CLERK'S COPY.

JOINT ABSTRACT OF RECORD

IN THE

Supreme Court of the United States

OCTOBER TERM, ~~1927~~ [redacted] 1961

No. ~~7~~, ORIGINAL. 1

STATE OF WISCONSIN, STATE OF MINNESOTA, STATE OF OHIO, AND STATE OF PENNSYLVANIA, COMPLAINANTS,

vs.

STATE OF ILLINOIS AND SANITARY DISTRICT OF CHICAGO, DEFENDANTS; STATE OF MISSOURI, STATE OF KENTUCKY, STATE OF TENNESSEE, STATE OF LOUISIANA, STATE OF MISSISSIPPI, AND STATE OF ARKANSAS, INTERVENING DEFENDANTS.

No. ~~11~~, ORIGINAL. 2

STATE OF MICHIGAN, COMPLAINANT,

vs.

STATE OF ILLINOIS AND SANITARY DISTRICT OF CHICAGO, DEFENDANTS.

No. ~~12~~, ORIGINAL. 3

STATE OF NEW YORK, COMPLAINANT,

vs.

STATE OF ILLINOIS AND SANITARY DISTRICT OF CHICAGO, DEFENDANTS.

FILED JANUARY 24, 1928.

PRESS OF JUDD & DETWEILER, INC., WASHINGTON, D. C.

TABLE OF CONTENTS.

Joint Abstract, in Narrative Form, of Portions of the Record Filed by the Special Master Herein with His Report on November 23, 1927, Embracing Material Not Considered to be Sufficiently Set Forth in Said Special Master's Report, Submitted by Counsel for All Parties, Pursuant to Order of the Court Entered Herein on January 4, 1928.

COLONEL CHARLES KELLER, FOR COMPLAINANTS.

I reside at Evanston, Illinois. I am a graduate of the United States Military Academy 1890; served in the
1267 Corps of Engineers between the grades of 2nd-Lieu-
1268 tenant and Colonel, serving largely on rivers and harbors, including two years as resident member of Board of Engineers for Rivers and Harbors; member of Special Board of Engineers for a Waterway from Lockport, Illinois to the mouth of the Illinois River, reported in House Document 762, 63rd Congress, 2nd Session; now retired, now assistant vice-president in charge of engineering of the Byllesby Engineering & Management Corporation, Chicago, testified as follows:

1269 With a 9-foot waterway from Lockport, Illinois to Utica, having locks 600 feet long, 110 feet wide, with a maximum lift of 41 feet, a water supply of 1,000 second-feet throughout the year would be more than sufficient to accommodate a traffic of 100,000,000 tons annually. Traffic possibilities on this waterway are large, but it is doubtful if they will ever exceed 100,000,000 tons annually within a measurable period of time.

1272 The great ports are — New York, with a total ton-
1273 nage of imports and exports of 20,000,000 tons; London, with about 22,000,000 tons; Antwerp, with about 20,000,000 tons; Amsterdam, with about 5,000,000 tons; Hamburg ,with about 26,000,000 tons; Rotterdam, with about 17,000,000 tons; Liverpool, with about 20,000,000 tons; Marseilles, with about 5,000,000 tons; and Hongkong, with about 34,400,000 tons.

1274 The number of locks in the waterway does not
1275 affect the lockage water requirements which are governed by the lock of the greatest lift.

1275 My estimate that the amount of water required on the Illinois River is 1,000 c. f. s. relates solely to the amount required for the locks. That figure assumes that there would be locks and dams from Utica to the mouth of the Illinois River, a canalized waterway.

1276-*a* I do not intend my estimate of a thousand c. f. s. to relate in any way to the amount of water that would be required in the Illinois River for navigation in the event that there were no locks and dams in that river.

Ex. 62 The total amount of lockage water used in the American canals at St. Marys Falls between Lake Superior and the lower lakes from 1921 to 1925 varied from 681 to 796 second-feet and for the American and Canadian canals ranged from 788 to 902 second-feet.

Ex. 66, p. 7 The amount of commerce annually passing through the canals at St. Marys Falls from 1921 to 1925 ranged from 48,000,000 tons to over 91,000,000 tons.

GENERAL W. H. BIXBY, FOR COMPLAINANTS.

2102 2105 I was educated at the Massachusetts Institute of Technology, United States Military Academy, Engineers School of Application, French Government School of Highways and Bridges; graduated from West Point 1873, commissioned in the Engineering Corps, U. S. Army, serving from 1873 until 1913. Chief of Engineers, U. S. Army, 1910-13. Retired for age. Advisory Engineer, National Waterways Commission, which studied inland waterway systems of Europe in 1909; district engineer at Chicago, 1904-08. I was recalled into the service during the World War. I served on the Board on the Fourteen Foot Waterway from Grafton to St. Louis, and various other boards. From Utica to Grafton, a distance of about 230 miles, the Illinois River drops only about 33 feet. In the improved river there were eventually four locks of about 8 foot lift each. The river here flows in practically an alluvial plane. The banks and bed are alluvial. The river is a very level, slow-moving stream under ordinary circumstances and continues that way until it almost reaches the Mississippi where it has to go out into the Mississippi through a cut in between high banks, at least on one side. The section of the river from Utica to the mouth is easily

dredged and maintained. In the annual report of the Chief of Engineers, 1895, page 2716, Major Marshall states:

2109 "The channels dredged in the Illinois River are found to be nearly permanent. Channels dredged twenty years ago are but little deteriorated, and it is surprising to find that there has been no deterioration in the channels created by the Henry and Copperas Creek dams after from 15 to 20 years use. We can then expect the cost of maintenance to be very little."

2113 No addition to the flow of the Illinois River is necessary for a nine foot channel created by locks and dams. The improvement to river navigation with a channel of nine feet under existing circumstances cannot be properly secured until there is a dam in the Missis-
2114 sippi River below the mouth of the Illinois River. The corps of engineers of the War Department has never recommended a greater depth of improvement for the Illinois River than nine feet.

2116 With a nine foot channel, from 500 to 1,000 feet
2117 per second will furnish all the lockage water that is necessary for about sixty million tons per year from Lockport to Utica. None is needed during the closed season of navigation.

2126 In 1925 the Panama Canal through the summit
2127 level used 992 second-feet of water for a commerce of about 24 million cargo tons, and in 1926, used 989 second-feet of lockage water for a commerce of 26 million tons. Lockage on the Panama Canal goes both ways, from the summit to the two oceans. The amount required for lockage water one way on the Panama Canal is less than 500 second-feet. In the Illinois waterway the lockage only runs one way, from Lockport to Utica, since the summit level is Lake Michigan. There is surplus water in the Panama Canal so that they need not be economical in the use of lockage water.

2111 In my opinion, the proper method of improving the section of the Illinois River from Utica to Grafton for a nine foot channel is by locks and dams all the way through to the Mississippi.

2113 The improvement of the river for a navigation of nine feet under the existing circumstances cannot be properly secured until there is a dam in the Mississippi River below the mouth of the Illinois.

2130 A diversion of 10,000 c. f. s. from Lake Michigan will raise the low water elevation of the Illinois River 5½ ft. at La Salle, 5½ ft. at Peoria, 5½ ft. at Kampsville, and 4½ ft. at Grafton.

The flood of 1922 would have been about 18 inches lower at Peoria and 3 inches lower at Grafton if it had not been for the Sanitary District flow.

2133 It would be quite possible and it would be practicable if there was a diversion of from 8,500 to 10,000 c. s. f. of water from Lake Michigan to improve the Illinois River for a waterway of nine feet without any dams from Utica to Grafton. Such an increment might save considerable money in the lower end of the river, but that amount of increment makes it awkward for navigation at the upper part of the river between Lockport and
2134 Utica. This stretch of the waterway is entirely improved by Locks and dams, but it is in the section of the river which has a steep slope, naturally composed of rapids.

2135 The dams do not make quiet pools with that flow of water.

2136 I am inclined to think it would be feasible and practicable to construct a nine foot waterway without any dam from Utica to the mouth of the Illinois River with a diversion of from 8,500 to 10,000 c. f. s., but I would not vouch for it.

2131 The actual low water flow of the Illinois River is
2132 about 500 c. s. f. in the upper river and 1,500 c. s. f. at its mouth.

2133 In times of flood, dams in the Illinois River would tend to collect silt a certain distance above the dams. Dams act like bars on the river, and always between the bars there are deep pools.

JOHN W. WOERMANN, FOR THE DEFENDANTS.

I am the principal Assistant Civil Engineer in the employ of the office of the United States District Engineer at Chicago.

I was graduated from Washington University in 1890, taking for my degree thesis, "The Lakes to the Gulf Waterway and the Disposal of Chicago Sewage." Ever since that time, I have been employed, almost continuously, by the United States Engineer Corps at St. Louis and Chicago. For over 35 years I have been familiar with conditions, relating to the improvement of the Chicago, Des Plaines, Illinois, Missouri and Mississippi Rivers, the operation of the Illinois and Michigan Canal, and the construction of the Hennepin Canal, the Sanitary and Ship Canal and the Illinois Waterway. In the Summer of 1890 I worked under Captain W. L. Marshall making observations, maps and estimates in connection with the Government "Survey of a Waterway from Lake Michigan to the Illinois River," reported upon in House Document No. 269, 56th Congress, 1st Session (sometimes called the "Marshall Report"), made on March 10, 1890, pursuant to the Rivers and Harbors Act of August 11, 1888, which called for surveys, plans and estimates for a channel improvement for locks and dams in the beds of the Illinois and Des
4099, Plaines Rivers and for a channel from Lockport
4100, to Lake Michigan not less than 160 feet wide and
2, 6, 8, 9 14 feet deep.

I was assistant to the Division Engineer in the St. Louis office for 12 or 13 years and am now Principal Assistant to the District Engineer at Chicago. Following 1905 I had private practice for three years on construction of a bridge across the Illinois River at Peoria and a hydro-electric plant at the mouth of the Des Plaines River and other miscellaneous work. In 1908, I went to St. Louis and for a

time was engaged in making plans and estimates for a 14-ft. waterway from St. Louis to Cairo, in the employ of the United States under the Board of Examination and Survey of Mississippi River. That survey was authorized by the Act of Congress approved March 2, 1907, and re-
4111 ported on in H. D. 50, 61st Congress, 1st Session. The
4112 same quantity (10,000 c. f. s.) of diversion of water from Lake Michigan was taken into consideration as a basis for that survey.

4114 I was on the upper Missouri River about 6 or 7 months on a survey until the end of 1890. I was on the survey and construction of the Hennepin Canal from January 1, 1891, until July, 1902, nearly 12 years, under the United States Engineer's Office at Chicago. I was employed from the summer of 1902 to the summer of 1905 by a Board of Engineers of which Colonel Ernst was Chairman, in making the surveys, plans and estimates for a 14-foot waterway from Lockport to the mouth of the Illinois River, reported upon in H. D. 263, 59th Congress, 1st Session, 1905, commonly known as the "Ernst Report" with relation to a waterway from Lockport to St. Louis. In 1910, I made estimates for an 8 foot and a 9 foot waterway from Lockport to St. Louis under the so-called "Bixby Board."

4117 I was assisting in the division office of the Western Division at St. Louis from 1909 until April, 1921, at which time I was transferred back to Chicago where I am at the present time. I have been continuously in the employ of the United States since June, 1890, with the exception of three years.

About 1901, after the diversion of water began the old practice of using as a datum or reference plane the low water of 1879 was abandoned and has been continuously abandoned ever since. All work since that time has
4132 been done without reference to that old datum plane.

4124 In the improvement by the United States Government on the Illinois River between La Salle and the mouth from time to time those improvements have been made with reference to the new low-water levels as those

new low-water levels have from time to time been affected by the diversion of water from Lake Michigan.

4177 The 7-foot project of the Federal Government adopted in 1880 in the Illinois River was never completed, except in the sense that I indicated that by taking advantage of the increased flow it had been com-
4207 pleted.

Complainants objected to the competency of the foregoing testimony and testimony along the same line, and took an exception to its allowance.

Congress was providing a 7-foot channel as in its
4177 judgment sufficient for navigation on the Illinois River, and the engineers took such steps as they found necessary as conditions developed to give the 7-foot channel.

4120 Until a few years before the drainage canal (the Sanitary and Ship Canal) was opened, when it seemed a reasonable thing for all concerned to take advantage of the additional water which was expected to come and to use that as the new datum or reference plane, the low water of 1879 had been taken as the datum or reference plane, from which it was attempted to establish the project depth in the Illinois River.

4226 Since 1900 there have not been sufficient appropriations for the improvement of that stretch of the Illinois River to have maintained the project depth of 7 feet without the diversion of water from Lake Michigan at any time during that period. The reference plane or datum represented by low water of 1879 was officially established by the Chief of Engineers upon the recommendation of the District Engineer and the other sub-project reference planes from time to time, as indicated by this correspondence (Exhibit 1145, 1 to 17) have been established officially in the same way.

4113, 264- In the Marshall Report of 1890, the effect of
51-1, p. 27 the diversion upon the Illinois River is stated in the following language: "The larger discharge, 11,000 cubic feet per second, will raise the present

low water surface under present conditions about 5.5 feet at La Salle or to 9.9 feet above original low water; about 5.5 at La Grange; about 4.5 feet at Kampsville and about 1.5 in the Mississippi at the mouth of the Illinois."

4109 In making the surveys of the 14-foot waterway, re-
4110 ported upon by the Ernst Board in 1905 (H. D. 263-59-1) the maps, plans and estimates for that project were based upon a diversion of 10,000 cubic feet per second from Lake Michigan.

4111 That amount of diversion was reported as the basis of the survey in the 1905 Ernst Report, by the use of the following language: "In preparing this estimate the Board has assumed that the full discharge of 10,000 cubic feet per second contemplated in the plans of the Sanitary District will eventually be permitted by the Secretary of War."

4123 I made the surveys and estimates for the 1911 Bixby Report. In making my surveys and estimates for a 14-foot waterway it was, of course, necessary to use some uniform basis for putting soundings on the maps, and I used for that purpose the low water of 1901 which was the lowest since the opening of the Drainage Canal on January 19, 1900. The flow during the three summer months of 1900 being about 3,000 cubic feet per second, it seemed likely that the river would never be any lower than that, and all of my soundings are referred to that common basis. Following that the United States Engineer Department adopted that low-water line of 1901, which was fully established the entire length of the river in connection with my survey as a basis of the 7-foot project. That was the result which was aimed at to secure 7 feet below that low water of 1901.

4166 For many years the project depth and the project
4167 width for this stretch of the Illinois River between La Salle and the mouth of the Illinois has been a 7-foot depth and a 200-foot width. At no time since the beginning of the diversion from Lake Michigan into this waterway through the Sanitary and Ship Canal down to

the present time, would that project depth and that project width have been available without any diversion from Lake Michigan in the stretch of the Illinois River from La Salle to the mouth of it. Without any diversion the depth would have fallen short of 7 feet at low water at critical points of navigation about 4 feet.

During the low water years from 1900 down to the present time the least amount of diversion of water from Lake Michigan through the Sanitary and Ship Canal that was necessary to have produced an available depth of 7 feet at low water at the critical points of navigation, in that stretch of the Illinois River from La Salle to its mouth was from 8,000 to 9,000 c. f. s.

4118 With conditions as they have existed or did exist in the year 1925 in that stretch of the Illinois River between La Salle and the mouth of the Illinois River the average depth at low water at the critical points of navigation in this stretch of the river, with the diversion of water from Lake Michigan, which then amounted to 8,500 c. s. f. was from 7 to 7½ feet and the minimum available width was about 200 feet.

4120 From my estimates and conclusions and observations as to the conditions as they existed in the year 1925 the effect in that stretch of that river of the 8,500 c. f. s. of diversion of water from Lake Michigan upon the average depth in that stretch at low water at the low critical points of navigation in the year 1925 was to raise it an amount, varying from 4 feet below the Kampsville Dam up to as much as 9 feet at La Salle, except that the water level was not raised that much immediately above the dam. There was no place in that stretch that this diversion did not raise the natural level of the water at critical points of navigation at least 4 feet. The minimum value in feet of this diversion to that stretch of the river is 4 feet.

4228 There was not obtained at low water 7 feet of available depth in the Illinois from La Salle to its mouth before 1925.

4169 During the period from 1901 to the present time by the diversion of 8,500 c. f. per second from Lake

Michigan through the Sanitary and Ship Canal the available depths in the different portions of that stretch of the river between La Salle and the mouth of the Illinois River have been increased about 9 feet at La Salle, 6.5 feet at Peoria, and 4.3 feet below the Kampsville Dam.

4177 If the flow through the Drainage Canal was suddenly shut off the water would drop 6.5 feet lower at Peoria and 4.3 feet at Kampsville, at low water.

4170 The value of 8,500 c. f. per second from Lake Michigan through the Sanitary and Ship Canal in this stretch of the Illinois River between La Salle and the mouth of the Illinois River is from 4 to 9 feet. The minimum value through that stretch during all that period has been at least 4 feet.

4225 Since 1900 the estimates for improvements on the stretch of the Illinois River between La Salle and its mouth, reported to the Chief of Engineers for appropriations on that stretch of the river have been based upon low water conditions in that stretch of the river as affected by the diversion of water from Lake Michigan.

4226 There have not been sufficient appropriations for the improvement of that stretch of the Illinois River at any time since 1900 to have maintained the project depth of 7 feet without the diversion of water from Lake Michigan.

4237 When the Illinois Waterway is completed the locks will be very much larger than those the Federal Government has built along the Illinois River.

4215 The masonry for the lock two and one-half miles below Marseilles has been completed, although the steel gates have not been installed; and the lock at Lockport, at the end of the Chicago Drainage Canal, the masonry and upper gates are about 98 per cent completed, according to the report we made at the beginning of this month.

4216 Work has been started on the lock at Starved Rock, just above Utica, about five or six months ago.

4203-4 The effect of the reversal of the Chicago River has been the creation of a current in that river amounting to a mile or a mile and a half an hour, which has tended to discourage traffic to some extent. I would hardly consider the situation serious, but it unquestionably has an effect. Occasionally it does become serious. If a very large boat, especially at the Clark Street Bridge, which is the only remaining center pier on the river, gets crosswise, it may rub on one side or the other. At rare intervals further down on the south branch, boats will get crosswise and get aground on one end or the other. Such situations occur rarely.

4204 The statement of the Barlow Board that 10,000 cubic feet per second would make additional traffic through that river impracticable applies to the river as it existed before the Sanitary District widened it, deepened it and rebuilt the bridges.

4223 The low water of 1879 included some diversion of water from Lake Michigan about 700 c. s. f. coming from the old Illinois and Michigan Canal. The reference plane indicated by the low water of 1879, used as the datum for a number of years was determined and based upon that amount of diversion from Lake Michigan.

4177–78 4207 As I understand it, Congress was providing a seven foot channel as in its judgment sufficient for navigation on the Illinois River, and the engineers took such steps as they found necessary and as conditions developed to give the seven foot channel. If the flow from the drainage canal were suddenly shut off, the water level would drop nine feet at La Salle, 6-5/10 feet at Peoria, and 4-3/10 feet at Kampsville, providing the engineer corps had done no more work in maintaining and improving the river. This is because the corps of engineers did no more work during this period than was necessary to maintain the seven foot depth with the water that happened to be flowing in the river. In all projects, the river must be dredged and maintained annually or the depth provided by the Government will not exist. The Illinois River is not different in that respect than other rivers. In fact, the lower Illinois

is a much easier river in which to maintain depths by dredging than the majority of rivers in the United States.

The seven foot project adopted in 1880 by the Federal Government was never completed, except in the sense of taking advantage of the increased flow in the river. All projects require constant dredging to maintain. One would not expect any project adopted in 1880 to continue to have the required depth unless there was constant and regular maintenance and dredging for that purpose.

JAMES R. FULLER, FOR DEFENDANTS.

4238 I am a Civil Engineer and an Assistant Engineer
4239 for the United States Engineering Department stationed at Peoria. I entered the government service in 1889 and ever since have been almost continuously employed by that department as clerk, overseer of construction and engineer in charge of survey and improvements on the Illinois River.

4240 When I first observed the Illinois River in 1889, it was very sluggish and shallow, and the available depth in that stretch at low water was from 16 to 18 inches over the worst bars.

4241 At the present time, at low water, the navigable
4242 capacity of that stretch of the Illinois is 7 feet deep and 200 feet wide at low water. When I first began working on that river in 1889 the official reference plane datum used for the improvement of that river was low water of 1879. At that time, the project capacity was a navigable channel 7 feet deep at low water.

4242 Low water of 1879, as a reference plane, was abandoned in my work after the completion of the lock and dam at Kampsville in 1893, when it had become certain that the Chicago Drainage Canal was going to be opened and it had been estimated that the flow from that would raise the low water plane. The dredging operations that were carried on after that were done to that reference plane.

