep Waterways.

In the evening the Committee on Permanent Organization appointed by the convention submitted their report, which was adopted, recommending the following officers and committees:

OFFICERS OF THE CONVENTION—Chairman, J. Enoch Thompson, Toronto; First Vice-Chairman, E. V. Smalley, Minnesota; Second Vice-Chairman R. R. Dobell, Quebec; Secretaries, J. H. Boyle, Toronto; Denison B. Smith, Toledo.

COMMITTEE ON ORDER OF BUSINESS—James Suydam, St. Paul; R. C. Steele, Toronto; Alderman Graham, Toronto; Alderman Dunn, Toronto; Captain J. S. Dunham, Chicago; Charles E. Wheeler, Cleveland.

COMMITTEE ON RESOLUTIONS—James Suydam, St. Paul, Chairman; Frank A. Flower, Superior, Secretary; A. P. McGuirk, Davenport; Lieutenant George P. Blow, U. S. N., (Honorary); J. H. Davidson, St. Paul; R. R. Dobell, Quebec; T. W. Taylor, Winnipeg; James Conmee, M. P. P., Port Arthur; O. A. Howland, M. P. P., Toronto; L. E. Cooley, C. E., Chicago; Captain J. S. Dunham, Chicago; J. Brown, Toronto; Alderman Hewitt, Toronto; L. R. Keck, Cincinnati; H. W. Seymour, Sault Ste. Marie; A. L. Crocker, Minneapolis.

COMMITTEE ON PERMANENT ORGANIZATION—A. P. McGuirk, Davenport, Chairman; Frank A. Flower, Superior, Secretary; James Suydam, St. Paul; R. R. Dobell, Quebec; H. W. Seymour, Sault Ste. Marie; J. Brown, Toronto; A. L. Crocker, Minneapolis; T. W. Taylor, Winnipeg; L. R. Keck, Cincinnati; O. A. Howland, M. P. P., Toronto; James Conmee, M. P. P., Port Arthur; L. E. Cooley, C. E., Chicago; H. D. Goulder, Cleveland; J. H. Davidson, St. Paul; J. S. Dunham, Chicago.

Mr. Thompson: We have welcomed many conventions to this city, but none of greater importance than the one assembled here. There are many schemes before the public more or less favorably spoken of; but there are eminent engineers at this convention; there are business men here, and they may be relied upon to promptly expose any utopian or foolish schemes as quickly as they would endorse any that are good and reasonable. This is a convention of business men. We have among us representatives of our parliament and representatives of the American congress, and the United States government has sent a representative from the department that deals with the lakes. We have, therefore, a convention that is able to speak intelligently on every question that will come up here for discussion. I have much pleasure in asking His Worship, Mayor Kennedy, to deliver his address of welcome.

ADDRESS OF WELCOME.

His Worship Mayor Kennedy: Mr. Chairman and gentlemen composing this convention: I am conscious of the honor conferred upon me in being requested to tender this large gathering a welcome to the city of Toronto. In my capacity of mayor I have been called upon on several occasions formally to tender addresses of welcome to conventions visiting our city, but I regard none that I have had the honor of addressing—viewing it from a physical standpoint—so important as the convention now assembled in this city hall. (Applause.)

A very large convention assembled in the ciy some weeks ago, which was important indeed, and we could scarcely judge which was the more important. I refer to the great convention which had for its object the moral well-being of the community, the Young People's Baptist Church convention, which was some six thousand strong. Their object was of a moral nature. They had one special object in view, and you have another; but still both have in view the welfare of humanity, the promotion of trade and commerce, and the elevation of our race, the doing good to our fellow men. The importance of this convention can not be over-estimated.

I gladly respond to the call of the Committee of Management to address a few words of welcome. The subject that will be considered by you is very tempting indeed, but, sir, I will tread very lightly on the domain you are about to traverse, and anything I may say must not be regarded as stepping-stones on the highway, or rather the waterways, you are about to investigate. (Applause)

Mr. Chairman, I congratulate you on the success of this convention. I congratulate you, your associate aldermen and the members of the Board of Trade, on the success you have achieved. I know the great labors you have gone through, the anxiety and toil you have had, the vast amount of correspondence and all those necessary details. You have passed through them all and you have done your duty cheerfully.

Our Great Creator has given us a noble heritage. Nature has dealt very bountifully with us, giving us noble streams and lakes. These vast waters are at our command, and Nature invites us to supplement the work she has done, so that we may control these extensive sheets of water and utilize them for the benefit of mankind in facilitating the transportation of the products of the West to the Atlantic seaboard, in order that the millions on the eastern shores may share in the products of the fertile fields of the west, by having them transported at a very low cost.

The Anglo-Saxon race has been entrusted with the destinies of this North American Continent. The wonderful ene gy displayed by that race is to be seen all round us, both in the United States and Canada. This Anglo-Saxon race is destined to control the world. To-day 120,000,000 of people speak the English tongue. To us, then, is committed this great trust, and I believe we shall prove ourselves equal to the emergency. I believe a sound from this convention will ring out in a way that can not be mistaken, and the interest of the people of the Dominion and the United States will be aroused to the importance of the great subject that will be debated at this convention.

It is clearly demonstrated that a convention of this kind is necessary if we consider the demands that have been made in the west and northwest for cheaper transportation. Farming operations in the northwest can not be profitably carried on if transportation to the seaboard is wholly or partially limited to the railways. The future price of wheat must inevitably rule low, exc. pt under conditions that are abnormal, such as the failure of crops or the existence of war. It is considered by experts that the price of wheat will rule low for all time to come. We in America have to contend with the products of Australia, Russia, India. The farmers of the Canadian and American northwest realize that economy in transportation lies at the very basis of their prosperity, and we know that the cost of transportation to-day is such that when it and other expenses incidental to farming are deducted from the receipts very little indeed is left to the farmer. The average cost of transportation by rail is six times the average cost of transportation on the great lakes. We believe that while it is physically impossible to transport the farms to the ocean, it is quite possible for us to bring the ocean near the farms. (Applause.) If the mountain will not come to Mohammet, Mohammet must go to the mountain. Here is a little extract I have taken from one of the city papers showing the difference between rates by water and rail:

Freight from Brandon to Fort William, 560 miles, 12 cents.
The charge from Chicago to Buffalo by vessel, 900 miles, is from 2 to 3 cents. Rail freight is consequently six times greater than by water.
From Duluth to Buffalo by water, 1,000 miles, the freight rate is between 3 and 4 cents.
From Duluth to Montreal by water, 1,400 miles, 6 to 7 cents.
From Winnipeg to Montreal by rail, the distance being the same as from Duluth to Montreal, the charge by rail is 27 cents.

These figures show the cheapening of the cost of transportation that can be effected by the creation of a canal system that would practically transform the lakes into great oceans. We know the people of the northwest are pushing this question very strongly. The Americans are urging upon congress that something must be done, that a great and final effort should be made to remedy the difficulties under which we labor.

We are all agreed something ought to be done, and were we all of one mind in regard to waterways that should be deepened it would doubtless be easily accomplished, but unfortunately there are general methods proposed and each one has its numerous ardent advocates. Several schemes have been brought before the attention of the public. There is the Ottawa valley canal, ascending the lakes by way of French river, and the Hurontario ship canal. The latter has been before the people of Canada for forty or fifty years, since the time it was first advocated by Mr. Capreol. This route possesses great advantages. I advocated this scheme myself years ago. It is intended vessels should come from Georgian Bay to Lake Ontario by this canal. You will observe that even this project, which is one I have always favored, involves the enlargement of the St. Lawrence canal. I understand a company has subscribed the necessary stock to prosecute the work of the Georgian Bay ship canal. Then there is the Hurontario ship railway, designed to carry vessels of 5,000 tons overland, along the same route.

Furthermore, an air-line from Collingwood to Toronto has been suggested, but all those schemes involve the enlargement of the St. Lawrence canals and waterways. We may say what we will, but here is the natural course to the ocean. Nature invites us to use it. The obstructions that exist there can be removed, but at a great cost, of course. The national highway to the ocean is by the great St. Lawrence river. As you have stated, Mr. Chairman, we can not deal with this as a merely local question. We must deal with it in its broad, international aspect. (Applause.) Lengthy discussions have taken place in the house of commons upon this question. One government has given us a twenty-foot waterway for 800 miles, but here we find we are stopped by a fourteen-foot canal, so that vessels drawing twenty feet can not proceed the whole way to the ocean. Transhipment is necessary. Some say you are asking too much when you ask the government to stop working on their fourteen-foot system and change it to twenty feet. Railway rates east of Chicago have become reduced to a minimum. Still, the rates are entirely too high, and New York can scarcely hope to continue to be the seaport of the west when prices of products become lower and lower, unless she can provide transportation on a much larger scale than the tow-path affords. Numerous conventions have already been held to agitate this question. I remember some twenty years ago, one was held at Des Moines; in 1891 one was held in Detroit, and in 1892 at Grand Forks. Again, there was a convention last year at St. Paul. The deep water outlet was considered by far the most important of all matters at these conventions, but no definite canal route has yet been decided upon. A resolution was submitted to the United States congress in 1892 to authorize international negotiations on the subject. The resolution reads as follows:

Resolved, That the Senate and House of Representatives of the United States of America, in congress assembled, that the President of the United States be and he is hereby requested to invite negotiations with the government of the Dominion of Canada to secure the speedy improvement of the Welland and St. Lawrence canals and St. Lawrence river, so as to make them conform in depth and navigability, so far as practicable, to the standard adopted by the government of the United States for the improvements now in progress within the United States of the waters connecting the great lakes, and to that end the President is hereby authorized, if he deems expedient, to appoint three commissioners to negotiate, on behalf of the United States, with the representatives of the government of the Dominion of Canada, the terms and conditions of any agreement which may be entered into between the two governments, in pursuance of any proposition submitted in that behalf by the government of the Dominion of Canada.

It is somewhat encouraging to us in the Dominion to know that at least the government of the United States sympathizes with this movement to make the waters of the St. Lawrence navigable for large vessels all the way to the sea. Our own government has constructed the Welland and St. Lawrence canals, but these have proved too small for the necessities of the case Then we have both governments constructing each a large canal at Sault Ste. Marie, each canal having only one lock. These magnificent canals admit vessels of heavy draught, but we want to carry out the same idea in regard to the whole system right to the sea. It may be said the Dominion government is not able to accomplish this itself. Fifty-four millions have already been spent on canals, and a very large sum is yet required to accomplish what is aimed at. If the Dominion government is not able to accomplish this, and if this convention and the people of both countries were to unite in one demand that the canal should be improved, then if our government feels it could not undertake the work, let it be admitted, and let the United States be asked to take part in this matter. Some say there can't be joint control. Still, there can be control by one of the powers. The Dominion government can give the United States rights commensurate with the amount they spend on the work. I have no doubt the governments of the United States and Canada will consider the resolutions that will be carried at this convention.

I tender you a very hearty welcome on behalf of the city council and the people of Toronto, and I trust your meeting will be of a pleasant character, and that what you do will benefit the people of the Dominion and of the whole continent. (Applause.)

THANKS FROM THE UNITED STATES DELEGATES.

Mr. E. V. Smalley: I think I may take it upon myself, Mr. Chairman, to return, on behalf of the delegates from the United States, our very cordial appreciation and thanks for the warm welcome given us by your mayor. You will not find among our delegates from the northwest any national prejudice that would stand in the way of our joining you in what is unquestionably the best and quickest way to get to the sea, because none of us can fail to recognize the fact that these two great English-speaking peoples, that face each other along a line 4,000 miles in length, are being drawn by the circumstances of their own condition and by the force of civilization into nearer and nearer accord. (Applause.) Whatever it may be with the politicians, the people are fast seeing that it is for their interests to draw near together for the accomplishment of great objects which will benefit both countries.

In looking into your faces here, I cannot imagine myself in any foreign country. Hearing the friendly tones of your voices, I cannot imagine that I am not at home. I have attended conventions in nearly every state, and if brought into this room blindfolded, if I could not see the portrait of your Queen on the wall there, it would be hard for me to fix my location.

In conclusion, gentlemen, let me say you will kindly treat us somewhat as pupils going to your school. Give us all the facts and information, and depend upon us after we have got home to mass our public sentiment in the west in favor of some measure that will give to our great cereal products a free and cheap outlet to the markets of the world. (Applause.)

Col. J. H. Davidson, St. Paul: In response to the address of welcome from the mayor of Toronto and to the other indications of welcome that have been extended to us, let me say that we are glad to be with you. We are here for business, and the delegations for which I speak are largely composed of business men. I have been requested to represent at this convention the Commercial club of St. Paul and the Commercial club of Minneapolis, the two largest and most influential business organizations in the twin cities. Our object is to secure such facilities for transporting the products of the west to the markets of the world as will leave a larger margin of profit in the hands of the producer. In looking at this problem, we do not know the one government from the other. We are speaking for a continent and a race. We are here advocating something not for the puny generations that now partially cover this continent, but we are speaking for the millions that are to come after us. (Applause.) Both countries will produce a vast surplus in the near future, which ought to reach the markets of the world by the cheapest route. Our progress has been so wonderful within the past few years that we have girdled the continent with steel railways. There is a network of iron spun all over this vast expanse of territory on your side and ours, north and south, east and west, carrying vast loads of people, millions of tons of freight. We are constantly developing. What a few years ago were considered the most wonderful iron mines of the world have been distanced and left in the shade by those wonderful discoveries in the Mesaba range, north of Duluth, which supplied the raw material to the furnaces of Ohio, Michigan and Pennsylvania. So you have upon your side of the line wonderful natural resources—mines that are inexhaustible, a timber belt which cannot be consumed by coming generations for hundreds of years. We want an opportunity to subdue the wilderness; to open the waterways; to bring into closest connection the citizens of every part of this great continent.

We are all of the Anglo-Saxon race—a wonderful race, that holds the reigns of power on this continent and Europe. It is the dominating power, and, thank God, it is a Christian power (hear, hear), dictating peace between warring nations, settling mighty disputes that a few years ago would have involved the moving of vast armies. We are rapidly seeing that state of things pass by, and we can now arbitrate all the great questions that arise between civilized people. We may, I think, reasonably hope that war has now almost forever ceased among the most powerful nations of the globe. The wonderful development we have seen on every hand, which we are witnessing day by day, is drawing into closer communion all the nations of the earth. We learn that we have the same sympathies, the same lives, the same emotions; and while you may love your good Queen, and while you may be attached to the stable government that has done so much for the world, we may be equally attached to another form of government. We raise no question as to the best. We are each in our own way working out the problem of civil government, of government for the people and by the people. The interests of the eastern states, of the extreme southern states, may be against the St. Lawrence project, but the states of the northwest, of the middle states, of almost the whole vast continent, are dependent largely upon the cheapening of transportation to the ocean. Our plans must be broad, so that we will grasp not only the connection by way of the St. Lawrence, if that route shall be found the best, but a connection southward, from the great lakes to the Mississippi, and then we shall have a waterway from the mouth of the Mississippi through the centre of the continent of North America.

As far as the experiment of deepening waterways is concerned, we are finding wonderful benefits from it in the west. Were it not for the great facilities afforded by the great lakes for the transportation of fuel to the ports of Duluth and Superior, we could hardly keep warm in the northwest in winter. And were it not that the products of the northwest can be transported so cheaply to Buffalo, we would not receive anything like what we do for our products.

Gentlemen, let me say in conclusion, we are here for work. We are ready to commence now, or to-morrow morning, and to sit till we have finished the job. (Applause.) We want to get it so thoroughly started that it will swell in power and volume like an avalanche that sweeps down the mountain and carries everything before it. If you start it in Ontario we will carry it into Michigan and Ohio and Minnesota. We will see it spread and destroy every fragment of opposition. It may not come in 1894 or 1895, but it is as inevitable as fate. As your mayor has remarked, the Architect of the universe has ordained the St. Lawrence as the great natural highway to the sea. We cannot wipe that out even if we would. It was fixed when the continent was formed, something that cannot be obliterated, that cannot be changed. And as God has pointed out the way let us make haste and walk therein.

Col. Denison: I would like to take a few moments of your time to give the reason why I moved a resolution as to the canals last session. I noticed the government had decided to build a new canal at Soulanges. The reason of their building on the north side of the river was because it was considered cheaper to build a new canal than to deepen the old one at Beauharnois. That being the case, I wished to place before the house my opinion that the government should not continue the old policy of a 14-foot waterway, which had been decided on twenty or thirty years ago. I felt that times had changed in twenty years, that the vessels now on the lakes were larger than before, and I thought we ought to inaugurate a new policy of 20-foot canals. In the building of our canals we have been acting like a crab—we are working backwards. My idea is that we should start at the sea and work towards the upper lakes. With that view I advocated the work being started at Soulanges, and as our means would permit it should be carried on as a Dominion enterprise. It has been suggested that the Canadian people might deepen their canals alone and unaided, and as a *quid pro quo* the United States should give us some advantage in the way of reciprocity to make up for it. I think that there may be something in that suggestion. I hope this convention will be a great success.

Tuesday, September 18—Morning Session.

DEEP WATERWAYS.

Mr. J. Enoch Thompson: This paper I am about to read will contain many facts which have already appeared in the papers. Many of the facts and figures given here have been printed before, but they were new to me and doubtless will be to the others in this chamber who have not previously been interested in the canal question.

Most people know in a general way that the commerce of the upper lakes has attained large dimensions, but few are prepared for the immense array of figures which confront them in whatever direction they look up statistics of lake traffic. The freight carried on the great lakes exceeds in one season of seven months 30,000,000 of tons, being equal to one-fourth of the freight carried by all the railways of the states in twelve months.

The traffic carried through the St. Mary's Falls canal, the one connecting link of the 20-foot waterway that is completed, exceeds that carried through the Suez canal, as will be seen by the following statement:

	St. Mary's Falls Canal.			Suez Canal.		
	1893.	1892.	1891.	1893.	1892.	1891.
No. vessel passages	12,008	12,580	10,191	3,341	3,559	4,207
Tonnage, net registered	9,849,754	10,647,203	8,400,685	7,659,068	7,712,028	8,698,777
Days of navigati n	219	223	225	365	365	365

The value of freight carried on those lakes exceeds in one season three hundred and forty-two millions of dollars ($342,522,000).

The lowest rate charged by railways is 5.04 mills per ton per mile, charged by one of the great coal lines. The average cost, according to the United States interstate commission, is 9.22 mills per ton per mile. The average cost to the shipper by lake steamer is 1.03 mills per ton per mile. In one year's business which passes through the St. Mary's Falls canal the saving to the shippers, as against railway rates, equals $64,000,000. It is only as these figures are known that the immense importance of deep waterways is realized.

From the head of navigation in Lake Superior to the sea there are about 70 miles of canals required to make the connecting links in this magnificent waterway furnished by nature. These have been constructed by Canada at her own expense, but the increased traffic and size of the vessels employed make them inadequate for the present day. The following table gives the length, size and cost of the Canadian canals:

Canals.	Depth in Feet.	Length in Miles.	Cost.
Sault Ste. Marie	22	¾	$ 2,243,890
Welland	14	27	23,762,294
Galops — Williamsburg canals	9	7⅝	2,940,551
Rapid Plat — Williamsburg canals	9	4	
Farrau's Point — Williamsburg canals	9	¾	
Cornwall	9	11½	4,649,574
Soulanges — duplicate	14	14	4,750,000
Beauharnois — duplicate	9	11¼	1,611,690
Lachine	14	8½	9,686,684
St. Lawrence river improvements	......	......	943,178
Total		85⅜	$50,587,856

The above figures include the estimated cost of the Soulanges canal, not yet finished, which is a duplicate or alternative route to the Beauharnois canal on the opposite side of the river. Here we have an expenditure by Canada of $50,587,856, with not over three millions of her people directly interested, while the United States, having seventy-six millions of her people living in the states bordering on the lakes, has spent only $7,931,900 on the improvement of the waterways which are used on the same terms by the vessels of both nations. Whether we consider the question from the point of population benefited or the products to be transported, we find the United States interest largely preponderate. By population the United States has 89⅔ and Canada 10⅓ per cent. of those directly interested in canal deepening.

The percentage of crops does not vary very much from this proportion, whether we take wheat, the chief staple, as the standard or include other cereal crops. The following tables from the United States and Canadian official reports of 1892 show the immense importance of the traffic affected by the cost of transportation:

STATE.	Corn.	Wheat.	Oats.	Value.
	Bushels.	Bushels.	Bushels.	
North Dakota.	375,000	34,998,000	12,5 0,000	$21,851,979
South Dakota	17,700,000	31,707,000	18,472,000	26,292,851
Minnesota	24,192,000	41,210,000	43,573,000	46,289,854
Wisconsin	27,347,000	8,814,000	50,572,000	30,460,536
Michigan	23,218,000	23,854,000	27,800,000	36,395,489
Illinois	165,327,000	28,370,000	75,065,000	92,313,853
Indiana	103,334,000	39,885,000	29,175,000	76,779,597
Ohio	83,853,000	38,022,000	26,364,000	70,291,659
Total	445,346,000	246,860,000	283,529,000	$400,675,818
Ontario	11,229,498	28,782,892	64,758,053	$35,148,740
Manitoba and Northwest Provinces	....	14,453,835	11,654,090	8,671,740
Total	11,229,498	43.236,727	76,412,143	$43,819,918

STATES INDIRECTLY BENEFITED.

Colorado	2,773,000	2,504,000	2,836,000	$ 3,525,526
Kansas	145,825,000	70,831,000	44,094,000	93,502,292
Nebraska	157,745,000	15,670,000	43,131,000	60,355,554
Total	305.743,00	88,005,000	90,061,000	$157,883,372

The wheat harvest for all Canada (1892) was 48,182,295 bushels.

The total crops are:

	Bushels.
Corn	762,318,498
Wheat	378,101,727
Oats	450,003,143
Total	1,591,423,368—Value, $602,000,000.

It is not claimed that these immense crops, or even the greater part of them, will find an outlet through the deepened canals, but whatever increase in price is gained by improved transportation will apply to every bushel of grain raised in the west by whatever route it reaches the East.

Mr. James J. Hill, president of the Great Northern railway, is on record as having made the following statement:

> The government engineers propose to give us 20 feet of water. We shall accept the 20 feet and use it when we get it, but I promise you whenever they will guarantee me 18 feet I will build a line of boats that will carry 6,000 tons instead of 3,000, which is now the limit, and cut the present cost of lake transporation square in two.

There is another material advantage to be secured by the enlarging of our canals of special interest to the Americans. They own a magnificent fleet of over 300 large steames, which are land-locked and idle during half the year, having no employment during the winter months. Enlarged canals will enable the large lake vessels to reach the sea, where the ports of the world are open to them, so that their crews may earn wages and the vessels engage in profitable trade during the season when lake traffic is closed. Among such vessels I might mention the

Owego	350 feet long.		
Harvey P. Brown	359 "		
Selwyn Eddy	Carrying	4,364	tons.
Maritana	"	4,771	"
North Wind	"	3,000	"
E. C. Pope	"	3,830	"

Various estimates have been made of the cost of deepening the canals. They vary from fifty to seventy-five millions of dollars. The expenditure even of the larger sum would not be an unreasonable price to pay for the benefits to be derived from it. Mr. E. L. Corthell, the celebrated engineer, made an exhaustive report on this undertaking about two years ago as follows:

To increase the present canals and rivers to 14 feet (part of this has since been done)	$12,750,000
To enlarge Welland canal 14 to 20 feet, including greatly enlarging the locks, etc	25,000,000
To deepen St. Lawrence canals and river 14 to 20 feet	27,000,000
Total	$64,750,000

The same engineer estimates the cost of enlarging the Erie canal at $250,000,000.

Whatever the cost may be, the important point is where will the money come from. If the financial aspect were viewed simply as a business transaction free from feelings of national sentiment it would not present any serious difficulties.

Few will contradict the statement that a twenty foot waterway to the head of the great lakes would prove of such undoubted advantage to so large a section of the United States and Canada that its cost, distributed according to the territory and interests benefically affected, would be a comparatively small matter. Such a waterway would vitally affect the interests of the states that are tributary to Superior, Chicago, Milwaukee, Detroit, Ashtabula, Cleveland and a hundred other lake ports as well as the Canadian northwest.

If the city of Manchester, single-handed, can afford to spend $75,000,000 on a canal, surely it would not be a stupendous undertaking for a dozen large cities, at the head of which is the great city of Chicago, to divide between them and the territory behind them the cost of this undertaking. While the only practical route is within Canadian territory, the business of that country is not sufficient to justify her undertaking the work alone. We might take a hint from our municipal methods on the question of finance: When a street requires paving, the cost is assessed against the property on each side of the street, and every owner pays in proportion to his frontage. It would seem reasonable to apply this principle to canal deepening, which is neither more nor less than improving the road in front of the respective properties interested.

Canada has already spent more than her proportion, and recently there have been indications of a growing disposition on both sides of the line that the deepening of the canals should be a joint and international affair. The St. Lawrence river, the greater part of it wholly within Canadian territory, and the great lakes are free, without restriction, and it would seem to be a simple matter to declare the 70 miles or so of artificial waterways as part of the great water highways and governed by the same navigation laws. Such seems to be the opinion of many prominent men in the United States and Canada.

