

5.

L.

The World's Columbian Water Commerce Congress
CHICAGO, 1893

THE PROPOSED ENLARGEMENT

OF THE

WATER WAY FROM LAKE MICHIGAN

TO THE MISSISSIPPI RIVER

VIA

THE ILLINOIS RIVER

BY

L. E. COOLEY, C. E.

J. No. 19844

BOSTON
DAMRELL & UPHAM

The Old Corner Bookstore
283 Washington Street





I- 354081

Biblioteka Politechniki Krakowskiej



100000318899



~~11 17689~~

THE PROPOSED ENLARGEMENT OF THE
WATER WAY FROM LAKE MICHIGAN
TO THE MISSISSIPPI RIVER,

VIA THE ILLINOIS RIVER.

I.

A commercial water way *via* the Chicago Divide and the Desplaines and Illinois Rivers, through the State of Illinois, from Lake Michigan at Chicago to the Mississippi River near St. Louis, is an enterprise of the first importance when viewed in its most restricted relations as a channel uniting the Mississippi River and its thousands of miles of navigable tributaries, and the Great Lakes with their phenomenal commerce; or even as uniting the Metropoli of the two great and productive valleys of North America. In its broadest aspect, however, such a water way is to be considered as a link in a system of navigation from the Atlantic Ocean, *via* the Great Lakes, to the Gulf of Mexico; which, as a result of a progressive development and a wise policy, shall ultimately extend the navigation of the high seas through the resourceful heart of the continent, and make tributary to the one artery, all its rivers and lakes.

Reservoirs at headwaters and the Great Lakes can furnish a steady low-water volume as required to develop any useful depth that commerce may demand through the alluvial river sloping southward. The lake outflow can be restricted by works that are incident to overcoming the sharp declivities dropping eastward. The work in opposite directions is complementary, and thus the largest development is made possible. The solution of the engineering problem is feasible at moderate cost, measured

efke ~~3684/51~~

DPV- B-2/2013

by the economic achievement; and the resources of statesmanship and finance should render it practicable.

The idea of a water route from the Atlantic *via* the Lakes to the Mississippi and the Gulf, is nearly a century



MAP OF THE WATER WAY FROM CHICAGO TO CAIRO.

From the *Railroad Gazette*, by the courtesy of its editor.

old. Such a route, scarcely developed to the meager canal proportions of our fathers, actually exists to-day. The possibilities of development to all the demands of deep-

water commerce have been suggested by the writer on other occasions. It is referred to here as furnishing a view point in considering the water way from Lake Michigan to the Mississippi River, through the State of Illinois.

The improvement of the connecting channels of the Lakes, now in progress, for a depth of 21 feet, would seem to exhaust the useful limit of navigation for the short routes of these land-locked seas. In extending deep navigation to the ocean, remoter possibilities of development, up to 26 feet, should govern in the planning of works. The improvement of the Mississippi by itself, beyond the fullest needs of steamboat and barge navigation, has been questioned; and this doubt has also applied to the river in its extension to the Lakes, on account of the material change in regimen to be brought about through nearly 1,500 miles of alluvial streams, and the radical difference in type of shipping, as developed on river and lake.

When, however, the matter is looked at as a whole, a homogeneous development from the Lakes, both to the east and to the south, becomes the primary consideration; and it is seen how the engineering possibilities are mutually facilitated, and, also, how a common interest throughout the continent may enlist in the consummation. Navigable waters have everywhere evolved the types of shipping suited thereto, and when deep channels shall unite lakes, rivers, gulfs, and seas, the type of carrier which will best utilize the situation will hardly fail the need.

The link between the Valley of the St. Lawrence and the Valley of the Mississippi through the State of Illinois, is the determining factor in the entire project, and sets the gauge of what shall be attained. This work may be so planned as to measurably foreclose the future, or it may define a policy which shall ultimately exhaust the engineering practicabilities.

In an age when so many take comfort in their "practical ideas," and are unskilled in what Tyndall is pleased to term "the scientific uses of the imagination," it is difficult

to contemplate a policy which seeks to achieve more than what is now usefully in sight, even though it be feasible to plan equally well for the present need and in harmony with a policy of progressive development. It is fortunate, therefore, that this broader project may be accomplished in separate links, each of which finds local justification, as the joining of Lakes Erie and Ontario, and the uniting of Lake Michigan and the Mississippi. It is still more fortunate that the Illinois water way has immediate occasion for development, and is now actually under way, and, further, that urgent public needs, aside from navigation, have determined for the governing reach a capacity of channel and a plan of work in harmony with the ultimate demands of commerce.

II.