4245 At this point the Special Master made the following statement with reference to this line of testimony:

"Well, the question is not now whether the reference plane has ever been changed. The question is as to the actual conduct of the engineers, and whether or not the amount of water received by virtue of this diversion at Chicago was not taken into consideration in the actual operations. * * * Why can we not go forward with the idea that the engineers, irrespective now of just what authority they had or what official adoption there was of any reference plane, thought that, because there was a certain amount of water in this waterway, they did not have to ignore it in their operations to get a certain depth?"

4249 I have made observations and calculations to determine the effect of the diversion of water from Lake Michigan through the Sanitary and Ship Canal into the stretch of the Illinois River from La Salle to its mouth.

4249 With conditions as they existed or did exist in
4250 the year 1925 in that stretch of the Illinois River the available depth at low water at the critical points of navigation with the diversion of water from Lake Michigan, which then amounted to at least 8,500 cubic feet per second was slightly over 7 feet and the minimum available width was approximately 200 feet.

4250 The available depth in that stretch of the river at
4251 the critical points of navigation during the year 1925 if there had been no diversion from Lake Michigan, would have been 3 feet or possibly a little bit more. The minimum amount by which the diversion has raised the low-water plane in that stretch of the Illinois River at the most critical points of navigation, is about four feet. The minimum value of this diversion in that stretch of the river is four feet. At no time since the beginning of the diversion from Lake Michigan into this waterway through the Sanitary and Ship Canal from the year 1900 down to the present time would the project depth of 7 feet at low water have been available in that stretch of that river without any diversion of water from Lake Michigan.

4252 There was no time since the beginning of the diversion when the project width and the project depth would have been maintained without the diversion.

During the low-water years, from 1900 down to the present time, the least amount of diversion of water from Lake Michigan through the Sanitary and Ship Canal that was necessary to have produced an available depth of 7 feet at low water at the critical points of navigation in that stretch of the Illinois River from La Salle to its mouth was about 8,500 cubic feet per second.

During the period from 1901 to the present time a diversion of 8,500 cubic feet per second increased the available depth in the Illinois River at La Salle about 9 feet.

4254 The diversion raised the water in the Illinois River at La Salle in 1901 5.5 feet; in 1910 about 7.5 feet; in 1914 about 8 feet; in 1919 about 9.3 feet and in 1925 about 9.6 or 9.7 feet; at Peoria in 1901 about 2.8 feet; in 1910 about 5.4 feet; in 1914 6 feet; in 1919 6.5 feet; in 1925 about 6.7 or 6.8 feet and below the Kampsville Dam in 1901 2.5 feet; in 1910, 4 feet; in 1914, 3.7 feet; in 1919, 4.3 feet and in 1925 it was practically the same. All of these elevations are not exact, but they are as close as can be approximated. They are within .1 of a foot or .2. Those figures, at the respective points for the respective years in the varying amounts of diversion represent the value of the diversion in feet upon the navigable capacity of that stretch of the Illinois River.

4255 On the 3d of March, 1925, as conditions then existed in ordinary practice it would have taken about five years to have dredged or otherwise improved that stretch of the Illinois River from La Salle to its mouth so as to have made the project depth of 7 feet and the project width of 200 feet available, with a diversion of only 3,000 cubic second feet.

4255 It would take five years from the present time to
4256 accomplish the same result with a diversion of only 3,000 cubic second feet. Without any diversion it would take two to two and one-half times as long, or ten or twelve years, anyway.

4256 By diversion from Lake Michigan in my testimony just given I mean the quantity of water that the Sanitary District is turning into the Illinois River at Lockport, measured at Lockport. That is inclusive of water used in the city for sanitary purposes.

4257 My assumption of the length of time it would take to complete the established project on the Illinois River if there were no diversion does not mean that not a drop would come from Lake Michigan because that assumption is based on the original low water plane, when there was a little water coming in out of the old Illinois Michigan Canal, six or seven hundred feet.

4261 The amount of diversion assumed in 1901 was 3,000 second feet, in 1910 about 6,900 c. f. s., in 1914 about 8,400 c. f. s., in 1919 about 8,500 c. f. s. and in 1925 about 8,700 c. f. s.

4262 In testifying as to the amount which I found the Illinois River was raised by the diversion at these critical points I assumed those figures.

The effect at the mouth of the Illinois is a little more than 1.2 feet, with an 8,500 diversion, between that and a foot and a half. The Mississippi affects that, or affected that at the time.

4263 Our official authority for the change in reference plane is the District Engineer. I have knowledge that authority higher up knew what he was doing.

4264 His reports to the Chief of Engineers showed what we were doing, so that they knew the actual conditions.

It would take five years from today to complete the existing project on the Illinois, with a diversion of 3,000 c. f. s.

4264 I estimated that it would take from two to two
4265 and one-half times as long if there were no diversion, except the diversion of six to seven hundred feet, which was flowing through the Illinois and Michigan Canal

in 1879 and upon which was based low water of 1879, the old reference datum.

4266 With no diversion I doubt whether, if you increase the plant still further, you could do it in the same length of time, five years.

4270 We were first able to obtain in that stretch of the river the project depth of 7 feet with the diversion as it existed about 1925.

4272 There were never available appropriations and
4273 funds sufficient to obtain at any time the project depth and the project width referred to in this stretch of the Illinois River, without at least 8,500 cubic second feet of diversion of water from Lake Michigan. We asked for more funds many times.

Ex. 1145 (1 to 17) 4121 **Correspondence Between the District Engineer and Division Engineer and the Chief of Engineers Concerning the Reference Datum for Improvements of the Illinois River.**

Ex. 1145-1 On May 4, 1900, the Assistant Engineer at Kampsville wrote to the District Engineer regarding the dredging to be done there that season, as follows:

> "The approved project provided for a channel 7 feet deep at low water and of sufficient width for free navigation.
>
> "This would require a large amount of dredging using the low water of 1879 as a datum. The addition of the water from the drainage Canal of Chicago will probably raise the low water plane materially."
>
> * * * * * * *
>
> "I would recommend that the dredging done this season be done with a view of providing the 7 ft. of water below the new low water plane."

This letter was approved by the District Engineer on May 7, 1900.

Ex.1145-2 On March 25, 1907, the Dis trict Engineer at Chicago wrote a letter to the Chief of Engineers, which is in part as follows:

"1. In compliance with instructions contained in department letter of March 7, 1907 (Ed. 42877) I have the honor to submit the following projects for the expenditure of the appropriations by Act of March 2, 1907, for:

1. Improving Illinois River, Illinois: continuing improvement and for maintenance, $50,000, * * *

"Major (Now Lieut. Col.) W. L. Marshall adopted 130 feet for the immediate navigable width, but made 200 feet the width to be ultimately obtained, with 7 feet at low water. This depth is still considered sufficient for present needs, but considerable work remains to be done to obtain a uniform width of 200 feet at all points, as well as dredging of bars to maintain 7 ft. navigable depth at low water of 1901."

* * * * * * *

"4. It is therefore recommended that the available balance with the new appropriation be applied to maintaining the plant in efficient condition, repairing the same and rebuilding when necessary, snagging over the whole of the river from its mouth to Copperas Creek, and to such dredging as may be required to provide and maintain a navigable channel at low water of 1901 of 7 ft. depth and 200 feet width, as far as funds will allow. * * *"

* * * * * * *

"6. It is therefore recommended that the appropriation for the Illinois River from Copperas Creek to La Salle be applied to maintaining the plant in efficient condition, repairing and rebuilding the same when necessary, snagging, removing bars, widening out channels, easing curves and crossovers, for the general purpose of securing and maintaining a navi-

gable depth at low water of 1901 of 7 feet, with a project width of 200 feet, * * *''

This was approved by the Chief of Engineers April 6, 1907.

Ex. 1145-3 Under date of July 20, 1910, the District Engineer at Chicago, in submitting a project for the expenditure of the appropriation, made in the Act of June 25, 1910, for the Illinois River, wrote a letter to the Chief of Engineers at Washington, which is in part as follows:

> ''2. The present general project for the Illinois River contemplates the creation and maintenance by appropriate means of a channel of indefinite width, 7 feet deep at low water (of 1879) below Copperas Creek, and of a channel 200 feet wide and 7 feet deep at the low water of 1901 from Copperas Creek to La Salle.''
>
> ''4. The increased depth has been secured largely by dredging, and continuous dredging is required to maintain that depth.''

This was approved by the Chief of Engineers on August 10, 1910.

Ex. 1145-4 Under date of July 21, 1910, J. W. Woermann, Assistant Engineer, wrote to the District Engineer at Chicago as follows:

> ''MEMORANDUM.
>
> July 21, 1910.
>
> Major KELLER:
>
> Permit me to refer to the following point, which has probably not been brought to your attention before.
>
> Paragraph 2 of your project for the expenditure of the recent appropriation of $30,000 for 'Improving Illinois River' states that the general project contemplates a channel 7 feet deep *at law water of 1879,* below Copperas Creek. While this statement may

be technically correct and can probably be supported by reference to earlier reports, as a matter of fact it is dead letter. Practically, the present project is to maintain a depth of seven feet with the present low water flow and not that of 1879.

The low water profile of 1879 became a matter of history when the river was canalized and the volume of flow is the only feature that can have any bearing on the present project. The natural low water discharge of the river was about 500 second feet at Utica and about 1,000 second feet at the mouth. To this the Chicago Drainage Canal is now adding about 7,000 second feet (not official, but reliable) although their permit only calls for about 4,300 second feet.

This addition from the Chicago Drainage Canal has raised the low water surface not less than three feet, on an average, so that a channel seven feet deep with the low water flow of 1879 would be at least ten feet deep under conditions as they now exist.

My suggestion is to omit the words 'of 1879' in similar statements in the future. This practice sems to be the more common in other districts, viz., to state the required depth at low water without specifying any particular year.

The river and harbor act of 1910 seems to have gone one step farther in stating that 'the depth of water * * * shall be understood to mean the depth at *mean* low water unless otherwise expressed.' (See p. 42 of 6″ x 9″ edition.)''

1145–5 Under date of July 15, 1912, the District Engineer at Chicago wrote to the Chief of Engineers at Washington a letter which is in part as follows:

''* * * I have the honor to submit the following sub-project for the expenditure of the funds carried in the pending act 'making appropriations for the construction, repair, and preservation of cer-

tain public works on rivers and harbors, and for other purposes,' in the following item, viz:

> 'Improving Illinois River, Illinois; continuing improvement and for maintenance below Copperas Creek, twenty thousand dollars.'

"The present project for the Illinois River contemplates the creation and maintenance by appropriate means of a channel of indefinite width, 7 feet deep at the low water below Copperas Creek, and of a channel 200 feet wide and 7 feet deep at the low water of 1901 for Copperas Creek to La Salle.

"A channel 7 feet deep has been secured throughout the entire portion of the river under improvement, but the needs of navigation have not demanded dredging to the full project width of 200 feet up to the present time.

"Continuous dredging is required to maintain the project depth which has been secured largely through dredging.

"It is proposed to expend the funds covered in above item in maintaining the navigable channel of 7 feet depth * * *."

Ex. 1145-6 This letter was approved by the Chief of Engineers on July 28, 1912, in a letter (file 7868/19) to the District Engineer stating "The subproject submitted is approved."

Ex. 1145-7 Under date of April 18, 1913, the District Engineer at Chicago wrote a letter to the Chief of Engineers which is in part as follows:

"Subject: Project, Improving Illinois River, Ill.

"Complying with instructions contained in Department letter of March 11, 1913 (E. D. 42877), I submit herewith the following sub-project for expenditure of the funds appropriated in the following item of the River and Harbor Act approved March 4, 1913:

'Improving Illinois River, Illinois: Continuing improvement and for maintenance below Copperas Creek, $10,000.'

"The project for improving this river is given in the Annual Report for 1912, pages 1021-1022, and the last sub-project was approved August 28, 1912—E. D. 7868/19."

Ex. 1145-8 On May 25, 1914, the Assistant Engineer at Peoria wrote a letter to the District Engineer at Chicago, which is in part as follows:

"Subject: Project, Illinois River.

Answering the questions in your letter of the 22nd inst. in the order asked:

1st. The original project for this river below Copperas Creek Lock, adopted in 1880 was for a 7 feet depth at low water of 1879 of indefinite width to be provided by dredging, with the aid of locks and dams.

The sub-project approved April 6, 1907, for expending money appropriated that year for a channel 7 feet deep at low water of 1901 and 200 feet wide, from Grafton to La Salle, $50,000.00 having been appropriated for Improving Illinois, General Improvement, and $50,000.00 for Improving Illinois River, Copperas Creek to La Salle.

The sub-project approved August 28, 1912 for expending the money appropriated that year provided for a channel 200 feet wide and 7 feet deep at low water, the appropriation being for Improving Illinois River, General Improvement, only.

The project for improving the river by locks and dams and dredging was based on low water of 1879. When Kampsville Dam was finished, progress on the Chicago Drainage Canal had reached a point where it was only a question of a few years until it would be opened, and all dredging done between that time and 1901 was done with a view to providing 7 feet

with the aid of water through this canal. The canal was opened January 17, 1900 and the low water of 1901 was the lowest there has been on this river since, except for the first 15 miles above the mouth of the river.

The year 1910 was very dry and the Upper Mississippi had the lowest water on record between the Mouth of the Missouri and St. Paul. As the fall in this river is very small, the Mississippi affects the lower end of this river very materially. So much so, that although the discharge through the Chicago Drainage Canal in 1910 was twice as great as it was in 1901 the low water of 1910 in this river for the first fifteen miles above Grafton was the lowest on record.

The estimate of 500,000 cu. yds. to complete the project refers to the project approved August 28, 1912 for 7 feet at low water of 1910.

The lowest water between Copperas Creek and Kampsville Lock after Kampsville and La Grange Dams were finished was in 1894. This was also the lowest stage below Kampsville Lock, except for the last 15 miles of the river. Where the stage reached in 1910 is the lowest as noted above. To provide a channel 200 feet wide and 7 feet deep at low water of 1894 from Copperas Creek to Grafton will require 2,500,000 cu. yds. of dredging. To dredge the last fifteen miles of the river to 7 feet at low water of 1910 will require 200,000 cu. yds. additional. It is believed that with proper equipment this dredging can be done at a cost of 12½¢ per cubic yard or a total cost of $327,500.00."

1145–9 On May 26, 1914, the District Engineer at Chicago, wrote a letter to the Assistant Engineer at Peoria, which is in part as follows:

"As to the low water from which depth should be measured, it seems to me that the low water of 1879 lost its importance when the Drainage Canal water was admitted and that it would be fair now to assume

the low water from which the depth should be calculated as the low water of 1901." * * * "I wish very much that I could get a reasonable and proper statement of this project and of the amount necessary to complete so that I might obtain authority from the Chief of Engineers at this time to embody same in my annual report, and thus get the matter straightened out."

1145–10 On January 29, 1915, the Assistant Engineer at Peoria wrote a letter to the District Engineer at Chicago, which is in part as follows:

"Referring to paragraph 1 of your letter of January 28 will say that hereafter whenever low water is referred to it will mean low water of 1901 unless otherwise stated."

1145–11 On February 5, 1915, the District Engineer at Chicago wrote a letter submitting estimates for dredging to the Assistant Engineer at Peoria, which is in part as follows:

"It is now understood that, until a change is made, our project depths will be referred to low water of 1901, from Grafton to Kampsville Lock, and from Bedford to Copperas Creek Lock; to low water of 1908 from Kampsville Lock to Bedford; and to low water of 1879 when referring to the mitre sills of the two locks."

1145–12 On May 10, 1915, the District Engineer at Chicago wrote a letter to the Chief of Engineers at Washington, which is in part as follows:

"Subject: Sub-project for Improving Illinois River, Ill.

* * * * * * *

"In compliance with instructions contained in department letter of April 2, 1915, (Ed. 42877) the following sub-project is submitted for the expenditure of $50,000 allotted for improving Illinois

River, Illinois, (general improvement) from the $25,000,000 appropriated by Act of March 4, 1915."

"The existing project for improvement of this river provides for dredging and maintaining a depth of seven (7) feet at low water, and the construction of two locks, at Kampsville and La Grange, respectively."

1145–13 On May 18, 1915, the Chief of Engineers at Washington wrote a letter to the District Engineer at Chicago in reply to the above-mentioned letter of May 10, 1915, which is in part as follows:

"The sub-project submitted is approved."

1145–14 On April 20, 1916, the Assistant Engineer at Peoria wrote a letter to the District Engineer at Chicago, which is in part as follows:

"Subject: Estimates for completing Illinois River Project."

* * * * * * *

The following estimate of the amount of dredging required to complete a channel 200 feet wide and 7 feet deep at low water from Grafton to La Salle is submitted.

* * * * * * *

The above estimate is based on the low water of 1901 for 110.3 miles; Six mile Island to Kampsville Lock and Montezuma to Copperas Creek Lock; On the low water of 1908 for 18.5 miles, Kampsville Lock to Montezuma, and on the low water of 1910 for 8 miles, Grafton to Six mile Island.

The above is the lowest water over the reaches described since the opening of the Chicago Drainage Canal in 1900."

Ex. 1145–15 Under date of March 31, 1919, the District Engineer at Chicago wrote a letter to the Chief of Engineers in part as follows:

"Subject: Illinois River, Illinois.

(*a*) In compliance with instructions contained in circular letter dated March 8, 1919, the following *sub-project* is submitted for the expenditure of $10,000 allotted by the Chief of Engineers * * * from the lump sum appropriation of $140,000 by the River and Harbor Act approved March 2, 1919.

(*b*) The existing project for the improvement of the Illinois River is given on pages 1470 and 1471 of the annual report for 1918."

1145–16 On June 18, 1920, the District Engineer at Chicago wrote a letter to the Chief of Engineers at Washington, which is in part as follows:

"Subject: Illinois River.

"In compliance with instructions contained in the department letter of June 10, 1920 (Ed. 42877), the following sub-project is submitted for the expenditure of $25,000 allotted for the Illinois River from the River and Harbor Act approved June 5, 1920.

(*b*) The last printed statement of the existing project is given on page 1595 of the annual report for 1919.

(*c*) The two locks and dams have been completed and the dredging, exclusive of accumulated maintenance, is about 66% completed. The whole project, including locks and dams, is about 94.5% completed. Dredging towards completion of the project should be undertaken at once.

With the present unauthorized flow from Lake Michigan the controlling depth of the entire river from La Salle to the mouth is 6 feet but not for the full project width of 200 feet. On the hypothesis that there will be an increment from Lake Michigan of 4166 c. f. s., there yet remains to be done the dredging of about 1,290,000 cubic yards of material, of which about 640,000 cubic yards is new work and about 650,000 cubic yards is accumulated maintenance.

The increased importance of the Illinois River due to the recent approval of the plans for the construction of the Illinois Waterway by the State of Illinois, makes it imperative that more extensive dredging operations be carried on both for maintenance and for the completion of the project."

Ex. 1145–17 On March 21, 1921, the District Engineer at Chicago wrote a letter to the Chief of Engineers at Washington which is in part as follows:

"Subject: Additional dredging plant for Illinois River.

* * * * * * *

In order to complete the existing 7-foot project, assuming the flow from Lake Michigan through the Chicago Drainage Canal to be approximately that authorized by the Secretary of War and all dams retained, it will be necessary to remove about 1,900,000 cubic yards of material.

* * * * * * *

The existing dredging plant working under the most favorable conditions has a capacity of about 300,000 cubic yards per annum with double crew and would require from 12 to 13 years to complete the existing 7-foot project.

* * * * * * *

In view of the progress being made in the construction of the 'Illinois Waterway' by the State of Illinois it is very probable that a 9-foot project for the Illinois River will be adopted by Congress in the near future.

Should the 8-foot project be adopted it will probably provide for obtaining an 8-foot depth at a low water stage corresponding to a diversion from Lake Michigan of 7,500 cubic feet per second and the removal of the existing dams.

* * * * * * *

Neither the existing 7-foot project nor the suggested 8-foot project can be completed before the completion of the work on the 'Illinois Waterway'."

"NAVIGATION OF ILLINOIS RIVER AND WATERWAY PHYSICAL CHANGES."

Ex. 1, p. 42, Putnam Report, Nov. 1, 1923, "Diversion of Water from Lake Michigan." 3506 3510

"Previous to the opening of the drainage canal the reference plane for channel improvements was the elevation of low water of 1879. This was 439.25 at La Salle and 410.7 at Grafton, Memphis datum. Since 1900 the reference plane has been the elevation of low water of 1901, that being the lowest stage since the opening of the canal."

In House Document 762, 63rd Congress, 2nd Session, the Board of Engineers, in reporting to Congress in the year 1913 on the Illinois River, stated:

"FEASIBILITY OF THE WATERWAY."