Similar views were expressed in the Canadian house of commons on 30th of April last, when Mr. J. Martin, member for Winnipeg, said:

> I may draw the attention of the house to this fact, that not only are we in Manitoba and the territories vitally interested in a question of this kind, but the people of the northern states are vitally interested in this question (20-ft. canals), and it appears to me that in view of the immense expenditure that will be necessary, our government should endeavor to obtain cooperation and a joint expenditure with our friends to the south.

On 19th July last, the Manitoba Farmers' Institute at Brandon passed the following resolution:

> That inasmuch as the works now in progress on the Upper Lakes are calculated to furnish within the next two years a channel of 20 feet in depth, from the head of the lakes to Buffalo, it is most essential, in the interests of the northwest as well as the country at large, that the depth of the Welland and St. Lawrence canals should be further increased so as to make a channel of a uniform depth of 20 feet to the ocean.
>
> That inasmuch as the entire route is essentially an international one, and as the canals forming part thereof on either side of the line are by international treaty dedicated to the use of the citizens of both countries on equal terms, the work and the expense of further deepening the Welland and St. Lawrence systems ought to be undertaken and borne by both governments, so that the two countries shall contribute to the entire cost of the undertaking in proportion to their respective interests therein.
>
> That the whole water route, from the head of the lakes to the sea, should be put under control of a permanent joint commission to be appointed by both countries, and its protection should be guaranteed by international treaty.
>
> This institute rejoices to learn that the council of the city of Toronto are taking steps to hold an international conference at an early date, with a view to the advocacy of such a scheme.

The celebrated engineer, L. E. Cooley, in an article on enlarged waterways, referring to a paper by Mr. Corthell, says:

> The project is international. I can agree with Mr. Corthell that the problem can not be hemmed in by artificial boundary lines. Nature did not fashion the continent with a view to such limits, and the solution of the problem is a contribution to nature and an addition to the resources of the continent. Among a kindred people drawing prosperity from the same commercial resources, statesmanship should be broad enough to make the most logical interpretation of the physical and commercial conditions.

Mr. Bates, with a wide experience, is quoted by the well-known engineer, E. L. Corthell, as saying:

> Such a waterway would be a blessing to both countries, and the direct and indirect advantages which would accrue to the citizens of each, invite the cordial co operation of the respective governments. It should form a bond of union between the two greatest nations, and is a step towards that time when all nations shall be at peace.

The river Danube furnishes transportation from the wheat fields of our European competitors flowing through Austro-Hungary, Servia, Bulgaria and Roumania. In 1892 their wheat crop was:

	Bushels.
Austria-Hungary	185,347,206
Bulgaria	40,758,105
Roumania	59,828,160
Servia	4,000,000
Total	289,933,471

Here is a crop of wheat equal to that of seven states and Canadian provinces combined in active competition with us. The Danube, through which these crops reach the British market, was, in 1856, declared free to all nations and is managed by two commissions, one representing the European powers and the other the states on the banks of the river. It would seem that the position of the states and Canada is somewhat similar to the Danube principalities and similar methods might be adopted. The farmers of the west require passage for their products to the east free from obstacles or restrictions. No tolls are now charged on the Erie and St. Mary's Falls canals and every foot of navigation from the head of Lake Superior to the sea should be free.

It is not creditable to our boasted civilization and resources that no joint effort has been attempted to make the 70 miles of canals available for the largest vessels in use on the lakes. The completion of this work would give an impetus to the business of both countries and it is necessary to enable the farmers of the west to compete with the cheap labor of the east and the fertile lands of Australia and Argentina. There will doubtless be public men on both sides of the line who, under a mistaken idea of patriotism, will find objections to any plan of joint control or construction, but I venture to say such opposition will not be found among the tillers of the soil whose prosperity depends on cheap transportation. True patriots will sink all sentimental differences and boldly advocate what is for the common good.

Sometimes reference is made to the military side of the question. Should such an unfortunate contingency arise as hostilities it would make no difference whether the canals were on American or Canadian soil. The strongest would take possession of them, therefore, that point need not be discussed further than to suggest that if owned jointly neither country would wantonly injure them.

The millions of western farmers are surely entitled to as much consideration as a few Gloucester and Massachusetts fisherman for whose benefit the United States government paid $5,000,000 to secure them fishing privileges in Canadian waters, or the citizens of the Pacific slope for whose benefit it is reported the United States will contribute $85,000,000 towards the construction of the Nicaragua canal. The interest of the United States is so much greater than Canada's, the volume of her products so much larger, that it is unreasonable to expect Canada to provide all the funds for what is a mutual benefit, and she is not likely to do it.

Both governments should be urged to appoint commissioners to formulate some plan for providing funds in proportion to their respective interests to deepen the canals to 20 feet and to arrange for their future management and control. It might be considered desirable for Canada to complete the canals and sell or lease the free use of them to American vessels, or debentures for the purpose might be issued and payment assumed by each country according to their respective interests; or a plan similar to that by which the Canadian government relieved themselves of building the C. P. R., after having spent $37,000,000 on it. The work already done was transferred to a private company, a subsidy of $25,000,000 and a grant of 15,000,000 acres of land were added, and subsequently the government guaranteed 3½ per cent. on an issue of $15,000,000 worth of bonds. With this assistance the C. P. R., costing $200,000,000 was successfully built, and has been a financial success and a great benefit to this country as well as to the states.

A private company, with a capital of $150,000,000, might take over the existing canals; the money already spent might be considered a bonus, to be supplemented by a similar bonus from the United States, and the work of completing the 20-foot channel to the sea could be carried out as the C. P. R. has been built, under such restrictions and conditions as the two governments might agree upon.

Mr. Corthell in his report previously referred to, says:

Direct trade with Europe should be the demand of the northwest and of the people tributary to it. The direct pecuniary advantages to the people should not be estimated at less than $200,000,000 per annum.

It costs more to raise wheat in the western states than in other countries: in addition to this the western farmer pays 200 and 300 per cent. more freight than his competitors to market his crop. Wheat costs in Dakota 35 cents per bushel to raise; in California, 22 cents; in India and the Argentina, 13 cents.

The freight to Liverpool is:

From Dakota	28	cents per bushel.
" San Francisco	18	"
" Duluth or Superior	15	"
" India	11	"
" Argentina	10	"
" Danube	8	"

At the present prices the western farmer barely gets cost, while his rivals receive a fair profit. He can not reduce the cost of production, but improved waterways will reduce the cost of marketing probably 50 per cent. from Duluth. Some expect even a greater reduction, and that is the object of this convention to secure.

In conclusion, it might be interesting to give the quantities of wheat produced by the chief countries in active competition with the western farmer which ship direct to Liverpool:

	Bushels wheat.
Danube principalities, as above	289,933,471
Russia	241,578,934
British India (1893)	268,000,000
Argentina	29,394,666
Australia	37,096,221

Siberia is building a transcontinental railway, which will throw her surplus of 30,000,000 bushels on the market; the opening of the Nicaragua canal will bring the California crops into sharp competition with us, so that no time is to be lost in providing the western farmers with improved transportation to enable them to meet on equal terms the water-borne harvests of the world.

There was some discussion on Alderman Thompson's paper by R. C. Steele, R. R. Dobell and Frank A. Flower.

THE WASHINGTON TREATY.

O. A. Howland, M. P. P.: I was requested last night by the committee on the order of business to fill the gap in reference to the question which has been raised as to the terms of the Washington treaty, and how it refers to this matter.

To go a little further back than t e treaty of Washington, the Gulf of St. Lawrence was made free to the commerce of both nations by the treaty of 1783. When we come to the time of the Washington treaty, another step was made in the direction of civilization. The Dominion of Canada, without equivalent or return, as we consider it, consented to make it an element in the treaty that the navigation of the St. Lawrence in the first place, and the use of the canals in the second place, should be open on equal terms to the subjects of both countries. The exact clauses on these subjects are very brief, and it is perhaps as well we should have them in mind.

ARTICLE 26. The navigation of the river St. Lawrence, ascending and descending from the 45th parallel of north latitude where it ceases to form the boundary between the two countries, from, to and into the sea, shall forever remain free and open for the purposes of commerce to the citizens of the United States, subject to any laws and regulations of Great Britain or of the Dominion of Canada not inconsistent with such privilege of free navigation.

Then the clause as to the canals is in part a mutual clause, and reads as follows:

CLAUSE 27. The government of Her Britanic Majesty engages to urge upon the government of the Dominion of Canada to secure to the use of the citizens of the United States the use of the Welland, St. Lawrence and other canals in the dominion *on terms of equality with the inhabitants of the Dominion.*

The return for that was:

And the government of the United States engages that the subjects of Her Britannic Majesty shall enjoy the use of the St. Clair Flats Canal on terms of equality with the inhabitants of the United States, and further engages to urge upon the states' governments to secure to the subjects of Her Britannic Majesty the use of the several state canals connected with the navigation of the lakes or rivers traversed by or contiguous to the boundary line between the possession of the high contracting parties on terms of equality with the inhabitants of the United States.

As to the historical facts arising out of that treaty, we know that the United States has performed that part of the contract which was within its own power. I say nothing as to performance by the states. The United States government has always granted the use of the St. Clair Flats canal (the title to which, it has been discovered lately, lies really within Canadian territory, although it was supposed to have been within the jurisdiction of the United States). Every portion of the route within United States control from Sault Ste. Marie has been freely granted to Canadian vessels on the same terms as to the vessels of the United States, until a certain period of recent history when the treaty was practically abrogated. The cause of the abrogation was a dispute between the two countries on the application of those words: "On terms of equality with the inhabitants of the other country." The Canadian government did not understand that the terms in this treaty were intended to interfere with any regulations it might make to encourage the complete use of its whole system of canals. The St. Lawrence canals were unfortunately not enlarged *pari passu* with the Welland canal. The consequence was that a class of vessels began to be used for navigation through the Welland canal which could not be sent down the St. Lawrence, and they went only as far as Ogdensburg, and the trade was being, by virtue of the impossibility of going through the St. Lawrence canals, taken away from the ports, for the sake of which the Canadian government had expended so much money to complete the canals. A regulation was applied for by the vessel owners of the smaller class that vessels which descended the St. Lawrence canals might be recouped to some extent by a rebate of the tolls paid on the Welland canal. The government considered that application and granted it in terms which applied not to the vessels of any one nation, but equally to all vessels which should follow that route to the sea, to Montreal, instead of using only part of the system of canals. We are not going to debate in this convention the legal question whether that was a correct interpretation, whether it was just and equitable or not. It is sufficient for the purpose I am going to urge that a difference arose between these two governments, that radically different opinions were held by the people of the two countries, that a good deal of feeling was excited over it, and that the dispute was settled by a kind of violence. The United S ates insisted that there was a breach of the treaty. Finding their arguments did not prevail, they made a corresponding breach in the treaty, namely, by regulations in regard to the Sault Ste. Marie canal imposing a discriminating toll on Canadian vessels. From their point of view that was an admitted breach of the treaty. In the case of the regulations made for the use of the Welland and St. Lawrence canals, there was no question of nationality, it was a question of route. The American vessel was as free to take advantage of those terms as the Canadian vessel. Therefore there was, at all events, I think it will be admitted, an arguable question as to the right of the Canadian government to do this. But the United States government met it by what was admittedly a breach of the terms of the treaty. The trade of Canadian vessels in the northern lakes was so large and important that the Canadian government was compelled to yield the point in order that Canadian vessels might have the use of the Sault Ste. Marie canal. Now we know that the Canadian government has under completion at Sault Ste. Marie a canal of its own, which will make the Canadian line of navigation complete; so that should that question in any way arise again, the Canadian government's position can not be met in the same peremptory manner as it was at that time. Thus we see that under any international treaty questions may arise from time to time, and that at the present time there is no means of settling these questions by some mutual authority which commands the confidence of both countries.

There is a moral for us in this history of the Washington treaty. That treaty was supposed to be a liberal one. It was to have a beneficial effect upon the relations of the two countries. As a matter of fact it became the cause of difficulties which almost rose to a dangerous point.

This convention will want to recommend means that will make sure that no such results will follow from the measures it is going to recommend. (Applause.) We know that in every great agreement where there are two contracting parties, looking forward to the interpretation of that agreement in the future, it is usual to provide for possible difficulties being settled by some system agreed upon. A very common clause is an arbitration clause; it is very often used in regard to private matters. Arbitration has been used very largely in international matters. But there are very great objections to a provision of that kind, supposing it were practicable to insert one in an international arrangement. Arbitration always involves a great many preliminary difficulties and obstacles. A dispute arises and has to be carried to a certain length before there is cause for arbitration. Then there comes the appointment of arbitrators, which in international matters often causes very unpleasant discussions. We remember under the fisheries clause of the treaty how much feeling was caused on the question of the appointment of the arbitrators. That kind of thing should not be possible. There are two wings to the movement we have in hand; one is the commercial and financial, the other the political. It is easy for us to advance on one wing to convince the people of this continent that it would be a great economical advantage to them to have these waterways enlarged on a grand and perfect scale. But that would be useless, unless we accompanied it with work on the political line, work that will make it certain that we will not be met with complications arising out of international feeling and international suspicion. In my opinion we should recommend, contemporaneously with what we recommend in an economical sense, the consideration of the question of the formation between these two nations of a common high court for the settlement of all kinds of difficulties of an international character between them which may arise from any cause whatever. (Applause.) I consider that a mere arbitration clause in an agreement relating to this particular matter would not effect the object in view. It is to be remembered that all agreements are set aside in the event of the breach of the great agreement of peace between different countries. I agree with one of your speakers that the question of war seems to us a notion perfectly abhorrent and verging on the impossible. We may think so in our hearts, and our wish may be father to the thought. Remember that the governments of countries are bound to look forward to contingencies, which they must regard without being influenced by hopes or philanthropies. We must expect that the liberal attitude which ought to be brought to this whole question by both countries can not be brought to it unless the possibility of war is shown to be removed by institutions so adapted to secure that result that every reasonable man will say that war between the countries is as impossible a contingency as war between the various provinces of the dominion, or between the states of the American Union. (Hear, hear.) Therefore it impresses me—and I hope this convention will agree with me—that there is a necessity of urging simultaneously upon the different governments the consideration of the formation of an international court of a permanent character with an ascertained jurisdiction, with powers to execute its findings, so that it may appear that every possible question that may arise in the future has been provided for, and a way out has been made, by means that commend themselves to the sense of justice and equity of the whole people. Unless we do that we shall not be making the progress we ought towards the end we wish to attain.

THE STATE CANALS.

R. R. Dobell: I wish to state a fact which Mr. Howland has omitted in his valuable remarks on the treaty of 1871. He stated that the most liberal construction was expected to be given to that treaty. The treaty provided that we should give the use of our rivers and canals to the Americans on the same terms as we were to enjoy. Under that treaty American vessels leave New York and come via the Richelieu river and Carillon canal to Ottawa where they load lumber back to New York. You would naturally think our boats would be entitled to the same privilege; but such is not the case. I brought this matter before the foreign relations committee at Washington, and they contradicted me and said what I stated was impossible. I challenged them to disprove my statement. Mr. Blaine sent for the treaty and read it. He found I was correct. A small canal about 15 miles long in New York would not allow Canadian boats to go through. I asked the committee if they were using their best endeavors to obtain from the sovereign state of New York a reciprocal privilege for us in regard to that canal. If they had used their best endeavor to effect this purpose I don't think there would have been any difficulty.

Mr. A. McFee: Mr. Howland referred to a rebate on business going to Montreal. It was a condition that this rebate applied merely on cargoes that were transhipped in Canadian waters. For instance, a shipment from Chicago to Montreal would receive the rebate, but not if it were transshipped at Ogdensburg.

Mr. Howland: The main point I was endeavoring to make was that a difference arose on the construction of the treaty and it was found there was no means of removing that difficulty and we should contemplate better arrangements for the future.

John Brown: I would like to say that this matter of the so-called discrimination of charges would be entirely wiped out if the purpose for which this body has met should eventuate. I hope we will take such action at this convention that a misunderstanding in the course of trade and traffic will never again be possible by either government. We will have 20 feet of water and no transshipment.

Mr. Winton of Beeton: We were seriously handicapped by the operation of the imperial navigation laws, which allowed free entry into British ports of foreign shipping under charters from other British ports. No such privilege was granted our freight carriers in United States ports. While an American vessel may take cargo at Montreal or Halifax and discharge at Liverpool, or any other British port, we were not allowed to take cargo from New York or Boston to San Francisco, even around Cape Horn.

CANAL CONSTRUCTION.

L. E. Cooley, C. E.: I am somewhat embarrassed in being called on to give a paper on Canal Construction. This paper has not been prepared. I am obliged in a measure to speak my thoughts as they have been suggested to me during the last day or two. In inviting me to read a paper, your chairman referred particularly to the question of the various routes and of the cost of a deep waterway to the ocean. We have two governments, each with an engineering corps for the purpose of preparing estimates of this kind, and it is their work to prepare estimates of the work in question when we convince them of the necessity of its construction. I have been engaged for some time looking into this problem of a deep waterway to the sea. I gave it much consideration in 1888 and 1891. I have been engaged for some time gathering the various maps and profiles in regard to all the routes between Chicago and the seaboard. I haven't mastered them all yet, and I think it will be a matter of six months before all that material can be digested, so that any opinion which I may state to-day will be in the nature of a lawyer's curbstone opinion, subject to revision.

In the past ten years great progress has been made in the construction of ship canals. We have the Manchester ship canal, the North sea canal and one at Chicago that is bigger than any of them. The result of this experience was to throw an entirely new light upon the whole question of canal building, and it will convince the public in regard to the cheapness of the proposed work and its possibilties. I have in my pocket an index of the facts I wish to present. I prepared it principally because of a remark I once heard made in Chicago in regard to a man who was recognized as extremely able. "Yes," said the commentator, "that is so; but he hasn't got his brains indexed."

Taking this continent as a whole, looking at it geographically and from the engineer's standpoint, it is simply one design, one theory, from the Isthmus of Panama to the North Pole. There is but one problem in it, and it has no relation whatever to international boundary lines. If you look at the topography of the country you will discover throughout the continent a trough running from the Gulf of St. Lawrence to the Gulf of Mexico, a distance of 3,800 miles, and in that trough, and on the two slopes that extend from the Allegheny and the Rocky mountains down to the bottom of the trough, and from the North Pole to the Gulf of Mexico, is to be found 80 per cent. of all the material resources of the continent. (Applause.) From the Chicago standpoint the central idea is that there is only one waterway possible on the continent as a whole, and that is a waterway from the Atlantic by way of the great lakes to the Gulf of Mexico. We at Chicago are on the summit of that trough, and we are able impartially to look down both ways, 1,800 miles to the Gulf of St. Lawrence and 1,600 to the Gulf of Mexico. Within the environs of Chicago a raindrop could split on a blade of grass and part run each way. The divide between the great lakes and Mississippi system is only 8 or 10 feet above the level of Lake Michigan, and Chicago is to-day cutting a channel through it. The bottom of it is on the exact level of the Niagara river at Buffalo, 900 miles away, so you can see by what a narrow margin the geological formation of the continent favored the St. Lawrence route rather than that by the Gulf of Mexico. The idea which I wish to impress on you is the idea of a trunk waterway, establishing a circuit through the heart of the continent. Chicago is cutting the summit of the divide in order to establish this circuit. We are building a channel 26 feet deep. Chicago is spending $25,000,000 on the work, and in the next twenty years she will spend as much more on this enterprise. She is moving more material than was moved in the building of the Manchester canal. If we had to build the Suez canal we could do it at half the cost we are paying on this work. We could complete the German canal for much less money than it is costing them. Our excavations at Chicago are being done for less than two-thirds of what they were able to do similar work in Great Britain. These facts have an important bearl ing on the matter we are discussing. The rock work on the Chicago cana- is being done for less than one-half of the contract price. The actual cost to the contractor is not over one-third of what it was estimated it would cost by our government engineers. That is an illustration of how cheaply canal construction can be carried on with the most approved machinery for doing the work.

Capt. Dunham and I attended the Detroit convention, three years ago, but we were unable to urge any plan for its consideration. Chicago then had only 16 feet, while it has a commerce of 11,000,000 tons, which is equal to the commerce of Liverpool. It is one-seventh of the total entrances and clearances of all the ports of the great lakes, and yet the harbor is in a miserable little creek. Now that we are building this channel, a very little expenditure will give us the best harbor in the lakes. So that our attitude has changed since the convention in Detroit, three years ago. We don't want anything less than 26 feet deep to the sea. I want to say right here, that in my opinion, when we make an effort to get to the sea, we can get a stronger sentiment in the west and in the Mississippi valley for 26 feet than we can for 20 feet, and we can get it quicker. There is not a city west of the meridian of Detroit that will not use every endeavor and every argument and every resource to urge a plan that will give them access to the sea without being tributary to anybody on the route. They would prefer to have the time postponed a little longer, if necessary, rather than have something done which might for a time, and possibly for a generation, postpone the consummation of that idea. I think it would be well to give you some little idea of what ship canals mean, and I would not be a loyal Chicagoan unless I pointed to this diagram and showed you that we are out-doing by a little anything that anybody else has done. Our canal has the same depth as that of the Manchester and Suez. It is 40 feet wider in the rock cutting than at Manchester. When that channel at Chicago is completed we will have brought the Mississippi navigation and that of the lakes within 60 miles of each other. They are now 320 miles apart. We will turn enough water from the lake to raise the Mississippi 1 foot at St. Louis, and add 225 miles of navigable water to the Illinois river. We have put ourselves in a position to have 14 feet of water to the Gulf of Mexico and 26 to the Atlantic. The channel will make tributary to us the Mississippi valley, the future bread basket of this continent. We will be able to use that route nine months in the year, or two months longer than the Canadian route. We don't expect to do a large foreign trade in that direction. We do, however, expect to extend our commerce in the south, a region where we have not yet a stronghold. We expect to reach the Carribean, Mexican and South American coasts, very few harbors in which have more than 14 feet of water. This route is in no sense a rival to the lake route to the ocean; it is supplementary thereto.

I wish to point out another thing to you. We are building a channel right past Chicago, starting at Chicago and sending lake commerce right through, and doing it with our own money. We had a great many people in our town who thought that was extremely unwise, thinking the city of Chicago would be transferred to the other end of this channel. We had people in Chicago who, when William Ogden started the Galena road, the first railway that went west of Chicago, opposed the enterprise because they thought Chicago would be transferred to the end of that road. The state of New York, when it chartered the Lake Shore road out of Buffalo, would not permit it to connect with the New York Central because it threatened to destroy the teaming and transfer business of the city of Buffalo.

I don't think, and no one in Chicago thinks, that the prosperity of that city is based on the idea of levying tolls on traffic. Our supremacy will be maintained by reason of what facilities we can afford for collecting and distributing the products of the country. I don't think any city can maintain prosperity on any different plan for a long time or much longer than the rest of the people can combine against it.

There are some traffic statistics that have an important bearing on the question of route. The census returns for 1890 showed that the lakes were carrying 23 per cent. of the ton mileage of the United States. If you allow that the balance of the shipping of the United States is equally well employed then it follows that more tons of freight are to-day transported by water than by rail. That is one fact. Then take the Detroit river. Twenty-six and a half million tons of freight passed through there last year. Less than 4,000,000 tons crossed the river by the railways. Take the city of Chicago. There is not a week in a summer season, there is not a year in the last five years that more freight has not gone east by water than by rail. Of the entire commerce of that port, over one-third is done by water. These are facts you want to lay close to your mind in considering this question.

Take the census of population of cities in the United States of over 10,000, over 90 per cent. of that population is located on navigable waters. That is why people gather there. If you draw a line from Sandy Hook round by the great lakes, down the Mississippi to the Gulf of Mexico and back along the seaboard you have 68 per cent. of the city population of the United States. What are cities for? To transact commerce. That's what makes them, and sometimes I think that it is extremely fortunate that Providence has placed navigable waters alongside the big towns. I don't know how they got there unless it was specially done. (Laughter.)

Another point: There is a good deal of talk about railway opposition to waterways. I don't believe it exists. I don't believe any intelligent railway manager is fighting waterways. If there is he ought to be retired. Some time ago a gentleman who was then the controlling spirit in the largest trunk line running north and south made this remark:

> If you are building a little route to cut rates we are against you, but if you are building a big route which will divert commerce in this direction, we will get our share of it and we will promote such a scheme in every way we can.

I have the same opinion from different railway men in Chicago, whose lines compete with us in the south. The railways which are paying dividends are running in competition with water in every case. Railway managers have, during the past fifteen years, been discovering the fact.

There are certain general considerations as to the question of route. In looking at the question of route I consider it as an engineer would consider the location of a railway from the seaboard to Chicago. In building such a road engineering questions are not leading questions. The object of the road is to get traffic, and I would run my first line through all the traffic points I could reach, in order to get the support of everything possible along that line. In a case of this kind I would also like to get the people's moral support. Later, when the railway had developed a large traffic, and we found there was a great movement to the seaboard, and the road was overtaxed, I would begin to build a loop-line. I would shorten the route wherever I could and relieve the congestion of traffic. The same theory ought to prevail in regard to a canal route from the upper lakes to the Atlantic, modified to some extent by the question of cost and what we could afford to pay.