The Illinois water way, as a scheme of sanitary-relief for Chicago, has been persistently agitated since 1885. In the conflict of diverse interests between the city and the Desplaines-Illinois Valley, it took on a large capacity for flowing water, and dimensions designed to secure navigable proportions of channel. The enabling act, under which the present sanitary district of Chicago is organized, was passed by the General Assembly of Illinois in 1889. This provides for a gravity channel of not less than 18 feet deep, and 160 feet wide at bottom, and of a minimum capacity of 600,000 cubic feet per minute, all at low water, from Lake Michigan across the Chicago Divide, to a point where the water can be discharged into the Desplaines River, near Lockport, whence certain improvements are to be made to Joliet; and the authority is given to make any river improvement in the Desplaines and Illinois Rivers that may be required, to avoid damage on account of the water contributed to these streams. The law also contemplates a progressive enlargement of the channel with growth of population, and a volume at all times sufficient for a sanitary condition.

The joint resolution passed by the same Legislature, defined the policy of the State of Illinois to be the securing of a water way not less than 22 feet deep across the Chicago Divide, for a distance of some 40 miles, thence not less than 14 feet for 280 miles to the Mississippi, on such a design as will permit a progressive increase of depth to any limit that may ultimately prove desirable, and called upon the General Government to co-operate with Chicago in an early consummation of this project.

The Sanitary District of Chicago was organized in 1889-90, and has entered upon the actual construction of 28 miles of main channel and 7 miles of auxiliary works, by which the waters of Lake Michigan shall be delivered to the Desplaines River near Lockport, and conducted through Joliet to a point 38 miles from Lake Michigan. These works are set for completion in 1896, at a cost of from \$22,000,000 to \$24,000,000.

The plans for the extension of the work through the city of Chicago, so as to fully utilize this channel, are not yet matured, nor have any steps been taken to secure the improvement of some 60 miles of river between Joliet and La Salle. A movement is now on foot to enlist the United States, during the present Congress, in the improvement of the alluvial section of the Illinois, some 220 miles from the city of La Salle to the Mississippi.

It is anticipated that within the next four years the entire scope of the work over the 320 miles between Lake Michigan and the Mississippi will be defined, and that public sentiment will be fully crystallized, not only as to the utility of the work, but also as to the magnitude of the achievement and the ultimate policy involved.

III.

The physical features are peculiarly adapted to a great water way, and the topographical situation has no counterpart in commercial possibilities. The Chicago Divide is lower by nearly 200 feet than any other pass between the

basin of the Lakes and that of the Mississippi, and is the only practicable route for a water way of magnitude, considering the improvement of the Mississippi. The alluvial summit is but 12 feet and the rock summit but 8 feet above the level of low water in Lake Michigan, and some 4 feet less above high water. Lake level is practically reached in the Desplaines Valley at 30 miles from the lake, and thence in the next 10 miles the valley descends to 76 feet below lake level at the pool known as Lake Joliet. In the next 55 miles the river descends by a series of pools and rock-bound rapids to the head of the alluvial valley at Utica, the level of natural low water being 145 feet below low water of Lake Michigan (the present level, occasioned by the dam at Henry, is 142 feet below lake level), thence to the Mississippi. The lower Illinois has but 31 feet fall at low water in a distance of 227 miles.

The bottom grade of channel is in alluvium and drift for 16 miles from Lake Michigan; thence in Niagara limestone overlaid with heavy drift for 6 miles; thence in solid Niagara limestone for 9 miles; the next 9 miles of descent being also over the same formation. The descent from Lake Joliet to Utica is in a valley 1 to 2 miles wide, generally bounded by high bluffs, breaking down through coal measures and over St. Peter's sandstone to the last rock, the water lime at Utica.

The alluvial valley is from 3 to 6 miles wide to the Mississippi, with an extraordinarily low declivity for the modern stream, the bottoms being cut up by a large development of marsh, lake, and slough.

All the geological evidences point to a past time when the outlet of the Upper Lakes was to the south. Ancient beach lines testify to a lake level, 30 and more feet higher, when the site of Chicago was a bay leading to the rock-bound Desplaines Valley, where the water ran 20 feet deep over the rock floor, in volume not unlike the Niagara River at Black Rock, descending in a precipitous course to Utica, whence the stream flowed gently onward more

than 30 feet deep; a depth which may be presumed to have extended southward to the sea.

The logic of the past may guide the present policy even to better purpose than had the ancient conditions persisted. The cutting of the Chicago Divide on any scale of usefulness is simply measured by the funds which may be applied thereto, and the work may be planned for further development. The works required from Joliet to Utica involve no element of chance, and lend themselves to progressive treatment. Through the alluvial section, from Utica to the Mississippi, the depth obtainable is simply a question of water supply, dredging and channel correction, and the results attained can be regarded as substantially permanent.

A channel of 22 feet across the Chicago Divide will be adequate to supplying the water for the maintenance of a channel of not less than 300 feet in width and 14 feet in depth through the lower Illinois, and the intermediate stretch may be developed accordingly. The cost of the works for 280 miles from Joliet to the Mississippi will be less than that for the Chicago Divide, and of this two thirds are required for one fifth of the distance, or from Joliet to Utica. Greater depths may be attained through a larger water supply, in conjunction with such further works as will apply it to advantage, but this means a more capacious channel across the Chicago Divide than is now being provided.