H. D. 762-63-2, p. 4, Par. 3.

"In the valley of the Des Plaines and upper Illinois Rivers, excellent foundations for locks are available; the lower Illinois has a gentle slope, so that any reasonable depth can be obtained by dredging, and the present diversion* of water from Lake Michigan through the Chicago Drainage Canal is more than sufficient for navigation purposes. It is therefore the opinion of the special board that the waterway from Lockport to the mouth of the Illinois River is feasible."

Ex. 18, H. D. 4-69-1, p. 175, Bd. of E.

"Illinois River, LaSalle to the mouth.—The existing Federal project adopted in 1880 provides, in connection with the State project, for a navigable channel 7 feet deep at low water of 1879 from La Salle to the mouth of the river, by the construction of four locks and dams and dredging the bars."

---

*— 6945 c. f. s. (Special Master's Report, p. 22.)

Ex. 1360 Doc. 2,- 67-1, p. 9, Dist. E.

"Illinois River, LaSalle to the mouth.—The existing Federal project adopted in 1880 provides, in connection with the State project, for a navigable channel 7 feet deep at low water of 1879 from LaSalle to the mouth of the river, by the construction of four locks and dams and dredging the bars."

* * * * * * *

"All dredging since 1914 has been done by the United States dredging plant, and to a depth of 7 feet below low water of 1901, the lowest stage of river since the opening of the Sanitary Canal."

Ex. 18, H. D. 4-69-1, p. 8, Bd. of E.

"The Illinois River * * * is under improvement by the United States in accordance with a project providing for a channel 7 feet deep at low water of 1879 * * * to be obtained by two Federal locks and dams * * *. There are two other locks and dams * * * operated and maintained by the State of Illinois * * *; these were, however, necessary for navigation up to LaSalle previous to the present large diversion of water from Lake Michigan."

C. of E., Rep. 1890, Pt. 1, P. 261.

"The present project" on the Illinois River "includes the building of two locks * * * with 7 feet of water over the mitre-sills at low water of 1879, and dredging the channel where necessary to obtain 7 feet depth at low water in the pools thus created."

Ex. 207, C. of E. Rep., 1893, Pt.I, p. 362.

"The project" on the Illinois River "includes the construction of two locks * * * with a depth of 7 feet in water over sills at low water of 1879, and dredging the channel where necessary to secure 7 feet depth of water at low water in the pools thus created."

This appears also in Report of Chief of Engineers, U. S. Army,

1894, Part I, p. 334.	1897, Part I, p. 416.
1895, Part I, p. 372.	1898, Part I, p. 404.
Part IV, P. 2714.	1899, Part I, p. 480.
1896, Part I, p. 327.	1900, Part I, p. 505.
Part IV, p. 2597.	

Ex. 207, C. of E. Rep., 1897, Pt. LV, p. 2815. "The present project" on the Illinois River "includes the construction of two locks * * * with 7 feet depth at low water over sills, and dredging the channel where necessary to secure that depth of water at low water throughout the pools created by the dams."

This also appears in Report of Chief of Engineers, U. S. Army,

1898, Part IV, p. 2436.	1900, Part V, p. 3799.
1899, Part IV, p. 2841.	1901, Part IV, p. 3006.

Ex. 207, C. of E. Rep. 1901, Pt. 1. "The project" on the Illinois River "includes the construction of two locks * * * with 7 feet of water over sills at low water of 1879, and dredging the channel where necessary to obtain 7 feet depth at low water was adopted in 1880."

This also appears in Report of Chief of Engineers, U. S. Army

1902, Part I.	1908, Part I, p. 682.
1903, Part I.	1909, Part I, p. 718.
1904, Part I, p. 541.	1910, Part I, p. 796.
1905, Part I, p. 548.	1911, Part I, p. 853.
1906, Part I, p. 609.	1912, Part I, p. 1012.
1907, Part I, p. 635.	1913, Part I, p. 1133.

Ex. 207, C. of E. Rep., 1907, Part 1, p. 636. "From Copperas Creek to LaSalle. The first appropriation for this section of the River was made March 2, 1907, and the approved project for its expenditure provides for securing the same navigable conditions

from Copperas Creek to LaSalle as are planned for the lower river i. e. a channel depth of 7 feet at low water."

This also appears in report of Chief of Engineers, U. S. Army

1908, Part I, p. 682.	1911, Part I, p. 835.
1909, Part I, p. 719-20.	1912, Part I, p. 1021.
1910, Part I, p. 797.	1913, Part I, p. 1133.

Ex. 207, C. of E. Rep. 1910, Pt. II, pp. 2164-65.

"Improvement of Illinois River, (a) Below Copperas Creek. The approved project provides for a channel 200 feet wide and 7 feet deep at low water of 1879."

This appears also in Report of Chief of Engineers, U. S. Army,

1911, Part II, pp. 2367-2368. 1913, Part II, p. 2817.
1912, Part II, p. 2555.

Ex. 207, C. of E. Rep. 1912, Pt. I, p. 1020.

"Improvement * * * includes the construction of two locks * * * with 7 feet of water over sills at low-water level of 1879, and dredging the channel where necessary to obtain 7 feet depth at low water, was adopted in 1880."

"From Copperas Creek to La Salle— * * * project * * * provides for securing the same navigable conditions from Copperas Creek to La Salle as are planned for the lower river, i. e., a channel depth of 7 feet at low water."

Ex. 207, C. of E. Rep. 1914, Pt. I, pp. 1170–72.

"The admission to the Illinois River of Lake Michigan water via the Chicago Drainage Canal has raised the lower water plane; but inasmuch as the quantity of water which may thus be admitted is a matter of present litigation, it is impracticable, as yet, to ascertain what the low water plane will be."

"Each lock is 350 feet long, between sills and 75 feet wide, with 7 feet on the mitre sills at low water of 1879."

"Copperas Creek to La Salle. * * * The state of Illinois * * * has built locks * * * with 7 feet on the mitre sills at low water of 1879."

Ex. 207, C. of E. Rep. 1915, Pt. I, p. 1266.

"Illinois River (Note on p. 1266). The admission to the Illinois River of Lake Michigan water via the Chicago Drainage Canal has raised the low water plane, but inasmuch as the quantity of water that may thus be admitted is a matter of present litigation, it is impracticable to ascertain what the future low water plane will be. At present there is admitted nearly 8,000 cubic feet per second as against 4,166 cubic feet per second authorized."

This appears also in the report of Chief Engineers, U. S. Army,

1917, Part I, p. 1423.
1918, Part I, p. 1470.
1919, Part I, p. 1595.
1920, Part I.
1921, Part I, p. 1575.
1922, Part I, p. 1593.

"The existing project * * * contemplates improvement to a 7-foot depth at low water by dredging and by the construction of locks * * * with 7 feet on the mitre sills at low water of 1879."

"Copperas Creek to La Salle. * * * The State of Illinois has built locks, * * * with 7 feet on the mitre sills at low water of 1879."

Ex. 207 C. of E. Rep. 1916, Pt. I, p. 1367.

"Illinois River * * * below Copperas Creek * * * project * * * contemplates improvement to a depth of 7 feet at low water by dredging and by * * * locks, * * * with 7 feet on the mitre sills at low water of 1879."

This appears also in report of Chief of Engineers, U. S. Army,

1917, Part I, p. 1423.
1918, Part I, p. 1470.
1919, Part I, p. 1595.
1920, Part I.
1921, Part I, p. 1576.

Ex. 207, C. of E. Rep. 1923, Pt. I, p. 1451.

"Existing project * * * provides for the improvement * * * by dredging to afford a depth of 7 feet at low water of 1879."

This appears also in report of Chief of Engineers, U. S. Army,

1924, Part I, p. 1448.
1924, Part I, p. 1358.

"The admission to the Illinois River of Lake Michigan water via the Chicago Drainage Canal has raised the low water plane, but inasmuch as the quantity of water that may thus be admitted is subject to progressive reduction, it is impracticable as yet to ascertain what the future low water plane will be."

Ex. 207, C. of E. Rep. 1922, Pt. I, p. 1593.

"Illinois River * * * existing project * * * provides for improvement * * * by a construction of two locks and dams and by dredging to afford a depth of 7 feet at low water of 1879 and * * * from Copperas Creek to La Salle by dredging and other improvements to afford the same depth."

"Feasibility, Illinois Waterway."

Ex. 1195-A Judson letter, Aug. 11, 1919 to C. of E. on Ill. Waterway, pp. 9–10.

"In this connection it seems enough to point out that along the line followed by the proposed waterway there already flows a commerce vastly greater than the proposed or any other reasonably designed waterway could accommodate. The lands bordering upon the river-and-canal system of which the Illinois Waterway would be a part are among the richest, agriculturally, in the country.

The Illinois River traverses a great coal field. The timber marketed via the Great Lakes is becoming exhausted and increasing amounts of pine are being brought to Chicago from the South. Along the proposed waterway itself are enormous deposits of stone. At Joliet is a great steel plant. At La Salle there are large zinc reduction works and a number of cement mills having a capacity of approximately 4,000,000 barrels yearly. Chicago and the wonderful industrial district at and about Chicago are at one end of the waterway. From Chicago to the seaboard proceeds a vast volume of commerce, including grain and other food products and all kinds of manufactured articles. Some considerable portion of this commerce will be destined to pass through the Panama Canal, and the Illinois Waterway would be a link in a waterway system continuous to and through the Panama Canal."

In 1925, Major General Harry Taylor, Chief of Engineers, appearing before the "Select Committee On Nine-Foot Channel From The Great Lakes To The Gulf, United States Senate," testified relative to the amount of water required for purposes of, and the effect of the diversion upon, navigation along the Illinois River, as follows:

Ex. 209 "Of course, the amount of water depends entirely upon how the improvement shall be made. We could get 8 or 9 feet in the Illinois River with 1,000 second-feet or with 10,000 second-feet diversion but by different methods of improvement and at different costs."

Ex. 209 "With 1,000 second-feet you would have to have locks and with 10,000 second-feet no locks would be required; that is, below Utica."

In 1926 General Taylor appeared before the Committee on Rivers and Harbors, House of Representatives, and testified relative to the amount of water required for purposes of navigation along the Illinois River as follows:

Ex. 209 "It is shown in the table and published in the report that the channel can be obtained with any amount of diversion annually from 1,000 up to 10,000. That answers your question."

In 1926 General Taylor also appeared before the United States Senate, Commerce Committee, where he testified as follows:

Ex. 209 "There is a certain amount of water used for domestic purposes, approximately 1,200 second-feet, and that would go back into the river and go down the river. With a diversion there at Lockport of only 1,000 second-feet, which is less than the amount they are using at the present time for domestic consumption, the cost would vary. With complete canalization it would be $2,666,000, and with partial canalization, by taking the State dams out, it would be $5,133,000. In other words, with a flow from the lake of only 1,000 second-feet, the cost would be between $2,555,000 and $5,-133,000."

Ex. 209 "Navigation can be provided for with a thousand second-feet."

After considering this testimony of General Taylor before the "Select Committee On A Nine-Foot Channel From The Great Lakes To The Gulf, United States Senate" the "Select Committee" made its report (Report No. 955, 68th Congress, 2nd Session) which, among other things, states:

Ex. 1099, p. 6 "The portion of the Illinois and Mississippi Rivers proposed to be improved is a natural waterway having a fall of only 30 feet in 230 miles. In fact, except in flood, the Illinois is naturally a more navigable stream than the Ohio. However, what concerns navigation on any river is neither the average nor the flood flow, but the minimum flow available throughout the year. We find available for the waterway proposed here a low, natural dry-weather flow supplemented by an existing diversion of 10,000 cubic feet of water per second

from Lake Michigan. This quantity of water, we believe, is needed to give the 9-foot depth proposed in the lower Illinois River. Likewise, we believe this amount of water diverted from Lake Michigan increases by about one-third the dry-weather flow of the Mississippi River at St. Louis and provides an increase in the low-water depth of this portion of the river of about 1½ feet without dredging."

In House Document No. 4, 69th Congress, 1st Session, transmitted to the Congress March 29, 1926, the Board of Engineers for Rivers and Harbors with respect to the effect of the diversion from Lake Michigan upon the methods and cost of providing a 9-foot channel in the Illinois River stated:

Ex. 18, p. 10, par. 8, Bd. of E.

"The estimated cost of navigation improvement, which is the question asked, depends both on the amount of diversion and the method of improvement. For any of the three depths, the river can be improved by one or more of at least four different methods; complete canalization, using five locks and dams; partial canalization, using the four existing locks and dams; partial canalization, using the two existing Federal locks and dams and taking out the two State dams; and open channel improvement. The following table shows, for a channel 9 feet by 200 feet, the costs by these methods, for the five diversions given in the resolution and for additional diversions as well (1,000, 3,000, 5,000 and 6,000 c. f. s.). It is assumed, that by 'diversions' the committee meant 'average annual diversions based upon the year most unfavorable to navigation.' (Par. 7-c, col. 1.) The division engineer concurs in these cost estimates. The board concurs and submits them, as the answer to the first question, as regards the 9-foot depth. Data on 7-foot and 8-foot depths and certain alternative estimates for 9-foot depths appear in the district engineer's report and appendices thereto."

Ex. 18,
p. 11,
par. 8,
Bd. of E.

"ILLINOIS RIVER, ILL.

"Method of Improvement	Instantaneous maximum diversion, Lockport, cubic feet per second	Annual average diversion, Lockport cubic feet per second	Cost, thousands of dollars.[1] First Cost	Maintenance and operation	Annual Charge (maintenance & operation plus 4 per cent first cost)
Complete canalization[2]	1,650	1,000	2,666	226	[2] 332
Partial canalization (State dam out)			5,133	210	415
Complete canalization[2]	3,300	2,000	2,619	216	[2] 321
Partial canalization (State dams out)			5,108	171	375
Open Channel			6,050	105	347
Partial canalization[2] (present dams retained)	4,580	3,000	1,914	191	[2] 268
Partial canalization (State dams out)			3,697	147	295
Open Channel			4,482	97	276
Partial canalization (present dams retained)	6,050	4,167	1,383	180	235
Partial canalization[2] (State dams out)			2,262	133	[2] 224
Open Channel			3,465	89	227
Partial canalization (present dams retained)	7,050	5,000	1,264	178	229
Partial canalization (State dams out)			1,789	130	202
Open Channel[2]			2,365	87	[2] 182
Partial canalization (present dams retained)	8,250	6,000	1,141	168	214
Partial canalization (State dams out)			1,349	126	180
Open Channel[2]			1,925	80	[2] 157
Partial canalization (State dams out)	10,050	7,500	942	122	160
Open Channel[2]			1,540	76	[2] 138
Partial canalization[2] (State dams out)	11,250	8,500	171	114	[2] 121
Open Channel			1,320	70	123
Partial canalization (State dams out)	13,050	10,000	171	105	112
Open channel[2]			990	63	[2] 102

[1] On the assumption that the flow is regulated primarily in the interests of navigation.

[2] Indicates method which, considering, first, maintenance and operation costs, is cheapest, in terms of Federal money expended, for the given diversion."

Ex. 18, p. 15, par. 22, Bd. of E.

"22. Pending further developments and investigations along these lines, the board is unable to give its opinion as to what is the exact amount of diversion which would result in the maximum of benefit to the Nation as a whole, taking all factors into account. The board therefore feels that it would be premature definitely to fix the diversion at this time. As it happens, it is needless from the viewpoint of navigation on the Illinois thus to fix it. The Illinois can be given a 9-foot channel by several methods, as shown above; two of these are of special merit, being applicable for any annual average diversion as low as 2,000 cubic feet per second, and equally applicable for a diversion as high as 10,000 cubic feet per second. The two methods are (1) removal of all dams, and (2) partial canalization by removal of the two State dams and retention of the two Federal dams, together with in each case dredging and supplementary work."

Ex. 18, p. 3, par. 3, C. of E.

"6. The district engineer, as a result of a careful economic study, is of the opinion that the most suitable dimensions are a governing depth of 9 feet and a governing width of 200 feet. The division engineer concurs in this view. The Board of Engineers for Rivers and Harbors also concurs on the basis both of the district engineer's computations and of the general significance of a navigable connection between Lake Michigan and the Mississippi as an important part of the future system of trunk-line waterways in the interior of the country."

p. 4, Par. 8.

"8. The question of what diversion is necessary to produce a channel 9 feet by 200 feet by any of the several practicable schemes, other than complete canalization, is answered by the table in paragraph 5 above. More complete data on this and other depths appear in the district engineer's report."

p. 4, Par. 11. "11. The district engineer recommends a 9-foot channel 200 feet wide, to be obtained by an annual average diversion of 4,167 cubic feet per second and a maximum instantaneous diversion of 6,050 cubic feet per second, both measured in the drainage canal at Lockport, the channel to be provided by dredging, partial removal of the two State dams, and retention and alteration of the two Federal dams, at an estimated cost of $2.262,000 with $133,000 annually for maintenance. The division engineer submits certain comments on the amount of diversion required for navigation. Taking all factors into consideration, he concurs in the recommendations of the district engineer as to the works to be undertaken, and considers that the diversion at Lockport should not exceed 4,167 cubic feet per second annual average."

Ex. 18, p. 6, Par. 14, C. of E. "14. The board therefore recommends modification of the existing project for the Illinois River to provide a channel with least dimensions of 9 feet in depth and 200 feet in width from the mouth to Utica, by dredging and by the partial removal of the two State dams and by the retention and minor alteration of the two Federal locks and dams, at an estimated cost under present conditions of diversion of $1,350,000 with $126,000 annually for operation and maintenance; provided that the State of Illinois transfer to the United States without cost all rights and titles in the two State-owned dams on the Illinois River; that local interests furnish the United States without cost all necessary areas for the economical disposal of material dredged in creating and maintaining the channel; provided further that no work on the Illinois River shall be carried out according to the project herein outlined, with the existing or any subsequent diversions, until the Secretary of War and the Chief of Engineers shall have received satisfactory assurances that local interests will provide an equal depth for through navigation in the Illinois waterway. The amount of $1,350,000

should be made available in the initial appropriation. With any future reduction in the diversion a reestimate of the cost of completing or revising and maintaining the project will become necessary. If after the completion of the Illinois waterway several years hence the large commerce expected has developed in such a way that the Federal locks are becoming inadequate for the navigation, consideration should at that time be given to the relative desirability of the partial removal of the dams or the provision of increased lock capacity, as may then appear best."

p. 7, Par. 16, C. of E. "16. After due consideration of the above-mentioned reports, I concur in the views and recommendations of the board."

In House Document 762, 63rd Congress, 2nd Session, the Lakes-to-Gulf Waterway Board, after discussing a diversion of 10,000 c. s. f. and its relation to navigable depths stated that,

H. D. 762-63-2, pp. 13-14. "The Board has also shown * * * in its preceding report that such a diversion was not necessary to obtain the 8 or 9 foot navigation recommended from Chicago to the mouth of the Illinois River."

H. D. 762-63-2, p. 12. "Compensation for the loss of elevation on Lakes Michigan, Huron, and Erie, and their connecting waters, due to an assumed diversion from Lake Michigan of 10,000 second-feet, will by the plan above outlined involve an expenditure of about $475,000, to which should be added an amount for the maintenance of the weirs, estimated at about $15,000 per year, the total cost being much less than the cost of restoration of depths by dredging. It is the opinion of the board that while other plans have been proposed, compensation by fixed contraction works similar in general to those above described affords the cheapest and most satisfactory method of preserving the levels of the Great Lakes."

p. 11. "To restore the diminished levels in the Lakes by constructing contracting works in their outlets does not however present any serious difficulties."

pp. 12-14. "* * * The board reiterates that a diversion exceeding 1,000 second-feet is not necessary for navigation purposes alone in the Illinois River, and that an added discharge will produce a slight and inadequate effect on the Mississippi River."

"* * * The effect of any diversion upon gauge height will always be small, and at the highest stages practically nothing, but the exact effect at any time or at any stage is impossible to determine, since this effect will be complicated or obscured by various other changes in the regimen of the river."

p. 2. "The influence on the volume of the Mississippi River due to any diversion from Lake Michigan will be an increase approximately equal to the amount of water diverted."