In considering the question of origin we have two points, Chicago and Superior, which we recognize has a place on the map, too. These are the starting points in any waterway. The Atlantic coast, New York, Philadelphia, Baltimore, etc., receives several times the traffic from the west that goes to foreign ports. New England alone receives more than is exported. Furthermore, the movement of domestic freight is steady and constant. The foreign movement is heavy some seasons and dull others.

If you consult the history of canals and railways you will find that the line of domestic transportation determines the line of foreign shipment. You have your Welland canal. There never was a time when that was not a better route than the Erie canal; and yet there never has been a time that the Erie didn't carry five times as much as the Welland. These are facts we have to take into consideration in determining the best route. From the waterway standpoint there is another important fact which the engineer considers, and that is the question of free water. I was once told by an eminent ship builder that one of the great Cunard liners cannot make its best speed unless it is running in a thousand feet of water. I believe it is true. We all know the effect of steaming in a restricted channel. In regard to canals, it would be an extraordinary one that would allow a vessel to make five miles an hour. Then as to lockage. I think great improvements are about to be made in locks, by which the evils of lockage will be greatly diminished. You have to allow ten miles for every lock. The question of length of route is not the point in regard to a canal. It is the length of time to make the trip through it. The distance from Chicago to Toledo is 180 miles. A canal between these points would cost $750,000 per mile. We could start a lake propeller at Chicago and run her quicker round Michigan than by any canal that money can build. What is the use of talking of it?

Now let us get at the application of some of these ideas on the practical side. Take the question from the American standpoint. We are obliged to come into Lake Ontario on any theory that I can formulate. We can't escape that. Then we are divided as to the Mohawk and Champlain routes. All routes that are possible from the lakes to the American seaboard go through the Hudson valley. We are obliged to construct it in the vicinity of Albany, either by the Mohawk or Champlain route. To properly build the Mohawk route so that boats can go through it with any degree of speed and satisfaction, will, in my opinion, cost three-quarters of a million of dollars per mile. The distance is 180 miles.

The Champlain route is down hill all the way. It would afford a wider and deeper route. In the Mohawk route there might be a difficulty about the water supply; but that, I believe, can be overcome. Looking at the country as a continent, without reference to boundary lines, I am entirely clear on the point that the first deep water development should be to the Atlantic seaboard by the Lake Champlain route, with an incidental section by way of Montreal for foreign commerce. If I owned the country as a czar I would start and make twenty feet through all that line as quickly as it could be done. (Applause.) I would put all permanent structures down to twenty-six feet. I would construct the work in such a way that there would be no more difficulty in adding two feet to the depth from time to time than now exists in deepening the shallows of the lakes. That is the policy upon which I should work. At the same time, there will come up the question of shortening the route, and it will be a shorter time in the future than most of you will imagine. When that time does arrive you can spend money more profitably in deepening than in shortening. Deeper and larger boats will carry freight cheaper than smaller boats on shorter routes. Ultimately, the congestion at the locks will have to be relieved by new cut-off routes.

I wish to give you some facts in regard to the Sault Ste. Marie canal lock. Last year the actual working time of boats going through the locks was 160 days out of 230 days of navigation. There are times when boats are delayed there for a considerable length of time. For all practical purposes the limit of the old lock of 1881 is now reached. So there is a limitation in regard to what a canal will do.

As far as we represent Chicago we are not here to agitate any particular route. If anyone has a route, be it long or short, by which he is going to get deep water to the sea, we will bid him God-speed. We simply want to get there, and get there quickly. I believe that in 8 or 10 years any canal you might build to the American sea-board would develop a commerce that would practically overtax it. I am prepared to believe that 20 years will see a commerce of 50,000,000 through any route which may be built. There will be room for all the projected canals, Ottawa, Hurontario, Mohawk. They will all come in their proper order, according to the efforts and ability of the men who are pushing them.

I think I have now covered the leading points from an engineering point of view. The other side of the question, the international aspect, lends a gravity to the matter. There ought to have been no boundary in the first place. (Laughter.) The commissioners who laid it out didn't lay it out with regard to water routes, or they would have included the sweep around by Rouse's Point in the United States, the territory where this Champlain route ought to be made.

In considering this question we must, to a certain extent, ignore these boundary lines, or subvert or provide for them in some way, so that when we attack this work we virtually go at it for all commercial and practical purposes as one people. How that is to be brought about I don't know. I hope some one will be here to point that out, and that there are statesmen big enough to solve it. Just as surely as this continent is laid out on one grand plan, independent of boundary lines, just so surely will the people be bound together by commercial links that will ignore all questions of internationality.

You have Mr. Corthell's estimate of $27,000,000 for a 20-foot waterway down the St. Lawrence. I have no doubt it can be done for that sum—that is, from Lake Ontario to the sea. Then we have an estimate of $23,000,000 for the proposed canal on the American side, between the Niagara river and Lake Ontario, by way of Tonawanda. These estimates are official. In looking the matter over, I have no doubt we can build the canal proposed in a far more elaborate style than contemplated for $23,000,000. So the estimate for making a 20-foot channel from Lake Erie to the sea is $50,-000,000, that is on the supposition that the Welland would not be utilized on the new system. If the Welland were used, the locks would have to be lengthened. We have boats 130 feet longer than the Welland canal locks. It would be better to build a new canal altogether. The Welland canal has about three times as many locks as it should have. To project the work in such a way that you could obtain a 26-foot channel in the future need not add a great deal to the cost. I should say that could be provided for by adding about 10 per cent.; but I would not want to present that figure with confidence. I only judge from what I know of the Chicago enterprise. The route giving 20 feet of water from Lake Champlain to New York would cost $50,000,000. If we only had the necessary territory, we could get to the American seaboard for $100,000,000.

A Delegate: Are there any natural advantages in the proposed Tonawanda canal over the Welland?

Mr. Cooley: No, except we get a little better system of locks. There is a fall of 326 feet between the two lakes. In building the Chicago drainage canal, we were advised to use the old canal across the divide, but we found it absolutely cheaper to build an entirely new channel, rather than revise the old one, and maintain the traffic while we were doing the work. I have the lake and river charts down to the boundary line, and I find that down the St. Lawrence there is a general depth of from 30 to 50 ft. It is obstructed in places by shoals and here and there by rock and reef. My limitation in regard to the depth of the canal is 26 feet. I should not be surprised, in 3 or 4 years, to become convinced that 30 feet would be more desirable, but it must be remembered that when you get beyond 26 feet, the proportion of shallow water becomes very large, and the liability of injuring deep draught is so great that it is doubtful if it would pay to go deeper than 26 feet.

Mr. Faulkner: What would be the cost of deepening the St. Lawrence so that vessels could make the down trip?

Mr. Cooley: I do not know. I have not considered that question. I should say, up to 20 feet it could be done, There is a good deal of uncertainty in moving rock in a heavy current.

Mr. Faulkner: I understand Capt. Harbottle says for a million or so he could make a channel for a 20-foot vessel.

Mr. Cooley: I would sooner his boat would make the trip than mine.

A Delegate: What route would you have to take to keep altogether in American territory?

Mr. Cooley: The Mohawk is an altogether American route.

Mr. Battle: On the Welland canal there are twenty-five locks in a fall of 326 feet. How many of these locks could be done away with?

Mr. Cooley: The French build little locks, twenty-one feet wide, 130 feet long and ten metres or thirty-three feet high. There is no reason why the Welland should not have locks of forty feet, and I don't know but you could exceed that. The locks in the Welland are fifteen feet. When we reach Montreal with our commerce, if we have no Champlain route, we are still further from the Atlantic coast than if we remained in Chicago, because Montreal, by the sea route, is 2,000 miles from New York. The deepening of the canals to Montreal would only provide for our surplus products. But if the Champlain route were built in connection with the St. Lawrence system, Canadian vessels would save 1,000 miles going to the West Indies. The proportion of shallow water in the Hudson is not very large. There is less shallow water to dredge in the Hudson than the St. Lawrence. Taking the whole route, from Chicago to New York and Montreal—1,265 miles to Montreal and 1,440 to tide water in the Hudson—you could get a route that will not have more than 100 miles of canal, nor more than 100 miles of shallow water.

Mr. Gor'der: How far is Troy from the St. Lawrence by the Champlain route?

Mr. Cooley: From St. John to Troy dam is 200 miles.

Mr. McFee: Can you give us any idea of possible rates?

Mr. Cooley: I see no reason why you should not carry traffic from Duluth to New York for $1.00 per ton.

Mr. McFee: As against the present rate of how much?

Mr. Cooley: $4.80 by rail from Duluth.

Mr. McFee: How does the Champlain route compare in length with the Erie canal route?

Mr. Cooley: It is 200 miles longer.

Mr. McFee: Don't you think the railways will meet any competition that improved waterways may bring on?

Mr. Cooley: No; I do not. Improvements in steam navigation during the last ten years has kept ahead of the improvements in railway transportation.

Mr. McFee: Is not the return cargo a very important factor in rates in the upper lakes?

Mr. Cooley: Yes; a return cargo cheapens the rate.

Mr. Nettleton: I think I understand you to say you must get into lake Ontario?

Mr. Cooley: Yes.

Mr. Nettleton: If you could get into lake Ontario by the Georgian bay canal or by a ship railway, wouldn't that be the best route? It would save 300 miles.

Mr. Cooley: We cannot afford to side-track lake Erie, which is our most important lake from a commercial standpoint.

Mr. Cumberland: What is the depth of water between New York and Albany?

Mr. Cooley: They are asking to get fourteen; they have nine. Up to within thirty miles of Albany there is twenty feet of water.

Mr. Wheeler: What effect would the building of a twenty-foot canal have on the mean level of the lakes?

Mr. Cooley: I don't think it would amount to a practical question.

THE ECONOMY OF THE 20-FOOT CHANNEL.

Peter McIntyre, of Toronto, read the following paper:

In dealing with the subject of cheap transportation, a retrospective glance at the history of the carrying trade of the St. Lawrence river and great lakes will be instructive.

My own experience in steamboat and transportation business goes back to the year 1867, when the various provinces were welded into what is now our great Dominion. At that time the Welland canal locks admitted vessels of 144 feet length, 26 feet beam and 10 feet draught, while the St. Lawrence locks admitted vessels 180 feet long, 45 feet beam and 9 feet draught. I have never been able to see the wisdom of having this difference in size of the canals; and when, in 1874, our government commenced the work of enlarging the Welland canal to 270 feet by 45 feet and 14 feet deep, and left the St. Lawrence system unimproved, I failed to see the wisdom of commencing the improvement of a waterway at the terminus instead of at the natural starting point

It seems to me that it would be well for us to-day, in recommending any improvement of our waterways, to keep this fact fully in view, and see that the error of the past is not repeated, but that the future improvements start at tidewater and work upwards. Those of you who were in the vessel business of those early days will remember the fleet of Welland canal propellers trading from Montreal to Chicago, and the large fleet of N. T. line propellers running from Ogdensburg to the west The moment the Welland canal was enlarged these small boats found it impossible to live in competition with the larger class of vessels that were built the full size of the new canal, and one by one they disappeared, were either lengthened to 180 feet or put on other routes. To-day the Canadian fleet in the Montreal trade is reduced to about 10 or 12 steamers, the majority of which tranship their cargoes at Kingston into light draft barges, while the Ogdensburg fleet consists of large steamers like the Haskell, Prince, Governor Smith, and others, carryinging 65,000 bushels of wheat to their destination.

The rapid increase in size of the vessels on the Chicago and Buffalo route within the past five or six years is remarkable, and the fact of the S. S. Curry, a steel steamship of the most recent type, carrying 5,130 tons cargo into South Chicago on a draught of 18 feet, the other day, shows that the era of large-sized lake steamers is here to stay.

It must pay to run such large craft, or the shrewd western vesselmen would not continue building them. Another fact it is well to remember is that while there is no doubt if a 20-foot channel was in existence from the great lakes to the ocean a great many of the ocean freight steamers would find their way to our lake ports, but still the modern lake steamer must be a vessel of 20-foot draught in order to get the maximum of economy in carrying.

In order to show the economy of running the large vessel as compared with the smaller one, I have estimated the earnings and expenses of a whaleback steel steamer, full size of the present Welland locks, of the model made by Mr. W. E. Redway, marine architect of this city, who has given considerable attention to designing of such craft, and a similar steamer 350 feet long, 42 feet beam and 20 feet draught water, both of a 12-mile speed. Supposing they could carry through to Montreal without breaking bulk, taking full cargoes of wheat down at five cents, and bringing back half their capacity of freight at $1 per ton, the result is that the large vessel can earn a 20 per cent. dividend, while the smaller one, under precisely similar conditions, can earn only 14 per cent. In other words, the large steamer could carry grain from Chicago to Montreal for four cents per bushel, and make as good a dividend as the smaller vessel getting five cents. This represents a saving which runs up into the millions when it is applied to the vast grain crops of the west and to the freight moving from east to west.

Estimate of earnings and expenses of a steel steamship of the Redway model, 255 feet long, 42 feet beam and 14 feet draught water, on the route from Chicago to Montreal, via the Welland canal, 1,266 miles:

Cost of vessel	$115,000.	
Speed	12 miles per hour.	
Consumption of coal	1,800 lbs. "	
Time, Chicago to Montreal	140 hours	Total, 360 hours.
" Montreal to Chicago	160 "	
" In port	60 "	
Carrying capacity	75,000 bush. wheat, or 2,250 tons, on 14 feet.	

ESTIMATED EARNINGS.

13 trips of 75,000 bush. (975,000 bush.), at 5 cents	$48,750	
13 trips, 1,125 tons upwards, at $1	14,625	
		$63,375

ESTIMATED EXPENSES.

Wages and board 21 men, 210 days, at $35	$7,350	
Coal, 230 tons per trip, 3,000 tons, at $3	9,000	
Engine expenses, oil, etc	500	
Elevating 975,000 bush., at ¼ cent	2,437	
Shoveling 975,000 bush., at $4 per 1,000	3,900	
Shortage 975,000 bush., at $2 per 1,000	1,950	
Canal tolls on 29,350 tons	2,925	
Canal tolls on 14,625 tons up	1,462	
Customs fees, etc	500	
Outfit and repairs, at 2½ per cent	2,875	
Insurance, at 4 per cent	4,600	
Management	2,000	
General expenses	2,000	
	$41,499	
Depreciations, 5 per cent. on $115,000	5,750	
		47,249
Net profit, 14 per cent., or		$16,126

Estimate of earnings and expenses of a steel steamship of the Redway model, 350 feet long, 42 feet beam, 20 feet draught water, on the route from Chicago to Montreal, via the Welland canal, 1,266 miles:

Cost of vessel	$225,000.	
Speed	12 miles per hour.	
Consumption of coal	3,000 lbs. "	
Time, Chicago to Montreal	140 hours	Total, 360 hours.
" Montreal to Chicago	160 "	
" In port	60 "	
Carrying capacity	151,000 bush. wheat, or 4,530 tons.	

ESTIMATED EARNINGS.

13 trips of 151,000 bush. (1,963,000 bush.) at 5 cents	$98,150	
13 trips up, 2,265 tons, at $1	29,445	
		$127,595

ESTIMATED EXPENSES.

Wages and board 23 men, 210 days, at $37	$ 7,770	
Coal, 430 tons per trip (5,590 tons), at $3	17,770	
Engine expenses, oil, etc	750	
Elevating 1,963 000 bush., at ¼ cent	4,907	
Shoveling 1,963,000 bush., at $4 per 1,000	7,852	
Shortage 1,963,000 bush., at $2 per 1,000	3,926	
Canal tolls on 58,890 tons down	5,889	
Canal tolls on 29,445 tons up	2,944	
Customs fees, harbor dues, etc	750	
Outfit and repairs	5,625	
Insurance, 4 per cent. on $225,000	8,000	
Management	2,000	
General expenses	2,000	
	$70,183	
Depreciations, 5 per cent. on $225,000	11,250	
		81,433
Net profit, 20 51-100 per cent., or		$46,162

I estimate that a steamer of the large size (350 feet) could make two trips per month during a season of seven months, but I allow the time for one trip for unforseen circumstances, detention, fog, etc. I expect, of course, that all the artificial or improved channels will be made as easy to navigate as science and money can make them.

The river navigation between Montreal and Quebec is somewhat difficult, but the excellent system of buoys and beacons for day, and range lights at night at almost every bend in the river, makes navigation of this river to-day a far easier task than it was thirty years ago. With our canals with the latest improvements in locks, draw instead of swing bridges, the crooked places made straight, proper appliances for the safe handling of the large craft in the locks, I feel confident that as good time can be made navigating our canals and rivers with the steamer carrying 150,000 bushels as with the steamer carrying 50,000 bushels.

The immense strides made during the past few years in the size and speed of the Atlantic passenger steamers and the improvements in marine boilers and engines all go to show that improvements can be made on our lake craft, and although the speed of the Atlantic liner is not needed for our lake transportation, yet the economy derived from large size and improvements in machinery must be taken advantage of if we wish to keep pace with the times and hold our own in the great race.

I have taken 12 miles per hour as being the most economical speed, but I am confident that the improvements that are being made in the most modern marine engines and boilers will warrant a speed of 15 miles per hour. At this increased speed two more trips could be made during the season at the cost of coal and canal tolls, which would add to the dividends very materially.

THE ST. LAWRENCE ROUTE.

David Blain spoke as follows: Mr. Chairman and Gentlemen—The subject on which I am to address you is one that has occupied my attention for a great many years. I need hardly to deal with that portion of the river that is below the city of Montreal. The Dominion government has, at very large expense, afforded facilities for vessels drawing 27½ feet of water from tidewater to the port of Montreal. But, in ascending the river from Montreal, we find several obstructions. In the first place, from Montreal to the head of what is now called the Lachine canal, a distance of 8½ miles, we have two systems at present in existence that apply to these portions of the river as well as other portions of the river. The vessels coming down with heavy cargoes run the river from the city of Kingston to Montreal without touching the locks. As a matter of course, in ascending the river it is essential that there should be lifts to overcome the rapids that are now overcome by the locks. So I have always had in my mind the desirability of affording the vessels ample accommodation to pass from the city of Kingston to Montreal, whether they draw 7 feet, as they do now, or whether they draw 14 feet, as they will do when the contracts that are now let by the Canadian government for these portions of the navigation are completed, or whether, as may be in the future, we may be able to get 20 feet of water from the head of the lakes to tidewater. Going down they will have a running speed of not less than 15 miles an hour, and in some places more, because, as you can understand, the boat must go faster than the current of the river in order that it may have headway and so be governable by the helm. The nature of the stream forces the vessel to the deepest channel, and, except for the danger of turning the vessel and striking on the rocks, they are perfectly safe in running the rapids.

The question arising is a practical one—what will be the expense of getting 20 feet of water on this river from Kingston to Montreal, and what will be the additional expense that will give us lockage to enable us to ascend the river? I have here charts of only a portion of this river. The distance from Montreal to Kingston is 175 miles. From Kingston to the head of the Galops rapids probably an expenditure of a few thousand dollars might be wanted to improve the channel. But there is now 30 feet of water and practically not the slightest difficulty in passing down this distance, being 110 of the 175 miles from Kingston to Montreal. From the head of Galops rapids down to Cornwall but little expenditure will be needed in order to secure 14 feet of water. There are three small canals known as the Williamsburg canals between the Cornwall canal and the head of the rapids. These, like the other canals, are under contract to be deepened, and the whole work will be finished as the minister of public works expects, inside of three years. When that is done we shall have 14 feet of water from the head of the lakes to tidewater. From the point I have indicated to Cornwall the expenditure would not be very great. When we come down the river a little, to the first point shown on these charts, we find that considerable expense will be required to afford the necessary facilities for navigation. But when you go still further down and reach that portion of the river whose difficulties are overcome by the Beauharnois canal, and will be better overcome by the construction of the Soulanges canal at the north side of the river, very considerable outlay will be necessary. But here again the outlay for 14 feet of water will be comparatively little. But in the entire stretch of water from Kingston to the head of the Lachine rapids the portions I have referred to are the only portions where there are serious obstructions to a 14-foot channel. But you can very well understand that, as Mr. Cooley said this morning, the deeper you go down into the river the more obstruction you will find, and in going from the head of the Galops rapids to the head of the Lachine canal it might be quite safe to say that in a great many places there would be a few of the hard heads in the bottom of the river that would have to be blown off, but in some other places there would have to be a good deal of work done. I think probably I might safely say that 17 feet of water could easily be had all the way down to the head of the Lachine rapids, and there would be no insuperable difficulty in getting 20 feet of water from Kingston to Montreal. It will be a matter of expense, of course, but it will not involve anything like what the people have calculated on in the past. I was very glad to find from the instructive discourse that we had from Mr. Cooley to-day that he gave such an estimate as he did of this work. Let me say, that in parliament they have estimated the whole work from the city of Montreal to the west end of the Welland canal to cost something like $120,000,000.

Mr. Cooley to-day gives you the idea that the work can be done for $50,000,000, and I am glad to be able to say, after carefully examing the subject, that so far as the $27,000,000 estimated by Mr. Corthell for the St. Lawrence river is concerned, I very strongly believe that that would be ample. I had the impression that the authorities in the United States had calculated the expense of the canal on the other side of the Niagara river at a much higher figure than Mr. Cooley's—that they had put it at $39,000,000.

Mr. Cooley: Not in recent years.

Mr. Blain: I was not quite sure of it, and I have no doubt Mr. Cooley's figures are correct. So that this would give us facilities for vessels drawing 20 feet from Lake Erie—and that means from the head of navigation, for the works are virtually completed—to tidewater at a very moderate figure indeed.

I noticed that while Mr. Cooley was speaking, a great many gentlemen in the convention were anxious to see what the effect of these works would be. I do not profess to deal with that question fully, but I may say that the people of the eastern states require 300,000,000 bushels of grain to sustain their population. I made inquiries of the largest shipper in Toronto what he would carry grain for from Port Arthur to Montreal, and his answer was, six cents a bushel. What could we carry it for with a 20-foot system of navigation? Three cents. The calculation is easily made. On the grain required for the eastern states alone, you have a saving of $6,000,000, or a saving of 12 per cent. upon the entire outlay Mr. Cooley has spoken of.

And, gentlemen, that was but one item. As the gentleman representing the United States last night said, I have been considered a crank on this subject. I am not at all displeased at that, for the crank is a very important part of the machine. I did intend to draw your attention to the river below the Lachine rapids, but my friend, Mr. Conmee, who will second my resolution, has examined that portion and is prepared with a plan showing 20 feet of water and only one lift between the foot of Lake St. Louis and the city of Montreal, and when he comes to second my resolution, or move one himself, he will give an explanation of how that can be done. Reaching the head of the Lachine canal, we have a long stretch through Lake St. Louis, the depth of which will be 50 or 60 feet. There will probably be a little spot at the second lighthouse where some small dredging would be required, but that is a mere trifle. We ascend until we come to the entrance to the Beauharnois canal. That is about 11½ miles in length and has nine locks The intention is to build a new canal and contracts are let for a canal 13 miles in length to overcome both the shallow water and the rapids on the river. The canal, it is expected, will be finished in about three years. Above this we reach Lake St. Francis. The accommodations for shipping on that lake are so great that although the United States authorities have made the most minute inquiry as to the whole bed of the river—and these are the charts from the United States department amended last year, the most approved charts of this river that we have—they found that it would be simply a waste of time to record the soundings of that lake and, therefore, the lake is passed over without a single depth being given. What may be the depth of the lake I can not tell, but I know that the record shows that in some places it is 120 feet deep. The point where the 45th degree of north latitude intersects the river is the point where the boundary line between the United States and Canada, running westward, traverses the middle of the river. Please remember that, because my resolution is intended to deal with thir great scheme in two divisions, so that Canada may take the lower part and manage it, and the United States take the upper part and manage it. This is in order to get rid of the political influences on both sides of the line. Going beyond the point I last referred to, we come to the Cornwall canal. I assure you, as to the rest, there will be no difficulty in getting 20 feet of water down through the river itself, and if we have sufficient capital invested in the lake trade we shall have no difficulty in overcoming the rapids. For the few miles above Cornwall to the head of the Galops rapids, I am not able to give you a clear explanation. There is but one chart in the city that gives the information and that was old Captain Bayfield's chart of 60 or 70 years ago, when the facilities for making the survey were not equal to what they are at present. But I do not hesitate to say, and I should be sorry to say it, if I was not sure of my facts, there can not be the slightest difficulty it getting 20 feet of water from the head of the Galops down to the point I have spoken of.

When we come to the head of the Galops, ascending the river, we can have 30 feet of water if we want it; and, indeed, I do not think there would be any difficulty in getting 40 feet. But there is no use in talking of that at present, seeing sea-going vessels require only 27½ feet. But we ought to have the waterways deeper than the draught of the boats. I want to point out clearly that it is absolutely necessary that we should go down this river from Kingston with our lake boats without the necessity of using the locks.