It is evident that the opening of the channel across the Chicago Divide will of itself bring lake and river navigation within 60 miles of each other, for very little improvement is demanded with this volume of water to carry 10 feet through 227 miles of the Lower Illinois.

This scheme of improvement contemplates the removal of the four State, and United States dams below Utica, and an open and unobstructed river thence to the Mississippi: in other words, all permanent structures on a route of 1,600 miles to the Gulf, are restricted to the first 100

miles, between Lake Michigan and La Salle. The anticipated effect of the additional water is more than one foot to low-water bar depths between the mouths of the Illinois and the Ohio, and half as much below Cairo. This is a sensible aid to the improvement of the Mississippi, and has the merit of greatest effect on the upper reaches of the river, where the attainment of adequate bar depths presents the greatest difficulty.

IV.

The project for a minimum bar depth of 10 feet, at extreme low water, from St. Louis to the Gulf, may be considered as established, and the General Government has entered systematically on the attainment of this object. This improvement can be as well carried over the forty miles intervening between St. Louis and the mouth of the Illinois. Extreme low water is limited in duration, and is not always recurrent in successive years; so that low water is not the criterion of boating stages, nor of the draft of shipping in which the bulk of the water commerce is carried. With 10 feet minimum, boats of a draft of 14 to 16 feet will navigate the Mississippi with the same facility as do the steamboats and barges of a draft of 8 to 11 feet on the present depth.

In 1890, the writer made an investigation of the stages of the Mississippi from gauge records extending through many years. It was concluded that when the present project is completed, 14 feet of water will be carried through the Mississippi for 9 months of the average year; so boats from Lake Michigan drawing 14 feet could always reach the Mississippi, barring some 70 days of closure by ice on the Upper Illinois, and could pass thence to the Gulf for 9 months, and boats of less draft would be interrupted on an average of but 70 days, and this on account of ice.

In contrast with this, navigation on the Lake and the Atlantic seaboard is interrupted for 140 days. The Wel-

land Canal carries 14 feet only into Lake Ontario, while the St. Lawrence canals carry but 9 feet, though their improvement to 14 feet is in progress.

It will be useful also to consider the effect of an increase in the low-water volume at St. Louis of 60,000 cubic feet per second; 20,000 cubic feet to come from reservoirs at head waters, and 40,000 cubic feet from Lake Michigan. Such a volume would double the cost of the Illinois water way on a basis of 20 feet for through navigation. The depth of 14 feet would be continuous in the Mississippi, and 20 feet would prevail for 9 months.

It will be perceived that there is no useful limit to the improvement of the Mississippi by restricting the Lake outflow eastward, and turning the available waters southward through the Illinois water way, sufficiently enlarged to answer as a conduit, and that the largest useful depth between the Lakes and Gulf may be thus attained. Nor does the restriction of the Lake outflow on the Niagara and the St. Lawrence present any insuperable obstacles from an engineering standpoint.

The available navigation of 14 feet which present policies contemplate is a most useful and far-reaching achievement. It will serve most satisfactorily the Mississippi trade with the Lakes, and for lumber, coal, and ore, and it is adapted to boats which may pass from the Lakes to the ports of the Gulf, of the Caribbean Sea, and the South Atlantic coast, and it will permit the entire Lake fleet to seek employment in the general commerce of the world in the 5 months of winter idleness which now obtains. It will stimulate North and South commerce as yet scarcely begun in this country, and it will enable all raw material for manufacture to assemble in the bread basket of the continent.

V.

The present project of the Sanitary District of Chicago provides substantially for a depth of 22 feet of water, in a channel of a width of 160 feet at bottom in the rock and

162 feet wide at the flow line ; and 210 feet wide at bottom, and 290 feet at the flow line in the clay, and the capacity is to be not less than 600,000 cubic feet of water per minute, or 10,000 cubic feet per second, under the most unfavorable conditions at low water of the Lake. In a length of 28 miles of main channel now under contract or to be soon advertised, there are 11,000,000 cubic yards of rock and 31,000,000 cubic yards of earth excavation, the average depth of cutting throughout being 35 feet. These quantities will be added to by the work required between the end of the main channel and Lake Joliet, and that required to connect with Lake Michigan in order to utilize the full capacity, but the plans for this additional work have not been matured.

The increase of the depth so as to give a minimum of 26 feet when properly connected with Lake Michigan, is being urged, which will involve an extra outlay of about \$600,000, and materially increase the capacity of the channel. To give the channel a minimum capacity of 1,000,000 cubic feet per minute under extreme conditions, with a depth of 26 feet, when properly connected with the Lake, will involve an extra expenditure above that for the channel now under way of about \$4,000,000 ; and this has been suggested as better satisfying the prospective needs of the city, and as a justifiable present investment. These are matters which will doubtless be fully considered before the channel is completed.