H. D. 762-63-2, p. 106 "For purposes of navigation a diversion from Lake Michigan of less than 1,000 second-feet of water is all that will be necessary."

p. 106 "For purposes of sanitation the works of the Sanitary District of Chicago were designed to allow the diversion of 10,000 second-feet and now contemplate a total of 14,000 second-feet, the additional 4,000 second-feet to be obtained by the diversion of water through the Calumet River and a connecting canal following the Sag route."

p. 107 "While it appears to have been assumed that the Sanitary District may be allowed to divert 10,000 second-feet so long as actually necessary for sanitary purposes, the diversion of the waters of the great Lakes from their natural outlets for power development alone is inadmissible, under the recent treaty between the United States and Great Britain."

p. 107 "The claim that more than 1,000 cubic feet per second is required for purposes of navigation cannot be maintained."

p. 107 "The treaty, however, recognizes as proper the use of water for sanitary purposes, and it is the opinion of the Board that only such water should be diverted from Lake Michigan as is indispensable for sanitation, and then only with a provision for proper compensating works in the outlets of the lakes to prevent a lowering of their levels. Water thus diverted may be used incidentally for power purposes, but care must be exercised in authorizing the diversion of water for sanitary purposes, to restrict it to the amount necessary for those purposes alone."

"The work now proposed by the State in connection with the canal of the Chicago Sanitary District contemplates a waterway from Lake Michigan to Utica, which, although departing from the line of the old canal, substitutes a waterway more than sufficient for any probable navigation. This will in effect fulfill the original agreement between the State and General Government for this section and incidentally develop a water power which the State considers a profitable business investment. State or local agencies are better adapted than the General Government for conserving water power for their citizens."

H. D. 762-63-2, p. 8 "It is understood that the Sanitary District of Chicago and the State expect to develop considerable water power on that portion of the waterway between Chicago and Utica. As it is proposed that the navigable channel between these points shall be built without cost to the United States, it is believed that the General Government should relinquish to these local agencies any rights that it may have in the power to be thus developed. It does not appear that there is any question of water power, flood control, or other matter that can be co-

ordinated with that portion of the work to be done by the United States for the improvement of navigation, so as to lessen the cost and compensate the Government for its expenditures made in the interest of navigation."

p. 113 "It is understood that the Sanitary District of Chicago and the State expect to develop considerable water power on that portion of the waterway between Chicago and Utica. As it is proposed that the navigable channel between these points shall be built without cost to the United States, it is believed that the General Government should relinquish to these local agencies any rights that it may have in the power to be thus developed."

p. 7 "The construction of such dam is not necessary for the execution of existing projects for the Illinois and Mississippi Rivers or the projects recommended in the partial report printed in House Document No. 1374, Sixty-first Congress, third session. The special board reports that the work would be enormously expensive and not justified by resulting benefits to commerce and navigation or by the returns from water-power development."

In House Document 1374, 61st Congress, 3rd Session, being report on a waterway from Lockport, Illinois, to the mouth of the Illinois River, the Board of Engineers, after considering a channel 8 or 9 feet deep, with appropriate widths and locks, stated:

H. D. 1374-61-3, p. 7, p. 8. "A waterway of these dimensions would have a capacity exceeding 100,000,000 tons per annum, * * *. Such a waterway will not require a diversion of more than 1,000 second-feet from Lake Michigan and this amount would not injuriously lower lake levels nor cause excessive flooding of lands in the Illinois Valley * * *. "For purposes of navigation a diversion from Lake Michigan of less than 1,000 second-feet of water is all that will be necessary.

Warren Rep. Ex. 182, 19.

In reviewing the Warren Report, upon the subject of water diversion from the Great Lakes and the Niagara River, transmitted to Congress December 7, 1920, the Board of Engineers stated with respect to the needs of navigation from the Lakes to the Gulf:

Warren Rept. P. 19.

"The diversion through the Chicago Sanitary Canal averaged 8,800 cubic feet per second in 1917, although some daily averages were 10,000 cubic feet per second or more. Of this diversion 6,800 cubic feet per second is incidentally used in the development of power, as will be explained later."

"Such small navigation as now exists would be amply served by a diversion of 500 cubic feet per second, and twice that amount would be sufficient for the needs of the greatest probable commerce of the so-called Lakes to the Gulf Waterway."

p. 414

"At extreme low water the navigation of the Mississippi suffers from insufficient draft. On the 25-mile stretch, between the mouth of the Illinois River and the mouth of the Missouri, extreme low-water flows as small as 25,000 cubic feet per second have been reported. Under such conditions the addition of the Chicago diversion would be a real assistance to navigation."

On February 28, 1912, W. H. Bixby, the then Chief of Engineers, reported to the Secretary of War on the subject of the diversion of water from Lake Michigan, as follows:

Ex. 12, Doc. 40, p.1.

"For the purposes of navigation alone by canal and canalized river from Lake Michigan to the Mississippi River, on the Illinois River and its headwaters and connecting canals, and to keep the locks and pools full, a diversion from Lake Michigan of less than 1,000 second-feet of water will easily supply any reasonable demands and is all that

will be actually necessary, and any greater diversion is a greater injury than benefit to navigation."

M. G. BARNES, FOR DEFENDANTS.

5603 I am Chief Engineer of the Division of Waterways of the State of Illinois, which position I have held since 1917. My first experience was as surveyor and county engineer in Nebraska. I received the degrees
5604 of B. S. and C. E. from the University of Michigan, where I took a post-graduate course in hydraulics and masonry. Later, that University conferred upon me the degree of Master of Engineering. After leaving the University, I was employed on the design and construction of power locks, power houses, hydroelectric plants and paper mills at Sault Ste. Marie, Michigan, and
5605 Ontario. My next work was on the survey and design of the Black Warrior Canal, after which I was employed by the Board of Engineers on Deep Waterways, in connection with the survey of a deep waterway from the Great Lakes to the Atlantic.

In this employment I made a topographical survey on the St. Lawrence from Lake St. Francis to Lake Champlain and hydraulic surveys of both of these lakes.

5606 I was next engaged for six years, as United States Assistant Engineer and later as Resident Engineer, on the design and construction of the Hennepin Canal, which connects the Illinois and Mississippi Rivers. Following that, I was employed as United States Assistant Engineer in the design and construction of the Moline lock on the Mississippi River. I then became designing engineer in charge of the design of the structures for the Panama Canal. When that work was finished, I was appointed as designing engineer on investigation of the dams and other structures for the New York water supply.

5607 In 1907, I was appointed by the Governor of New York, as a member of the Consulting Board, in charge of design and construction of the New York Barge Canal. On that Board, I was associated with W. A. Breckenridge, chief engineer of the Niagara Falls Power

Company, who later resigned to become managing director and vice-president of the Southern California Edison Company, Commander A. B. Frye, United States Navy, who lived at New York City, Edward A. Bond, ex-State Engineer of the State of New York; Colonel Thomas W. Simons, U. S. A., and Mr. Joseph Ripley, former Assistant Chief Engineer of the Panama Canal. Following that I was engaged for several years in private practice at Albany, N. Y., as Consulting Engineer for the United States and various municipalities, in connection with the design and construction of waterways, harbors and water power plants. In 1917, I retired from private practice to become Chief Engineer of the Division of Waterways of the State of Illinois, to which position I was appointed by Governor Lowden. In that capacity I have designed and directed the construction of the Illinois Waterway and have represented the State of Illinois in the negotiations between the State and the Federal Government with reference to the approval of plans for that project.

5608 5612 Ex. 1192 "The Illinois Waterway" is the official title given to that branch of the improvement of the Illinois and Des Plaines Rivers reaching from the lower end of the Sanitary and Ship Canal and connecting with it at Lockport down the Des Plaines River to its mouth, thence down the Illinois River to Utica, a distance of about 65 miles. Its minimum dimensions are—depth 8 feet in earth and 10 feet in rock, and bottom width 150 feet—locks 600 feet usable length and 110 feet wide, with all structures 14 feet below low water.

5615 5616 It is intended to serve the same purpose as the old Illinois and Michigan Canal, in a more efficient way, being larger and deeper and in every way modern. The new improvement parallels the old Canal from Utica to Lockport, where it connects with the Sanitary and Ship Canal.

5609 Before the 1919 Illinois Waterway Act was passed, negotiations with reference to the location, dimensions, slope and capacity of the channel were carried on between Illinois and the Federal Government. A preliminary

plan and a copy of the proposed bill were prepared and presented informally to the Chief of Engineers for his comment and criticism. After receiving those, the bill was presented to the legislature and enacted. Application was then made to the Chief of Engineers for the formal approval of these plans and he submitted them to the District Engineer for his recommendations.

5613 Ex. 1194 The final plans, which were approved by the Chief of Engineers and the Secretary of War in March, 1920, contain a profile map of the proposed improvements. Upon this is a straight line indicating the position and slope of the water surface in the various pools between the several locks. Above this straight line are figures, which indicate that the amount of flow, upon which these plans are based, is 6,000 cubic second feet.

This is shown by the following entry—"W. S.—6,000 C. F. S. flow." The entry is explained or qualified by an arrow-notation in the following language:

> "The water surfaces shown on this profile are based upon an assumed flow of 4,167 cubic feet per second, already approved, as a diversion from Lake Michigan, plus the normal flow from other sources in various pools."

When these plans were first submitted by Illinois to the United States District Engineer at Chicago the profile map did not contain this "4,167 cubic feet per second" arrow notation.

5613 5614 This 6,000 second-feet flow is neither high water nor low water. If there is only 4,167 cubic feet per second diverted from Lake Michigan, that would mean that the remainder must come from natural sources. However, at low water there is no such amount of water flowing from its natural water shed, hence it must mean that there is more than 4,167 cubic feet per second coming from lake Michigan or some other source. The actual low water at that point from natural sources is something less than 500 cubic feet per second.

5614 In discussing these plans with the Chief Engineer of the Illinois Division of Waterways the United States District Engineer stated that he feared that the approval of the plans as submitted might be construed as an approval of 6,000 cubic second-feet from Lake Michigan, and asked me to have the "4,167 cubic feet per second" arrow notation placed on the map, which I did.

5614 In presenting the plan in its original form the District Engineer recognized that there were more than 6,000 feet of water in the river, and that the State might be justified in making this improvement under existing flows, and that we would receive a greater depth than called for by the Act, if the approval were based on 6,000 c. s. f. of flow in the river. It was also noted that with the flow that then existed something between 8,000 and 9,000 from Lake Michigan, very nearly nine feet in depth would pervail.

7123 With reference to my statement before the Select
7124 Committee, the fact that I did not know what the diversion would be was not the only reason that I did not design our power plant. The main reason was that we have no money to design the power plant. I designed the locks on the belief that we would have 10,000 feet of water and on the belief that we would have the water as shown on the plans approved by the Secretary of War.

7124 "Q. Was not the fact that you went ahead with the design for the locks but not for the power plants influenced by the fact that your locks would be perfectly useful with the diversion of 1,000 second-feet or less, whereas your power plants would not have any value unless you had a large abstraction of water from Lake Michigan?

A. No; nothing of the kind at all.

Q. You did not consider that at all?

A. I did not consider what?

Q. Whether your power plant would have any value if the abstraction was not had from Lake Michigan?

A. The question of power plant, as I told you repeatedly, must remain in abeyance until we can secure money and until this matter is finally settled in the courts.

Q. Well, will not the amount of money that you will request should be made available for you depend upon the amount of water?

A. Yes, sir."

6230 The particular location of this improvement was based upon an assumption of a diversion of water from Lake Michigan, because in the lock and dam structures it was necessary to know the amount of water that could be expected, both at low water and high water periods, so as to get the proper discharge capacity at those points. In our dealings, the United States required that the structures should be so located as to develop the greatest amount of power; and to accomplish this it was necessary to

6231 leave plenty of room for the power house structures. In addition to the navigation there was the question of power that was both for the State's interest and to comply with the requirements of the Federal Government. That is, the structures had to be so designed as to make the maximum use of the power available. The preliminary permit provided that the structures should be so located as to permit the development of the greatest amount of power and preceding the preliminary permit, we had endeavored to secure a permit from the Secretary of

6232 War for the structures for the waterway and power development. These requirements which I have mentioned are reflected in the plans for the construction of the waterway as well as in the plans for the proposed power development. The amount of diversion from Lake Michigan relied upon in those plans and negotiations was 10,000 c. s. f.

6774 Exhibit 1194.

When I submitted plans for Exhibit 1194 the War Department, being present approval of plans for the Illinois Waterway, the arrow notation concerning the "6,000 c. s. f. flow" entry, as follows: The water surfaces shown on

this profile are based upon an assumed flow of 4,167 cubic feet per second, already approved as a diversion from Lake Michigan, plus the normal from other sources in various pools," was not a misstatement of what my plan was. I did not intend or expect merely to get 4,167 second-feet from the Lake and the balance from local drainage.

Condition "B" of Exhibit 1196, being the first approval of plans for the Illinois Waterway, provided:

> "That it is understood that such approval does not authorize the diversion of water from Lake Michigan through the waterway. It merely expresses the approval of the Federal Government to the plans so far as concerns the public rights of navigation."

6775 The explanation of 6,000 feet of water in the river is this:

> There are several power plants above that long reach, and the best use of that power, which the Conservation Commission desires that we shall make, some of the water must be held back, so that full use can be made in the load factor that is obtained. In such conditions there will be not more than 6,000 and in some cases even less than 6,000 feet of water in the river. The Federal Power Commission was not in existence when we started, but, we could not obtain a permit from the War Department until it was known what the Congress was to do in regard to the Federal Power Act. They held us up at that time.

Ex. 1194 The second approval of plans dated March 6, 1920, contained the following condition:

> "That it be understood that such approval does not authorize the diversion of water from Lake Michigan. It merely expresses the approval of the Federal Government to the plans so far as concerns the public right of navigation, and this provision is with-

out prejudice to the use by the State of Illinois of such flow as may be existing at any time in the Illinois and Des Plaines Rivers."

6790 Ex. 1194 At the time the plans of the Illinois Waterway were approved, there was a flow in the Illinois and Des Plaines Rivers from Lake Michigan of between 8,000 and 9,000 feet. The flow was in excess of 6,000 feet, but I did not feel it was safe to design an 8-ft. depth based on that because of the power situation. That matter was taken up at considerable length with the District Engineer at the time and we finally fixed on a low water flow of 6,000 feet of water. Part of it to come from Lake Michigan and the balance of it from the local flow.

6791 I know that the Chief of Engineers considered that we would get more than the 4,167 from Lake Michigan because there was not 2,000 feet of water in the Illinois River at that time at low water stages. He knew that from the records in his office. He knew the low water flow at that time was about or less than 500 and that, therefore, it must come from some other source.

The figures "4167 c. f. s." on the plans were put there at the request of the Chief of Engineers. I had no personal dealings with the Chief of Engineers.

6792 6793 In the negotiations with reference to these plans, the dealings of Illinois were had with the District Engineer. He knew the amount of water there was flowing in the Illinois and Des Plaines Rivers at the time and knew that the permit of the Secretary of War limited the flow from Lake Michigan to 4,167. He asked the Chief Engineer of Illinois to put the arrow notation on the plans so that it would not by any inadvertence or by any other method be construed as a permit for 6,000 c. s. f. of water from Lake Michigan. In his conferences regarding these plans with the Chief Engineer of the State of Illinois the District Engineer stated that there was plenty of water in the river, and that in his opinion we would always have enough water to make that safe to design for an eight-foot channel based on 6,000 c. s. f. The arrow notation on the

plans, which were submitted to the Secretary of War and Chief of Engineers as the basis of their action and approval was a fair representation of the facts and one which they might be fairly asked to act upon. I do not think that the legend indicated that all of the water was coming from Lake Michigan.

The District Engineer knew, and had his record before him all the time, and he knew the flow from Lake Michigan. I don't know that the Chief of Engineers knew anything about where the flow of water provided for by my design came from. I do not suppose that he would ever know where it came from from its legend. In any event he took the recommendations of the District Engineer.

7008 The part of the navigable waterway between Lake
7009 Michigan and the Mississippi River selected by Illinois for improvement in the construction of the Illinois Waterway was fixed by what the Government had previously taken to develop and control. The Sanitary District at Chicago had carried the navigation improvement down to Lockport. The Federal Government had carried the improvement up to La Salle.

7010 That left a reach of about 72 miles unimproved. The State undertook to develop that portion that had not been taken under control by the Federal Government, or the Sanitary District. In the conferences of Illinois with the United States District Engineer it was agreed that if Illinois would carry the development to or in the vicinity of the Utica bridge, the Government could very fairly extend its project up to that point.

5629, Ex. 1193 When it became evident that the old canal could no longer serve the needs of transportation, the State began casting about for something that would take its place. The State-wide movement for an improved waterway became so insistent that finally a proposal was presented to the people to issue bonds in the sum of twenty million dollars for improving the link between Lockport and Utica, so as to provide a canal of modern dimensions, and, incidentally, so as to develop the sur-

plus power along that reach. That question was submitted to the voters in 1907 and approved by them in 1908.

6231 Ex. 1242 Certain of the conditions of the preliminary permit issued by the Federal Power Commission of Illinois on January 14, 1922, were:

> "That full practicable utilization will be made of the water, storage possibilities, and the head at the site to be developed,"
>
> and that "said project will be in general accord with the most beneficial utilization of water for navigation, water power, and other beneficial uses."

7609 November, 1920, our design for the Starved Rock lock was on the left bank of the river. Subsequent to that date we asked the Chief of Engineers for a modification of the permit permitting us to locate the lock on the opposite side of the river. At that time the negotiations were on, looking to the sale of that power; and in the final design of the lock and dam I was influenced to locate the lock sufficiently away from the stream to give us a power site for the flow that I had expected would be in the river.

7095 When I testified at the hearings before the Committee on Rivers and Harbors of the House of Representatives, 69th Congress, 1st Session, on the subject of the improvement of the Illinois River and the abstraction of water from Lake Michigan, I said that the Engineering Board had stated that open river navigation in the Illinois can be obtained with any flow above 2,000 c. f. s. of
7096 diversion. I was asked by Mr. Chalmers whether with two locks in the Illinois River, 1,000 c. f. s. of diversion would not be sufficient and I answered that it would not be sufficient. Mr. Mooney than asked me whether 1,600 c. f. s. would not be and I answered that it would not be sufficient, but I did say, "If you go on and excavate sufficiently, then you can do it." I so testified before that Committee, but that was for slack-water navigation.

By enormous expense you can do almost anything
7097 in any stream. The Illinois River has a fall of about 35 feet, as I recall it, in its full length. Various

methods of making slack water navigation have been proposed, all the way from six locks to only one lock; and it is a matter of cost and a matter of damage as to which method is the more practical and feasible to use.

You can make a canal and obtain a 9-foot channel in the Illinois River with locks and dams and with a diversion of a thousand second-feet. It is inadequate and inappropriate for the purpose, but a canal can be obtained for a thousand cubic feet per second if enough locks are put in to make complete slack water.

7096 The slackwater navigation in the Illinois River,
7098 with the locks that have been proposed, does not give as full width and as full a depth as will obtain in the Illinois Waterway. However, it is entirely possible to so locate the locks and so make your excavations as to give as great width as will obtain in the Illinois waterway above.

7046 If you assume that there were some locks remaining in the Illinois River, you could operate from Utica to the mouth, in many years, without water from Lake Michigan. However, Utica is 100 miles from Chicago and no engineer would recommend the improvement
7047 of the lower Illinois without extending it to Chicago. If you make slack water navigation, with five or six or seven locks in the reach between St. Louis and Utica, you can secure a fair amount of water ordinarily for lockage purposes.

7114 The low water flow of the Illinois River is 500 feet
7116 per second at LaSalle and about 1,000 second-feet at the mouth. It is not sufficient to economically develop an adequate channel without intervening locks. The locks could be constructed with this flow and of the same size as those in the Illinois waterway. The locks would have a much lower lift than those in the Illinois waterway and would require a much smaller quantity of lockage water for a given commerce. There is no question but that with this flow, the channel could be dredged to a depth of 9 feet, but I seriously question the economy of any such thing.

5644 The amount of diversion of water from Lake Michigan has a bearing upon the cost of construction and upon the navigable capacity of the Illinois Waterway. As the amount of water from Lake Michigan is increased, the cost of excavating and forming the channel decreases. Also the structures must be modified in accordance with the amount of water obtainable from Lake Michigan. Based on a flow of 10,000 cubic feet of water from Lake Michigan, the extra cost for channel only, if the diversion were decreased to 1,000 cubic feet per second, I estimate to be about $1,400,000.

6806-8 The lock at Lockport as designed and without any change would be more than ample to take care of traffic which was limited by the controlling depth of a nine-foot channel without any diversion, as far as the lock is concerned.

6812 The effect of reducing the diversion to 1,000 c. f. s. upon the construction of the Illinois Waterway would not relate merely to the excavation of the channels between the locks. There would be the additional depth it is necessary to go in the location of the locks and the design of the locks, the depth on the bottom of the sills to comply with the State Law.

6813 The locks must be 14 feet under the State law. Leaving aside all legal questions under the State law, a 9-foot waterway could be obtained in the stretch covered by the Illinois Waterway, as shown by Exhibit 1194, with the diversion reduced to 1,000 second-feet without any further change other than possibly additional excavation in the channels between the locks, but that would be in violation of the State Law. I could build a waterway based on the present plan with a thousand c. f. s. diversion so that a boat drawing nine feet could still get through. I cannot tell you exactly just what differ-
6814 ence it would make in excavation between the Lockport Lock and Brandon Road Lock to obtain a 9-foot channel with a reduction of the diversion to 1,000 second feet.