I have gone through the Suez canal, and I suppose it is the best built canal in the world, or it might have been. It is simply a straight cut through a sand bank. Yet I find that, notwithstanding the fact that that country is so well suited to canal building, it is not possible for vessels to go faster than from three to four miles an hour. If it is possible for us to run down the rapids at twenty miles an hour, it is most important that we should not be confined to a rate of four miles. I have gone over the ground, every foot of it, several times. There is no serious difficulty except above the city of Montreal at the Lachine rapids. There the boat takes a plunge and, as a matter of course, when the centre of gravity is transferred to the front part of the boat, she goes down and strikes heavily upon the water, giving a considerable shock. But in no case is there half the shock that I have experienced on board an Atlantic vessel when the vessel has leaped, as it were, from one wave to another. We can overcome that pitch without any difficulty, as I dare say Mr. Cooley, as a practical engineer, knows. We might improve the river at that point a little. The very nature of the river forces the boat down through the deepest water. I have it upon the very best authority, upon the authority of those who have actually navigated this river, that with suitable facilities, easily afforded, there is not the slighest difficulty in passing a loaded vessel drawing twenty feet of water, and having not less than 5,000 tons displacement, from Kingston to Montreal.

While I am on my feet perhaps you will permit me to say—as it is information that ought to be at the disposal of the convention, though I am not going to deal with it at length—that we have also surveys of that portion of the route which is known as the Georgian bay connection with the city of Toronto. I may give a few facts in relation to that in order that you may consider the question. In the first place, we have a survey from Governor's island, New York, and according to my recollection, lake Ontario is 247 feet above tidewater. When we come up through lake Ontario we find that the elevation of lake Simcoe above lake Ontario is 473 feet. The elevation of lake Simcoe above Georgian bay is 130 feet. If that is so, you will see that the altitude of Georgian bay above lake Ontario is 343 feet. These elevations must be considered in any plan for a canal that is made. The cut through the ridges for a twenty-foot canal, if fed by the waters of lake Simcoe, would be 220 feet deep. The proposition, if I understand rightly, is that this canal is to come directly from Georgian bay and to be fed from Georgian bay. In that case, the cut at the apex of the ridges will be 350 feet deep. And a cut will average so much that I will be almost afraid to mention it, seeing that we have not had instrumental survey. But I need hardly say that this would be an enormously expensive canal. It is proposed, I understand, to use the hydraulic principle in scooping out the mountain. But I do not see how we could use the waters of lake Ontario to scoop out a mountain 350 feet above it. In California where they have an immense fall they can bring down the water in their pipes and turn the nozzle on the brow of the hill and scoop it out without difficulty. But that principle cannot be applied here.

It has been proposed that other means than deep waterways may be used. One is the ship railway, already incorporated, instead of the canal. Another—which is proposed by my friend, Mr. Ketchum of the Chignecto marine railway, which it is expected will be finished before a very long time, and which when finished will carry vessels across the peninsula as vessels were carried 300 years before Christ's time, where the Corinth canal now is—is to raise the vessels on pontoons, and thus carry them down without the necessity of making any changes in the canal. So that you will see we have three propositions to replace the miserable system of canals we have at present. A canal is like a chain, its strength is in its weakest link. The smallest lock upon a canal fixes the capacity of the canal and of the system. At low water a vessel can scarcely go through our canal system drawing seven feet of water. As I have said, speaking in the house of commons, the engineer who designed this system must have supposed that a vessel was like a rubber ball, capable of being squeezed to smaller dimensions without injury. I do not know of anything in which so much money has been lost as in our canal system. We are going to get rid of our present system and we are going to have fourteen feet of water. That is already under contract. This work should have been finished long ago. When the various provinces agreed to confederate and form the Dominion of Canada this was one of the terms of union—that the federal government should improve these waterways so as to meet the convenience of the people of the great northwest. And let me say, gentlemen, that I have met some men sufficiently short-sighted to say that we want these waterways for ourselves. We want these waterways for the human family, and for my part, I do not care whether the benefit is to this side or the other; it is in the interests of the producer, it is in the interests of the consumer, that we should have deep waterways, that we should have enlarged facilities for carrying from the head of the great lakes that will enable us to reach tidewater and so to place our products in the markets of the world.

Mr. Smalley: I would like to ask whether, if the deep waterway by way of the river is made, it would lessen the cost of boats returning from Montreal or whether it would merely reduce the time of transit down the river.

Mr. Blain: I may say that I was very much struck with one remark of Mr. Cooley to-day, that we are constantly outgrowing our facilities. The gentleman who has asked the question will see that by facilitating transport down the river we more than double the capacity of our canals, we can do more than double the work we could do by going down the canal. And another point that might bear upon the case is, as generally recognized, the return freights are usually not as great as the freights from the west to the east.

Mr. Flower: I would like Mr. Cooley to say whether there is any other route besides the St. Lawrence that would afford two channels to the sea, one carrying the cargoes by the quicker course in the current or main thread of the stream and the other taking return loads upward through the locks.

Mr. Cooley: All things are possible in engineering, but there is no route that compares in cheapness with the St. Lawrence. I do not see any difficulty in the way of making two channels, as suggested by Mr. Flower, and that might be a useful thing. In fact I believe they have already applied that at the Galops.

Mr. Blain: While Mr. Cooley is on his feet, I would like him to answer a question. We have been debating very seriously here whether we could not resort to the hydraulic lift and dispense with locks. Such a system, if practicable, would greatly reduce the expense necessary to give us the required facility for shipping.

Mr. Cooley: So far as the St. Lawrence is concerned, you have no rise on any canal over fifty feet except on the Beauharnois canal, where there is a rise of eighty-five feet. I do not see any difficulty from an engineering point of view.

Mr. Alan Macdougal: We have heard about this engineering question, and, as an engineer, I would like to have the benefit of the opinion of some practical shipmaster as to what would be the effect of putting a ship upon one of these hydraulic lifts. When a paper was read before the Canadian Society of Civil Engineers on the subject we are now discussing, it was brought out in the debate on the paper that many of the ship owners would not be disposed to have such large vessels as would carry 5,000 tons subjected to the strain likely to be caused by one of these hydraulic lifts. Every ship owner, I understand, dislikes to have his ship go into a lock, on the ground that it receives more or less damage every time it does so. If that is the case under the present system of locking, what would be the probability if, as engineers, we were to strive to replace the present system with hydraulic lifts? It has been suggested that in connection with some schemes it might be practicable to make a lift from forty-five to fifty feet in height. That would be possible from an engineering point of view. The question is, even if this is accomplished, would it be of any advantage from an economical point of view. Would any ship owner allow his ship to be put into the lift and carried to that height? We have here many gentlemen who are interested in the shipping trade, and I would like, as an engineer to have their opinion.

JAMES SUYDAM'S PAPER.

James Suydam: Mr. Chairman and Fellow Continentals: I like Mr. Cooley's thought this morning that he wished there had been no boundary, that we had been fellow-citizens. But we are glad to greet you here this afternoon as fellow continentals—not the "old continentals" that we of the United States used to hear about, who went about in three-cornered hats and knee-breeches shooting the Britishers, but the new continentals who are here to make the waterways the means of continued peace and improved trade. I am here to represent the twin cities of the northwest.

We claim, continentals, that we are at the summit of water transportation, and we are just one hundred feet in our elevation higher than the city of Chicago. I think that justifies our claim. Mr. Cooley made another statement, in which I can go him one better, and I do not know but more than one. He said that if a drop of water fell at the centre of Illinois, part of it would flow to the Gulf of St. Lawrence and part to the Mississippi. But if a drop should fall at one point in Minnesota, part of it would run in three different ways—one part to lake Winnipeg, and so to Hudson bay; another part to the Mississippi, and so south; and the third part would go into lake Superior, and so to the sea by the Gulf of St. Lawrence.

Now, we are here to ask to be placed not in the geographical centre alone, but in the hydrographical centre. We are very glad to-day that there has not been a shovelful of earth or a pound of rock taken out of the route of the Lake Superior and Mississippi canal. That is the name by which our scheme has been christened. We are at the head of the father of waters. And we expect to bring there the mother of waters, and make such a union as will make our section the home of a great commerce.

When I lived in Chicago I thought a 12-foot canal was a wonderful thing, but since I have lived in St. Paul, and particularly since I have come to Toronto, I have learned that what we want is not a 10 or a 15-foot canal, but one of 20 or 26 feet. I am here to present to you an adopted child of my own.

[The speaker then outlined a project for constructing a canal from Superior on Lake Superior to the Mississippi river.]

Mr. McIntyre: I would like to ask what is the length of this canal?

Mr. Suydam: That depends on the route you take. From 150 to 250 miles. When I find that men are talking about constructing canals with locks of 80 or 90 feet and providing for a fall of 347 feet in 66 miles I think I can go back to Minnesota and tell them there is nothing for us to fear in overcoming an incline of 400 feet in 125 or 130 miles. Let me refer to another matter in Mr. Cooley's address. He drew you a line around from the lakes to the Mississippi river, but he did not take it from far enough north. This project that I have told you of, covers a larger part of the United States than any other that has ever been presented connected either with the great lakes or with the Mississippi river. I say that with all deference to the Chicago canal, the wonderful waterway that is now being built. This Chicago work is well enough for the southern portion, but it leaves the northern part of the country still at the mercy of the railroads and we expect to ask and urge that feature upon the convention and we believe that we are in good shape for progress.

Mr. McIntyre: What depth of water have you in the Mississippi at St. Paul?

Mr. Suydam: Only four feet at low water and at high water as much as fifteen feet.

Mr. McIntyre: If you get the canal built to the Mississippi do you expect then to make a twenty-foot channel down the Mississippi?

Mr. Suydam: Yes, ultimately.

Mr. Flower: A great many wonder why this St. Paul canal and a number of others of the same kind are mentioned in this convention. It is true railroad men do not build their sidetracks and feeders first, before they construct their trunk line. But before a railroad man builds a line he considers this matter of side tracks and feeders and where they are to be built. All these little canals brought forward by their special projectors have a relation to the main subject before this convention, because we are asking for a deep channel to the sea and the better feeders we can have for it, the more successful that channel will be.

Mayor Taylor, of Winnipeg: I do not wish to reflect on any great international scheme, but Mr. Brown has brought up the question, and it seems to me that his point was well taken. It has been stated by one of the speakers that it was contemplated to have a waterway to Winnipeg by the Red river into Lake Winnipeg, and, I premise, on into Hudson bay. That would give the whole of Manitoba, the northwest territories, Minnesota and Dakota an ocean port of their own, without regard to the lake route; and if the other scheme were carried out, of having a route by Winnipeg river and Lake Winnipeg and the Lake of the Woods, across the Height of Land, it would give us access to the St. Lawrence system of navigation. I cannot see how this proposed canal is an international scheme, unless it is a feeder to bring the freight from Minnesota and the Dakotas through Canadian territory to Hudson bay, and thus by the shortest route to Liverpool.

TUESDAY, SEPTEMBER 18—EVENING SESSION.

THE GEORGIAN BAY CANAL.

Mr. E. A. Macdonald: The subject upon which I shall briefly address you this evening is one which has agitated many minds, beginning with the time before I saw the light. And it pleases and inspires me to see one of the early movers in this project before me. I refer to the chief engineer of the old Huron and Ontario Ship Canal company, Mr. Kivas Tully, who made all the surveys and collected all the data which have been of any use to our company or to the public up to date. In the fifties or early sixties the traffic was so small that the company then incorporated could not hope to carry out their project as a commercial work unendowed by the government, so they sought a grant of 10,000,000 of acres of land, and I believe the negotiations were nearly completed, but the work was never carried out. But though interest in the work declined, it had never entirely subsided, and has been revived at different periods. Two years ago the matter was taken up again, several new features being added to the project. One feature, the power aquaduct feature, does not interest you as a convention. I may explain, however, that there are two distinct features of the work in hand, one the power aquaduct, by which the company can develop half a million horse-power from Lake Simcoe and the waters flowing into it. This one feature alone more than counterbalances the disadvantage of not having the old bonus of 10,000,000 of acres of land. The productive power of the aquaduct makes government aid wholly unnecessary. In Mr. Tully's work we find there were borings made to the depth of the bottom of the then proposed canal. That canal was to have as its feeder and summit level Lake Simcoe, which is 130 feet higher than Georgian bay. The plan was to lock up to the level of Lake Simcoe, and down a corresponding distance. We propose to cut the canal through on the Georgian bay level. In those days that would have been an unthinkable work. On the Lake Simcoe level the work was estimated to cost from $22,500,000 to $40,000,000, and on the Georgian bay level, five times as much as that, or possibly even more. Such a stupendous undertaking was of course at that time simply out of the question. The promoters of this work did not realize that they had easily within control a power that would dig the canal in a comparatively cheap and simple way. I refer to the hydraulic method of excavation, which has only lately come into vogue, by means of which a canal can be made almost as cheaply on one scale as on another, that is, if the formation of ground is suitable. Of course we can not apply the hydraulic method in the excavation of rock, but for soil of the nature of that between here and Georgian bay it will apply very well. I have here some plans which will give the convention an idea of the work to be done.

The Nottawasaga river has slack water 15 to 30 feet in depth for a distance of ten or twelve miles. Then the fall is gradual to a point within forty-eight miles of Toronto, where we propose that our tunnel shall commence. We know accurately the nature of the soil, except here beneath the summit and through the heavy cutting. The plan is to construct a 12-foot conduit, or larger if necessary, from a point twelve miles from Toronto to the point where dredging would be impracticable. The water of the Nottawasaga river and Georgian bay is available in illimitable quantities. Gates would be constructed and means of controlling the water at will provided. Imagine this conduit made, and the water flowing into the tunnel. The tunnel is lined with wood—a temporary lining. I would like that clearly understood, because some attempt has been made to ridicule the idea on the supposition that this lining was to be permanent. The water coming down will, of course, destroy the end section of this lining—the force will be enough to split it into match-wood. That will leave the next section exposed, when a similar result would follow, and so on. The water would wash the earth away. Of course the only thing that keeps the tunnel from falling in is the pressure of the earth around it, and as that is washed away the earth will fall in and will be washed away in its turn. The question is asked, how if it should not fall? All we have to deal with is the earth at the end of the tunnel, as the lining gives way section by section. If any part does not fall in in its turn, a dynamite cartridge will easily bring it down, when it will be washed away by the water. The novelty of the idea has caused a good deal of comment, and even of ridicule; but if you stop for a moment and consider the power of water, and the illimitable supply we have at command, you will see that the taking away of an obstruction of any size is only a question of the size of the tunnel. Some engineering gentlemen have asked, suppose you strike boulders? We expect to strike them. But ordinary boulders will be carried away by the force of the water. Even the stiff, indurated clay will be broken up and washed away. The whole tunnel can be made at an infinitessimal portion of the cost of building the canal by the old method.

Mr. Conmee: Have you had borings made?

Mr. Macdonald: We have had borings made below the level of Lake Simcoe, but we had no systematic borings made by our company down to the level of Georgian bay. While we are constructing the aqueduct this fall we will proceed with the borings and test-pits all along the way. It is recommended that the borings be a quarter of a mile and the test-pits a mile apart. Those who have heard of this method of construction for the first time will regard it as new. But while it is modern, it is not entirely new. It has often been used in Colorado and other western states for irrigation purposes. They bore a hole through a mountain, and, if it is drift or earth formation, it is easily cut out by the flow of water running through the tunnel. If the method can be applied for twenty or thirty miles, you can easily see that it is only a question of power to apply it for a longer distance, and we have the power.

Mr. Conmee: What will be the effect of this earth flowing into Lake Ontario?

Mr. Macdonald: Why, we will simply be taking earth from districts where land is worth $25 to $50 an acre, and using it to make land where it is worth $1,000 an acre.

Now, Mr. Chairman, I have been reading a great deal about this convention, and I have studied the statistics showing the saving in the cost of carrying freight by improved waterways. The circular issued by the committee states that the carriage by water is seven times cheaper than carriage by rail. That may be so on long distances. But so far as the lakes are concerned, I find by examination of the returns that the saving by water carriage as against rail is just about half. That is the actual cost reported on Chicago freight by water as compared with land. Of course there is no through waterway, but the combined rail and water route costs just about half that of the all-rail route.

We may say that this Georgian bay canal will save a distance of 304 miles from the upper lakes to any Lake Ontario port, or 608 miles the round trip. In addition, we propose to have, instead of a large number of locks as heretofore, just four very large locks, to overcome the height of 347 feet from Georgian bay to Lake Ontario. Another advantage is, that by using the hydraulic method of excavation we can make this canal as wide as may be deemed desirable. The great drawback in canals has been the slow rate at which vessels must go. I was over at Rochester aud saw the barges on the Erie canal there going at the rate of two miles per hour, and I believe that four miles an hour is a very respectable rate even for the best canals. Upon this canal vessels will be able to go at the same rate as upon an open river. We intend to make this not only the deepest, but also the quickest artificial waterway in connection with the great lakes. It would be the most direct aud cheapest route for freight destined for the far east. Of course, we never hope to divert the trade destined for Lake Erie ports.

Mr. Suydam: When do you expect to have this route ready for operation?

Mr. Macdonald: That will depend upon what we learn by further investigation. If the ground is such as we expect, we shall be able to build through on the Georgian bay level; but if not, we will have to take the Lake Simcoe level, but we have not the information to speak with certainty about the canal on the Georgian bay level. We expect to have the work completed in 1898.

Mr. Suydam: What is the estimated cost?

Mr. Macdonald: From $30,000,000 to $40,000,000.

MR. TULLY'S RECOLLECTIONS.

Kivas Tully: I have listened with a great deal of pleasure to the speeches made at this convention. I was particularly struck with the statement made by his worship the mayor, at the opening of the proceedings, that the congress of United States had considered a resolution that three commissioners should be appointed to confer with the comissioners from the Dominion of Canada for the purpose of establishing a system of deep water navigation for the commerce of the great west. Now, I have some little consolation to give you in this matter, and I think the point has not been previously referred to. While the great war was going on in the United States we were building up the Canadian provinces. In 1864 there was a conference of the provinces of Quebec, and at that conference the following was passed as the 69th resolution, and was afterwards confirmed by the act of confederation, the constitution of the Dominion of Canada:

> The communication with the northwestern territories, and the improvements required for the development of the trade of the great west to the seaboard, are regarded by this conference as subjects of the highest importance to the federated provinces, and shall be prosecuted at the earliest possible period the state of the finances will permit.

This work the Dominion of Canada has been carrying out. The contracts for deepening the waterways to 14 feet have been let, and it is promised that this work will be finished in three years. If this convention declares that it is necessary to have 21-foot or 26-foot navigation, the Dominion of Canada, under the resolutions that I have read, will be bound to carry that out, for there appears the express will of the confederated provinces, that whatever is necessary for this trade from the west shall be properly carried out. I may mention that I believe myself to be the sole survivor of the convention that met here in 1855. I was not a delegate, but I was appointed by the convention to make a survey of the canal between Toronto and Georgian bay. I have worked steadily for the completion of that project ever since, and nothing has gratified me more than to see this great convention met here to work out this great scheme of deep waterways, which was originated in 1855. To a certain extent I have modified my views with regard to the Georgian bay ship canal. The great expense involved has been the cause of that modification of view. For the last few years I have advocated the construction of a ship railway. I was converted to that project by the late Captain Eads. He projected a ship railway between the Atlantic to the Pacific, across the isthmus of Tehuantepec; and if he had lived that project, no doubt, would have been carried out, and the Panama or the Nicaragua canal would not have been heard of as practical works.

Mr. Corthell was Captain Eads' assistant, and most of you have read his pamphlet on the subject of the ship railway, and on the water route by Montreal, and the cost of deepening the canals to the Atlantic. He estimates the cost of securing a depth of 21 feet at $27,000,000. Captain Eads wrote a letter to the effect that this was the most favorable route for a ship railway that he knew. The ship railway will only cost half what the canal will cost. There is no reason why large vessels may not be lifted out of the water and carried across the land at the rate of 10 miles an hour without damage. But it does not matter to me whether we have a ship railway or a ship canal; I want to see either one or the other, so that the traffic of the great west can be accommodated. I believe that the commerce of the great west will require all the improvements that can be made either by the canal across the Niagara peninsula or from Georgian bay to Lake Ontario, or by the Ottawa ship canal, or any other way. I am favorable to all these projects and I believe that the great west can make good use of them all. I may mention, without detaining you too long, that the first canal projected in Canada was the Lachine canal, which was mentioned in the constitutional act of 1791. The work was begun in 1821 and finished in 1825, the very year that the Erie canal was completed. If the Hon. William Hamilton Merritt had lived till the present day he would have been surprised at the demand for 21-foot navigation from the great west to the ocean, he having been satisfied with the Welland canal for vessels of from 40 to 60 tons. When the Welland canal was projected it was estimated to cost £800,000. It cost $6,500,000 before it was finished.

The question has been mooted here whether the Americans would assist us in deepening our canals. Why, Hon. John Henry Dunn, who was receiver-general of the province, was sent to New York when the Welland canal was projected, and he got nearly £70,000 in New York to construct the Welland canal, this being at the time when it was to cost £800,000. You need not be afraid; if commerce demands it, we shall be united in giving it. I do not see how it is possible for governments to interfere with the people's will. The Rideau canal was commenced in 1829, and the late Sir John Franklin, who lost his life in exploring the arctic regions, laid the corner-stone at Bytown, now the city of Ottawa. The Rideau was built as a military canal.

The construction of the Erie canal took away the trade from the St. Lawrence route. The book I hold in my hand is a work on the Canadian canals by the celebrated Dr. Kingsford, who is now writing a history of Canada, a very able work. When he was preparing his work on canals, in 1865, he asked me to put my opinions on record with regard to the Georgian bay canal. I will make a quotation from what I then wrote:

Will the enlargement of the Welland and St. Lawrence canals ensure the division of the western trade from the Erie canal to the St. Lawrence? I think not, for the following reasons: Judging by past experience, it appears reasonable to suppose that the bulk of the western trade having passed the St. Clair river and reached the eastern end of Lake Erie will find its way to

New York by the Erie canal. To compare distances, which is after all the most important consideration, apart from the question of lockage, it will be found that New York is forty eight miles nearer to Buffalo than Quebec, which is taken to represent tidewater. The following figures demonstrate the distances:

Buffalo to Troy by the Erie canal	350	miles.
Troy to New York by the Hudson river	150	"
Total	500	"
Buffalo or Port Colborne to Port Dalhousie	23	"
Port Dalhousie to Kingston	180	"
Kingston to Montreal	170	"
Montreal to Quebec	160	"
Total	548	"

At New York the produce of the west has arrived at the Atlantic ocean, whereas at Quebec the lower St. Lawrence and the gulf have to be traversed, a distance of about 800 miles before the Atlantic ocean is reached. The distance from Quebec to Liverpool is, however, 478 miles shorter than from New York, the respective distances being 2,502 miles and 2,980 miles. Deducting forty-eight miles from 478 miles, the difference in distance from the eastern end of Lake Erie to Liverpool would be 430 miles; but the high ocean freights consequent on the supposed dangerous navigation of the lower St. Lawrence, still concentrates the western trade at New York, and as the St. Lawrence and the Welland canals have never been filled to their utmost capacity, whilst the Erie canal is crowded, even after the recent enlargement, the inference is that the enlarged Welland and St. Lawrence canals would not divert the western trade. And should there be the slightest probability of such a result the state of New York would immediately enlarge the Erie canal in the same proportion.

By the construction of the Georgian bay canal 428 miles additional would be saved in distance besides the annual losses on the St. Clair flats, which average about $1,000,000. I consider these advantages would alone divert the trade, which is useless to expect can be accomplished under any other circumstances.

I hope to live to see the work commenced, as I have worked in the interests of the project so many years. Whoever lives to see it completed will see the results I have spoken of here. But if the trade once gets into Lake Erie it will go by the Erie canal to New York. I should not be surprised if the state of New York made a ship canal yet from Buffalo to Albany. I suppose it does not matter to the western trade whether the route is by Lake Erie or Lake Ontario, provided it is the cheapest and best. I believe that the cheapest and best route possible is across Ontario into Lake Ontario. Mr. Corthell, the eminent engineer, of the United States, has proved that clearly. Having such authority, I can only say, that as long as I have breath I will support this line.

FOR THE PATRONS OF HUSBANDRY.

Mr. A. Gifford, of the Patrons of Industry: I am here simply to watch the acts of the convention in order that I might report the same to my constituents.

Reference has frequently been made here to the fact that agriculture is at the basis of all industry in this country, and it has been inferred that by cheapening the cost of transporting agricultural products all classes would be benefited. One consideration seems to predominate, and possibly the idea may strike me differently from the generality of people. The great object seems to be to provide facilities for transporting grain.