The considerations which have determined the deep channel across the Chicago Divide are purely economic, and pertain solely to a conduit for carrying the required volume of water. The fact that the half of the channel most remote from the Lake is in rock, makes a deep prism throughout and an enlarged section in the earth economical, thus lessening the total grade and the amount of rock excavation. The economical limit for the prescribed width in the rock, and the stipulated capacity, is a depth of 22 feet, and in an earth section about fifty per cent in

excess of the rock section. The channel of greatest economy also involves moderate velocities, which are in the interests of navigation.

No argument is required to show that depth, rather than width, saves grade, thus making regulation easier at the lower end of the summit level, and that the volume flowing is less variable on account of lake fluctuations and ice; it is also apparent that for a given water section the excavation above the flow line will be lessened. The most economical channel has been adopted after elaborate calculation, and it is peculiarly fortunate that the channel so determined is also in the highest degree adapted to the requirements of navigation. Should a still greater capacity be finally adopted, the depth for economy will increase to the limit of any possible navigable requirement.

When the main channel is opened out to the Lake the summit level will be 31 miles long, and will be available throughout as a lake harbor of 22 feet depth to meet the improvements now in progress through the connecting channels of the Lakes; and with a depth of 26 feet it will be adequate to the needs when deep water is extended eastward to the sea, and will furnish a local reason for such a standard of depth, which will be valuable in promoting its consummation.

The uses of the summit level as a harbor, of which Chicago is in great need, gives substantial commercial reason for its development on a large scale, and in harmony with the remoter requirements as a water way; and in this view it is fortunate that each 100 feet of additional width on the first 13 miles through, and behind the city may be had for \$2,000,000 for excavation.

It is thus seen how all the present needs and local advantages, both sanitary and commercial, are in strict accordance with the broader development as a link in a continental water way. The large areas of land necessarily acquired, the dockage which accrues to the Sanitary District, the water power of 100,000 horse power between

Lockport and La Salle, and 300,000 acres of land to be reclaimed in the Lower Illinois Valley, are all potent local and State factors in urging the early and full completion of the Illinois water way, and in such a manner as not to impair any of its functions as an instrument for the accomplishment of the greatest useful depth through the Mississippi to the Gulf.

The improvement of the Lower Illinois so as to utilize fully the steady volume of flow in useful depth, will no doubt be undertaken before the completion of the channel across the Chicago Divide, and in anticipation thereof, and this may go on progressively to meet current commercial needs. Thus will the navigation of the river at Utica be brought within 60 miles of lake navigation at Lockport. This stretch will cover the permanent works required for the descent of 140 feet, and their construction is likely to be deferred until the work on the Chicago Divide is so fully determined in the public mind, as to insure their development on some plan that will permit their fullest utility in extending deep navigation.

VI.

The present status of the Illinois water way may be recapitulated as follows:—

A channel 22 feet deep has been determined across the Chicago Divide, which is to be adequately connected with Lake Michigan, so that deep water will be extended 31 miles from the Lake, and partial works will be extended from 6 to 8 miles farther; and this part of the project is in actual process of execution.

The water from this channel, with very little aid, will give 10 feet minimum for 227 miles throughout the Lower Illinois to the Mississippi; and it is proposed to enlist the General Government at an early day in dredging operations and channel improvement, by which 14 feet shall be secured as fast as the same may be useful.

The Joliet-Utica stretch of 60 miles is to be promoted as soon as the work on the Chicago Divide is sufficiently

determined to make clear the character of the work that should be projected.

The securing of any depth required to the Mississippi presents no serious engineering difficulties. Considerably over half the cost is involved in the first 40 miles, and over five sixths in the first 100, the remaining 220 miles involving less than one sixth the total expenditure. The work proceeds on the theory of a conduit that may be enlarged to any capacity for supplying water to strengthen the low water stages of the Mississippi; and further, that the present project of 10 feet minimum for the Mississippi exhausts the possibilities without radical disturbance in regimen, and that further improvement is to be accomplished largely through equalization of flow by contributions to the low-water volume.

The channel across the Chicago Divide may be constructed of still greater capacity and of a depth of 26 feet when completed to the Lake, thus exhausting the possible utility as a future harbor and permitting a higher development southward, and said channel will furnish much needed harbor facilities for the deep navigation of the lakes now developing.

In addition to the harbor facilities, the works now projected and under way will furnish dockage, provide water power by the wholesale, and ultimately reclaim several hundred thousand acres of land.

Local needs and State interests insure the immediate carrying out of such a portion of the works as will set the gauge for the water way through Illinois, and thus will be practically determined the scale of future achievements east and south; and thus will the policy be set which links, by separate steps, a chain of deep navigation along the lowest continental line through the productive heart, and unites all navigable waters in one systematic whole. The idea that deep navigation shall extend from the Atlantic *via* the Lakes and the Mississippi to the Gulf, is no idle dream, and men here to-day should live to "go down to the sea in ships."