6982 I cannot, from my memory, tell you what is the slope of the section between the foot of the lock and dam at Lockport and the one on Brandon Road, or in any of the pools of the Illinois Waterway, with a flow of 10,000 second-feet. I have prepared no design to show that. The plans, as approved by the Secretary of War, are based upon a flow of 6,000 c. f. s.

6983 The scale on the map is so small that you cannot tell definitely what it is. It would take a detailed map to determine definitely what the slope is.

6984 The depth of the water over the sills of all of the locks in the Illinois Waterway, with a flow of 10,000 second-feet, is at least 14 feet, and undoubtedly more than 14 feet.

5866 I estimate the capacity of the Illinois Waterway at 60,000,000 tons per year. The Engineer Corps has estimated its capacity in excess of that amount.

5855 Ex. 1236 Page 13 Colonel Judson, in a letter to the Chief of Engineers, dated November 24, 1915, stated that along the line followed by the proposed waterway there already flows a commerce vastly greater than the proposed or any other reasonable waterway could accommodate.

Special Master 5867 "I suppose that there, as in other cases, it may be assumed that if there is a highway of commerce in this country, certainly in relation to such a port and mart as Chicago there will be traffic. How much there will be might be a matter of a good deal of conjecture."

5867 On a maximum use of the channel at its capacity it will require at least 1500 cubic feet per second for lockage purposes at summit level. If the traffic increases so that twin locks are required, additional water will be required, and if and when traffic should increase to the full capacity of the twin locks, double the amount of water would be required at that time.

6991 My estimate of a capacity of 60,000,000 tons for
6992 this waterway is based on a maximum tow of 9,000 or 10,000 tons.

6993 There is about three million cubic feet of water used at each lockage at Lockport on the 41-foot lift. That is the full 10,000 foot flow for a period of five minutes or in other words if the flow was reduced say to one thousand, only one lockage per 50 minutes could be made with the water supply of one thousand cubic feet per second.

6997 One lockage at Lockport, according to my computations, requires about 1/100th of a cubic foot per second per year. A thousand cubic feet per second would permit 28½ lockages per day unless I have made some mistake in my calculations.

6998 With a cargo of 9,000 tons per lockage this would accommodate a commerce of 265,500 tons per day, and with open navigation 365 days a year an annual tonnage of 93,622,500 tons.

If you reduce the number of locks in the Illinois Waterway and increase the fall you do not therefore increase the quantity of water needed for a lockage.

6999 If I had reduced the number of lockages from some other design that does not follow that I reduced the lift at the Lockport locks. That has been fixed by nature, and could only be changed by putting in a flight of locks with a slight saving. If the Lockport lock were a double lock it would not cut the amount of lockage water required in two.

7559 When a vessel passes into the lock from the lower
7560 pool it displaces water equivalent to the cargo, and
7752 as it passes up into the upper pool the amount of
6994 water required is the volume of the lock plus the displacement, forgetting any displacement resulting from the boat itself, inasmuch as the boat must return. In passing down stream the amount of water taken from the summit level is the volume of the lock minus the cargo capacity, hence whatever is added in one direction must be subtracted in the other.

7559 I have estimated that the up-bound traffic will
7560 greatly exceed the down-bound traffic, measured in tons. The proportion of the up-bound traffic to the downstream traffic would be about three to one.

7033 Assuming a tow of such size that it can enter the locks and no interference from other navigation, the average time of a lock through the locks on the Illinois Waterway probably would not exceed 15 minutes. To this must be added the time of slowing up, mooring the boats, and getting them under speed. The delays to the ships or to the fleets on the average would amount to very nearly one hour in such a case.

7035 45 minutes for an average lockage would not be very far from the fact if there are not too many vessels in the way.

5643 In my opinion the sum of twenty million dollars
5644 appropriated for the Illinois Waterway is sufficient to complete that waterway in accordance with the plans and the amount of diversion indicated on the plans.

5646 If the diversion from Lake Michigan is reduced materially below 4,167 cubic second-feet there will not be funds available under the $20,000,000 bond issue to complete the work.

6274 The structures of the Illinois Waterway as now approved and partially constructed, are not practically usable and cannot be used without a diversion of water from Lake Michigan.

As the advisor of this project of the State of Illinois I would not have recommended the construction of this waterway according to those plans if I or the State of Illinois had been led to believe that there would not be a diversion of water from Lake Michigan in excess of one thousand
6276 cubic second-feet. There is a limit below 4,167 at which I would not have recommended the construction of a waterway of the dimensions that we have designed. I do not know that I am competent to say exactly what point that would be, but it would be a point where the amount of water needed for the use of the canal would not

have been adequate to supply its entire use and where the funds available would not be sufficient to complete the structure.

7561 The first work on the Illinois Waterway was commenced in November, 1920. By June, 1922, about 50% of the Marseilles lock, the entire cost of which was $1,254,000, was completed.

5612 The Marseilles lock has been completed, the
5645 Starved Rock lock is about 20%, and the Lockport lock is about 99% complete. About $6,000,000 of construction on the Illinois Waterway have been completed or placed under contract.

5886 As is well known, the Mississippi River is unstable in banks and bed and must be protected and regularized in order to keep it within bounds. No such improvements are required on the Illinois River to any great extent. It is, therefore, quite manifest that the best improvement of the Illinois River is with an open channel; that is, without locks. In order to obtain that water must be supplied sufficient to fill the channel. Various studies have been made by me and by others, particularly the Engineer Corps, to show the best possible means of improvement of the river under various assumptions of flow of water in the stream. In its natural condition the Illinois River has a low-water flow at the upper end; that is, at La Salle, of, roughly, 500 cubic feet per second. This increases downstream until at the mouth it will have a flow of approximately 1,000 cubic feet per second. That is not sufficient to economically develop an adequate channel without intervention of locks.

My studies show that at least 5 locks and possibly 6 must be placed in the stream to develop the channel at such low flow, and even with that flow it is quite questionable whether there is at all times sufficient water for canal purposes.

5887, There are now constructed and in use in the
5888, Illinois River four old locks, two built by the Fed-
5889. eral Government and two by the State of Illinois. These with the flow available in the stream now are

capable of producing a channel 7 or 8 feet in depth, and with proper improvement these depths could be increased.

With this flow maintained, that is, the flow of 10,000 cubic feet of water in the Illinois River maintained, all of these locks and dams can be removed and open river transportation afforded similar to that in the Mississippi River from the mouth of the Illinois to the mouth of the Ohio.

If, however, the amount of water must be reduced to that necessary for lockages in the Illinois River, these dams and others must remain and commerce must be injured, stopped, in passing all these structures. Probably the easiest way of estimating the cost of navigation interests caused by such delays is to follow the method of the International Board which recently reported on the improvement of the St. Lawrence Waterway. That Board estimated that a delay in one lock on the St. Clair River would cost navigation, because of delays at one lock, one cent per ton. The difference between that stream and the Illinois River is that in the Great Lakes their vessels run at about twice the speed that the vessels would on the Illinois River and do on the Mississippi River, but the cost of transportation on the Great Lakes is about one-half the cost of transportation on the Mississippi River. Hence the conditions would be relatively the same.

With six locks intervening there would, therefore, be a loss to navigation of six cents per ton, and with a tonnage of 30,000,000 tons, which is entirely possible and probable, this would mean a loss to navigation of $1,800,000 per year; or capitalized at 4 per cent, which is the same capitalization that has been used in other instances in this case and which the Government used in its reports, that represents a capitalized value of $45,000,000.

In addition to this, it will be necessary to construct and maintain the six locks and dams necessary with the reduced flow. The cost of such structures has been estimated at various times by engineer officers and myself at various amounts, but with modern traffic that we are providing for, that the State has provided for in the upper Illinois and that the Federal Government has provided for in the Ohio, it will be necessary to reconstruct all these locks or build

twin locks at all places commensurate in size with the standard locks constructed by the State and by the Federal Government.

I assume that these structures and incidental improvements to channels would cost not less than $10,000,000 and probably might exceed $13,000,000. There is also a further item that is measured in dollars and cents as to the adequate channel that would result from this means of capitalization. The channel would be narrower and of less depth in many of the reaches that now have greater depths, and such condition, of course, retards vessels and adds to the cost of transportation, but the amount cannot be easily ascertained and shown in dollars.

5891 My estimate of the value of diversion for navigation in the Illinois River is $55,000,000, generally speaking, as reflected by the difference between slack water navigation and open river navigation on the Illinois River, on the basis of six locks at a cent per ton per lock.

7036 With an average flow of 10,000 second-feet in the Illinois River without locks and dams the current might reach three-fourths of a mile per hour, possibly a little more. The engineer officers have estimated its flow somewhat higher than that.

Ex. 18
House Doc. 4,
69th Congress
First Session
Page 206.
7037 In Exhibit 18 it is stated that 10,000 cubic feet per second annually would produce a current of 1.63 feet per second, which would be about 1.1 miles per hour. A tow of coal coming up from the mouth of the of the Illinois River to La Salle, with a speed of three miles an hour, would take 76 hours to make the trip. If you introduced a current of one mile per hour it would not necessarily reduce the speed of your tow by that much. It would if you were traveling at the maximum speed of your tow. The coal comes from southern Illinois and must be transported for 100 or 200 miles over the Mississippi River where the fall is from three to four times the fall in the Illinois, and the velocity is much in excess of the velocity of the Illinois River. The tow must be equipped with power sufficient to overcome

that reach of transit, hence there would be excess power available when you reach the Illinois River.

Ex. 18 Doc. 4, 69th Congr. First Sess. Page 208 7039

I understand from page 208 of Exhibit 18 that the engineer attempted to compute a loss of 10 hours in one-way traffic upstream by reason the current velocity with open channel navigation, but I do not subscribe to that report.

I believe that the corps of engineers in computing a delay to barge traffic in tows by reason of the introduction of current in the Illinois River through a large diversion is in error in this location.

7040 If it were assumed that this figure of the Federal engineers for loss of time for the tow upstream, in case of a current caused by the 10,000 second feet, were accurate it would mean that the time lost by such tow through the current would be a great deal more than it would be from passing through four locks in that stretch, but I think the reasoning is entirely erroneous. My claim of loss of time by reason of the location of from two to four locks in the lower Illinois River is based upon an assumption that there would be no delay caused by the currents in the case of a 10,000 second-feet flow with open channel.

Exhibit 18, House Doc. 4, 69th Congress, First Session, Page 23.

In the report on the Illinois River, Illinois, transmitted to Congress on March 29, 1926, the District Engineer stated:

"19. In studying the potential traffic on the Illinois River it must be remembered that this stream is a part of a system of water routes converging upon the Mississippi River. The completion of the "Illinois waterway" from Lockport to Utica will join this system to that of the Great Lakes and make Chicago its northern terminal. Since the Mississippi River is now under improvement below the mouth of the Illinois and construction of the "Illinois waterway" is well under way, the Federal section can not be treated by itself in a study

of the economics of the question; it must be considered as integral with the entire system.

"20. The study of prospective commerce indicates that a water traffic of considerable volume will result from the opening of the "Illinois waterway" and the deepening of the connecting channels which make up the through route from Chicago to the Gulf of Mexico; that inland waterway carriers of the most modern types will seek to use this improvement, and that a substantial return on the investment in construction, maintenance, and operating costs will be realized.

"21. Assuming that no change is made in the project depth in the Mississippi River above Cairo and this limits the potential interstate traffic, it is found that the following is a reasonable estimate of the traffic expected to result from the improvements contemplated, most of which will pass through the portion of the Mississippi having a limiting depth of 6 feet:

	Tons per year
7-foot project	4,940,000
8-foot project	5,140,000
9-foot project	5,340,000

"22. This tonnage is composed of ore, sand, gravel, coal, grain, lumber and some general cargo. If the limiting project depths in the Mississippi River are increased to conform to those under consideration for the Illinois River, the potential tonnage is expected to be as follows:

	Tons per year
7-foot project	5,265,000
8-foot project	6,315,000
9-foot project	7,515,000"

THOMAS Q. ASHBURN, FOR DEFENDANTS.

3984 I am, Brig. General, United States Army, and Chairman of the Advisory Board of the Inland Waterways Corporation of the United States and Execu-

tive thereof under the Secretary of War. The corporation was created by Congress to carry out the mandate contained in Section 500 of the Transportation Act to promote, encourage and develop waterways and to foster and preserve in full vigor both rail and water transportation, and to carry out further functions prescribed in Section
3990 201 of the Transportation Act. The Corporation operates the Mississippi-Warrior Service, a fleet of boats, between St. Louis and New Orleans, then through the coastal waters of the south to Mobile and then up the Black Warrior to Birmingsport. On the upper Mississippi it is building a large fleet to operate between St.
3991 Paul and St. Louis. Exhibit 502 shows the volume, routes, origins and destinations, by Congressional Districts, of southbound traffic handled by the barge
3992 line during the calendar year 1925. The map shows that the benefits of the service have been extended to the Eastern and Western Coasts, the south and interior, and practically all of the United States, except the Inter-
3995 mountain States. Transportation is conducted in this manner from these interior points with joint through rates in which the barge line and rail car-
3997 riers participate. These rates are all published by the barge line and concurred in by the railroads.
4015 The loading of barges by the barge line depended upon the stage of the river, which is supposed to have a general depth of 8 feet from St. Louis to Cairo and 9 feet from Cairo to New Orleans, but the barges are loaded to within 6 inches of the bottom, depending upon river stage up to the time that the final depth of 8½ feet is obtained.

THEODORE BRENT, FOR DEFENDANTS.

4024 I am Traffic Manager of the Inland Waterway Corporation with headquarters in New Orleans.

Note: As the testimony of this witness covers both operating conditions on the Mississippi and traffic and economic matters, we will first briefly state the effect of his testimony as to operating conditions and then as to the other branch thereof.

I have been engaged in occupations connected with transportation for about 25 years, and have held most
4025 every position in the traffic department of railroads and waterway carriers, and was federal or general manager of the Inland Waterway Service on the Mississippi and Warrior Rivers. My appointment as federal manager was in 1920 at the time the project was returned from the Railroad Administration to the War Department. The witness produced and identified photostatic copies of records kept by the barge line in its ordinary business, showing the movement of every tow and barge from October,
4027 1922 to November, 1926. These charts, each one being a month's operation, were introduced as one exhibit, Defendants' Exhibit 505. On the chart, the horizontal portion thereof represents time and the vertical portion represents distance; in the margin at the left are the points along the stream and the mileage distance from New Orleans to St. Louis. A tracing is kept on the chart in accordance with reports, showing the exact movement of each
4028 boat. At the end of each month the chart is photostated and preserved as a permanent record. A straight horizontal line indicates that the boat is stopped, and where this occurs at one of the main ports, obviously the boat has stopped to take on or discharge freight, but where any other straight horizontal line is noted on the chart it indicates grounding, port work, breakage of
4029 machinery, weather conditions, etc., so that each chart contains a history of operations. Referring to the chart for August, 1922, its general appearance is
4030 decidedly different from the one for March. The general saw-tooth effect of the chart indicates what is called "double tripping" indicating that the channels were so narrow from lack of water, that a towboat could only get through with a single barge, and that under difficulties. Under these conditions, the larger part of the tow of six barges would be laid at a point to which the towboat could proceed in usual formation, and from that point on the towboat could proceed with a single barge and dredge her way through with difficulty, lay the barge down at
4031 a convenient point and go back for the others. Referring to the month of September, 1920, a glance at

the chart indicates that the condition has become much worse; for instance, the towboat St. Louis was stationary at a point just above Memphis from the 16th of September to the end of the month, and turning to the chart for October, you will find that she was still there until the 19th of October. In that period, all of the power boats of the line were gradually approaching this point under difficulties, and the power boats above were drawing into the same territory. The fact was that there was no channel, and some of the tows were aground; some simply stationary because of lack in the channel of sufficient depth to get through. This condition continued until the middle of November when it got appreciably better, and with some little interruption in December, which were finally cleared up by the end of the year. But from early August until the end of December, we were in constant difficulty because of low water in the whole stretch of the river between Memphis and Cairo, and at intervals between Cairo and St.
4032 Louis. These conditions were recurrent in the fall periods of almost every year of the eight years that I have been connected with the line. They have been
4033 conspicuous by their absence in the year 1926, due to the unprecedented fall rains in the whole Mississippi watershed. In the year 1923, for a period of three months, we had serious interruptions. In the year 1924, in the month of November, we had very serious in-
4033 terruptions. In 1925, we had a slight interruption.

I kept a record of business results of the barge line operations for six months periods, and am able to state of my own knowledge that the conditions indicated by the charts in these recurrent periods of interruption of traffic due to low water are reflected in the operating results of the barge line as shown by the accounts. During the
4036 fall period these interruptions occur, and our traffic falls to very much lower proportions than normal. We do not succeed in delivering our freight. Our operating expenses are increased. We have generally been able to look for a result of net earnings in the first six months of each year, and have almost invariably had red figures in the last six months of each year, except for 1926, in
4039 which we had good water throughout the year. The average tonnage per freight car of all freight in the

Middle West is about 30 tons, and we can easily propel down stream in one tow, 15,000 tons, or 500 loaded freight cars.

The barges draw 8 feet. We need a channel of at
4040 least 8 feet 6 inches and should have 9 feet. We could not handle the quantities of freight handled with tow boats of less power and different construction.

4050 Assuming and expressing no opinion as to the fact that if the diversion of water from Lake Michigan were terminated, the effect on navigable depths in the Mississippi would be to reduce ordinary navigation depths from 9 feet to approximately 8 feet or less, this reduction would be very disastrous to the operations of the service on the river during the months when there is a low normal flow in the river, because, and the fact is shown by many operations, when the river falls to such narrow depths,
4051 we cannot operate our powerful tow boats without interruption. The result to the general business is extremely bad. We also operate between Cairo and St. Louis where the project depth is 8 feet. This is ob-
4052 tained when there is sufficient run-off to get it, but we frequently do not have it during the fall months. The charts show that during these months we are compelled to operate tow boats other than our 8 foot boats in that stretch of the river, miscellaneous boats of 5 or 6 foot draft. These are all of much smaller loads and therefore operating results are much inferior to those in the stretch below Cairo.

In order to render the public the service we render, I
4053 regard it as essential to continue operations on an 8 foot boat basis. The results from that kind of operation are secure.

Cross-examination.

4067 Sometimes the depth of the water in the Mississippi between Cairo and St. Louis during the fall of 1922 period was not five feet. We had places where
4068 it was not five feet. They were the places substantially where our boats are shown stranded and stopped on these charts. There were some crossings
4069 where there was probably less than five feet of water. In that stretch of the river between Memphis and

Cairo during that period of that year there were twelve different points where we had difficulties, and those crossings in length measured about three and one-half miles, and they varied from sometimes seven to at times five feet of water.

One of our barges loaded to 2,000 tons draws 8 feet
4069 6 inches. I cannot at this date point out the places
4072 on the river and the dates when the depth of the
4073 water in the river was five feet or less in the navigable channel. Those were matters which came to me in the operation of the line at that time. I cannot state how many days in 1922 or for any other year during which I have engaged in these operations when the water in the navigable channel of the Mississippi River between Cairo and St. Louis was less than eight feet. It is my testimony that in a substantial part of the time in recent years, there has been substantially less than eight feet in the navigable channel of the Mississippi between St. Louis and Cairo, and there have been considerable periods of time when there was less than 9 feet between Memphis and
4082 Cairo. There are private barge lines on the river but there are no other common carriers with joint relations with railroads.

6149 As Federal Manager, I had supervision of the navigation on the river. I traveled on the boats and frequently when there was difficulty. One of our tows going down stream as ordinarily operated has six
6153 loaded barges, in a staggered formation, each barge 45 by 230 feet, tied together and to the tow boat by steel lines, so that they may be manipulated as a unit. The tow carries ordinarily about 11,000 tons dead weight of revenue freight. Such a tow would be 135 feet wide
6157 and 600 feet long. Either the channels are so narrow or so shallow that it is impossible to get through without grounding. There are at least 50 crossings between Cairo and Memphis which require almost constant attention in the fall of each year in order to keep them open. In that reach of the river there are only three dredges, and it is a physical impossibility to keep the river in such shape that we can go through without groundings.