Farmers now regard grain as the raw product of their profession. The great object of the more advanced farmers is to concentrate with a view to putting their products in more valuable shape. As all are aware the grain produced in Canada and the adjoining states must face conditions different from those in years gone by. We have to face the competition of all countries in our common market, Great Britain. In view of this, it seems to me that we would have to have a change in the system of exchanging commodities, as it were, not only within our Dominion, but with the United States, in order to realize the full advantage of a change in the system of carriage such as would be brought about by deepening the waterways. We have had a practical illustration of the effect of exchange of products between this country and Great Britain, which is our market. We applied to the shippers in Montreal to give us a reduction on the rate on cattle to Great Britain, a matter in which we are much interested. The answer was that if we could so adjust affairs between this country and Great Britain that return cargoes would be secured, one-half of the export rate might be thrown off, but under existing conditions, they could not carry more cheaply than they were doing. Although grain can be produced more cheaply in Manitoba than in Ontario—and this is true also of the Dakotas, Minnesota and other western states—the people there will find that they must convert their grain into some other form before they can compete with other countries. The most progressive farmers in Ontario are feeding all their grain. I can realize about 80 cents a bushel by feeding pork, which is very much in advance of what can be got for the grain in the market. Our farmers are finding this out and the question is whether there will be sufficient trade to justify us—and this is a question I would like to see dealt with—in spending a large amount of money to carry on improvements the object of which seems to be to carry raw products. Once convince us farmers of that and we have liberality enough to go heartily for any project that is for the advantage of the country. Undoubtedly some things have been brought out in these discussions that are beyond what I expected. For instance, I find it proposed to have a deep water canal from Duluth or West Superior to St. Paul and Minneapolis and thence north to Winnipeg, and deepening the Mississippi southward to enable free passage of vessels drawing twenty feet of water. It seems to me that if that is to be included in the project it will be too large a matter for this Dominion to think of. But if it can be restricted to a more simple scheme, it will commend itself to the farmers more readily. I shall report to my constituents such notes as I have taken of the discussion and perhaps they may see fit to publish them. I shall be able to bring my ideas out more clearly in that way than in these few remarks. I thank you for your kind hearing, I trust you may come to satisfactory conclusions and, in closing, I assure you again that the farmers of the Dominion are liberal enough to support anything which they believe will conduce to the interests of the people of this country as a whole.

Mr. John Brown: What Mr. Gifford says about the necessity of our farmers going out of the business of furnishing raw material for the world's market is quite true. But that does not settle the question. The principle recognized to-day in fixing freight rates is that the rate shall be enlarged according to the state of manufacture in which the article is. Ontario is king in one thing—cheese. The province produces over 93,000,000 pounds of cheese, all or nearly all of which goes for export. Suppose a line of vessels was started to carry only cheese, and suppose the Ontario product were shipped from Toronto, its natural outport. You will see that we would keep one freight line carrying cheese from the city of Toronto for a whole season.

Improved facilities for transportation would mean a saving of $3,000,000 on the products of the farm exported from the province of Ontario alone. I base these figures not upon the product of any one year, but taking an average of eleven years. If that is true with regard to this province alone, our friends will have a standpoint from which to estimate the importance of this question to the immense area in the west which this project will benefit. The saving upon cattle alone for this province would not be less than $400,000; on hogs there would be a saving of $200,000.

The question has been raised—and a reasonable one it is—have we sufficient incoming freight to induce these steamers to come to our ports, as they would not be willing to take a cargo out and return light. Last year the city of Toronto received over $21,000,000 of goods, dutiable and free, as shown by our customs returns. That is nearly one-sixth of the entire import of the Dominion. I can assure you, Mr. Chairman and our friends, that the distribution of that trade will come, and it will not be a matter of the far future.

INTERNATIONAL WATERWAYS AFFECT THE NORTHWEST.

Mayor Taylor, of Winnipeg, read the following paper, prepared by James Fisher, M. P. P., a delegate for the Farmers' institute of Manitoba:

No more serious problem faces the farmers of Manitoba to-day than that of transportation, nor is it one of less importance to the settlers of the Canadian northwest territories and to those of Minnesota and the Dakotas. Situated in the very center of the vast continent, far removed from the great markets of supply and distribution, the prairie region of the northwest is at a striking disadvantage, in respect of convenience of access to these markets, as compared with other countries and districts that compete with them for the supply of food products. In the case of the Canadian northwest the difficulty is intensified by the circumstance that between it and the seaboard to the east there lies a vast stretch over a thousand miles in width of at present practically unproductive territory, save at a few points. This entire district contributes little to the maintenance of the one line of rail that connects us directly with the Canadian east. The farmers of Manitoba and the territories have to pay rates, both on the outgoing and incoming freights, sufficient to make up, not only the cost of maintenance and a dividend on the cost of construction, in respect of the portion of the line within their own country, but also in respect of the larger mileage in the unproductive area. And the burden thus laid upon their shoulders is made all the more grievous by reason of the enormous cost of that very portion of the road traversing the country that fails to contribute to either construction or maintenance. Speaking for the farmers of Manitoba, it is not too much to say that the public in the eastern part of the Dominion have scarcely realized the hardship of their position in this respect. The settlers on the prairies of the northwest occupy a country over which a line of rail can be and has been constructed at a cost very much smaller than the cost in any other part of the Dominion. With more favorable grades and with a much lighter snow fall than in most of the other parts of the Dominion, it would seem to the ordinary observer that the rates of freight in such a country ought to be much lower than in districts that are less favorably situated in those respects. In other words, the conditions of the prairie region are, in themselves such as should insure to the settlers rail transportation at unusually low rates. Unhappily for the settlers of the northwest, the reverse is really the case; and the rates charged to them are in fact higher than in districts where the greater cost of construction and operation would naturally make it otherwise. This is due, not only to the great distance of the prairie region from the outer markets, but to the circumstance also that they have to bear the burden, in part, of construction and operation in the expensive but unproductive districts. Upon the shoulders of the prairie settlers has thus been placed a double burden. It is not proposed in this paper to contribute one word to a discussion of the question whether the rates charged to the settlers of the northwest are reasonable or otherwise from the standpoint of the railway company. Whether reasonable or not, the settlers feel at all events that they are a most grievous burden upon them, nor have they any hope that in the near future the conditions will be so changed as to bring about a material lessening of the load.

As a result of the position I have described, more than half the price obtained for the grain of the prairie region, in the ultimate market, is taken to pay the one item of transportation; out of the remainder of the price has to be paid the extra cost of incoming freight, so the settler's candle is in these respects made to burn most fiercely at both ends. When grain fetched a good price in the markets the burden was not so keenly felt, but now that it has reached the present low prices the position is, to say the least, disheartening.

Under these circumstances the farmers of Manitoba are looking about for some means of deliverance from the burden of the rates, and they have been turning their eyes to the great stretches of water that extend from the head of the lakes to the Atlantic. They are beginning to realize more and more the wonderful extent of those great bodies of water stretching from Belle Isle, at the entrance of the Gulf of St. Lawrence, to the zenith city of Minnesota, at the head of the lakes, a distance of nearly 2,400 miles, and at least 150 miles longer than the distance across the Atlantic from Belle Isle to Liverpool. They have been taking note of the fact that for this entire distance, with the exception of about 73 miles, we have continuous, unimpeded navigation for seven months out of the twelve, over a highway received as a gift from heaven itself as joint and common heritage by the two greatest nations on the globe—Great Britain and the United States—a highway which has cost not one dollar for construction, and which never goes out of repair. The farmers of Manitoba have been giving their earnest attention to the unparalleled advantages offered by this great highway as a means of transporting the commerce of the country. They have been recalling with interest the wonderful development of the traffic carried over these waters in late years. They have been reflecting on the wise counsels that have led both of the great nations interested in them to overcome the obstructions that impeded navigation in the seventy and odd miles referred to, and on the equally wise policy, worthy of such nations, that has insured by solemn international treaty the use of these improvements on absolutely equal terms to the citizens of both countries, no matter at whose expense they were made. The history of the canal enterprise along this route, and of the development of the traffic thereon, is indeed an interesting one, and its consideration just now by the farmers of Manitoba, in connection with a proposal to further improve the channels, is timely.

Our western farmers have been considering too, in connection with this question, the remarkable difference between freight rates by water and those charged for rail carriage. To carry their wheat from Brandon to Fort Willam, 560 miles, they pay 11.40 cents per bushel, and this is a special rate allowed only for the shipping season. The standard rate by rail from Winnipeg to Montreal, about 1,400 miles, is, I understand 27 or 28 cents per bushel. Against this the farmers of Manitoba place in contrast the water rate of 6 to 7 cents per bushel from Duluth to Montreal, about the same distance. They contrast it also with the water rate of 2 to 3 cents per bushel from Chicago to Buffalo, 900 miles, reduced in 1891 to 1.9 cents, and reaching at one time as low a rate as 1 cent per bushel. They compare it with the water rate of 3 to 4 cents per bushel from Duluth to Buffalo, 1,000 miles, and that of 2½ to 3 cents from Buffalo to New York, about 500 miles, by the little horse-power barges of the Erie canal and the Hudson river, which take about a month for one return trip. Our urban population in the west, too, cannot help contrasting the rate of $3 per ton on coal from Port Arthur to Winnipeg, 426 miles, and the rate of $5 per ton on the same product from the Rockies to Winnipeg, 900 miles, with the water rate of 30 to 40 cents per ton from Buffalo to Duluth, 1,000 miles, reduced one year to 29 cents, and reaching at one time as low a rate as 10 cents per ton.

The western farmers see plainly how it comes that the rates by water are so much lower than those by rail. They recognize that nature's highway is not easily controlled by any monopoly, but that it is open and free to every person who has capital and enterprise enough to place a vessel upon the waters. Indeed, it is a remarkable fact that it has been found utterly impossible for the various companies that own the great lines of vessels plying on the lakes to form any combination for fixing rates, or even definitely to settle any rates whatever. Especially is this the case in regard to rates on grain. This arises, doubtless, from the fact that more than half the grain carried over the lakes is taken by "tramp" vessels, whose owners make their own rates and render it utterly impossible to organize or combine.

There are amongst us some who are looking forward hopefully to the day when, under proper regulations and restrictions directed by some high authority, more than one railway company—aye, half a dozen companies, if convenient—may run their rolling stock over one line of railway. A sturdy fight was once made in our province of Manitoba, though without success, to secure such an arrangement over the line coming in from the United States, since operated by the Northern Pacific company. What an advantage it would be to eastern Canada, for instance, if all the lines of railway in that country, including the Intercolonial, could be used alike and on equal terms by the two great trunk lines that occupy the country. But we have no hope that in the near fuutre such an advantage can be secured for the public. In the case of the waterways, however, we have it already. The most unpretentious craft that can carry a load of grain is as free to use the highway as the greatest of the noted liners that float on the waters, and in that respect the waterway is better than half a dozen lines of railway, even though they were in active competition with each other.

One need scarcely refer to the fact that an important factor leading to the immense reduction in freight rates in recent years on the lakes has been the increased size of the lake vessels and the consequently larger loads that they carry. In the history of the development of the lake traffic, nothing is more remarkable, indeed, than the revolution that has quietly taken place through the increased size in vessels. Some of those now on the lakes carry in one load as much as 125,000 bushels of grain to Buffalo. It costs but little more to carry 125 000 bushels in a vessel of that capacity, than it does to take 50,000 bushels in a vessel built to carry that quantity. I understand that a carload of wheat takes about 650 bushels; it would take about ten trains of twenty cars each to carry the load taken by one such vessel. When our St. Lawrence canals shall have been deepened even to 14 feet, one of the "whaleback" steamers with two large barges in tow, will, I am told, take in one load from Port Arthur to Montreal, about a quarter of a million bushels without breaking bulk. To take this quantity by rail would require nearly twenty trains of twenty cars each. One of these steamers, with three barges in tow, as I have read somewhere, has already carried about 312,000 bushels in one load to Buffalo. That means a load equal to the capacity of twenty-four such trains. Many trains, of course, take much more than twenty cars of grain, but often they are less. A writer in a recent magazine says that the average load carried by freight trains in the United States is less than 182 tons. Some of the new vessels on the upper lakes with a draught of only 16 feet take in one cargo over 3,700 tons, equal to more than twenty such average trains, while the whaleback steamer with her three consorts in tow will in one load, with one staff of hands, with one outfit of steam power, with one set of machinery, with no wear and tear of the track, and with little wear and tear to the vessel, carry through the 14-foot channel to Montreal, when completed, nearly 9,500 tons—or more than is carried by fifty of such average freight trains.

The result of this increase of capacity in the vessels, in respect of freight rates, is seen in figures such as these: In 1887 the average rate per ton per mile on the lakes was 2.3 mills; in 1891 it was 1.3 mills. In 1871 the average rate on wheat by lake and canal from Chicago to New York was over 17 cents a bushel; in 1880 it was 13.13 cents; and in 1891 it was less than 6 cents. In 1880 the average rate by lake from Chicago to Buffalo on wheat was 5.7 cents per bushel; in 1890 it was 1.9 cents. In 1887 the average rate on wheat from Superior to Buffalo was 6.6 cents per bushel; in 1890 it was 3 cents. In 1887 the average rate on coal from Buffalo to Chicago was $1.05 per ton; in 1891 it was 56 cents. In 1887 the average rate on coal from Buffalo to Duluth and Superior was 70 cents; in 1891 it was 29 cents.

All this is the result of securing a continuous waterway of a depth of 16 or 17 feet, from the head of the lakes to Buffalo, within recent years, and of the consequent increase in the capacity of the vessels carrying the traffic. What further reduction in rates to Buffalo may we not expect, when, in two years more, we shall have the waterway deepened to 20 feet and when one of the great vessels that will then be on the lakes will carry a cargo of 6,000 or 7,000 tons?

But the farmers of Manitoba are especially interested in the proceedings of this convention because it is called with a view to discuss the feasibility of improving the channel right through to the ocean, so as to give a 20-foot waterway throughout. To the people whose interests I seek to present before the convention such a scheme would be one of momentous importance. The advantage of the lake and river route can never be fully enjoyed by the settlers in the northwest until we shall have such a channel, so that the largest cargoes on the upper lakes can go through to the seaboard, or if need be to Liverpool, without breaking bulk. But the farmers of Manitoba will, I am sure, make no unreasonable demands upon the Canadian public. I believe they will not expect that Canada, after spending $50,000,000 on these works, will for the present at all events, out of her own purse, undertake the deepening of the Welland and St. Lawrence canals to the increased depth suggested. The farmers of the northwest will, I believe, ask no more of the Dominion at present in respect of these channels than that the work of deepening them to 14 feet shall be pushed forward with the utmost possible vigor. If this convention, by any action it may take, shall be the means of having this work hastened, so as to insure its completion at the very earliest possible moment, it will have done a great deal to help the farmers of Manitoba. I have seen a recent statement from the department, intimating that it is expected to complete the work by the spring of 1897. If I mistake not, it was said by the minister, less than two years ago, that its completion was confidently expected in the spring of 1896. Let us hope that even the spring of 1897 will not find it still uncompleted. And is it not possible by a special effort, such as was put forth in the case of the Canadian Sault canal, to complete it at even an earlier date? Expectations are held out to the people of the west that a very considerable reduction of rates by water will follow the completion of even the 14-foot channel. And if, as we understand, the whalebacks can then carry loads of from 75,000 to 85,000 bushels of grain, making a quarter of million for one steamer and two barges, such expectations ought surely to be realized.

If I interpret aright, the views of the farmers of Manitoba on the question of the deepening of the Welland and St. Lawrence channels to 20-feet—and I have been at some pains to enquire into their views—I believe they will be found favorable to its being done as an international work. Assuming that the accomplishment of such a work would be an advantage to both countries, it is difficult to understand why it should be done otherwise than at the expense of both nations. For Canada alone to spend another $50,000,000, or possibly more, on a work in which the people of the northern and northwestern states are at least equally interested, would seem most unreasonable. It may be frankly said at once that under present conditions Canada can not afford to bear the whole cost. There is evidently a very strong public opinion in the United States in favor of securing a 20-foot waterway from Buffalo to the seaboard, and if our good neighbors make up their minds to have such a highway they will proceed to construct it even if they have to open a new channel entirely through their own country. We have, however, much evidence that there is, as might be expected, a strong opinion amongst the citizens of the United States in favor of improving the Welland and St. Lawrence route in preference to any other. It is recognized, of course, in the first place, that the St. Lawrence route is the natural channel, and the only natural channel leading from the lakes to the Atlantic. It seems to be conceded that the deepening of the Erie canal to such a depth is an engineering impossibility. Then it is also the shortest and most convenient route to be had. Upon this question of directness of route, the statement made by Mr. T. C. Keefer, C. E., a number of years ago, is so apt that, though recently re-published, it may bear repetition on this occasion. Said Mr. Keefer:

If a thread be stretched upon a globe from any point in the British channel to Toledo, Ohio, and arranged so as to be on the shortest line, it will be found that the St. Lawrence does not deviate at any point more than 30 miles from it, connecting in the shortest possible distance with the most capacious, steady and economic mode of communication, the greatest food-consuming country with the greatest food-producing country in the world, inhabited by the parent and offspring of the most favored race of men.

Again, I find Mr. Keefer giving the following figures as to distances: From Chicago to Montreal, via the Welland and St. Lawrence, is 1,261 miles, of which 71 are canal, 185 river, and 1,005 lake—the canals having 54 locks, with a lockage lift of 563 feet. From Chicago to New York, via the Erie canal, is 1,419 miles, of which 352 are canal, 202 river, and 865 lake—the canals having 72 locks, with a lockage lift of 665 feet.

The advantage of the St. Lawrence route from an engineering point of view is well put by Col. Orlando M. Poe, chief engineer of the American Sault canal, and his statement on this question, though frequently published, is also well worthy of being repeated here. A resolution having been introduced into congress in 1892 authorizing the President of the United States "to invite negotiations with the government of Canada to secure the speedy improvement of the Welland and St. Lawrence canals, so as to make them conform in depth and navigability to the standard adopted by the United States for the waters connecting the great lakes," that is 20 feet, the resolution was submitted to Col. Poe for his report. His answer was in these terms:

The Welland and St. Lawrence canals undoubtedly occupy the most favorable and therefore the best line of water communication between the lakes and the ocean. A deep waterway can be opened by their route at less cost than by any other, and there can be no question as to its advantage in an engineering point of view. So far as communication between the lakes and the countries beyond the Atlantic is concerned every argument favors the proposition of this bill.

It is interesting to note in connection with this resolution that the committee on interstate and foreign commerce of congress made its report declaring that "the great lakes furnish a highway for commerce that has no parallel in any other country," and that "the impracticability of deepening or improving the Erie canal, so as to admit the passage of ocean-going vessels seems to be admitted on all sides."

Is it in any sense an unreasonable proposition that the two nations should unite in the improvement of the water channels that are the joint and common property of both? Certainly the idea of a joint expenditure upon them has been the subject of serious consideration in the past by statesmen on both sides of the line. In the negotiations carried on in 1874 by Sir Edward Thornton and George Brown with the American government, one of the proposals submitted was "that a joint committee be formed and continued charged with deepening and maintaining in efficient condition the navigation of the St. Clair and Detroit rivers and Lake St. Clair." It is true, the treaty then proposed fell to the ground, and I have never seen it suggested that any objection was made to the proposition that the improvement of the waters named should be made by both nations, and it is impossible to conceive that such a proposal would be objected to. On the contrary, if I mistake not, the two nations did actually, about that time, make an expenditure to improve the navigation on the Detroit river. Were it possible by rock cutting or otherwise to remove the obstruction in the Niagara river, that stands there in the shape of the great cataract, would it be considered reasonable that one alone of the two countries should undertake the entire work? Surely no one would argue for a moment in that way, And if, because of the character of the obstruction, it has become necessary to divert the joint and common watercourse through the land upon one side of it, is it less reasonable that the two nations should join in doing it?

Is the fact that the canal has to be made through the territory of one country a reason why the other should not join in its construction? I can not understand why it should be so, so long as the canal is but a diverting of the joint and common highway to avoid a natural obstruction that stands in its path. If such a reason be indeed a good one, it would be conclusive against Great Britain or the United States spending money upon any canal in a foreign country, *no matter how advantageous to either or both the countries.

It is reasonable to imagine that these two nations can unite in a scheme for constructing, maintaining and protecting, even in the event of a war between themselves, such a work as the Nicaragua canal in a foreign land, and that they can not enter into a friendly arrangement for improving the channels lying between the two countries themselves, over which so much of the commerce of both countries is carried? Can Great Britain and the United States, in short, enter into such an arrangement to provide a ship canal "for the benefit of mankind" on a foreign soil, and yet be prevented from joining in providing such a channel on the boundary line between their own lands?

Surely there can be but one answer to the whole question, and that is, that the two nations ought to join in this great work, if it be indeed of such advantage to them both, as we all believe it to be. Surely it may be left to the good sense of the two governments to make such provisions for the maintenance, control and operation of the joint work as would secure its being always free to carry the commerce of both nations.

The farmers of Manitoba will, I believd, rejoice if this convention can throw its influence in favor of such a work being undertaken as an international one. But the people of the west are a long distance beyond the head of the lakes, and one of the most serious phases of the question of transportation for them is the cost of carrying their produce over that distance. They have a hope that in the near future it may be possible to open water communication between the Red river and Lake Superior. The same question is now a living one in Minnesota and the Dakotas, and the people of those states are enquiring into the feasibility of opening a channel from the head waters of the Mississippi to Lake Superior. The people of the Canadian west do not now call upon the government to open such a channel. Sufficient information has not yet been obtained to justify us in saying that such a scheme is feasible. It is known, however, that some of the conditions are extremely favorable There is practically water communication now, though of very little depth, from the Lake of the Woods to the Red river, across the prairie region. The alluvial character of the prairie soil is such as to make the opening of a ditch a matter of comparatively small cost. Between the Lake of the Woods and Lake Superior there is almost a continuous waterway. The opening of a complete channel in that distance would no doubt be attended with a very great cost While it would be unreasonable, with the information in our hands, to advocate at this time the opening of such a channel either easterly or westerly from the Lake of the Woods, the farmers of Manitoba having intimated, by a resolution of the Farmers' institute, that they think the government of Canada should, at all events, go to the expense of having a survey made with a view of considering the feasibility and cost of constructing such a channel. It will be a great help to them should this convention join them in urging this much at least upon the attention of the government.

DISCUSSION.

Mayor Taylor: At this hour I shall not detain you with any lengthened remarks of my own. It would seem that since this convention was opened one of the great difficulties in the way of this scheme of deep waterways has been removed. The statement has been freely circulated in Manitoba, and has been given on the authority of a leading article in one of our newspapers, that this work would cost somewhere in the neighborhood of $150,000,000. But when I had a conversation with Mr. Fisher I found that he had reached the conclusion that it would cost $50,000,000, and it was with that idea that I came here. There is no doubt that it will be an advantage

*NOTE.—Nicaragua Canal—see Clayton-Bulwer treaty of April 19, 1850, in the paper in this volume by Mr. Flower.

to have the canals deepened to 14 feet, but it would be much better to have 20 feet or even more, as it has been clearly shown that the larger the vessel the cheaper the freight. Even if this great project goes on it need not interfere with any other scheme for reaching the markets of the world. I believe that Manitoba, Minnesota, the Dakotas and the whole western country will, in the course of time, and that no very distant time, produce more than you will able to bring down through the lakes. It will be necessary for that country to reach its natural harbor and that harbor I consider to be Hudson bay. I have heard some strange remarks with reference to the Hudson bay route since coming here. Still you will hardly find a resident of Manitoba to-day who has not the greatest faith in the Hudson bay route as the means of reaching the consuming market.

Hon. John Ferguson: It would be inexcusable to detain you with a long speech at this late hour, but there are one or two observations I should like to make. First, there is no difference of opinion, so far as I can learn, as to the desirability of deep waterways from the upper lakes to the Atlantic. The only difficulty is to convince the public as to the right way to accomplish the object in view. We in Canada have been progressing rapidly and doing so much in the way of building canals within the last two decades that it would be impossible for us as a people, and through our government, to undertake so large a work or with our present revenue, even to contribute any considerable sum towards it. But, if the ways and means can be provided—and I think the attention of the convention ought to be drawn more to that subject—we could probably agree upon a plan to be followed.

So far as the produce of the farm is concerned—and to cheapen the freight on that produce is the main object in deepening the canals—when you get to Montreal you are in exactly the right spot, far better off than if you were at New York, and I will tell you my reasons for thinking so. You know that the difficulty in transporting meats, eggs, cheese and nearly everything the farm produces, is the warm water of the gulf stream. The water through which you have to travel most of the way from New York to Liverpool is 70 to 75 degrees, and runs as high as 80 and even 85 degrees. From Montreal you go through water at 40 degrees. Your produce of every kind reaches the markets of Europe in better condition and therefore commands a higher price. Navigation from Montreal is open seven months in the year. The difficulties of navigation in the St. Lawrence are sometimes spoken of, but we need hardly discuss them. Now that we have our light-houses and buoys everywhere, a vessel can speed as rapidly from Quebec or Montreal as from New York.