APPENDIX.

EXCURSION OF THE MEMBERS OF THE CONGRESS TO THE
CHICAGO MAIN DRAINAGE CANAL, BY E. P. NORTH,
Mem. Amer. Soc. C. E.

(From the *Railroad Gazette* of October 6, 1893.)

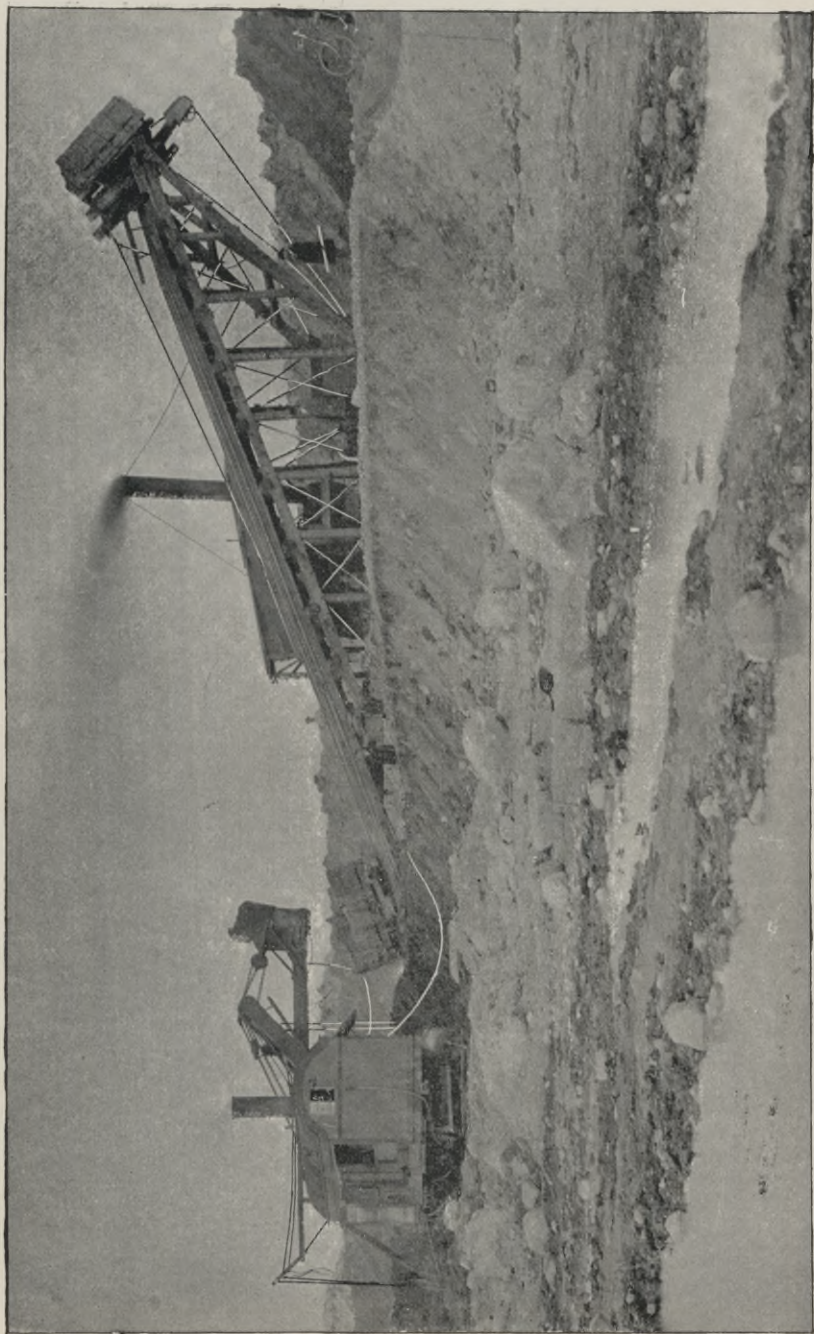
One of the most instructive incidents connected with the Congress at Chicago, was an excursion to the canal just described. Through the kindness of the Board of Trustees of the Sanitary District, on August 7th, a train was placed at the disposal of the members of the Congresses, by means of which the various points of interest were visited.

Without repeating Mr. Cooley's description of the canal, it is sufficient to say that the contracts for the excavation of the 11,000,000 cubic yards of rock have been let at an average of 87 cents per cubic yard; and those for 18,000,000 cubic yards of earth at an average of 26.7 cents per cubic yard. The extreme prices are 20 to 30 $\frac{5}{8}$ cents for earth and 73 to 91 cents for rock. Some of the earth may have to be relet.