The witness identified a report dated December 15, 1922, to Major General Beach, Chief of Engineers, covering the month of November, together with carbon copy of letter of transmittal, Defendants' Exhibit 536. Similar reports for September, Defendants' Exhibit 537; for October, 1922, Defendants' Exhibit 538; and for December, Defendants' Exhibit 539; for August, 1922, Defendants' Exhibit 540. The witness also identified a tabulation of the actual performance of the two boats St. Louis, Natchez and Cordova on the eight days between October 16 and 24th, prepared for him by the General Superintendent of the line about October 25, 1922, and copies of radiograms from the Masters of the two boats Memphis and St. Louis to the General Superintendent at Memphis concerning conditions on October 25. (Defendants' Exhibits 541, 542, and 543.) Defendants' Exhibit 543 is as follows:

> "Patton, Memphis, Tennessee" signed "Boles, 12:42 P. M.
>
> "Eight feet at Point Pleasant. Nine feet at foot of Madrid Bend. Eight feet at Darnalls. Nine and a half at Cherokee. Nine at Stewarts, Nine at Bass. Eight and a half at Fritz. Seven at Sandy Hook. Channels are very narrow not wide enough for two barges. Dredge 'Fort Gage' working at Morrison's when we left New Madrid. Dredge 'Harrod' left Bass this morning at ten and dropped down and tied up at the bank at Hathaway. Understand she will go to work on Sandy Hook. Box dredge still at Hotchkiss. Dredge 'Henry Flad' at Point Pleasant channel about finished."

Exhibit 542 is as follows:

> "Str. St. Louis, October 25, 1922.
>
> "Patton, Memphis, Tenn.
>
> "Dredge 'Fort Gage' at Morrison towhead. Dredge 'Henry Flad' at Toneys. Found eight feet there. Point Pleasant nine feet. Darnall eight and half. Stewart eight. Bass nine. Dredge has been working at Bass left about ten A. M. Island 14 bar

eight and half feet. Sandy Hook seven feet. Dredge 'Harrod' laying at Hathaway. Think she is going work in Sandy Hook crossing. All crossings are one barge channels account of width. Owing to general conditions we consider ourselves lucky to be as far down as we are. On way now for last barge 543 which is heaviest.

Clay 2:30 P. M."

It does not make much difference, however, if the
6170 barges are loaded to eight 6 or 7 feet, because the tow boats draw 8 feet, and of course the barges cannot get through without the tow boat. In my
6177 judgment it is essential to profitable and successful navigation that we should have the full project width of 250 feet by 9 foot depth. With that we can easily manipulate these boats of the present dimensions. Our experience is that transportation on the Mississippi River cannot be successfully conducted in any other way than by the large tows.

4040 In reference to the barge line rates, the Railroad Administration at the inception of the project adopted a theory that the water rates should be 80 per cent of the rail rate, and when we went to secure joint rates with the railroads, they determined that the differential should be fixed by taking 20 per cent of the rail rates applying at the port at which we took the freight to the port at which we discharged it, reducing that to a factor of cents per hundred pounds, and subtracting this factor from the published through all rail rate from point of origin and point of destination in making up a through joint rate. That formula has been used in extending our rates over the entire territory now governed by joint rail and barge, barge and rail and rail-barge and rail rates. The formula is sup-
posed as nearly as possible to approximate in the
4045 through rate the portion of economy in the water portion of the haul. I am able to state that there has never been a common carrier on the river with any appreciable system of joint rates with railroads or which has joined in the publication of through routes and joint rates

with the railway carriers. The railroads did not desire this during the time of earlier water operations, and there was no law requiring the creation of such relations.
4050 At the time our operations began, there were no precedents of that nature to be found.

4056 The introduction of water transportation as far inland as St. Louis has tended to bring cities in that vicinity more nearly in line with the eastern seaboard in doing business with the Pacific Coast. The seaboard from the time the Panama Canal was finished has had the advantage because the rail rates from the East and from Chicago are the same, while the water rates from the East have been very much less. Therefore, industry has to a very marked degree not only transferred its operations but its business from the Chicago District and from the Middle West to the eastern seaboard. With the introduction of our water transportation, we have been able to quite
4057 a considerable extent to equalize those conditions as far as operations go. The average ton mile earnings on the Warrior and on the Mississippi as a whole, slightly exceeded 4 mills per ton mile. We have for the last three seasons handled grain for export from St. Louis and Cairo at a rate of 2 mills per ton mile. The average earnings of the railroads on grain, according to testimony in the Western Rates Case, has been about 8 mills per ton mile. The barge line rates cheapen transportation of grain and have, therefore, been of considerable benefit to the territory of the Middle West which has only one outlet practically today, and that is the Gulf, for export.
4061 The barge line participates in the movement of import and export freight aside from the grain mentioned. We handle a great deal of freight from the
4064 Central West into the Southwest. Through traffic comes from hundreds of points beyond and goes to hundreds of points beyond.

4089 There is a considerable and growing traffic in private barges particularly out of the Ohio River, which is coming down during the months in which navigation is possible to carry it. The principal commodities handled by

these barges are steel products. We handle these products as agents for the owners at Memphis and load it into cars and switch it for their account to the trunk line railroads.

This steel originates in the Pittsburgh District.

6240 The witness produced and identified two statements, one showing imports and exports with the exclusion of sugar, and the other showing tonnage handled by months and years, north and southbound, and totals, compiled from the monthly reports of the barge line. He testified this is an analysis of the tonnage moving through New Orleans for export and the import tonnage moving north for the years 1921 to 1925, inclusive, and the first ten months of 1926. The import figures do not include sugar which although an import, was received by us in a refined condition and as a domestic product. Our movement of sugar northbound in 1926 was about 300,000 tons.

(Introduced in evidence as Defendants' Exhibit 546 and 547.)

6254 The base rate which controls the entire exportation from the Mississippi River, is the published proportional on all grain of 18 cents from St. Louis and 15 cents from Cairo to New Orleans. The barge line contemporaneously charges on grain for export from St. Louis 11½ cents and from Cairo 10 cents to New Orleans, under conditions substantially similar to those for rail carriers. The barge rates here named are exactly 2 mills per ton mile for the barge line's respective hauls. These rates apply to grain actually moving day by day and year by year con-

6255 stantly on the Mississippi River. The amount of saving is 6½ cents per 100 pounds or substantially 4 cents per bushel. The map in reference to grain rates described just above is in evidence Defendants' Exhibit 549.

COLONEL ROBERT ISHAM RANDOLPH, FOR DEFENDANTS

4495 Direct Examination:

As Secretary of the Internal Improvement Commission and Rivers and Lakes Commission of Illinois, I made a

number of inspection trips on the Mississippi; in addition to my practical experience, I made a study of the effect of the increment of water diverted from Lake Michigan upon river stages and channel depths of the Mississippi based upon all available authentic sources of information. I submit a number of exhibits showing these basic data, all official records, the first a hydrograph of the Mississippi River, being an average of observations from 1861 to 1920.
4503 (Defendants' Ex. 507.) This exhibit, a correct copy of an official document prepared by the engineer corps, shows a hydrograph of the extreme low daily stages during the sixty years in question and a similar hydrograph of the high daily stages and a mean hydrograph made up from the averages throughout the sixty years. In addition, the chart shows a discharge curve showing the gauge height at the left of the chart and the volume of discharge figures at the bottom, the curve representing the relation of discharge and river stage at the St. Louis gauge.

The project for the improvement of the Mississippi between the mouth of the Missouri and the mouth of the Ohio calls for an 8 foot depth referred to plus 1 of the St. Louis gauge at present, although in 1906 and prior thereto, the project was referred to plus 4 of the St. Louis gauge.

Referring to Exhibit 507, at mean low water plus 1 of the gauge, the discharge is 40,000 c. f. s., including approximately 10,000 c. f. s. from Lake Michigan and from the discharge curve, a decrease of 10,000 c. f. s. would
4506 lower the stage one foot and a half. At plus 2 of the gauge, the 10,000 increment makes a difference of a
4507 foot; at plus 4 approximately .8 of a foot; at 35 of the gauge, about .3 of a foot. Exhibit 507A is a sim-
4508 ilar discharge curve based on observations from 1900 to 1904, prepared by the government engineers.

The witness similarly introduced Exhibits 508 to 512, inclusive, being similarly prepared discharge curves for Chicot, Arkansas, Columbus, Kentucky, Vicksburg,
4510 Mississippi, Red River Landing and Carrollton, Louisiana. At Columbus, Kentucky, the addition of
10,000 c. f. s. at low water (stage 5 of the gauge) increases the depth one foot and a quarter to one foot and a

4512 half; at Chicot, Arkansas, at low water (plus 8 of the gauge) the increment of 10,000 makes a difference of a foot in depth; at Vicksburg, according to the chart, at low water (7½ of the gauge) the increment of 10,000 has a value of slightly less than a foot; at Red River Landing .7 of a foot and at Carrollton .6 of a foot. These changes 4513 in stage as deduced from the curves are the results shown by observations made by the government engineers.

The witness then produced in evidence Exhibits 513 to 516, inclusive, being hydrographs furnished by the Mississippi River Commission for the years 1922 to 1925, inclusive. The charts are graphs showing in a curve the daily record of gauge heights. It is apparent that these hydrographs taken at various points from St. Louis down 4516 are similar at each point with a slight lag as you go down the river. Similar hydrographs for the river from Cairo to Port Jackson for the same years were 4517 introduced as Defendants' Exhibits 517 to 520, inclusive. The witness then introduced certain charts prepared by him showing two hydrographs, the upper one being simply a copy of the previous hydrograph for the same year for the same stretch of the river. The lower hydrograph was obtained by applying the discharge curve to the stage shown on each day so as to find the stage which would have occurred on that day if the discharge were 10,000 second feet less and therefore, the lower graph represents the daily river stage for the year and location 4519 in question as it would have been without the water from Lake Michigan. The witness then noted at the bottom of each of these charts certain information obtained from the operating charts of the Mississippi-Warrior Barge Line previously introduced as Defendants' Exhibit 505.

NOTE.—This Exhibit consisted of one chart for each month from March, 1922, to December, 1926, inclusive, showing in a graphic way the operation of each towboat of the Mississippi-Warrior Barge Line, and indicating the progress of the boat up or down the river, and the cause and nature of any delays. The Exhibit was qualified and in-

troduced by the witness, Theodore Brent, and, he testified, was a photostatic copy of business records of the Barge Line kept in the ordinary course of business.

The information furnished by Exhibit 505 was classified and collected and transferred to the charts prepared by the witness under two headings, first, "Held Up By Bad River" and second, "Barge Groundings by Days." The information was so taken from Exhibit 505 as to show the actual number of hours a barge was aground, but the time taken was the time of grounding whether one or more barges was actually aground. I, in preparing the chart, assumed that the fact of grounding indicated a lack of sufficient navigable depth in the channels, the record giving no information as to actual depth at the particular point and time involved.

No assumption was made as to the information under
4528 the "Bad River" heading. On Exhibit 518, it appears that there were 19½ days of barge groundings for the year 1922. I assumed the fact of grounding at a particular stage of the River indicated an actual lack of navigable depth at that stage and by applying the stage to the lower hydrograph indicating what the stages would have been without the Lake Michigan increment, I ascertained the additional time during which there would have been the lack of navigable depths if the volume in the river had been decreased by the amount of the Lake Michi-
4526 gan increment. I made no assumption as to depth
4527 needed to float the barges. The project depth calls for the maintenance of 8 feet, but the channel shifts and bars form, and a mere rise of stage does not
4531 necessarily indicate a corresponding rise of depth.

My assumption was that without regard to the depth of the barge, if it was shown by the operation charts, Exhibit 505, to have grounded at a particular stage, at that stage there was insufficient navigable depth in the channel. I further assumed that the hydrograph at St. Louis fairly represented the river stages in the stretch of river from the mouth of the Ohio to the mouth of the Missouri. On the assumptions involved and by applying the discharge curves to the lower hydrograph representing what would

have occurred without the Lake Michigan water, I found that in 1922, while barges actually were grounded for an aggregate of 19½ days, without the Lake Michigan water, this would have been increased to 101 days. In
4534 reaching my conclusion, I gave consideration to the rise and fall of bars in the river, and offered in evidence Defendants' Exhibit 526, being a graph published in House Document No. 50, 61st Congress, First Session, Report of the Board of Examination and Survey of the Mississippi River. The graph was entitled:

> "Curves showing Relations between River Stage to Bar Heights and Depths Limiting Navigation in the Mississippi River between St. Louis and Cairo compiled for the Board of Examination and Survey of Mississippi River from the records of the United States Engineer Office, St. Louis, Missouri, for the years 1896 to 1908. The curve of mean depths shows for each foot of stage the average of the best depths found in the channel crossings of all bars between St. Louis and Cairo, and indicates the relation between mean bar height and stage: the total number of soundings represented by each reference mark
4539 being stated opposite thereto."

The curve indicates in general that as the river rises the bars rise with the river so that at gauge 10, for instance, an increase of stage of 1 foot indicates an increase of depth over bars of approximately .7 of a foot. This relation applies at the upper stages on a falling river. The re-
4540 lation does not hold true throughout, and does not apply at all to the lower stages. The curve indicates that at plus one of the gauge, the bar does not rise as the stage increases. Since the time of these observations, 1908, the project for the regulation of the river has been carried further and now in general upon a rising river at the higher stages, there will be an increase of bar height,
4542 but this would not be true for the lower stages. The witness introduced in evidence similar charts for the lower river similarly prepared, but referred to a
4544 different gauge, and the appropriate hydrograph.

Based upon my study of the basic data and experience on the river itself, in my opinion the increment of 10,000 second feet at low water stages of the river increased the navigable depth to the extent that the stage was increased, and further the government project for the improvement of the Ohio would necessarily tend to decrease the flow from the Ohio at low water stages, and consequently
4559 make more important sources of supply elsewhere derived.

4560 "I do not think we are going to try that, and I
Special judge from what the witness says that we would
Master have great difficulty in reaching a conclusion if we did, if the engineers at the War Department are doubtful about the extent of the effect."

Cross-examination:

4794 I am not a graduate of any school of engineering. I have made no field surveys on the Mississippi River. I have made surveys for drainage districts on the Mississippi River involving a study of flood heights and levee heights, but they did not have anything to do
4795 with navigable depths or location of the channel. I have never had any field work as an engineer dealing with navigation on the Mississippi, but I have taken several trips on the river. On my trip as Secretary
4797 of the Internal Improvement Commission I did no
4798 field work. It was just a trip on the river.

4800 My opinions expressed in my direct testimony are based entirely on the various charts, surveys and government reports offered in connection with my
4801 testimony. There is no other information or charts upon which I am relying.

4809 I agree in the main with the description of hydraulics of the Mississippi River found at page 44 of the report of the Special Board of Engineers on the 14-foot waterway.

When asked concerning instances of extreme low water below zero of the gauge at St. Louis shown on the chart,

Defendants' Exhibit 507, the witness pointed out that the entire plane of reference for the government project had been lowered since the Chicago diversion from plus 4 of the gauge to plus 1 of the gauge.

4855 The grounding on September 1st, 1922, shown by
4856 the operating diagram of the barge line occurred about 7 A. M. and it lasted until about 8 P. M., and then apparently moved down a little bit and again stuck and continued through the night until about 5 o'clock the next morning. I do not know the cause of the grounding.

4863 From Exhibit 521 I cannot tell how the tow or tug boat that grounded on the bar at a stage of five feet on the St. Louis gauge got off the bar when the stage
4864 in the St. Louis gauge was 4. The tow finally got off the bar when the mean daily stage as shown on this graph was a foot below the point where it originally grounded.

4865 If my relations had exact accord with the fact that there was one foot less water there than when the tow got on it could not have gotten off. I did not present these graphs as showing anything about the depth
4866 of water. According to the graph, the water surface was one foot lower when the tow got off than when it got on. The special master indicated that in view of this he was unable to see the effect of the charts. The
4867 depths would be affected by the dropping of the water surface if the river bed was stable or fixed but the bottom must have dropped out at that time,
4868 as it sometimes does under these bars and rises.
4868 "The net result seems to be that there was one
Special foot less when the tow got off than when it got
Master on."

4894 In response to the Master's questions, the witness replied that in the first place, the relation of river surfaces below St. Louis to the gauge at St. Louis, was a practice approved by the Engineering Corps; as indicated by defendants' Exhibit 526, the curve of depths over bars which related the information there contained throughout the stretch of river from the mouth of the Missouri to

the mouth of the Ohio to the St. Louis gauge. On this Exhibit there were two curves, one for mean depths over bars and the other curve of limiting or least depths over bars, the latter showing the depths controlling navigation. The chart itself states, in reference to the latter curve:

> "The average of the line channel depths, one for each through trip between St. Louis and Cairo, found by boats operated by the U. S. Engineering Office, indicates the relation between the controlling depth and the stage, the least depth of each trip being shown as a small dot, and the mean of all trips within a half foot of each foot of stage being shown as a large circle."

As indicated by my chart Exhibit 521, in the year 1922, on September 1, a barge grounded at gauge height plus 5 and as shown by the curve above referred to, the limiting depth at gauge plus 5, is 5.9 feet, and further that for a gauge height of 10, the limiting depth is 8 feet. The chart shows a fixed relation between bar depth and surface elevations and although based upon an accumulation of recorded observations between 1896 and 1908, in the opinion of the witness, the relations so established obtained at the present time.

4900 The assumption that I have made is that on September 1st, when this boat stuck on a bar at gauge height 5, that was the gauge height and the controlling depth at which that barge would have stuck under any conditions, and that with 10,000 second feet less water, skimming a foot off the top of the river at that point, that gauge height would have occurred three days earlier and the barge would have stuck three days earlier.

Now, it got off the same day, and in the interval between when it stuck and when it got off the river fell .4 of a foot. Some work was consumed to get it off. What kind of work was consumed I have a very good idea, but I am not able to state definitely of my own knowledge whether it was dredged off or dredged itself off with the aid of the twin screw propellers. It got off and went down the stream a little ways, as shown on the operating diagram, Exhibit

505, and got on another bar and stuck, and worked its way off and got off that bar at stage 4. Its progress was a succession of getting on and off bars through that difficult stretch of the river.

The assumption that I have made is that the actual grounding, as shown on the operating chart of the barge line, Exhibit 505, show clearly that for the months of September, October, November and December, navigable depths were not obtained in that stretch of the river, and as barges came to those places where the channel depth was not sufficient to float them, with 10,000 feet less water or skimming approximately one foot off the top of the river, the conditions would have been worse and the stage would have been as represented on this line graphically and at the left numerically.

4916 The conclusion is that the addition of 10,000 second feet would produce greater navigable depths at low water stages, and the measure of the increase would diminish as the stage increases. In support of my conclusion I also refer to the Annual Report of the Chief of Engineers for 1926, page 1028, which states:

4924 "The average natural depth available for navigation at low water, mean and bank full stages, are about 4½, 9 and 16 feet respectively, that is the crests of bars rise and fall with stage as 1 to 2½."

J. W. Woermann, for Defendants.

4569 Direct examination:

I have been in the division office at St. Louis for 12 years or more, and in 1915 I prepared the new article on the Mississippi River for the Dodd & Mead International Encyclopedia upon the recommendation of the President of the Mississippi River Commission.

4572 In preparing the 14 foot waterway plans at the request of the Board, I assumed a diversion from Lake Michigan of 10,000 c. f. s. I took one foot as the increase in stage at low water represented by this incre-

ment. The discharge curve at St. Louis published in
4573 the report indicates more than a foot, but I took a foot as a conservative value. From the mouth of the Illinois to the mouth of the Missouri, this increment would increase the low water stage between a foot and a half and two feet, and from the mouth of the Missouri to the mouth of the Ohio about a foot, and also a foot to Columbus, Kentucky, and down to half a foot at Carrollton, Louisiana. The more recent discharge curves indicate a greater effect at the present time; at St. Louis, for instance, it is close to a foot and a half.

Cross-examination:

4577 I state that the Board had accepted my assuming an increase of one foot due to the assumed diversion of 10,000 second feet. At low water the increase in gauge height of one foot would be the increase in navigable depth. The bars do not rise and fall with stage of the river at low water or near zero of the gauge. The St. Louis office endeavored with the plant at hand to maintain eight
4580 feet, but, of course, did not always do it.

The rise of the bars with the rise of stage does not occur at any particular definite point on the gauge, but begins at plus one or two, or more. The curves in
4582 the report indicate that the bars rise approximately .4 as fast as the rise on the gauge. The effect of a
4592 given increment depends as much on depth as it does on slope. I do not agree with the statement con-
4593 tained in Complainants' Exhibit No. 1 on page 47 as follows:

> "It would not be unwise to assume that the average raising of the water surface amounts to about one foot, but due to the hydraulics of the Mississippi River, where the elevation of the tops of the bars fluctuate with the height of the surface of the water, it is doubtful if the actual depths are materially increased. For this reason it is impossible to evaluate the benefit, if there is any."

I would not say it was an error. I would say it was very conservative value.