You are as near the market of Europe at Montreal as at New York, and much nearer the western country from which the bulk of the products come. When my friend, Mayor Taylor, spoke of the Hudson bay route I was glad to hear him, for I entirely sympathize with him. The future of the whole northwest is unquestionably by Hudson bay. I have given this subject a great deal of study, and have called attention to it through the senate. For 274 years that route has been navigated by small and very inferior craft, and that practically without loss. We have at Fort Churchill one of the finest harbors on the Atlantic coast; and let me tell you Hudson bay never freezes, Hudson strait never freezes.

It is the opinion of the best navigators that this route is navigable the whole year round, but unquestionably it is navigable from four to six months. The only time when it is dangerous is when the ice from Fox's channel floats down in April, May and June. With proper vessels constructed for the trade, the products of the great northwest will ultimately go to Hudson strait. I believe that the products of Minnesota and the Dakotas will also go down that way. Fort Churchill lies three degrees west of St. Paul, it is within 700 miles of Regina, within 950 miles of Calgary, within less than 900 miles of Edmonton, at the base of the Rocky mountains. At Fort Churchill you are as near Liverpool as at New York.

The products of that great country will not in the future be brought to New York for shipment when they have an ocean port so near. But there is plenty of territory to be benefited by the deep waterway. Therefore, I say, go on; the work you have undertaken is necessary and will be of incalculable benefit. It may be thought that I am in the wrong place to talk in favor of the Hudson bay route, but a public man's constituency is as broad as his country; and if he does not think so, he is not fit to sit in the parliament of his country.

This is not a local question, and I am not addressing a local convention, but a convention representing the whole continent. I am entirely in sympathy with the project of deep waterways, and I so far as I can assist in urging the project forward, consistently with due consideration for the finances of the country I live in, I shall be glad to lend my aid.

Mr. Coatsworth, M.P.: Without detaining you at this late hour, I may say that in the discussion of this subject in parliament last session, the difficulties spoken of as standing in the way of carrying out the scheme were, in the first place, the great expense involved in dredging and blasting out the channel of the St. Lawrence, and deepening and lengthening and widening the canals; and in the second place—a point that I have not heard raised here—that even if the channel were deepened and widened, the class of vessels used in lake navigation are not such as cross the ocean, and therefore there would have to be transhipment, as there is to-day, in order to cross the ocean. I have no doubt that that would remedy itself, and, so far as I am concerned, I am entirely in favor of deep waterways for this country, so as to give easy access from upper lake ports to Montreal and Quebec and so to European ports.

We must look to the future as well as to the present. The policy of deepening the canals and the St. Lawrence to 14 feet is now twenty years old. Twenty years ago this country issued a commission, which commission reported in favor of deepening the canals to 12 feet. But shortly after it was found that this was not sufficient, and a depth of 14 feet was decided upon. That has not yet been completed, and now the government has practically committed itself to a 20-foot channel by making that depth in the Sault canal. And so the probability is that if we are too modest in our ideas to-day we shall find those ideas behind the age before they are carried into effect. I have every confidence in the development of the country, and I feel that the development can be greatly assisted by carrying out the deep waterways project. Whatever may be the result of this convention immediately, the ultimate result can not but be favorable. I feel sure that at no distant date we shall see the policy of this country favorable, not to a 14-foot canal system, but to one of 20 or 30 feet.

Wednesday, September 19—Morning Session.

ORGANIZATION.

Mr. John Brown read the following paper: Probably that which will offer the most difficulty to overcome will be the vast territory which it will be necessary to cover if we aim at a thorough organization. Few even of those who have been actively promoting our object for years have any very definite conception of the ground to be covered by our association. Seated where you are, Mr. President, you are less than 50 miles further from Liverpool than is New York, and if you were to draw a straight line from here to New Orleans you would find it 200 miles shorter than a similar one drawn from New York, and hence we may safely say that all that district north and west of a line from here to New Orleans is nearer to the world's market by way of the great lakes than by any other known route. It is not to be thought that it is intended to attempt to organize two-thirds of the continent, but it is necessa-y that we interest the 26,000,000 of people which the government of the United States declares are di ectly tributary to the lakes and the 3,500,000 Canadians who will be directly benefited. In order to reach the people it is necessary that our association should have a branch in each state and province which shall have charge of the anvancement of our cause. The greatest obstacle in our way is the indifference of a large portion of the wealthy and influential classes of the people who have become, as the psalmist puts it, "enclosed in their own fat," but it is surprising how this class will bestir themselves when financial trouble meets them, and the recent financial depression will no doubt act as a powerful ally and assist us in our aims. The best means of overcoming the ind fference of the people is the press, which should be kept posted on all vantage points by our friends.

But by all means the greatest bar to our success has been that hitherto we have been absolutely without any form of thorough and systematic organization. We have been carrying on a sort of guerilla warfare against an enemy entrenched behind a barrier of wealth, of selfishness and of indifference. Our association must be as wide as its object and be established upon an international basis wide enough to allow the Nova Scotian and New Brunswicker to meet in amity and community of interest with the Dakotans and even the wild men of Minnesota.

In all cases, the officers of the state and provincial associations should be chosen for their capacity, knowledge and willingness to devote time and energy to the advancement of the cause. Honorary officers may be appointed if it is thought anything can be attained by doing so, but it should always be thoroughly understood that the executive offices must not be given as an honor, but as a trust. What I have said with regard to the officers of state associations is equally applicable to the selection and duties of the executive board. It is not desirable that this board should be very large, as it will be necessary that they be called together from time to time as necessity may arise, and it would entail great expense upon the association without, I think, commensurate benefit to the cause. Where there are few to elect there is not the slightest doubt that they will be chosen with the greater care, and the gentlemen upon whom your choice may fall will undoubtedly have a greater appreciation of the trust. No organization can be strong or effective where the members are not absolutely loyal to their whole platform.

All of us can not have a front seat in the wagon, we can not all get our particular pet fads given the prominence which we want, so we must, therefore, determine that the only road to ultimate success lies along the line of complete union to forward the great main aim of this convention. Choosing officers does not relieve a single member of this association of the responsibility which rests upon him to do all in his power, personally, to continue the agitation which has received new life and vigor at our meeting here.

It has been said that a resolution is of no service unless you put legs to it. We want our resolutions to travel, and for that purpose a strong and efficient organization is necessary to successfully crown our efforts, not in ten years, but within the next five.

Mr. Steele: I saw in one of the morning papers what I thought was a good suggestion to us, namely, that before these canals are built, the minds of a great many people will have to be broadened. I think that is the keynote for us. Senator Ferguson has stated that the matter has been pretty well threshed out, that we were all unanimously in favor of going on with the work, and that now we must arrange the finances. Well, the financing of such a work is a very heavy undertaking. The government of the country will only move when it knows it has a majority of the people behind it. I think we have made a mistake in being somewhat too narrow. At an earlier stage of the meeting I made a few remarks about the character of the interests involved. The interests involved are those of the whole people of this country.

Competition in markets of the world is going to become fiercer. In the *London World* I see a statement that samples of wheat had been shown on the London corn exchange from northern Siberia, where there existed tracts of arable land larger than the whole of the arable land of North America. These samples were similar to our hard Manitoba and Minnesota wheat. The captain of one vessel said for the past sixteen years he had sailed from London to Siberia, down the river Yenisei into this northern region. By a limited expenditure northern Siberia could be opened up for upwards of a couple of thousand miles, extending to the borders of Turkestan. There is a great deal of country not yet heard from which will send products into the market before many years.

I do not think anything has been made of the enormous volume of traffic that is going inwards as well as outwards on this continent. The *Winnipeg Commercial* had an article on "What is the matter with the trade of the country?" The writer of this article took the staple articles of this country that are imported. In Brandon granulated sugar sold, sixteen pounds for the dollar; in Winnipeg it was eighteen pounds. At the same time in Toronto twenty-two pounds were sold for the dollar. It took from four to six pounds to convey a dollar's worth of sugar from Toronto to these points. That is an illustration of very many things they use in every-day life: hardware, wire fencing, and everything of that kind. There is no interest you can name that does not depend upon agriculture as a basis for its prosperity.

I am surprised that the people of Montreal cannot see that their interests are to be served by furthering the objects of this convention, and assisting in the work of getting a deep waterway. I can understand why the people of Buffalo might resist it; but I am at a loss to see why New York and the New England states refuse to aid this movement. On the New England coast they have an industrial population of about 15,000,000 people who have to be fed. Their manufacturers have to compete with the manufacturers of the world. If they are to compete successfully, surely their policy ought to be to make such arrangements as will bring food as cheaply as possible to their working people. It is competition right straight along the line, and the people who do not recognize this are those who are going to be left behind in the race. I hope the voice of this convention will reach the whole continent of North America, that there will be no class in the community that will feel they have no interest in it. A prominent forwarder of the west has been quoted as saying that if you gave him a certain depth of water, he would cut the rates from Buffalo to Lake Superior in two. He has more than fulfilled his promise, although he has not had that depth of water. The same thing will happen with a 20-foot channel through to the ocean. Taking the average water rate from Port Arthur to Liverpool, it costs about 10 cents per bushel. Now, I feel confident that with a 20-foot channel we could cut that rate in two, and be able to send to Liverpool for just half the money. I am sure it is no exaggeration to say that with these rates cut in two within the next ten years, the saving effected to the people of the United States and Canada would be equal to the national debt of both countries, and leave a handsome surplus in the treasury besides. (Applause.)

THE NECESSITY FOR A DEEP WATERWAY.

Hon. Denison B. Smith, Secretary Toledo Board of Trade: The topic is one that from the beginning I have taken a very great interest in, and that interest increases as the years fly past me. My paper will be brief; it is in a measure a statement showing the absolute necessity for this great waterway to the sea, and in a measure a presentation of reasons of a financial character showing why it will be profitable to undertake this work for those who are engaged in commerce.

I am a born New Englander; of the strictest sect, a Puritan. But a life of nearly 60 years in the state of Ohio has softened, if not obliterated, the lines of conflict and intolerance that marked the character of my progenitors, A strong self-assertion was a living trait of those people, but that was a great moral force, and wherever the Yankee has pitched his tent in the wild and wooley west his coming has been marked by order, education, frugality, enterprise, prosperity, and bright and happy homes. These traits, including, as I said, a high order of self-esteem, were honestly derived. They were an inheritance from a race devoted to the best and highest pursuits of life. I am addressing a people to-day who are participants in the same glorious legacy. In North America, says Mr. Strong, now for the first time in the record of history, the greatest race occupies the greatest home. This future home of the great Anglo-Saxon race is twice as large as all Europe and is capable of sustaining the present pupulation of the globe. Such a country, with its future overwhelming numbers, homogeneous in their civilization, its resources fully developed, are thrice fitted to control the world's future. It is the representatives of such a people who have called this convention.

If we are not brethren, I think we ought to be. A common interest, unrestricted trade and a common destiny ought to mark and control our politics. I am in favor of free trade relations between the two countries. I do not know, and never did know, why Ohio should not trade with Canada and Canada with Ohio, as we do with Pennsylvania and New York. I have steadily maintained this position since the Union Commercial convention at Detroit in the sixties. It is commonly responded that Canada would obtain the advantage in open trade relations more than corresponding to the gain of the states, but under the influence of this English, Canadian, and New England spirit of self-esteem, I am prompted to say I should be ashamed of my people if they could not hoe a row with you all day, and all the years. Of course, reciprocal trade between Canada and the United States must be based on a parity of trade relations with other countries. I am happy to say that we have recently approached a closer approximation to these friendly trade conditions and they are good indications of the fruition of my hopes. I greet this convention as a possible harbinger of closer commercial ties.

But there are some points bearing upon the objects of this convention which demand attention and should be discussed at the threshold of our proceedings. Let us be frank. If your proposition is to open a water route for large vessels from the lakes to the sea, to include only Canadian vessels, the invitation to the exchanges on the other side to send delegates here was a mistake. If, on the other hand, you propose to adopt a broad and comprehensive policy, that will include and invite the greatest internal commerce on earth to seek an outlet to the ocean through your Dominion, on terms corresponding in all respects to the advantages of your own ships, such a policy, while it may not aid you in building your great work, will certainly aid you in supporting it.

The necessity for a channel of communication between the great lakes and the oceans of the world is growing with the years, and is inexpressibly interesting to a veteran who once knew the lakes as almost a waste of waters, whose limited traffic was confined to Lake Erie, and was represented by the emigrants' furniture, and supplies for a few western merchants; when Ohio was a frontier western state; when the maximum sail vessel tonnage was 100 tons. To compare all these conditions with the present results of a matchless growth is, I say, a never ending source of gratification. No man, living or dead, has ever witnessed so great an expansion of commerce in such a period. The waters of all the lakes are now plowed by the finest freight steamers. The evolution is from 100 to 5,500 tons; and what can more fitly illustrate a far-reaching commercial statesmanship than an outlet to the sea for such a commerce? We have no time to-day for expressions of the fancy, but as no human vision of sixty years since could have penetrated and measured this great growth in population, agriculture, mining and commerce, so whose prophetic vision can forecast the future of even twenty years?

I have spoken of the necessity of such a work as we are considering to-day, by either the United States or the Dominion. Every year sharpens the contest between the continent and other exporting states for supplying the importing states with bread and meat. The cost to the consumer is the key to the victory.

The agricultural resources of the United States and Canada are well-nigh unlimited. A recent compilation gives to the former 535,000,000 acres of land that may become productive by irrigation. On your side the productive area is equally vast, or more so. To reduce the cost of reaching the markets of the old world is not only to add to the value of our present producing domain, but every one cent per bushel thus saved expands this producing area into new fields, and where agriculture is supported, there follows the merchant, and trade, and manufacturing, and commerce. To aid in perfecting free water communications, cheapening the cost of transport, and enhancing the value of agricultural production lands, etc., is the exercise of the highest function of a government.

The point is sometimes urged against a direct exportation from the lakes to the old markets abroad, that our ships are not staunchly built and equipped for a sea voyage, and that a transfer at Montreal or New York is better. I can see no force in the position. When the time arrives that an outlet to the ocean can be counted on with surety, our ships will be built with the necessary feature of strength and the additional fuel capacity required for the trip. Again, after allowing for coal the cargoes of these vessels would equal the average shipments out of New York or Montreal. If my freight estimates are considered too rose-colored for the commencement of the traffic, I am sure time will effect a close approximation to them.

In years of large excess in exportation, as in 1891, the ocean freight on wheat from New York to Liverpool advanced to 12 cents per bushel, while the lake and Erie canal freight was 8¾ cents, including Buffalo transfer charges. The year 1894 has been a year of low freights to September 1, with present advancing tendency.

I feel justified in my estimates by the fact that the average freight rate on wheat from San Francisco to London is 26 cents per bushel. The average cargo is under 70,000 bushels. The average trip out is four months, which is eight times greater than I have given steamers from the lakes. Eight in 26 gives 3¼ cents per bushel, as a parity with our ocean trip. If the fuel is an added cost, the additional cargo is more than a compensation. But even at an increase on my figures, it is too obvious for dispute that the great supplies of food on both sides of the line must reach the consuming markets of the world by means of such direct exportation. That will be the solution of the problem. I am quite sure that on this low basis of freight, especially when the business is systemized and foreign freights can be secured for the return voyage, the commerce will prove profitable to those engaged in it.

With only quiet and sober expectations of the growth of the great west on both sides of the border, this project presents the grandest possibilities, but with one more touch upon its far-reaching effects, I must close. The tea and other commerce of the orient will reach at Toledo rapid steam transportation to London at a saving of 750 miles of rail transportation from Toledo to New York.

The great achievement of opening the commerce of the lakes to the oceans of the world, is in the direct line of developing the resources of this continent. It is an era of great conceptions and unequalled energy in execution and, in my judgment, this project is the leading culminating enterprise of the age.

Peter McIntyre: We have all listened with great pleasure to Mr.

Smith's paper. Speaking as a Canadian, I think that the Canadians will be ready to adopt the comprehensive policy outlined by Mr. Smith, provided they will not be called upon to bear more than their fair share of the expense. I think we are all united as to the economy of the deep waterway. Our friends are willing to assist us in the work of deepening the St. Lawrence canal, and for that reason some privilege should be granted them. If we have our waterway deepened to Montreal, they should have theirs deepened to New York. It seems to me there will be no difficulty in that. The management of the canal system must be international in its character.

I have had experience in sailing from Duluth to Halifax; I commenced in 1867, in a lake steamer. We experienced difficulty in changing from fresh water to salt water. Now there is so much improvement in the modern engine that there is no difficulty in the way of a lake steamer going from the lakes to any place in the world. Vessels that are able to stand the storms of Superior and Huron are able to cross the Atlantic.

W. I. Mackenzie: I had very much pleasure in being asked to participate in the preliminary work of the citizens' committee, out of which the convention has grown. I take upon myself to represent the working people of this city, in the first place, and of the whole of Canada, in the next place. I should like this movement to start with the working people and the laboring classes of the United States and Canada together. It is their question; it is the question of the man with the pick and shovel in his hand. I do not intend to make a speech further than to say this, that if we have the co-operation of the working people of Canada, and of the small traders and farmers, the question will be settled in a very short time. It need not take a quarter of a lifetime to get this thing accomplished. The greatest project that has been brought forward before any country during recent times is the one under contemplation by this convention, that is to say, the construction of a waterway from all the ports of the world right into the bosom of North America.

COL. DAVIDSON'S PAPER.

Colonel James H. Davidson, of St. Paul, presented the following paper: If, as a result of this and other like conventions, we can finally agree upon the equitable basis of trade and commerce, and an international deep waterway to the sea, we may hope that within the lifetime of the present good Queen of England, the Empress of India, we may hear her say to her stalwart son and her beautiful daughter, if they two agree, viewing their harmonious trade relations and the wonderful prosperity that would come to both, "What God hath joined together (commercially) let no man put asunder." My country wants no more territory—not another foot, and yours does not, I am quite sure; but we both want trade. We want commerce, we want manufactures, we want our forests felled, our mines opened, our natural resources developed, our fertile lands tilled, we want population, we want prosperity.

If we can, within a reasonable period of time, open deep waterways by a magnificent Canadian canal and the St. Lawrence river; by the Erie canal or Lake Champlain and the Hudson river, from the great lakes to the sea; and by a canal connect Lake Superior and the Mississippi river, and thence by that great natural trough reach the Gulf of Mexico, South and Central America and southern seas, then the blessings to result to the human race will not be bounded by the shores of this continent, but will reach to the remotest ends of the earth, and to the islands of the sea.

This work has been well begun; let us see that it does not lag for want of earnest support and zealous championship. The men who, like James J. Hill and Sir Donald Smith and their associates, have opened the Rocky mountains and cleft the Cascade range asunder with lines of gleaming steel, who have knitted together the mountains and the prairies and linked them to the lakes, and men like Capt. McDougall, who have whalebacked the lakes and the seas with a combination monster of steam and electricity, of steel and fire, more wonderful than ever was portrayed in "Twenty Thousand Leagues Under the Sea," can certainly adjust the simple elements of trade and commerce through an international deep waterway, and over the imaginary boundary line of two homogeneous nations who speak the same tongue, worship the same God, and with equal zeal seek after the "nimble sixpence" and the "mighty dollar."

Let us unitedly plan and strongly build, and work henceforth in harmony with each other, and with God's design and with His decrees, which are unchangeable, immutable and eternal.

RECIPROCITY SENTIMENTS AND CANAL DISCRIMINATIONS.

Senator Ferguson: I desire to remove an impression that appears to prevail among our friends from the other side. As a representative man in Canada I wish to say there is no selfishness on the part of the Canadian people, nor is there a desire for reprisal, as was referred to in one of the papers read before this convention. We have exhausted every effort within our power during the last thirty years to secure closer trade relations with the people of the United States. I say this for the purpose of removing a wrong impression which I believe prevails among some of our friends from the other side. In 1866 we sent a delegation to Washington to secure better trade relations; in 1868 we repeated it. That was under a liberal-conservative administration. In 1873, under a reform administration it was tried again. George Brown went to Washington with a number of clerks, and spent three months and $20,000 for the purpose of urging on the people of the United States the desirability of mutual trade relations between the two countries. In 1877 it was repeated, and in 1886 and 1887, and again in 1891. Canada has done everything within her power to effect this closer trade relation.

We desire that the Canadian canals shall be free to all; and here I wish to remove another impression made yesterday by a Canadian, and suggested also by the excellent paper of our friend from Toledo, and that was, that we discriminate against American vessels. There is no discrimination against American vessels or American ports, only in this way: by order-in-council a rebate was granted on cargoes going through the Welland canal of the grain that was brought to Montreal; what was not for export did not get the rebate. When it was used for Canadian consumption the rebate did not apply, whether it was a Canadian or an American vessel. The result of that apparent discrimination against Ogdensburg, was this: When the grain went there we could not tell whether it was to be used for home or export consumption. We could not follow the grain. That is the true explanation of the affair. I speak as a representative Canadian, and I say we desire to be as friendly as possible to the people of the United States. We have the same kind of hearts that you have, and we desire to see the commerce of this continent advance in every way, and I can assure you that the whole strength of the Canadian people will be put forward to advance the interests of the cause you are now discussing.

Mr. Faulkner: Our efforts to obtain reciprocity were in the line of natural products only. The Americans were willing to have free trade in manufactures. We have no objection to an interchange of natural products, but they wish to extend it to manufactures. I think you will find this is the cause of the trouble with regard to reciprocity.

Mr. Smith: I am not here to enlarge on this matter. When I referred to it I merely did so in an incidental way. The point, as I understand it, is simply this, that an American vessel paying tolls through the Welland canal, and going to an American port, had to pay a higher rate of toll than if the cargo went to a Canadian port. There are some exceptions to that, but they are intricate and complex, and it is difficult for us to follow them all, and therefore I hope and trust that in the future that sort of thing will be brushed away and the pathway made entirely clear.

Barlow Cumberland: The American people, in order that they might aid the transport of their internal products to the seaboard, took the tolls off the Erie canal and made it free for all products of the west which were passing through that highway. We, in Canada, could not afford to go to the same extent that you did, and we made the tolls upon our Canadian canals free upon whatever was going out for export; there was no rebate on business within our own borders. We admitted American vessels to the same privileges as our vessels enjoyed in this respect. The American vesselmen asked for something more. They asked to be allowed freedom of tolls when transacting trade in which the Canadian vessels could not be engaged. A Canadian vessel carrying grain from Chicago to Kingston and Montreal for export paid no toll; an American vessel doing the same likewise paid no toll. The Americans claimed that a vessel going from Chicago to Ogdensburg should be granted the use of the Welland canal. This was a business in which the Canadian people and the Canadian vessel men could not be engaged, and therefore our Canadian government said, "That is not upon similar terms, as the canal is used by the Canadian people." There was no answer to that question; they simply said, "We do not agree with you, and in consequence of our non-agreement we will deliberately break the terms of the Washington treaty and charge your vessels going through the Sault Sainte Marie canal."

What was Canada's reply to that? We objected to it in as honorable a way as one country can to another, and finally our government paid the charges that the Canadian vessels had been subjected to going through the Sault Sainte Marie canal. The answer of the Canadian people to that was that they would pay all that, even under a misconception, was demanded of them. We would not cavil with the decision to which you had come and we spent $2,500,000 in building a canal for ourselves to which we to-day invite the whole continent of America to use on the same terms as Canada. I hope we shall never more hear of this question of reprisals in navigation matters. They are based upon misconceptions and they have been in the past a source of irritation between the two peoples. We are ready to join with you in developing the internal communications of this continent.

Let me take the opportunity of saying that one of the prime objects that this convention should seek is to enforce the immediate completion of the work the Canadian people now have in hand. It is now 23 years since we first commenced to enlarge our canal to 13 feet. It has taken 13 years to go from 9 to 14 feet. To-day we stand in sight of the time when vessels can go without transhipment from the northwest to the sea. It was promised us in 1890. Afterwards it was again promised to be completed in 1893. This agitation of additional deepening has lost us three years, but the day is past for agitation of that kind because all the contracts have now been let and nothing an prevent the completion of our canals in 1895. What has reduced the rate from the northwest to New York? Your canal is no larger than it was when the rates were 25 cents. Your rates are now between 6 and 7. It has been the gradual increase of the size of vessels between Chicago and Buffalo. We have before us in the immediate future a perfect revolution. At the present time a vessel which brings 100,000 bushels to Buffalo is unloaded into canal boats of 8,000 bushel capacity. It takes one of these large boats and 12 canal boats to reach tidewater. At the present time we can bring down vessels of 14 feet to Kingston, but there we have to transship. As soon as the St. Lawrence system is completed to 14 feet a vessel with two tows of 50,000 bushels each will be used instead of one vessel and 12 barges. The opening of the completed canals will bring about a revolution in traffic by allowing these vessels to transship alongside the ocean vessels at Montreal. I hope, therefore, you will urge the immediate completion of the present incomplete system and this completion will then bring the fruition of 23 years long work and be a step in the direction in which you all desire to go, namely, the securing of deeper communication between the interior of the continent and the sea.

COLLINGWOOD-TORONTO AIR-LINE.