Handling the Material.—Teams and scrapers, or steam shovels were moving the earth and sending it to waste by a train of cars in the usual way. A noticeable exception to this was that of the Western Dredging & Improvement Co., which drew their loaded cars by a wire rope transversely to the line of improvement up a trestle about 30 feet high on to a tilting table, where they were discharged and run back by gravity to the steam shovel.

The rock work was distinguished by the breadth of cutting, the use of channeling machines for cutting the sides of the canal, and the employment of Brown's cantilever hoists or derricks for removing the rock,—the latter are

CHICAGO MAIN DRAINAGE CANAL.



HANDLING THE MATERIAL — METHOD USED BY THE WESTERN DREDGING AND IMPROVEMENT CO.

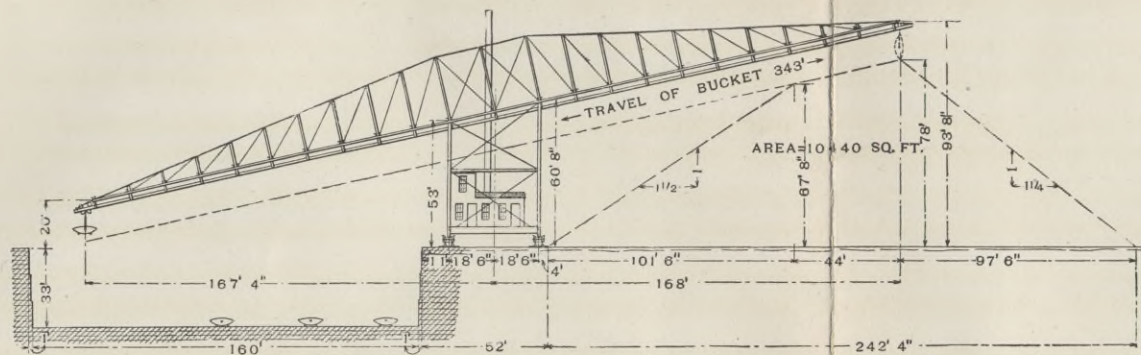
shown in line and in perspective in the engravings herewith. The rock operated on is a light colored limestone, and lies between the Lamont and Joliet beds, which are used for dimension stones; but it does not dress easily and is used for rubble masonry, dock filling, etc., so that it may be broken up and sent to waste by the quickest and most economical methods. The channeling machines leave a wall of great longitudinal smoothness, with two or three horizontal offsets; they also free the rock for blasting, so that it is thoroughly broken up by the use of about $\frac{8}{15}$ lb. of No. 2 dynamite per cubic yard. In some, if not in all instances, this channeling is sub-let by the contractor, at the rate of 15 cents per square foot, making the cost about five cents per cubic yard excavated.

The broken rock, as mentioned, is sent to waste alongside the canal by derricks, the principal dimensions of which are shown in the illustrations. It is understood that the wasting of the rock is sublet to the Brown Hoisting & Conveying Machine Company, of Cleveland, O., who build and operate the derricks, for about 15 cents per cubic yard, the contractor loading, hooking on and unhooking the kibles. The Brown company has built a track along the canal, as shown in the cut, on which 11 machines are now at work. These machines traverse the track parallel to the canal at the general speed of 150 to 200 feet per minute. While the visiting engineers were there, they made a speed of about 350 feet per minute. The capacity of the buckets is 75 cubic feet when even full, and when heaped, the load may be 9,000 or 10,000 lbs. The guaranteed capacity is 25 round trips per hour, discharging 88 tons on the waste pile. For a whole day an average of 32 trips per hour has been made, or, say 900 cubic yards per day. The engines have double cylinders $10\frac{1}{2}$ by 12 in., with patent band friction clutches, and are operated by three levers, one for hoisting, one for the travel of the kibble on the cantilever and one for the travel of the machine on the tracks. It is expected that the tracks and some of the

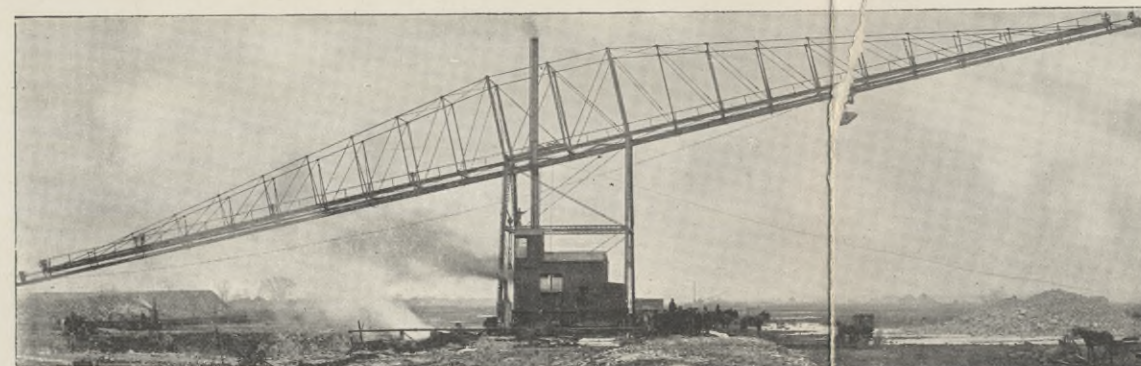
derricks will be employed in loading the wasted rock for use in and about Chicago when the canal is completed.