And when referred to the following statement by Major J. B. Cavanaugh, pages 38 to 40, H. D. 762, 63rd Congress, second session, the Bixby report reading as follows:

> "The effect of any diversion upon gauge height will always be small, and at the highest stages practically nothing, but the exact effect at any time or at any stage is impossible to determine, since this effect will be complicated or obscured by various other changes in the regimen of the river;"

said:

> "I absolutely do not agree with that statement.
4606 I was amazed when I read it. Major Cavanaugh when he wrote that was a long way from the Mississippi."

When his attention was directed to the statement on page 39 of the same document in reference to the comparison of certain discharge curves, the witness said that the writer was dealing with ordinary stages of the river; that the rise of bars was an unusual phenomenon and people nat-
4609 urally applied this phenomenon to all stages of the river, at some of which it did not occur. The discharge curve in the Bixby report does not show that the bars rise at lower stages. The curve stops at plus two of the gauge. If continued to zero, it would indicate that the depths on the bars increase faster than the water rises, which is, of course, absurd.

4610 I do not know whether there was any information obtained from actual tests in the river which would have permitted extension of that curve if the Board had seen fit. There were plenty of trips taken to give
4611 soundings for the lower stages to my personal knowledge. I do not know of any official report made by any member of the Corps of Engineers which would support my statement that there were data from which the curve could be deduced for a depth less than shown on the chart.

4612 I did not have any data that has not been in the hands of these various Boards investigating this question with respect to the relation between the heights of bars and the stage of water.

4613 It would be impossible to have any natural channel of eight feet in this river without dredging and other improvement during the low water stages.

4615 It is practical to improve that section of the river by revetment of the banks and regulation, but nothing can take the place of water, and if you develop as great a depth with a smaller volume of water you have a channel of less navigable capacity.

CAPTAIN WILLIAM L. BERRY, FOR DEFENDANTS.

Direct examination:

I am the Manager of Transportation at Paducah, Kentucky, for the Ayer and Lord Tie Company which
4720 operates barges and boats on the Mississippi, Ohio and Cumberland Rivers. My experience in navigation on the Mississippi River began in 1886. I obtained a license as a pilot in 1910, but was watchman and mate on tow boats prior to that time, at least half of my service being on the Mississippi. Prior to 1900, the barges would be loaded to capacity, from 6 to 8 feet draft up to around the first of August. After that during low water, they would be loaded to 4 and 4½ feet. I noticed a change in the conditions of navigation after the introduction of the Lake Michigan water in 1900. I think we had about a foot to 18 inches more water after the diversion of water from Lake Michigan; a slight improvement immediately, but an increase right along. We generally had an average of
4723 from 5 to 7 feet right along during the fall. Before 1900, there was frequently only 4 feet in the river after August. The barges are loaded in accordance with depths found in the river. I don't know about the bars rising with the river. I know as the river rises we have more water in the river. Of course, when we have high water the Mississippi River is changeable. It has a sandy

bottom and banks, and, of course, when we have high water the current increases and it moves the sand. Sometimes it moves it on either side. Sometimes it moves it straight ahead and flows into deep water. Sometimes it spreads and leaves a bar clear across the river. We could not afford to lay up and wait for the government to make the channel, but were compelled to load according to the actual available depth. I noticed a change when the water was turned in from Lake Michigan in 1900. I was towing ties from White River out of St. Louis, loading the barges to 5 feet and got stuck twice going up, and on the next trip after the introduction of the new water, I went through without touching.

My barges grounded some time in the summer or in
4731 the fall of 1900, I think. It was toward the latter
4732 part of the season. On the next trip taken about
4733 three weeks later my barges went up loaded to the same depth and did not ground. I think the change in those three weeks was due to the turning in of the Chicago water.

I could not see a great and sudden change, but know that boats have been loading right along in the last
4736 ten years for about 18 inches more of water. The government tried to maintain a depth of 8 feet, but did not succeed.

CAPTAIN OSCAR F. BARRETT, FOR DEFENDANTS.

Direct examination:

I am engaged in the river transportation business on the Ohio and Mississippi residing at Cincinnati. My
5387 experience began in 1882 in heavy freighting on the Mississippi and Ohio, with headquarters beginning in 1887 at Cairo. I was not always on the vessels during the trips, but practically always during times of low water. Before 1900, low water would begin any time after the middle of July, and with practically no rise above Cairo, until the middle of March or first of April. I would consider myself lucky if before 1900 there would be an average of 5 feet between Cairo and St. Louis, after the first of October and sometimes in September. During the low

water season, I used to tow lighters following the Anchor Line Packets in order to lighten these by removing freight to permit the big steamboats to get through the shallow river. The packet boat after the freight was off, would draw from 4 to 4½ feet, and from six to eight feet with the freight aboard. Before 1900 the channels were
5391 not only shallow but very narrow. Most of the barges before this period were double end barges which required being pulled at the side of the tow boat, and in order to meet this difficulty, square stern barges to be shoved ahead of the tow boats were designed in
5392 1896. Since the water has been turned in in 1900, the tow boats usually take three barges wide and two in length, six barges in all. For a number of years I have not loaded any barges down stream less than 7 feet, and as a rule load 6 to 6½ feet for up stream movement and usually get through without much trouble. The improvement began gradually after 1900. The improvement by the Chicago water was forcibly illustrated to me when I attempted to haul cement to Hannibal, Missouri, above Grafton. Barges were going to St. Louis with 7 feet draft although it was the dry season. They sent their barges to Hannibal, and although they had only loaded them to 3 feet, they couldn't get out. I went up the river to help these barges move, and had no difficulties until I got above Grafton. There was 7 to 8 feet in the channel up to Grafton, and above it dropped down to three or three and one-half feet. That convinced me that the water from the Illinois was the salvation of the Mississippi.

I fixed the time when I noticed the added water from Chicago in the river to two or three years after my
5406 father's death in 1897. I remember that instead of towing one barge at a time, I was frequently able to tow two and even three drawing more water than had been anticipated. I knew the improvement in conditions was caused by the Chicago diversion, because when I went up above the mouth of the Illinois River at Grafton, navigation was not so good. Then instead of 7 or 8 feet it
5408 dropped to 3 or 3½ feet. I think that it was about 1901 or 1902 that the change became definitely fixed

in my mind. The change did not take place within weeks or months, but within a year or two.

CAPTAIN H. W. NEYHE, FOR DEFENDANTS.

Direct examination:

I am the Manager of the Eagle Packet Company, operating boats on the Mississippi and Illinois Rivers.

I first had to do with the navigation on these rivers in
1888. The Eagle Packet Company was organized in
5801 1861. I began to operate on the Illinois in 1893. I
am a licensed pilot on both the Mississippi and Illinois; on the Mississippi from Cairo to Grafton. In 1892, we built a large boat for the Illinois River, 240 by 40 feet,
drawing about 4 feet, which we figured would carry
5802 a lot of people up the river on excursions to the
World's Fair in Chicago. We found we could not operate after the last of July because of low water. That generally describes the conditions obtaining in the Illinois
during those years; insufficient water during the
5803 summer and fall months. There was a change in the
river occurring to my best recollection during the season of 1900. We never take any soundings now in the Illinois River. Our boats draw about 4 feet light and loaded 5½ to 6 feet. With reference to the stretch of the Mississippi between Grafton and St. Louis, prior to 1900, we had a lot of trouble. One season, I think it was 1898,
we were unable to get to Grafton with a boat drawing
5804 3 feet. The difficulty was just north of Alton. We
operate north of Grafton on the Mississippi all the way to St. Paul. There has been a change in the condition of the river below Grafton, (the mouth of the Illinois). We never have any trouble there now in using these boats I described as operating on the Illinois. I think this change began in the season of 1900. Before 1900, we operated tow boats from Cairo to St. Louis. We could take from 3,000 to 5,000 tons a trip in a good stage of water, that is, 7½ to 8 feet. We could do that in the early portions of the season, say up to the first of September. After that, with a boat

we could tow about 3,000 tons with, we would gen-
5805 erally come up the river with about 1,000 tons, which would be unprofitable. This would be at a 4½ foot draft. We gave up that tow boat business in 1901 because of the uncertain stages of water. There has been a big change in the condition of the river since that time, between Cairo and St. Louis. Since that time, we have oper-
5806 ated packet boats, but I see what is coming up the river, and I have often remarked that if the present tow boats have the trouble to contend with we did before 1900, they would not be on the water. With the coming of the Chicago diversion, I noticed a marked difference
5807 in low water. It gave us a wider channel. I do not know that we would have an 8 foot draft all the time, but we have been having good water. I guess after that between 6 and 7 feet would be very close to what we got. Ever since I started on the river the Government has been dredging and building wing dams and dikes along
5808 the river in carrying out the Government improve-
5809 ment which does help in some cases and in other cases not. In 1898, we were laid out all fall trying to get to Grafton. Our packet boat then was drawing 30 inches. Prior to 1900, we could only draw about 4 to 4½ feet in the low water season in the middle Mississippi south of St. Louis. After that date, we would not get 8
5811 feet, but the prevailing draft was at least 7 feet. There was more water in the river than 4½ feet; that was the draft of the barges.

MAJOR JOHN C. GOTWALS, FOR DEFENDANTS.

Direct examination:

5453 I am United States District Engineer at St. Louis, in charge of the Mississippi River between the mouth of the Missouri and the Ohio since April 30, 1924; graduate of Pennsylvania State College in Civil Engineering in 1906; advanced degree of civil engineering from same institution in 1907. From 1906 to 1913 employed successively by the Pennsylvania Railroad tunnelling into New York City, by

the State of New York on the barge canal and by the
5454 City of New York on the Catskill Aqueduct. Commissioned second lieutenant in the United States Corps of Engineers as a result of competitive examination in 1912. On duty with troops in Texas, 1912 to 1917. 1917 to 1919 in charge of Searchlight Regiment in France. Engineer Officer of the Alaska Road Commission from 1920 to 1924. Chief Engineer of Alaska Railroad in 1924.

5455 I have the direct duty of improving the Mississippi. For that purpose I have reviewed all of the work that has been done since 1881 as well as its economic
Ex. 1180 value. My studies are incorporated in Exhibit 1180, being Document No. 9, 69th Congress, Second Session, Committee on Rivers and Harbors, House of Representatives, entitled "Mississippi River between the Ohio and St. Louis." My recommendations contained in this report are incorporated in the last Rivers and Harbors Act. This report gives a history of the project showing the initial appropriation in 1824 for the removal of snags and projects for certain specific improvements in 1836 and 1837, and later in 1844. The first general project for the improvement of the river was in 1872. The present project using revetments and permeable dikes was adopted
5486 in 1881, calling for a six-foot channel to the mouth of the Missouri and an eight-foot channel from there to the mouth of the Ohio. The project was modified in
5487 1895 by a provision for dredging in addition to the regularization work to maintain the channel, and in 1902 an increased appropriation for dredging was made, but no advantage was taken of this appropriation. No appropriations after 1905 were devoted to dredging until 1910. Paragraph 30 of the report reads as follows:

> "30. It is to be noted that the above defined low water is the natural minimum flow during the season of navigation, and includes no 'added volume' or diversion of waters from Lake Michigan. An increment of 8,000 cubic feet per second will raise the low-water plane at St. Louis about one foot, and because of rise in river bottom with rise in stage, character-

istic of the middle Mississippi, will increase the navigable depth about one-half foot."

5506 Paragraphs 58 and 59 of the report read as follows:

"58. It is not possible to predict exactly the navigable depths which will result after completing works of the nature proposed. Based on the natural velocities obtaining in the present low-water cross sections, reasonable computations indicate that the cross sections formed by the proposed contraction works will give a mean depth of 8 feet at low water and a channel depth of 9 feet over a width of about 500 feet in each of the three-river subdivisions. These computations are based upon the very conservative natural low-water volume for navigation of 40,000 cubic feet per second which includes no diversion whatever from Lake Michigan. (Par. 30.) So low a water has not occurred during navigation seasons of the last 22 years. * * *

"59. It is therefore a fairly conservative conclusion that a channel 9 feet deep at low water and at least 300 feet in width will result in completing the regulating works."

NOTE.—The three-river subdivisions referred to are found in Table 2 of the report which shows a mean depth of 8 feet and the "fairly conservative con-
5505 clusion" that a 9-foot channel will result, is based upon the inclusion of the Chicago diversion.

The report also quotes the following extract from Colonel Ernst's report of August 10, 1903:

"A dredged channel which does not maintain itself is a very precarious foundation for trade. There is probably no place in the world where a dredged channel will have a briefer existence than in the uncontrolled part of the Mississippi River below the Missouri."

Colonel Potter, Chairman of the Mississippi River Commission and Division Engineer, adds the following endorsement to Major Gotwal's report:

"2. This report is the result of a very thorough study based on many years' experience on the St. Louis engineer office in the regulation of the middle Mississippi, and the conclusions are well worth acceptance and thoughtful application to the problem of its improvement."

The witness also introduced a tabulation showing funds, appropriations and expenditures for regulating works and dredging from 1891 to 1926, inclusive. (Defendants' Exhibit 1184.)

5537 Exhibit 1185 was received in evidence, being a blueprint entitled "Mississippi River and Tributaries and the Great Lakes," which shows the elevations at various points on the Mississippi River and its tributaries above sea level at extreme low water, the distance from the Gulf to Mexico, the range in stage at various locations, the mean fall in feet per mile at extreme low water, and the maximum and minimum discharges of the tributaries entering the Mississippi.

In connection with the testimony of the witnesses
5538 there was received in evidence Exhibit No. 1186, being a table showing the effect of 10,000 c. s. f. diversion from Lake Michigan on the Mississippi River at Grafton, St. Louis, Columbus, Helena, Vicksburg, and New Orleans, prepared by the witness from official reports and documents, discharge and rating curves.

5539 Basing his testimony on Exhibits 1185 and 1186 the witness stated the extreme low water flow at Grafton just below the entrance of the Illinois River is 25,000 second-feet. Since the Illinois and upper Mississippi Rivers are streams with fixed beds a rise in stage probably would be reflected by a rise in navigable
5540 depth. The low water flows at Grafton of 25,000 second-feet and at St. Louis of 40,000 second-feet occur only in extreme mid-winter when navigation is closed by ice. 10,000 or 15,000 second-feet should be added to these figures to get the extreme low water during naviga-

tion season. Below the Missouri the effect of a rise
5541 in stage on navigable depths would be about one-half the rise in stage. At the low water the navigator goes in the very deepest channel, while during the high stages he avoids the deepest channel to avoid the stiff current.

There is a slight tendency in navigation records to show the bars a little higher at the high stages than is actually the case. I cannot take too seriously the adding up of the previous sounding over the bar and say that rise is exactly 1 to 2½ or 1½ to 2½, but it is something roughly in that neighborhood. You can say below St. Louis that with the rise in stage, due to 10,000 c. s. f., there is some increase in navigable depths.

5542 Low water generally exists from August to the close of the navigation season, which varies from December 10th to January 1st, during which period the average discharge is between 55,000 and 60,000 c. s. f. at St. Louis. A 10,000 c. s. f. diversion from Lake Michigan increases the navigable depths from six inches up to the full amount that the stage is increased by the diversion, depending upon how the river stage has dropped.

5543 The plan of improvement in the middle Mississippi
5544 consists in contracting the existing river into uniform widths so that the river would cut out the shoals as they form. With these contraction works it is very probable that the shoals will cut out through the entire river, though I am not optimistic enough to expect it to altogether eliminate dredging.

5545 With the completion of these regularizing works the pools will be a little shallower and the bars a little deeper, but I hesitate to predict whether this change would result in increasing the effect of an increment from Lake Michigan on the navigable depths. An increment of 10,000 c. s. f. has no effect, by erosion or otherwise, to create bars or to injure the navigable capacity of the river.

5549 Fourteen feet on the gauge would be the extreme limit at which navigation difficulties occur due to low

water. The hydrograph for 60 years shows that low water is not very long duration of the navigation season.

5552 Cross-examination:

The Mississippi River has an unstable bed from the mouth of the Missouri to the Red River, being most unstable nearest the Missouri and gradually stabilizing as one goes downstream. The Mississippi becomes practicallly
5552 stable above the mouth of the Missouri. The gravel bars there shift occasionally, but very little. There are undulations in the bed of the lower Illinois similar to Mississippi bars, but they are quite stable. Annual
5555 dredging is not required in the Illinois. The dredge cuts will last through a period of years. The same situation is true in the Mississippi between Grafton and the mouth of the Missouri.

5557 As the water increases above low water in the Mississippi navigators keep out of the channel over the bars in order to avoid the current. The current in the Mississippi River immediately below St. Louis varies from a mile and a half per hour at extreme low water to seven miles per hour at extreme flood.

5558 A prudent navigator keeps out of the mid-channel all the time. Even a current of a mile an hour increases the difficulty of handling his boats. Coming
5559 upstream he will cross a bar as far from mid-channel as his soundings will permit.

5560 In going downstream and approaching the bar a navigator backs his boat while he is flanking it, and he tries to avoid the swiftest current. This avoidance of the channel accounts for some groundings of barges when there is plenty of water. A good many of the groundings of the Barge Warrior Service occurred at times and places where there was ample water for the barge if the navigator had not gone in the "soft water" to avoid the current or if the navigator had not used poor judgment in picking a place in the river or having a boat with poor equipment, two or three rudders missing, thinking they would get by.

The conditions here described would prevail in barge
5562 navigation anywhere but to a lesser extent.

Even at the low current rate of 1½ miles per hour the navigator would avoid the channel if he felt sure there was no shoal water. Though with extreme low velocities, he is likely to look ahead and say the best chance of keeping in deep water is to keep in the lively current. However, if there is sufficient water over the bar, in the opinion of a navigator, he will avoid a channel current of a mile and a half an hour because it would mean a mile and a half more speed for his boat. There are towboats on the Mississippi with a still water speed of the naked boat of only six miles per hour. A good towboat has a still water speed of eleven miles per hour without a tow. A poor boat would have a difficult time in a swift current. At extreme low
5564 water the pool depth immediately below St. Louis is from 12 to 15 feet, at mean stage from 20 to 25 feet, and at high stage from 40 to 50 feet, though these are very wide estimates. Accordingly, the chief problem is to maintain project depths between the pools.

5565 The same situation obtains between the mouth of the Missouri and the mouth of the Illinois, but here the bars are stable. The records of dredging at points above the mouth of the Illinois show that the dredge cut lasts 10 or 12 years. The project depth of six feet is maintained in this section of the river. Probably six inches additional depth by dredging could be obtained if desired, although that section of the river is not under my jurisdiction. Six inches additional depth below the mouth of the Missouri could be provided by dredging.

5566 The bars appear more rapidly when the river falls suddenly. They do not cut out as the stage drops. Both government and commercial boats report on the condition of all bars. When a bar forms in the project depth we move a dredge there and make an estimate of how much further the river is going to drop. Our dredges are able to cut 14 feet below the stage at which they are working.

We usually work about 12 feet below that stage.
5567 The river helps very much in cutting through the bars and maintaining the channel. With dredge cuts 40 or 50 feet apart the current will occasionally scour out a full channel. At other times we have to dredge the entire distance.

5569 The formation of bars depends on the rapidity of the fall of the river, how the water comes in and where it comes from. A drop in flow from 80,000 c. s. f. to 70,000 would not of itself be so important as the rapidity of the drop. It is the rate of drop and not the extent which is a factor in maintaining depths over the bars. In the Mississippi River it is not the silt but the rapid changes in the stage which make trouble in maintaining project depths.

5570 No average length of time can be stated during which a dredged channel through a bar remains open. If the location is unwisely chosen the channel may not remain open a great length of time. There are many variations in them. There have been times when a particular bar has been dredged four times in a season, sometimes three or four days intervening between the dredgings. It is the rate of the fluctuation of the river rather than the quantity of water which makes this trouble.

5571 It is my recommendation that improvement of the river below the Missouri should be by contracting the beds rather than placing so much emphasis on dredging.

5575 The present velocity at low water is 1⅔ miles per hour.

5576 Contracting works would increase the velocity very slightly. This increased velocity would be decreased by decrease in the discharge of the river. If 10,000 c. s. f. were taken from the present flow there would still be adequate water for navigation. The river had it for 100 years before the increased flow came in.

Re-direct examination:

5678 A rise in the stage of one foot, roughly corresponding to an increment of 10,000 second-feet, will slightly increase the slope and velocity. Since partial dredging will in many cases cause the river to scour out the
5679 channel through the bar, to the extent that the velocity is increased, the time required to remove the bar will be shortened.

5680 The most important effect of an increment of six inches is in producing more water and more room in which to manoeuvre a boat. It might be possible to develop mathematically that an increment of 10,000 second-feet would slightly stabilize the flow of the river, but I would not like to do so. It is a principle of river hydraulics that the smaller the range between the high and low water the more stable the stream and its bed. The silt in itself would be nothing if it were not for the variation of stages retarding the current irregularly so as to cause the dropping of the silt.