Mr. Frank Moberley read the following paper:

Mr. Chairman and Gentlemen: The Toronto and Collingwood air-line railway, although perhaps not of the imperial magnitude of other matters brought before you, yet will beneficially affect so large a section of the community as to be worthy of your earnest consideration. This railway it proposed to build from Collingwood, which is at the extreme southerly end of Georgian bay, to Toronto, on as nearly an air-line as possible. The distance is about 70 miles, and the country passed over is particularly favorable for railway construction, and (one of the principal features in a railway intended for cheap carriage) the grades will be light.

At Collingwood there is an excellent harbor, approachable in all weathers, and which can be deepened to any extent necessary at a reasonable cost. The approach from the land side is good. It is proposed to make the Toronto terminus at Ashbridge bay; the trade being principally with the east, that would b~ the most convenient place for handling a heavy traffic.

This railway would place Toronto within two hours' haul for freight of the trade of the upper lakes, and being furnished with most approved appliances for the handling and transport of grain, it is intended the cost of carriage shall be reduced to a minimum, the through rate being such as to offer a material improvement on those now in vogue. This will be principally effected by the saving in time and distance.

Taking a point outside of the straits of Mackinaw which is common to all shipping either from Lake Superior or Michigan, the distance to Toronto via the air-line is 300 miles, which makes it 340 miles shorter than the all-water route; it places Toronto that much nearer the sea by the St. Lawrence route, and it also places freight by this route 290 miles nearer Boston and New York than by way of Buffalo, besides which shipping would avoid the dangerous navigation of Lakes Huron and Erie. Grain would be placed in Toronto with less time and cost than it could be placed in an equally favorable position by any other route, and Toronto has, as a distributing point, advantages held by no other place in regard to the number of competing routes that would receive the grain there. That for export, having the choice of the St. Lawrence, Boston and New York, while that required for the great centers of population to the south of us would reach its destination by way of Oswego and Rochester.

The amount of grain and its products traveling by northern routes from west to east amounts to about 400,000,000 bushels per season, less than one-half of which is for foreign markets, the balance being consumed in the eastern states and maritime provinces. Some thirty or forty millions of bushels of this reaches its distination by routes east of Toronto and the balance by routes west, but principally by way of Buffalo.

The port of Buffalo received by way of water alone last season 190,000,000 bushels of grain, and it also received 10,000,000 barrels of flour; and Toronto, although the most favorably situated to handle this traffic, did not recive a pound. That new competitors are entering the field for this trade is instanced by the construction of the Ottawa & Parry Sound, the Ottawa, Irondale & Orillia railways, both of which will run to the Georgian bay, and neither of which will help Toronto trade.

With Toronto as a distributing point a trade would be opened up by way of the St. Lawrence with the maritime provinces, the transfer of grain being made to ocean vessels, say at Pictou, where a return cargo of coal, or the ocean vessels' cargo for the west, would be obtained. The maritime provinces import their breadstuffs, and import largely in excess of their local requirements to meet a trade demand of their own. The ports of

River Du Loup and Rimouski would be favorable points to open a trade with New Brunswick.

The bulk of the trade, however, would always be with Oswego and Rochester, where the grain is required for home consumption by the country south of those ports. Oswego and Rochester also provide the principal supply of hard coal; and it is hoped arrangements can be made to handle this so cheaply as to furnish return cargoes west of Collingwood.

As a commercial enterprise the possibilities of the air-line can be readily arrived at. Having the shortest and cheapest route, we are pretty sure of a share of the traffic, knowing the amount of that traffic open for competiton, and being able to accurately estimate the cost of building and maintaining the road. We have data by which we can form a good idea of the results.

Toronto has expended enormous amounts on improvements. It is necessary she should lose no opportunity to increase her trade and revenue to be able to maintain her works in efficiency.

Mayor Telfer, Collingwood: While I am in the fullest sympathy with the great scheme of canal enlargement of our waterways, yet I believe, as time is the essence of the contract in this as in other things, that the most direct route will be adopted, and that is certainly via Georgian bay and through the province of Ontario into Lake Ontario. As Mr. Moberley has told you, this is the most direct route, and the work can be completed in a short time. It shortens the distance some 330 miles, and can be completed at an estimated cost of $2,500,000. If we as Canadians put our shoulders to the wheel I think we have the golden opportunity of capturing the trade of the west, inasmuch as the enlargement of the canals is not within the ability of this country to cope with in the immediate future. I think as Canadians we should think twice before inviting international effort to complete our waterways.

Mr. Nettleton: There is one phrase of this discussion that has been entirely lost sight of. What effect will the deepening of the waterways have on the lowering of the great lakes? As you are no doubt aware, the water has been going down on the upper lakes, and is now two feet lower, nearly all over the lakes, than it was some years ago. It is said the deepening of the Lime Kiln crossing has been the cause of that. In building the air-line proposed by Mr. Moberley we would get over that difficulty. This route will save the deepening of the Welland canal. The Soo canal is to be 20 feet. We have 16 feet in Collingwood, and it can easily be deepened to 20 feet. It is proposed to have floating elevators at Collingwood, and to run the grain by large cars through to Toronto. The estimated cost is 1 cent per bushel. By this air-line route we save over 300 miles of lake navigation. The project involves elevation, but I understand this process greatly improves the wheat. I think this is the only immediate and practical project by which we can relieve the congestion of the upper lakes and help the farmers of the northwest.

Mr. Steele: I think cheap transportation of produce is fairly within the scope of this association, no matter by what method that cheapening may be effected. Mr. Moberley is a gentlemen of wide experience. He has been in the railway business since 1866. By his scheme Mr. Moberley will be able to carry grain from Collingwood to Toronto at 1 cent per bushel. He proposes to build cars of 100 tons capacity. If he can do what he says, the whole matter is brought within the bounds of feasibility. While it is my earnest desire to see a 20-foot channel, at the same time I recognize the fact that the construction of such a channel is going to be the work of years. If Mr. Moberley can carry grain between the two points for 1 cent a bushel, and save over 600 miles on the round trip, he is going to assist very largely in solving this problem.

WEDNESDAY, SEPTEMBER 19—AFTERNOON SESSION.

AN ENLARGED WATERWAY TO THE ATLANTIC SEABOARD.

Mr. James Conmee, Port Arthur: What I have to say is not altogether on the St. Lawrence, though I may touch on that question before sitting down. I desire to discuss this canal almost entirely from a Canadian standpoint. I do not agree with those who say that the deepening and enlarging of these waterways is not within the resources of the Dominion of Canada. I see no reason why these canals could not be under joint control, but I contend that the completion of the work is quite within the means of the Dominion.

To satisfy the public mind that it should be undertaken by our government it is necessary to show:

1. That the advantage to the general public will be commensurate with the expenditure.
2. That there is an urgent and public necessity for the demand made.
3. That the route proposed is the best that can be selected.
4. That it is feasible.
5. That its accomplishment is within our means.

If it can be shown that the sum of money that may be required to carry out the undertaking in view can not be otherwise employed to so great an advantage to the general public, the claims of the undertaking to public attention is at once established.

That the undertaking, if carried out, would be of great public advantage may be seen by a comparison of the present cost of transportation from western Canada to the seaboard as compared with what would be available if the contemplated works were completed, and by a consideration of the advantages that would otherwise accrue by reason of the changed condition.

The Canadian Pacific railway lake and rail route from Fort William to Montreal is at present 15 cents per 100 pounds, or 9 cents per bushel, on wheat; the average rate at present by the all-water route from Fort William or Port Arthur to Montreal (and I presume about the same rates are available from Duluth), is 6½ cents per bushel, chance cargoes being carried as low as 5½ cents, thus ranging as high as 7½. There are but a few vessels engaged in the traffic on the lakes that take their cargoes, or even a portion of their cargoes, through the St. Lawrence canals to Montreal, and but a small percentage of our grain is carried that way.

The value to the public of water carriage as compared with rail carriage, and the advantages of canal construction to increase the scope of navigation, is forcibly shown by Mr. E. L. Corthell, an eminent American engineer, in an able and instructive paper written by him in 1890, in which he estimates the cost of enlarging the St. Lawrence canals to 21 feet depth, and to the desired dimensions, at $27,000,000, assuming our canals to have now a depth of 14 feet throughout.

The average tonnage of cargo through the St. Lawrence canals to Montreal is about 500 tons. With the waterways completed to a uniform depth of 20 feet the tonnage of cargoes would increase to 3,000 tons and upwards.

Statistics show clearly that reduction in freight rates have, generally speaking, been forced upon the railways by water competition, made possible by canal construction; and that as the waterways have been enlarged, the capacity of vessels has increased, and freight rates have been thereby correspondingly cheapened. Railways too, in order to compete, have been forced to increase their carrying capacity. A few years ago 10-ton cars were the rule, then 20 and 30 tons, and so on up to 40 and 60 tons, and rates have fallen from 2½ cents per ton per mile to ½ cent per ton per mile.

In 1855 a report was signed by the superintendent of the four trunk lines in the state of New York, and presented in congress, in which it was claimed that the lowest rates at which ordinary freight could be carried by rail and pay interest and expenses was an average of 2½ cents per ton per mile for agricultural products, 3 cents for groceries, and 4 cents for dry-goods.

The average cost per bushel for the carriage of wheat from Chicago to New York, from 1868 to 1893, by the lake and Erie canal, was 5.44 mills per ton per mile. The lake and rail rate was 6.66 mills per ton per mile, and the all-rail rate 12.67 mills per ton per mile. The present all-rail rate is 5 mills and under per mile.

Vessel owners who are taking cargoes through to Montreal state that with a uniform depth of 20 feet they could employ larger vessels, and could make as much profit on a rate of 2½ cents per bushel from Lake Superior ports to Montreal as they now make with the present class of vessel, and at the present rates.

From statistics submitted to congress in 1891 by the engineer of the Sault canal, it is shown that the average cost of lake transportation for the season of 1890 was 1½ mills per ton per mile. And by the statistician of the inter-state commerce commission it was shown that the average all-rail rate was 9.22 mills per ton per mile. Coal has been carried from Buffalo to Duluth, about 1,000 miles, for 25 cents per ton, or a rate slightly less than 1 cent per bushel on wheat.

With such a channel completed our grain and other exports would seek tide-water by the St. Lawrence route, and a much increased volume of the import trade would be drawn to it as well, while local traffic and interchange between the east and the west would rapidly increase. To be in the pathway of such a commerce would be of great advantage to our river and lake ports. Assuming that the total cost of enlarging the waterways from Lake Superior would aggregate $50,000,000, the annual saving to Canadians on the present basis of production would be ample, as I shall presently show, to pay interest and sinking fund charges on that sum.

Of the 3,678 miles from Fort William or Port Arthur to Liverpool (and which is over 700 miles shorter than via Buffalo and New York) there is but 71 miles that is restricted by natural obstacles, which here and there impede commerce. Is it to be contended that the modern resources, skill and energy of the western half of the continent, or even of the nation, are not capable of overcoming these barriers that at present obstruct our progress, and not only handicap our people in their competition with the products of India, Russia and Argentina, but permit avaricious grain speculators to extort undue profits from our producers?

It is not only Ontario, Quebec and the western provinces, that will be benefited, but the maritime provinces as well, as a means for their coal, iron and other products to reach the west will be made available. With the Chignecto ship railway completed, their shipping could participate in the lake traffic without difficulty. The benefits to be derived from the undertaking are not easily estimated, but some idea may be gathered from the fact that grain has been lately carried from New York to Liverpool, over 3,000 miles, for 2½ cents per bushel and under.

It is a fact well known that the major part of our grain is now shipped to American lake ports, west of the Welland canal. Why is this the case? The answer is to be found in the fact that over 400 vessels now plying on the great lakes, mostly American, draw too much water when laden to pass through the Welland canal. The great majority of vessels, both Canadian and American, are shut out from the St. Lawrence canals by reason of their short lockage and shallow water. The necessity for increasing the capacity of our waterways is forcibly emphasized by the fact that while the traffic through the Sault canals has increased to 10,000,000 tons annually, the tonnage of the St. Lawrence canals has remained about the same as in former years, being for the year 1892 but 518,373 tons both ways, the in tonnage being but 31,958 tons. It is quite evident that if Canadian vessels are to compete with American, or, in other words, if they are to handle our own grains, they must be equal in capacity.

The Welland canal has 14 feet of water, but already the vessels that can not pass through it when loaded have an aggregate tonnage of over 500 000 tons, while those that do pass through are obliged to reduce their cargoes by over 50,000 tons annually in order to get through, and at or below Kingston further transshipments are made so as to enable the few vessels that engage in the St. Lawrence trade to get through to Montreal.

The question is to be considered, however, from another point of view, viz., what does the producer under present conditions realize for his product, and what would he realize were the channel enlarged? The Manitoba farmer, the producer of the best wheat in the world, gets from 38 to 39 cents per bushel, when it is selling in Liverpool for 71 cents, a difference of 32 to 33 cents. This is not all occasioned by freight charges, for with the present rail rate from Winnipeg to Fort William, 10½ cents per bushel, and the rate from Fort William to New York via Buffalo, 6½ cents (the average rate during the season of 1892, as will presently appear), and the ocean rate, 4 cents, and allowing 3 cents for elevator and commission charges, we have a total of 24 cents for freight and other charges from Winnipeg to Liverpool, so that the producer should even now receive 46 to 48 cents per bushel, or 8 to 9 cents over the present price, and would probably do so were it not that he is handicapped by New York control. This view of the situation was forcibly put by Mr. James B. Campbell, of Montreal, in a letter published by him in April last. Mr. Campbell shows clearly that prices are based on New York grades, which are much inferior to our own, and that New York capital takes advantage of our want of facilities and is enabled to make abnormal profits at the expense of our farmers. The reason for such a state of affairs is the inability of our vessels and canals to handle the trade. Our producers cannot hold over their grain, and to compete successfully they must have facilities to market the yield each year, between the harvest and the close of navigation, at the lowest possible cost. It is argued that we should go more into mixed farming, so as to condense the products. The advice is good, but it does not obviate the necessity for this enlarged channel. Over-production may, and doubtless will, cause a fall in the price of meats, cheese and butter, just as it has in wheat; besides the product in whatever form, must be marketed, and in any case the cost of transportation is the important question and point of difficulty, so as far as western Canada is concerned. If the country is to sustain a large population, cheap and rapid transportation must be afforded. The distance from Fort William, or Port Arthur, to Montreal, by the all-water route, is 1,025 miles; from Chicago to Buffalo the distance is somewhat less, but for water rates it may be considered practically the same. Wheat has been carried from Chicago to Buffalo for 2 cents per bushel. Vessels are taking cargoes of three thousand tons and upwards because of the deep waterway that now exists on that route. Were our waterways improved we could get as cheap rates, or nearly so, from Fort William to Montreal as we now obtain from Chicago to Buffalo, which may be put at 2½ cents per bushel, and having regard to the downward tendency of freights and to the competition that would arise, it is not too much to assume that with the ocean rate at 4 cents and under Manitoba wheat could be put in Liverpool from Fort William for 6½ cents, making, even with the present rail rate of 10½ cents from Winnipeg to Fort William, a total of 17 cents per bushel freight charges to Liverpool.

But further rail competition between Fort William, Port Arthur and Manitoba, which the carrying out of the enlarged channel would greatly stimulate, it is reasonable to assume, would bring the inland freight rates down sufficiently to reduce the figure to 15 cents, and even to 12 cents. Grain is now carried by rail from Buffalo to New York, 440 miles, the same distance as from Winnipeg to Fort William, for 5½ cents per bushel. Assuming our waterway completed as proposed, and taking the lake and ocean rate at 6½, and the rail rate between Manitoba and Fort William at 5½, we have 12 cents freight charges from Winnipeg to Liverpool. But even assuming that the rail rate from Winnipeg to Fort William will not fall below 6 or 6½ cents, and allowing also 3 cents for elevator and commission charges, we would be able to put Manitoba wheat in Liverpool for from 15 to 16 cents total charges, and taking the present Liverpool prices at 71 cents, the Manitoba farmer should receive 55 or 56 cents for his wheat, or from 15 to 16 cents over the price he at present receives. That this is not an over-estimate of what may be expected is shown by the annual report of the department of railways and canals, Canada, for the year ended 30th June, 1893, which gives a statement of monthly freight rates for the season of 1892, from which I take the following: This report shows that the rate on wheat from Duluth to Buffalo during the season of 1892 ranged from 2¼ to 4 cents per bushel, the average being 3 cents. The canal rates on wheat from Buffalo to New York for the same season range from 2⅛ to 6 cents per bushel; the average for the season was 3½ cents. So that if we take the two average rates we have 6½ cents total freight charges from Duluth to New York. The average monthly rate during the season from Fort William to Montreal is not given, but I learn from reliable shippers that during 1892 it ranged from 6½ to 9 cents, the average being 7¼ cents per bushel, so that the Montreal route was in 1892 at a disadvantage as compared with the rate via Buffalo to New York of 1¼ cents per bushel (and I assume proportionately so on other freight) notwithstanding that via that route there are over 400 miles of canal to traverse, while by the St. Lawrence route there are 71 miles. [1]

The facts and considerations here presented establish the affirmative of the propositions under review, and fully warrant the conclusion that the advantages amply justify the proposed expenditure.

The greatest problem before the Canadian people to-day is the question of how best and quickest to reduce to a minimum the difference between the price paid by the consumer for our products and that realized by our producers.

In addition to the foregoing there is the Hurontario ship railway, or canal, as the case may be, which is incidental to this undertaking, but does not necessarily form a part of it, and if carried out would reduce the distance by at least 275 miles, and would doubtless afford a further saving in freight rates.

What I have said in regard to Canadian traffic and the interchange of commodities between the eastern and western populations applies with equal force to the United States. They, too, will be greatly benefited by the deepening of this great waterway—which should be free—and will share in the prosperity which it will spread over the great basin of 457,000 square miles tributary to and drained by the great lakes.

Estimating the present export of western Canada (that will be affected) including grain, flour, live stock, etc., to be equal to 15,000,000 bushels of wheat, a figure which I am assured is well within the mark, the direct benefit of our producers would, as already shown, be from 15 cents to 16 cents per bushel, or a saving of $2,250,000 annually. Canada can borrow the $50,000,000 (the estimated cost of the work) at 3½ per cent. The interest on this sum annually would be $1,750,000, leaving still to the good out of our annual saving on exports only the sum of $500,000, which, if invested annually as it accrues, will, with the accumulated interest, liquidate the debt for construction in forty years. Even if the expenditure was $60,000,000, as some estimates have put it, the saving on the class of exports would pay the interest on the cost and liquidate the same in fifty years. It will take some years to execute the work, and interest would have to be paid on the sum expended each year for which there would be no corresponding return. But even assuming that the charge would amount to five or six millions during the progress of the work, the saving to the country on imports and local traffic between Canadian ports will fully compensate for the charge, to say nothing of the prosperity that it will bring to the people. Besides, the country is not going to stand still. If our exports from western Canada are now equivalent to 15,000,000 bushels of wheat, it is reasonable to assume that ten years hence, or by the time the channel is completed, they will be equal to over 20,000,000 bushels, the extra saving on which will be ample to cover all possible contingencies. The conclusion, therefore, is inevitable that in our own interest, and as a further bond to bind the provinces together, Canada should proceed with the work.

It may be argued that although the United States has spent vast sums of money on the improvement of the Mississippi river, traffic on it has not increased to the extent anticipated, but it must be borne in mind that the case with which we are dealing is quite dissimilar to that of the Mississippi. What can be accomplished here can never be hoped for in that connection. It is, however, a fallacy to assume that because the volume of traffic on the Mississippi has not increased to the proportions anticipated, therefore the benefits are not commensurate with the expenditure. Mr. Corthell in his most excellent paper states that the improvements on the Mississippi give a direct advantage to the producers of the Mississippi valley of from $50,000,000 to $100,000,000 annually. For the reason that it not only affords greater shipping facilities, but, if for any cause the freight rates by rail rise, the river acts as a regulator to bring them down again.

However the work may be accomplished, whether jointly or separately, it is a work of the first importance in the interests of both Canada and the United States. If constitutional questions, or national sentiment, or other reasons prevent a joint control, yet each nation can complete those portions lying within its own borders. The St. Lawrence and its connections form a long boundry line and each nation can improve stretches of channel on its own side. Already we reap great advantages from the many channels connecting this great system, which have been deepened at the expense of the United States, and in like manner they have received advantages by expenditures that were made by the Domininion of Canada. No sound reason exists why united action should not be taken. Surely these two great nations, with kindred peoples and a common language, are not long to be baffled by barriers to their commerce which are inferior in point of difficulty and magnitude to works that have already been accomplished by each.

Canada has already expended in round numbers $100,000,000 on her great national railway from ocean to ocean, which has been of great advantage to the nation, but no one can dispute but that the enlargement of our waterways to the seaboard can be accomplished for a much less expenditure and that it will be of much greater public advantage.

The history of the St. Lawrence canal system, viewed from the light of to-day and with our present ideas of the future, present a lamentable want of foresight. No doubt much of our backwardness in this respect is to be accounted for by the colonial system of government that existed prior to 1791, and that which existed down to confederation, and by financial considerations and other exigencies that had to be met in those early days. But making allowances for all these and considering that we have had a national government for over a quarter of a century, it is quite evident that what has most retarded our canal improvement is the want of a comprehensive and systematic scheme of construction. We are not alone in this respect, our American neighbors have made the same mistakes, and are less excusable as their means were more ample. In their haste to traverse every section of their great country with railway lines they have overlooked the cheaper and readier means of transportation which a proper system of canals would have afforded them. We may claim to have followed their example, but whatever excuse we may assign for the mistakes of the past, there can be no excuse for further delay in putting our canal system on a proper basis.

Our best energies and our first attention should be directed to the one means by which our producers can be put in a position to compete with those of other countries. The advancement of the material interests of our ow i people should have paramount consideration over such novelties as a "Fast Atlantic Line," and "Oriental Trade." These latter are well enough in their way, but they will do very little if anything to enhance the price of our products.

It was a military necessity that at first brought about the construction of the St. Lawrence canal system, and the people now have it in their power to make it a political necessity to put them on a proper basis, and to have them completed with despatch.

Without going into a minute history of the St. Lawrence system of canals it may be pointed out that the total mileage of the canals, and their artificial connecting channels, is seventy-one miles, with about fifty locks and a total rise of 355 feet.

In considering the enlargement of the channel at Lachine to the dimensions proposed by the platform of this convention, it may be asked, why not utilize the channel which nature has provided, instead of making an artificial one? Being familiar with the conditions at this point, I believe the north channel could be utilized, and the lockage reduced to one lift, by cutting a channel from the Montreal harbor to the easterly outcrop of Au Heron island and by damming that channel of the river, from the island to the north bank, and running a wing-dam from the head of the island to the head of the rapids, and putting in a lock or a hydraulic lift to raise vessels from the lower channel to the water above the dam. From the Montreal harbor to the channel of the river south of Nun's island it has at present a depth of from 12 to 18 feet of water until the head of that island is reached. From there to Au Heron island the water varies from 4 to 25 feet, so that the heavy cutting to reach the desired point would probably not exceed 2½ miles. The banks of the island are 21 feet above the present water level, and the bed of the river has a deep channel, running from the foot to the head of Au Heron island, varying from 17 to 25 feet in depth and from 18 to 40 feet in width. So that, having regard to the rise of water effected by the cross and wing-dams, all that would be required above the cross dam would be the cutting off of the projecting points of the river bottom to the head of the rapid. The work would be light, except at one or two points, for short distances only. The effect of the cross-dam and the wing-dam would be to deaden the current, so that vessels could navigate the river without difficulty. A glance at the charts and an examination of the ground will show that the conditions are favorable for this plan. I am not giving my own opinion only, but that of several engineers who have examined into the matter closely. The only surprise is that it has not been previously adopted, as the dam itself would afford a great water power, which could be utilized in the city, and which would, I believe, prevent very largely the periodical back-water floods at that point.

Similar conditions exist at most of the other points. The total rise of the new Soulanges canal at Beauharnois is 82½ feet. Of this rise 70 feet is made in the first three-quarters of a mile by four lifts of 17½ feet each, showing that conditions exist by which the lockage could be reduced to one or two lifts. But we are not called upon to define the scheme by which the work is to be carried out. We will have done our duty when we have established the necessity for its execution, and shown that the benefits to the general public warrant the expenditure. The governments of the day are charged with the administration of the public revenues and the conduct of public works. Upon them devolves the duty to determine the scheme by which this great work shall be accomplished.

Mr. McIntyre: While I am glad to hear such a rose-colored view, I would like to get Mr. Conmee to explain how he can run a vessel, even of the largest size, from Fort William to Montreal at a 2½ cent rate?

Mr. Conmee: The distance is only 1,000 miles and they are carrying from Duluth to Buffalo and from Chicago to Buffalo for two cents.

The Chairman: For one cent.

Mr. Conmee: We are safe in saying two. If they can carry at that rate now, with ample water channel they can carry from Fort William to Montreal at the rate I have quoted.

Mr. McIntyre: But that is all open water, and you cannot run at the same rate in a canal,

Mr. Conmee: But of the 1,000 miles, there are only 71 miles of canals, and the freight now from Chicago to Buffalo is only two cents.

Mr. McIntyre: But there are no canal tolls, that takes 20 cents a ton off.