The advantages to the people living on the 1,600 miles from Chicago to the Gulf will be almost incalculable. The contribution to the wealth of this locality may be partly measured by the estimate in the "Report on the Internal Commerce of the United States for 1891," that the saving to the public by water transportation on the entire traffic of the lakes during 1890 was \$135,000,000. This immense sum, equivalent to a dividend of over 66 per cent on the gross expenditures by the general government on all rivers and harbors up to that time, must have been distributed between the producers who shipped via the lake route and their customers,—for any charge for transportation must come out of either the producer or the consumer. And as the freight charges by the lake route were about $6\frac{1}{2}$ per cent of the value of the goods shipped, whereas, if shipped an equal distance by rail, the cost would have been 46 per cent of such value, the low freight rates by water must have been the governing factor in the production of a large part of the goods shipped. It is this production which has filled up the Northwest with inhabitants and railroad lines.

The influence of deep water channels on population,—and population is a fair index to prosperity,—may be seen from a comparison of the inhabitants of four lake and four river cities. Up to 1858 the maximum governing depth between Chicago and Buffalo was $9\frac{1}{2}$ ft.; to 1871 it was 12 ft., and from that to 1874 it was 13 ft., and has been 16 ft. since. In 1870 the aggregate population of Buffalo, Cleveland, Detroit and Chicago, the four largest cities, was 589,107; in 1890 the aggregate was 1,822,743, a gain of 209 per cent. In the Mississippi valley, where there has been no noticeable improvement in the rivers, the total population of St. Louis, Cincinnati, Louisville and New Orleans, the four largest cities, was 819,269 in 1870, and in 1890 the total was 1,150,153, a gain of $40\frac{1}{2}$ per cent. There seems no reason to doubt that the prosperity born of a 14-ft. channel



The Brown Balanced Derrick—Chicago Main Drainage Canal.
Cross Section of Dump Shown in Broken Line.



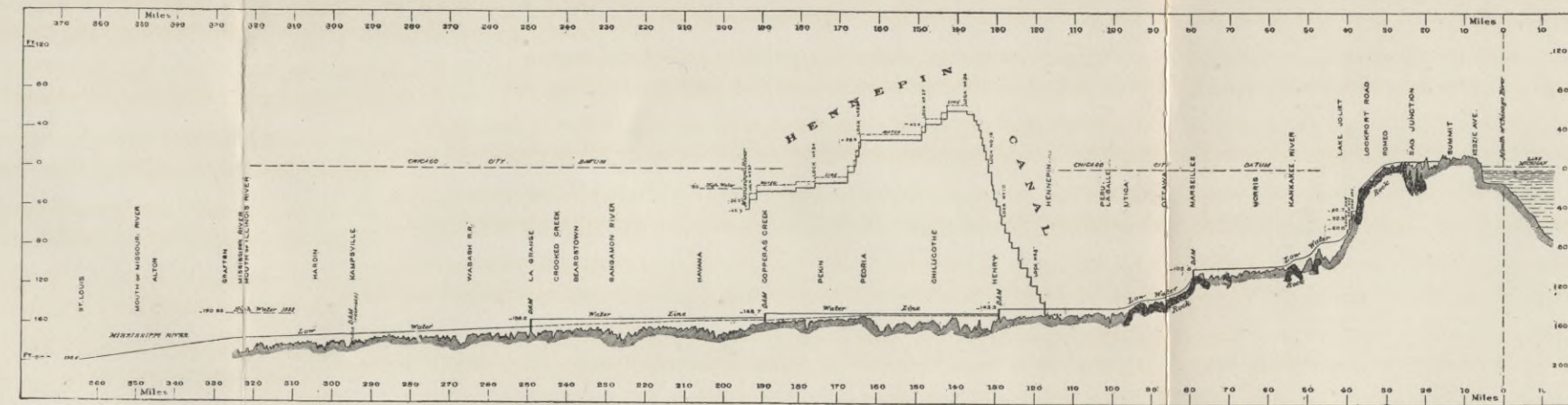
The Brown Patent Balanced Cantilever Derrick.

In use on the Chicago Main Drainage Canal—The Brown Hoisting and Conveying Machine Co., Cleveland, O.