Mr. Conmee: My calculation was based upon the assumption of free canals.

Mr. McIntyre: In all calculations as to cheap rates you must take into consideration the return cargo. According to Mr. Conmee's figures you would need full return freights.

Mr. Conmee: You would have the return freights. I did not enlarge upon it, as I did not want to take up the time, but this scheme is common with the Hudson river and Lake Champlain route. The best interest of Canada would be served by affording easy means of reaching the great cities of the United States.

Mr. Steele: During this summer grain has been carried from Chicago to Buffalo for 1¼ cents, and in some cases the vessels have only been able to obtain ⅞ cents. None of the vessels carrying at this rate have drawn over 17 feet of water. In view of these facts, it seems to me that Mr. Conmee's estimate is not too sanguine of what can be done when the 20-foot channel has been made.

Mr. Harvey: When, by means of deep waterways, you have reached the head of the great lakes, you are only at the edge of the prairie country, but at the end of the Canadian and the American great lake routes are enormous water powers, and I should like to see as an extension of the waterway system a project of transportation on land by means of railways run by power developed by electricity. I think that before half the members of this convention go over to the great majority we shall see the water-powers of Keewatin and Kakabekha falls and of the enormous powers of the lakes near the height of land in Minnesota profitably employed in furnishing transport and thus reducing freight rates from the interior prairies to Lake Superior. If we can save the cost of coal, and greatly reduce the expenditure for engineers and train hands, we shall probably get the interior rates reduced to half the present figures.

REPORT OF THE COMMITTEE ON RESOLUTIONS.

Gentlemen of the Convention: Your committee, to whom was referred all notices, prayers and resolutions, organized by adopting the motion of a committeeman, that only matters coming within the terms or meaning of the call under which this Deep Waterways convention came together be considered, and that all others be held for such action as the convention itself might determine. We have prepared and unanimously adopted and present as our report the following:

PLATFORM.

WHEREAS, This convention has assembled for the purpose of promoting the union of the lakes and the high seas by waterways of the greatest practicable capacity and usefulness; and, recognizing the supreme utility of such waterway development,

Resolved, That the depth of all channels through the lakes and their seaboard connections be not less than 21 feet, and that all permanent structures be designed on a basis of not less than 26 feet, in order that the greater depth may be quickly and cheaply obtained whenever demanded by the future necessities of commerce.

Resolved, That this convention recognizes the utility of the natural route to the sea by the St. Lawrence river as most quickly and cheaply improvable, and is also impressed with the commercial necessity of the route reaching the Atlantic ocean via the Hudson river.

Resolved, That we recommend that the governments of Canada and the United States appoint a joint commission to consider and report fully upon the advisability of the two countries uniting to establish deep ship channels from the great lakes to the sea, free and neutral, at joint expense, under joint control, as well as the probable character and expense thereof, together with the equitable share that should be charged to each country, and whether the two countries may not co-operate in said undertaking in all matters necessarily international in character.

Resolved, That we cordially approve all projects designed to extend marine commerce by means of waterways from the great lakes into new territory.

Resolved, That as a preparation for the joint promotion of common interests, it is desirable that a permanent court should be constituted for the decision by rules of law of all questions of an international character which may in any wise arise between the peoples and governments of the British empire and the United States.

Resolved, That these resolutions be respectfully communicated to the governments and parliaments of Great Britain and the colonies of the British empire and the government of the United States.

The following resolutions were also adopted, but not as a part of, though intended to be supplemental to, the general platform:

Resolved, That with the least possible delay the present locks of the St. Mary's Falls canals should be deepened to 26 feet over their miter sills.

Resolved, That it having come to the knowledge of this convention that Canadian boats are prevented from passing through the Whitehall canal, and are therefore unable to use the water communication between Montreal, Ottawa and Quebec to New York, while the American boats have the freedom of the Canadian canals, which enables them to use this route free and untramelled, the government of the United States is respectfully urged to take steps at their earliest covenience to carry out liberally the treaty of 1871, and thus enable Canadian boats to enjoy the same privileges in American waters that American boats enjoy in Canadian waters.

Resolved, That it would be desirable for an international commission of engineers to determine the outflow of the several great lakes and the practicability of employing dams or other works at the outlets of such lakes for the purpose of raising and controlling their levels, and thus deepening the waters at slight expense in the several harbors thereof, as well as the waters over the dangerous shallows at the mouth of Detroit river and at the foot of Lake Erie.

FRANK A. FLOWER,
Secretary.

September 19, 1894.
Unanimously adopted by the convention.

WEDNESDAY, SEPTEMBER 19—EVENING SESSION.

REPORT OF COMMITTEE ON PERMANENT ORGANIZATION.

Gentlemen of the Convention: Your committee, to whom was referred the matter of permanent organization of this convention, beg leave to report as follows:

NAME.

International Deep Waterways Association.

OFFICERS.

International President—Oliver A. Howland, M. P. P., Toronto.
International Vice-President (*U. S.*)—L. E. Cooley, C. E., Chicago.
International Vice-President (*Canada*)—James Fisher, Q. C., M. P. P., Winnipeg.

STATE AND PROVINCIAL PRESIDENTS.

Colorado—Senator E. O. Wolcott, Denver.
Iowa—A. P. McGuirk, Davenport.
Illinois—Captain J. S. Dunham, Chicago.
Indiana—T. W. Venemann, Evansville.
Michigan—Hon. H. W. Seymour, Sault Ste. Marie.
Montana—Senator Thomas C. Power, Helena.
Minnesota—W. C. Sherwood, Duluth.
Massachusetts—Edwin H. Abbot, Boston.
Nebraska—E. Rosewater, Omaha.
New York—F. S. Witherbee, Port Henry.
North Dakota—Geo. B. Clifford, Grand Forks.
Ohio—Luther Allen, Cleveland.
Pennsylvania—James A. Henderson, Pittsburgh.
South Dakota—Senator R. T. Pettigrew, Sioux Falls.
Wisconsin—Hon. Frank A. Flower, Superior.
Wyoming—Hon. Joseph M. Carey, Cheyenne.
Assiniboia—Capt. Davidson, M. P. P., Indian Head.
Manitoba—T. W. Taylor, Winnipeg.
New Brunswick—J. Robertson, St. John.
Nova Scotia—D. McKeen, Glace Bay.
Ontario—J. Brown, Toronto.
Quebec—R. R. Dobell, Quebec.
Saskatchewan—Captain D. H. McDowell, M. P., Prince Albert.

EXECUTIVE BOARD.

Ex-officio—Oliver A. Howland, M.P.P., Toronto; L. E. Cooley, C.E., Chicago; James Fisher, Winnipeg.

Elected—Frank A. Flower, Superior, Wisconsin; A. L. Crocker, Minneapolis, Minnesota; James B. Campbell, Montreal; Edwin H. Abbot, Boston; J. S. Dunham, Chicago; James Conmee, Port Arthur; James Snydam, St. Paul; H. W. Seymour, Sault Ste. Marie; R. R. Dobell, Quebec; A. Gifford, Meaford; L. R. Keck, Cincinnati.

Recommended; That in case the convention shall adopt this report, the executive board herein provided be and is hereby charged with the duty of drafting a constitution and by-laws, formulating an address or memorial to the people of both Canada and the United States, and providing generally to carry into effect the objects of the permanent association, with full power to act finally in all such matters.

Respectfully submitted,

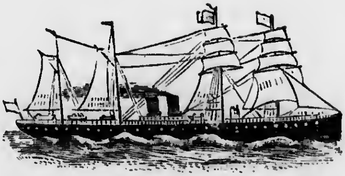
FRANK A. FLOWER, *Secretary*.

September 19, 1894.

Unanimously adopted by the convention.

Adjourned.

On Wednesday evening the Toronto city council gave a handsome banquet in the Rossin House to the members of the convention and on Thursday provided a ride about the city.



Fundamental Principles.

Toronto Platform—September 19, 1894.

WHEREAS, This convention has assembled for the purpose of promoting the union of the lakes and the high seas by waterways of the greatest practicable capacity and usefulness, and recognizing the supreme utility of such waterway development,

Resolved, That the depth of all channels through the lakes and their seaboard connections be not less than 21 feet, and that all permanent structures be designed on a basis of not less than 26 feet, in order that the greater depth may be quickly and cheaply obtained whenever demanded by the future necessities of commerce.

Resolved, That this convention recognizes the utility of the natural route to the sea by the St. Lawrence river as most quickly and cheaply improveable, and is also impressed with the commercial necessity of the route reaching the Atlantic ocean via the Hudson river.

Resolved, That we recommend that the governments of Canada and the United States appoint a joint commission to consider and report fully upon the advisability of the two countries uniting to establish deep ship-channels from the great lakes to the sea, free and neutral, at joint expense, under joint control, as well as the probable character and expense thereof, together with the equitable share that should be charged to each country, and whether the two countries may not co-operate in said undertaking in all matters necessarily international in character.

Resolved, That we cordially approve all projects designed to extend marine commerce by means of waterways from the great lakes into new territory.

Resolved, That as a preparation for the joint promotion of common interests, it is desirable that a permanent court should be constituted for the decision by rules of law of all questions of an international character which may in any wise arise between the peoples and governments of the British empire and the United States.

Resolved, That these resolutions be respectfully communicated to the governments and parliaments of Great Britain and the colonies of the British empire and the government of the United States.

Resolved, That the executive board herein provided be and is hereby charged with the duty of drafting a constitution and by-laws, formulating an address or memorial to the people of Canada and the United States, and providing generally to carry into effect the objects of the association, with full power to act finally in all such matters.

Cleveland Platform—September 25, 1895.

Recognizing the supreme utility of deep waterways through the great lakes and thence to the sea and reaffirming in full the platform adopted at the organizing convention held at Toronto in 1894, the International Deep Waterways association, in first convention assembled, declares as follows:

1. That the public welfare demands the deepest practicable channels between the several lakes and to the seaboard to enable vessels of the most economical type to pass between lake ports, or between the lakes and the seaboard, or to foreign waters without the necessity of transshipment.

2. That the said requirements call for a least depth of 21 feet in all channels and the building of all permanent structures for a navigable depth of 26 feet or more in order that the water courses may be progressively and economically deepened to the ultimate necessities of traffic.

3. That prompt action by the congress of the United States and the government of the Dominion of Canada providing a joint commission to investigate and report upon the establishment and maintenance of deep water between the great lakes and the sea, conformably to the resolution adopted at Toronto in 1894, is a matter for congratulation and that in view of the extended scope and great importance of the subjects to be examined by the said commission, this convention urges that the most liberal provision be made for the necessary expenses.

4. That the broadening of the channels through the connecting shallows between Lakes Erie and Huron and Lakes Huron and Superior, as recommended by lake carriers, is urgently demanded by the interests of commerce, and is in line with the progressive development of a great trunk water-route.

5. That the international interest in the great fresh-water seas of the American continent and in the ship-routes joining them to the ocean is recognized, and that the use of their waters and the control of their levels are proper subjects for international regulation.

6. That pending the development of the best deep channel or channels to the ocean, the promised early completion by the Canadian government of the St. Lawrence canals—if possible with lengthened locks—will result in marked benefit to international commerce and the producers of the interior; likewise, that the movement in the state of New York toward lessening the cost of transportation to tidewater by improving the Erie canal, which must have a permanent value, is noted with satisfaction;

7. That with respect to the several resolutions offered concerning local canal projects, all enterprises designed to extend marine commerce through lateral routes, tributary to the great lakes system, should be encouraged;

8. That special and renewed attention is called to the desirability of establishing a permanent international court, as set forth in the organizing convention in Toronto, in 1894.

International Deep Waterways Commissioners.

On Monday, November 4th, 1895, the President of the United States announced appointments, pursuant to the Act of Congress (page 330), as follows:

JAMES B. ANGELL, of Ann Arbor, Michigan (elected Chairman).
LYMAN F. COOLEY, of Chicago, Illinois.
HON. JOHN E. RUSSELL, of Leicester, Massachusetts.

On the 18th of November, 1895, the Government of Canada appointed the following as the corresponding Canadian members of the International Commission:

OLIVER A. HOWLAND, M.P.P., of Toronto, Ont (elected Chairman).
THOMAS C. KEEFER, C.M.G., M.I.C.E., of Ottawa, Ont.
THOMAS MONRO, M.I.C.E., of Coteau Landing, Province of Quebec.

James B. Angell was born at Scituate, R.I., in January, 1829; was editor of the Providence *Journal* six years; president of the University of Vermont for five years; has been President of the University of Michigan since 1872, except during 1880-1, when he was United States Minister to China, and President of the commission which negotiated the treaty of November 17th, 1880, regulating the immigration of Chinese, also the treaty proclaimed on October 5th, 1881, "concerning commercial intercourse and judicial proceedings;" was also one of the United States representatives on the international commission respecting the Fisheries Question. Author of well-known works on international law and other legal subjects.

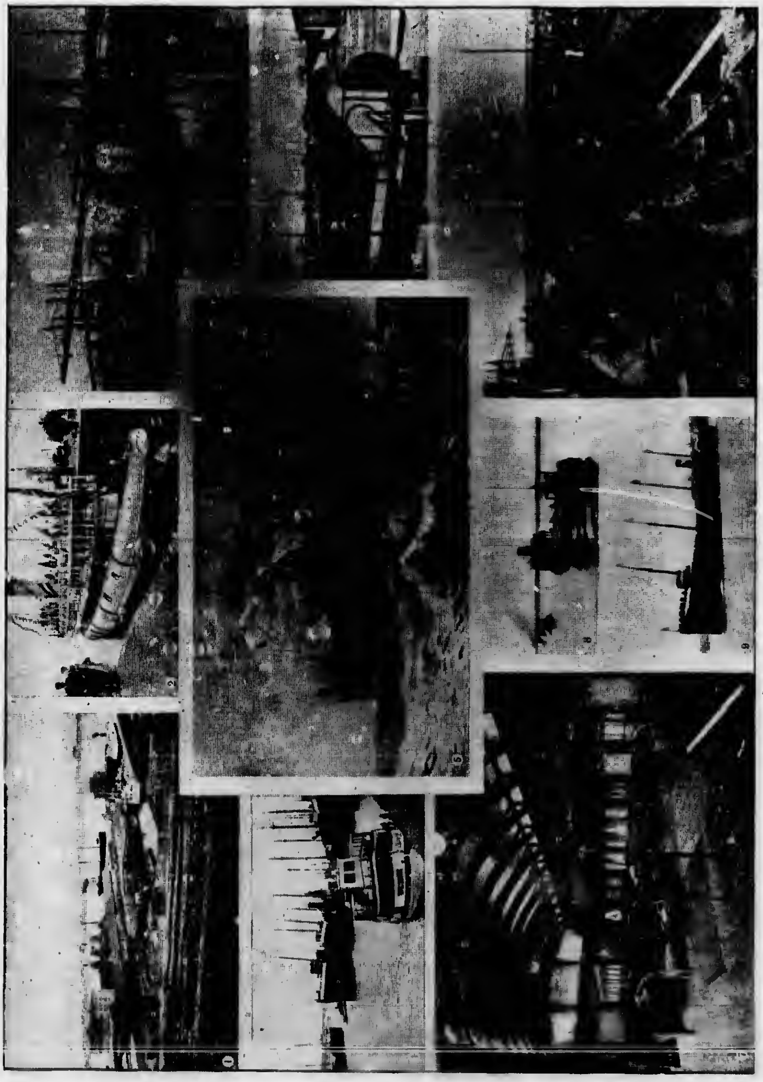
L. E. Cooley, graduate of New York Polytechnic Institute, was born December 5th, 1850, at Canandaigua, New York. He spent many years in the U.S. government and other service, on the waters of the St. Lawrence, Great Lakes, Mississippi and Missouri Rivers and Lake Champlain; occupied for four years the chair of civil engineering in the Northwestern University; was for some time chief engineer, and, for four years trustee, of the Chicago Sanitary and Ship Canal, of which he is the originator.

John E. Russell, a native of Greenfield, Mass., born January 20th, 1834; served in diplomatic capacities in South and Central America; served five terms as Secretary of the Massachusetts State Board of Agriculture; served one term as representative in Congress.

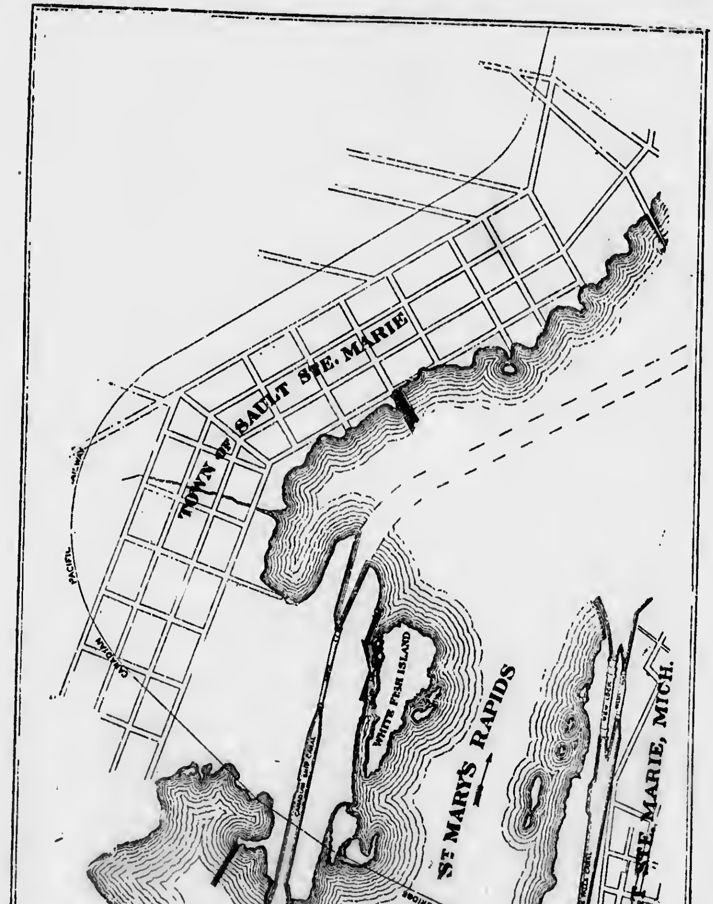
Oliver Aiken Howland, M.P.P., born near Toronto in 1847; educated at Upper Canada College and Toronto University; is a barrister-at-law by profession. Is President of International Deep Waterways Association, Chairman of Historical section of Canadian Institute; representative of the South Division of Toronto, in the Ontario Legislature. Author of a work, published in 1891, on the constitutional development of the British Empire, and its treaty, commercial and political relations with the United States. In this book an International Court of Appeal is proposed and advocated.

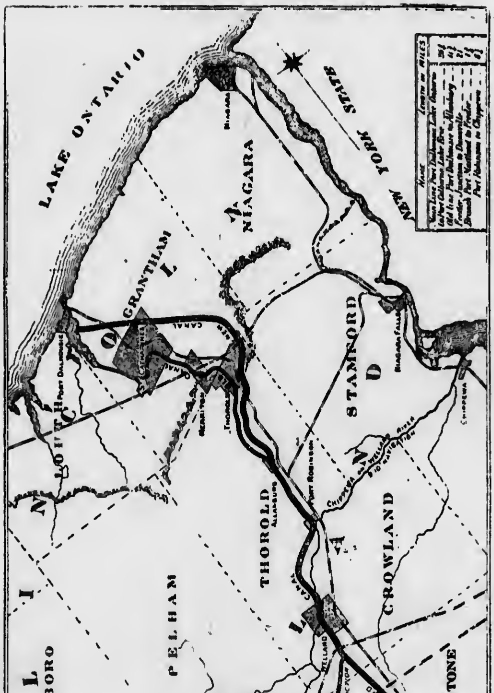
Thomas Caltrin Keefer, C.M.G., M.I.C.E., born 1821; educated at Upper Canada College, Toronto. A member of the Royal Society of Canada and author of essays on canals and railways; engineer on Welland and Erie Canals from 1838 to 1845; formerly Chief Engineer of the Province of Canada; Past President of United States and Canadian Societies of Civil Engineers; was Canadian Commissioner at the International Exhibitions at London and Paris; was appointed for his services a Companion of the Order of St. Michael and St. George.

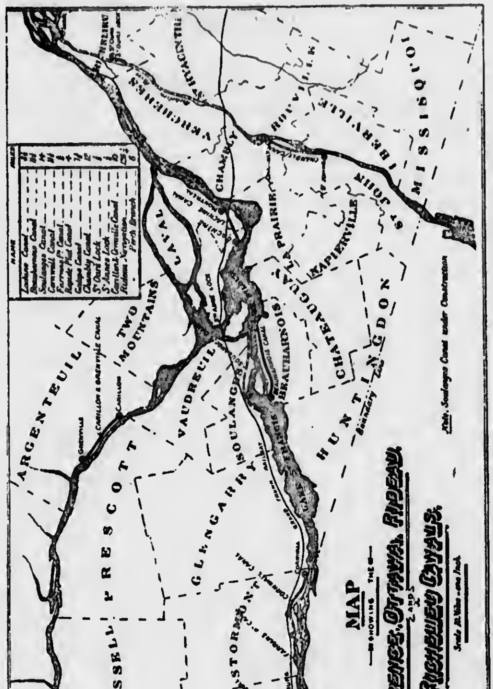
Thomas Monro, M.I.C.E., was President for 1895 of the Canadian Society of Civil Engineers. Born in Ireland; has resided in Canada since 1850; from 1860 has been in Canadian Government service; is engineer in charge of Canadian canals under construction



GREAT LAKES MARINE SCENES


TOWN OF SAULT STE. MARIE
PACIFIC
WHITE FISH ISLAND
ST. MARY'S RAPIDS
SAULT STE. MARIE, MICH.
INTERNATIONAL BRIDGE
LAKE SUPERIOR.


LAKE ONTARIO
NIAGARA
GRANTHAM
STAMFORD
THOROLD
CROWLAND
PELHAM
GAINSBORO
WAINFLEET
HUMBERSTONE
MOULTON
SHERBROOKE
LAKE ERIE
NEW YORK STATE
MAP
SHOWING
LINE OF WELLAND CANAL
BETWEEN
LAKES ERIE & ONTARIO


MAP
SHOWING THE
St LAWRENCE, OTTAWA, RIDEAU
AND
RICHELIEU CANALS.
ARGENTEUIL
TWO MOUNTAINS
LAVAL
VAUDREUIL
SOULANGES
PRESCOTT
RUSSELL
CARLETON
LANARK
GLENGARRY
STORMONT
DUNDAS
GRENVILLE
LEEDS
FRONTENAC
BEAUHARNOIS
CHATEAUGUAY
HUNTINGDON
LA PRAIRIE
NAPIERVILLE
ST JOHN
IBERVILLE
MISSISQUOI
ROUVILLE
CHAMBLY
VERCHERES
ST HYACINTHE
NEW YORK STATE
CANAL

Aftermath.

AMPLER NEW YORK CANALS—Under the terms of the new constitution a majority of the people of the state of New York voted on Nov. 5, 1895, to devote $9,000,000 to the enlargement and improvement of their canal systems. Of this sum $4,000,000 is available at once. Work will be begun as soon as practicable, bonds to be issued in payment thereof.

The bonds bear interest not to exceed 4 per cent. payable semi-annually and shall be issued for a period of not more than seventeen years. They shall not be sold all at one time, but in lots not exceeding $4,000,000. Within three months after the issuing of the bonds the law directs the Superintendent of Public Works to proceed to enlarge and improve the Erie, Champlain and Oswego Canals; the improvement to the Erie and Oswego canals to consist in deepening the same to a depth of not less than nine feet of water, except over and across aqueducts, mitre sills, culverts and other permanent structures, where the depth of water shall be at least eight feet; but the deepening may be performed by raising the banks wherever the same may be practicable; also lengthening or improving locks which now remain to be lengthened, and providing the necessary machinery for drawing boats into the improvised locks and for building veritical stone walls where, in the opinion of the State Engineer and Surveyor and Superintendent of Public Works, it may be necessary. The improvement upon the Champlain Canal shall consist in deepening the canal to seven feet of water and the building of such vertical stone walls as in the opinion of the State Engineer and Surveyor and Superintendent of Public Works may be necessary. All work shall be done by contract entered into by the Superintendent of Public Work on the part of the State, and shall be let to the lowest bidder, but in no case shall the amount of any one contract exceed the sum of $500,000.

This recorded liberality of the New York taxpayers is gratifying and the friends of cheaper transportation hope that the improvements voted will prove an appetizer which will lead to an early demand in the Empire state for the utmost feasible capacity of artificial channels.

CHARACTERISTIC EXHIBITS—Two conspicuous features of the Cleveland convention were the ship-canal exhibits by the Chicago sanitary and ship canal and the large working model of the Dutton pneumatic lock.

DETROIT RIVER COMMERCE—To the tables on page 340 should be added for 1894: No. U. S. vessels 34,800; registered tonnage 26,120,000; staple commodities 24,263,868; total great lakes clearances 54,758; registered tonnage 37,565,229.

INDEX.*

A

B

C

*Note—Names of persons and places merely mentioned, not indexed.

May you all live long and prosper.