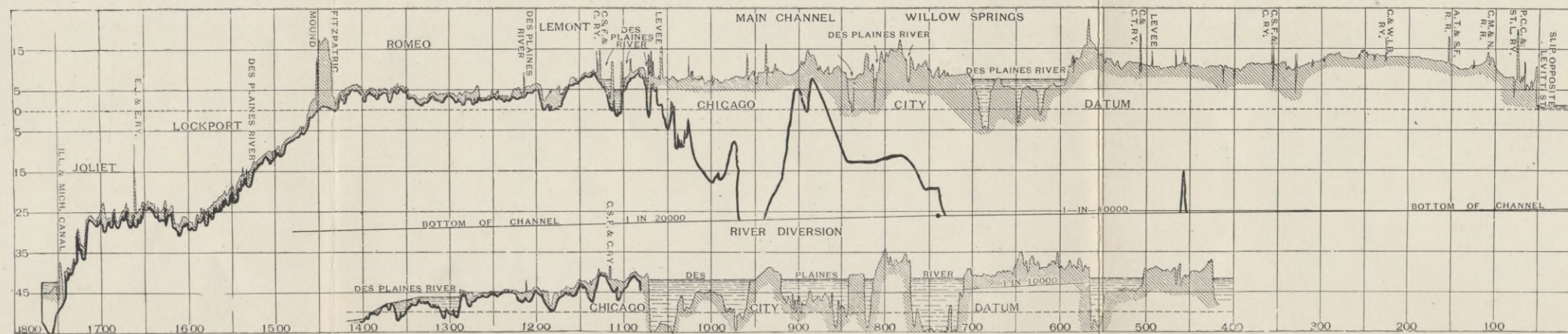
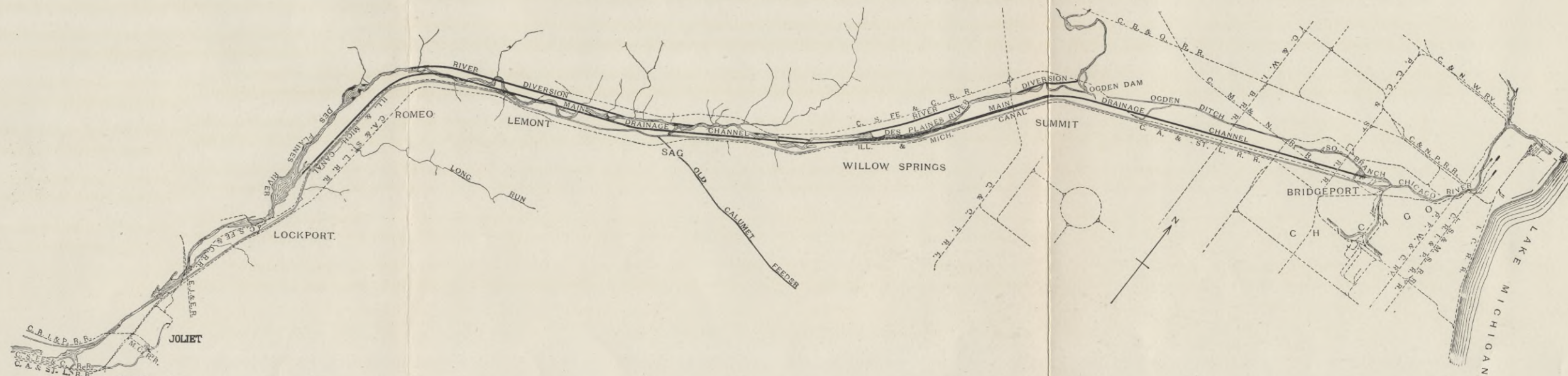
Height above ground, lower end, 20 ft.; upper end, 94 ft.
Total length of cantilever, 355 ft.
Working capacity of machine, 120 tons loose rock per hour.

Capacity of bucket, 75 cu. ft.
Speed of travel of entire structure on tracks, 150 to 400 ft. per minute.

These illustrations are reprinted from the *Railroad Gazette*, by the courtesy of its editor.



Profile, Lake Michigan to the Mississippi River through the Illinois River Basin



PLAN AND PROFILE OF THE CHICAGO MAIN DRAINAGE CANAL AND THE RIVER DIVERSION.

from Chicago to New Orleans, open nine months of the year, will justify a demand for a 20-ft. channel for the entire distance—a depth within the available resources. This depth (which would give Chicago control of the commerce of the north coast of South America), drawing freight from Buffalo on the one hand and Duluth on the other, will cover the route with manufacturing towns, which have always been located on lines of least resistance, in time and money, to transportation. The consumption of these towns will change the population of the Mississippi valley from “the hewers of wood and drawers of water” for distant consumers, to suppliers of the wants of near-by customers, and bring the average consumption per capita up to that of the North. Incidentally Chicago, which in 1859 Horace Greeley ventured to predict would contain a million inhabitants within the life of some child then born, will become the largest city on this continent.

31,50

Biblioteka Politechniki Krakowskiej



II-354081

Faint, illegible text, likely bleed-through from the reverse side of the page.

Biblioteka Politechniki Krakowskiej



100000318899