5681 Regularization of the river by controlling works is more efficient in maintaining navigable depths than dredging.

5683 The menace of the lower river is the flood heights and not lack of navigable depths. 10,000 second-feet would add to the flood heights now passing New Orleans, and some of which enter the lower Atchafalaya. There have been floods of 2,000,000 second-feet at Columbus converted by crevices to 1,400,000 second-feet past New Orleans, and something like three or four hundred thousand feet down the Atchafalaya. 10,000 second-feet is a
5685 very small contribution to that, but if that contribution happens to be the slight contribution which breaks the levees it is just as dangerous as though it were 500,000 second-feet.

Re-cross examination:

5686 The existing Federal project for the Mississippi River adopted January 21, 1927, provides for a chan-

nel nine feet deep and three hundred feet wide. This was a modification of an existing project originally adopted in 1881 and changed from time to time thereafter. None of these projects depended on the Chicago diversion which was not considered by me in my report for project just adopted.

5687 The records of flow on the Mississippi River at St. Louis since 1872 show that the only times during the navigation season when the flow in the river got as low as 40,000 second-feet was on October 20, 1889, and December 22, 1904. There is a little doubt about the measurement on December 22, 1904, being in the navigation season, because it is so late. These are the only times since 1872 when the flow of the Mississippi River got as low as 40,000 second-feet during the navigation season.

5688 Adding a permanent or fixed increment to the flow of the river would not change its characteristic of fluctuation to any material extent.

5689 The lowering of the low water plane in the Mississippi River at St. Louis, shown by Exhibit 1201, was caused by artificial improvement of the river. The extent of this lowering is a matter of controversy and study.

GENERAL W. H. BIXBY, FOR COMPLAINANTS.

8065–68 My experience on the Mississippi River includes service as District Engineer in direct charge from St. Louis to Cairo, as Division Engineer having supervision over all of the Mississippi and Missouri Rivers, as President of the Mississippi River Commission and as chairman of two boards of engineers for surveys from Lockport, Illinois, to the Gulf. During the World War I was recalled to active service in the St. Louis District and on the Mississippi River Commission.

8068 The Mississippi River has a shifting, movable, bottom, bed and banks. From St. Paul to St. Louis the river is small with a comparatively hard bottom, wide
8069 and shallow. While the upper Mississippi is not so long, it furnishes more water than the Missouri and

does not carry much sediment, sand or other material. The Missouri has a lesser flow but the higher floods tear up the beds and banks and send the sand rolling along the bottom. With the union of the upper Mississippi and Missouri rivers, the Mississippi assumes peculiar characteristics, in that it is composed of a series of deep pools separated every 3 or 4 miles by bars. The average depth
8070 of the Mississippi from St. Louis to Cairo is 18 feet. From Cairo to Memphis it is 31 feet. From Memphis to Vicksburg it is 37 feet. From Vicksburg to the mouth of the river it is 48 feet. Below the mouth of the Red River the bars are so far below the surface that they rarely interfere with navigation.

8072 Between the mouth of the Missouri and Cairo the natural depth on the bars has been somewhere between 3 and 5 feet. Below Cairo, down to Vicksburg the natural depth is between 4½ and 6½ feet. These bars not only rise and fall, but they travel down stream. The bars wash away on the upstream side and fill up on the downstream side, gradually changing their position. As the bars move down-stream, they gradually diminish in height and fade away. When a bar has moved down-stream to where it has nearly disappeared, another bar begins to form up above and moves down and takes its place. Hence the bottom of the stream is constantly changing, the bars constantly moving and the pools constantly filling up and scouring away.

8074 The navigation season commences in January or February and ends in November or December, when the water is away below the low water of the navigation season. At the low water of the navigation season the flow of the river is 40,000 second-feet. During the closed season of navigation the flow in the river is very small, so
8075 that everything is quiet on the bottom of the stream. The previous work of the season has cut channels through all the bars, so that the draft all through December and January is good, usually 8 feet from St. Louis down to Cairo, and 9 feet or more from there down to Vicksburg. This is the condition which exists when navigation resumes

in February. The water then commences to rise gradually at St. Louis and continues a steady continual rise until April or May. In May the river is nearly at full stage. During this time the navigation channel is even better than it was before because the current is gentle and grad-
8076 ual and not much material is carried to lodge on the bars. The bars do not rise as fast as the river stage rises, so that navigation depth may increase until April, May or even June. During this time the boats have more water than they need. If an unusual flood should come with a sharp rise and then drop very suddenly, the bars might reform, as they do in the fall, and cause trouble, but that rarely ever happens. Between July and August the river ordinarily reaches its maximum stage, which averages about 20 feet on the St. Louis gauge, although it sometimes reaches a gauge height of 30 or 40 feet.

8077 During this time there is more water than is needed for navigation.

8078 During this period of rising water the silt gradually begins to move, filling up the dredge cut through the bars. These bars have been gradually rising but because the water has been rising faster, the navigation depths have continued to improve. By July and August when the river begins to fall the Missouri river has risen to its full force. The Missouri tears away the water soaked banks, as the receding water removes their support, so that they fall into the stream. Some of this material is
8079 taken up in suspension and some is rolled along the bottom and emptied into the Mississippi. The volume of such material that annually rolls out of the Missouri into the Mississippi is about 400,000,000
8080 cubic yards, mostly during July and August. From time to time this material is deposited in eddies and on the bars.

8081 While the river is at full height, flowing with its greatest velocity, all this matter that is in suspension and rolling along the bottom keeps on moving; but as the river begins to fall and lose its velocity, a lot of the material that is suspended settles on the bottom and the rolling

material lodges on the nearest bar. When the river falls rapidly, the rapid diminution of the current piles a mass of material on the bars and they apparently rise up from the bottom of the river and come up close to the surface. Then a condition will develop where with 23 feet on the St. Louis gauge there is only an 8 foot draft over some bars down the river. Then the dredges must rush to the bar and cut a new channel. In July and August the government boats that are going up and down the river are always sounding over the bars that have made trouble in former years. Between St. Louis and Cairo there are 40 or 50 places where bars might form. In some years work is required on 13 to 20 of them and there are usually a half dozen of them that make trouble quicker than others.

8083 When the government boats find 10 or 11 feet over a bar where the project is 8 or 9 feet, the dredges go down there and start to work. If the bar still develops, a few cuts are made through the bars about 30 feet apart and 30 feet wide, after which the river will scour away the
8084 intermediate ridges and a good channel is established. In a good many cases those cuts when made through the bars last entirely through the season, especially if the river drops gradually and steadily. However, if the river drops and then rises 2 to 10 feet and then drops again, the trouble will occur again because the rising river has again picked up the material in suspension and rolled the material along the bottom so as to fill in the cut. Under such circumstances it has occasionally been neces-
8086 sary to dredge a bar 3 or 4 times a year. The bars generally form at from 10 to 20 feet between St. Louis and Cairo and at 10 to 15 stage below Columbus and at a little lower stage at Vicksburg. From the mouth of the Red river bars never trouble navigation. An inter-
8087 mediate stage is the best for navigation. But for the formation of the bars low stages would be better.
8088 The channel does not depend upon the volume of the water or the height of the water in the river. The channel depends upon the unequal movement of the water in velocity. Wherever the velocity drops a bar develops causing trouble. The bars form rapidly on a rapidly falling

river, which means that the river goes down 6 inches
8089 or a foot in one day. At the stage of the river when bars form a drop of a foot means a decrease of 20,000 to 30,000 feet per second in volume. This is the stage when dredges have to jump in and cut a passageway through the bars. 10,000 second feet diverted from Lake Michi-
8090 gan has no appreciable effect upon the navigation of the Mississippi river. It may make a difference of one-half a day in the time when the dredge starts work; but after the dredge has once started work that 10,000 second feet has no more value. If the river is falling rapidly the 10,000 second feet might be wiped out in a fraction of a day. The 10,000 second feet diverted would hardly
8090 make any difference in the time required for the dredge to cut through the bar because the dredge working through a falling river, makes a cut a great deal deeper than the project depth, so that the river will take hold more rapidly and widen and deepen that cut.
8091 An increment of 10,000 second feet from Lake Michigan would not make the cut through the bars last any longer. If the river falls slowly and gradually it keeps the cut dredged beyond the depth that is required for navigation. If on the other hand the river rises and falls again, the work has to be done over again and there is no gain from the 10,000 second feet. There is no gain in a constant increment of 10,000 second feet. With no dredge and no regularization work an increment of 310,000 second feet
8092 would have to be added to the Mississippi river to
8094 insure a 9 foot navigation.

Cross-examination:

8276 My statements as to the natural condition of the Mississippi are based upon the back records of the engineer's office at St. Louis and of the Mississippi River Commission. I had to look over these records to
8279 draw the 1909 Board report. I do not know what recommendation Gen. Robert E. Lee made. The Mississippi River Commission was created in 1879, and the present project of partial regularization or bank protection and dredging and levees, was adopted in 1881. Dredging

only gives a temporary channel. There have been a
8280 few dikes and some revetment work, meaning any-
thing that will prevent the banks from washing away
8281 into the water. We have always recommended the
8282 regularization of the channel. Major Gotwals simply
increases the amount of partial regularization. His report contemplates a channel 300 feet wide at all points and 9 feet deep. In navigation, both depth and width of channel are important. The 40,000 second feet definition of low water flow has only been made within the last few
years. Before that it was approximately 35,000 to
8284 40,000, since at least 1909. In 1909 the lowest meas-
8286 ured discharge during navigation was about 35,000
feet measured February 5, 1900. At the present time during navigation season, the water added from Lake Michigan is not approximately 25% of the low water dis-
8289 charge, because it has been impossible to flow more
than 8,250 feet through the canal. At low water, the increment of the Mississippi at St. Louis is about 10,000 feet per second, that is the amount of water needed to raise the stage one foot. The bars usually begin to form at anywhere between 15 to 23 feet on the gauge. The bars
usually begin to form about 20 feet. I refer to the
8290 chart in Document No. 50, First Congress, First
Session, the report of the 1909 Board, showing the correlation between bars and water stage for 12 years between 1896 and 1908, and there were some 30,000 soundings taken in getting up that chart. The chart shows not only the location of the soundings with reference to stage, but also the depth of the controlling bar on each trip, that is, the least depth on the trip. And these controlling depths are plotted on a curve. The chart is Plat 2 of House Document 50. There were 29,000 soundings taken when the stage was below 20, that is between plus 4 and plus 20 on the
gauge at St. Louis, and about 24,000 between 4 and
8292 15. Exhibit 507 shows the mean stage of the Missis-
sippi River at St. Louis and this shows that the river is over 20 feet on the gauge, an average each year of only 10 days. The chart shows that it commences to go over 20 feet about the 10th of June, is about a half a foot higher

the 15th of June, and drops down to about 20 feet the 22nd of June, and coasts along at 20 feet until the commencement of July. It goes down uniformly as a mean stage until about the 10th of September, when it is 9 feet. Then it goes along very gently and uniformly until about the middle of November when the stage is 8 feet, then faster until the 19th of December when it is down to about 5 feet on the gauge. There is a discharge curve on that exhibit. The curve shown in House Document 60, supra, following page 236, shows an increment between 4 and 5 feet of about 7,000 feet. The addition of 10,000 feet, therefore, with the river at stage 5, would increase the stage a little over a foot, but comparing the two discharge curves, the increment is about the same between 15 feet and 5 feet on the gauge, that is, 7,000 to 10,000 second feet. The effect of 10,000 second feet diversion from Lake Michigan is supposed to be somewhere between one foot and one and four tenths of a foot increase in stage. When the stage of water is 20 feet, there is usually sufficient depth for navigation.

I think the best navigation on the Mississippi is
8300 by all odds at very low water. Due to the rise of
8302 bars at low water, because of the diversion of 10,000 second feet, there is only an increase of half of the 1 foot and a half, that is, seven tenths of a foot so
8303 far as navigable depth is concerned. When the water is rising, the bars form only half as fast as the water surface rises. The bars rise about 2 feet for every 5 feet in water stage as the river goes up. As
8304 the river falls, the bars go down only half the decrease in stage. The discharge at 17 feet is 220,000 second feet; at 18 feet, it is about 15,000 feet more; at 19 feet it is about 255,000 second feet; at 20 feet, 270,000 second feet. Assuming that the increment at 20 feet is
8305 20,000, the effect of the 10,000 diversion at Chicago
8307 would be six inches in raising the water surface. You have a greater depth over the bars at the 20 foot stage of one-half of the six inches, or three inches, and the water that comes into the Mississippi from the Illi-
8308 nois River is not silt-laden water, but is clear. The object of the reservoirs on the upper Mississippi was

to provide water at low water times to improve navigation. If the water coming out of the Illinois were about 8,000 feet and this were taken away from the low water stage with a 40,000 discharge, the discharge would be 32,000 second feet, and navigable depths might be reduced about a foot. Between St. Louis and the Ohio, there are about 30 bars of which about 4 always make trouble. Every year they
8313 have to send a dredge to that particular locality. The localities are named at page 66 of Document No. 50. Bars rarely, if ever, form during a rise; they com-
8314 mence to form during the falling of the river. If there were a rise of 6 inches and then a fall of the same amount, there would probably not be any formation of bars to the injury of navigation. You might begin
8316 to look for trouble if the rise and fall were 5 feet. I cannot see that the addition of the Chicago water would make it any easier to dredge out the bar. If
8319 the river channel were stabilized we would not need any more water at all; we would have ample water at 14 feet. You get greater depth by deepening the channel. By changing the cross sections, the same volume of water would flow at a greater depth. I never found any
8323 pilots or river men or captains that agreed with me that the added water did not favorably affect navigation on the Mississippi. I never found any practical river man who did not feel that added water would help navigation. I do not think there has been any appreciable change in the flow of the river in the last hundred years. I
8330 do not think deforestation had any effect upon the flow of the Mississippi. The Chicago diversion adds something to the flow of the Mississippi. I do not think that flow has any appreciable effect on the handling of boats or on the depths. At high water stages they have more water than they want. At medium stages it does not help anything except for perhaps a short time while the dredge is getting into position. At low water stages, the depths are already there and they do not need any water. Assuming a 3 foot bar and the instantaneous removal of the Chicago diversion. I think there would be a difference of from 3 to 6 inches in depth at the 20 foot stage of the river for a

very short time. On a river flowing 200,000 second feet, I do not think engineers can measure the effect any closer. I would regard a change of from three to six inches as insignificant under those circumstances. If the depth over the bar were 8 feet 6 inches and the Chicago diversion were withdrawn, the depth would fall momentarily from 3
8337 to 6 inches at the 20 foot stage.

8341 The silt carrying capacity is dependent upon the velocity of the river and not at all on its volume. The modern dredge cuts 6 feet deep, 32 feet wide and 360 feet forward every hour. In connection with 1909, I examined the previous history of regularization of the
8348 river, and the project beginning with 1881. Since that time, there have been regular appropriations by Congress of certain sums spent by the Engineer Corps annually for this so-called partial regularization of the river, with the exception perhaps of a few years when there
8349 was not a sufficient appropriation and consequently no expenditure. From 1895 to 1909, I am unable to think of any particular year when by reason of expenditures by the Engineer Corps in any way anything was done which produced a marked change in the navigable channel. The river was being improved right along. I remember no year that stands out before 1909. I am familiar with the statement on page 391 of the report of the Chief of the Engineers for 1903 as follows:

"The result of the expenditure of this amount has
8351 been the partial improvement of the entire reach of the river from St. Louis to Cairo. During the past year there was at all times during open navigation a channel depth of 6 feet or more throughout this reach. The river attained a low water stage of 3.5 feet above standard low water."

I do not recollect anything different than that that statement occurred in identical language in the 1903, 1904
8352 and 1905 reports. The following statement occurs at page 413 of the 1904 report:

"The result of the expenditure of this amount has been the partial improvement of the entire extent

> of the river from St. Louis to Cairo. During the past year there was at all times during open navigation a channel depth of 8 feet or more throughout this section."

Very probably the 2 foot difference in channel might easily be taken care of by the difference in rainfall or run-off on the Mississippi and Missouri Rivers. The 1904 report states:

> "The river reached a low water stage of six-tenths of a foot below standard low water;"

indicating that when there was an 8 foot channel the river reached a stage of 4 feet lower than when there was a six foot channel. It is the fact that every year after 1904 for 10 or 12 years, the same statement as to the 8 foot channel was repeated in the annual report of the Chief of Engineers,

8355 and there were all kinds of variations in the low stages of the river. This would indicate that the variations in low water had nothing to do with the maintenance of the 8 foot channel. A difference in rainfall or run-off would easily explain the change in one year in channel depth of from 6 to 8 feet. It did not occur to me that the additional water from Lake Michigan might have some effect. I should say that the way in which the dredges were handled was more responsible. The 2 foot difference in depth undoubtedly resulted from some cause, but whether it resulted from water flow, dredging, rainfall or run-off, it would be extremely difficult to tell. The one thing that occurred there more than anything else, was that the officer in charge that year was very effective in seeing that his dredges did all the work that the money would pay for. The money expended in 1904 was less than the amount expended in 1903.

Redirect examination:

8358 In reference to the 2 foot change in channel depth, the additional water required would be 30,000 or 40,000 second feet. The reservoirs on the upper Mississippi were only used at St. Paul during the three months of low

water season, and they raised the water about 14 inches, and the whole effect disappeared 50 miles below. In regard to the improvement of the Mississippi to obtain the best navigation from Grafton to the mouth, whether by dredging, regularization or other kinds of work or combination, I do not think the cost would be appreciably decreased by the addition of 10,000 feet per second added to the natural flow of the river.

Ex. 1111 3361 The total diversion through the Chicago Drainage Canal in 1903 was 4,971 and in 1904 was 4,793 second feet.

In the Final Report of the Lakes to the Gulf Waterway Board, House Document No. 762, 63rd Congress, 2nd Session, the Board States:

8024 Ex. 171 "The influence on the volume of the Mississippi River due to any diversion from Lake Michigan will be an increase approximately equal to the amount of water diverted. The effect upon gauge

8025 Ex. 171 height will be small even at low stages, and at high stages it would scarcely be appreciable and not of any importance.

* * * * * * *

8028 Ex. 171 The effect of any diversion upon gauge height will always be small, and at the highest stages practically nothing, but the exact effect at any time or at any stage can not be determined, since this effect will be complicated or obscured by various other changes in the regimen of the river."

In said Final Report there were quoted certain statements contained in the report of the Board of Engineers on the Survey of Mississippi River from St. Louis, Mo., to its mouth, published in House Document No. 50, 61st Congress, first session, page 44, as follows:

8038 Ex. 171 "Repeated measurements (see graphical plot hereto appended) on the bar crossing of the Mississippi between St. Louis and Cairo show that up to a stage of about 20 feet above low water the

available depth across the new bar is increased on an average only about one-half foot for every foot in the rise of water. (Between Cairo and Red River similar measurements show even less increase in navigable depth per foot of rise of water surface.)

8038 Ex. 171 Due to the permanent character of the diversion, the above ratio of elevations of water surface and river bed would not hold, and any permanent increase in gauge height would be less than that indicated by the standard curve, and would represent a change in the regimen of the river, which would be accompanied by a rise of the river bed practically equal to such increase. In any case, the gain in navigable depth would be insignificant for any permissible diversion."

8047 Ex. 175 The Board of Engineers for Rivers and Harbors, reviewing the Warren Report, on page 98, with respect to the effect of the Chicago diversion, said:

"The aid which it affords to low water navigation is very small above the mouth of the Missouri River and trifling below that point."

8050 Ex. 177 The Board of Engineers for Rivers and Harbors in House Document No. 4, 69th Congress, 1st Session, being a report of the Illinois River, states the effect of the Chicago diversion on the Mississippi River as follows:

"It would not be unwise to assume that the average raising of the water surface amounts to about one foot between Grafton and Cairo; but due to the characteristics of the Mississippi River, where the tops of the bars seem to rise with the surface of the water, it is doubtful if the actual depths are materially increased. For this reason it is impracticable to evaluate whatever benefit exists."

Condensation of Certain Extracts Relating to the Physical Characteristics of the Mississippi River Taken from House Document 50, 61st Congress, First Session, Being a Report by a Special Board of Engineers on the Survey of the Mississippi from St. Louis, Missouri, to Its Mouth, and Including a Consideration of the Survey of a Proposed Waterway from Chicago, Illinois, to St. Louis, Missouri.

Ex. 170

7983 The natural result of a greater volume of water
Ex. 170 flowing into the Mississippi River at the higher stages is to produce immediately greater channel depths to the advantage of navigation. However, this high water channel rarely coincides with the low
7984 water channel, and not only does an increase in
Ex. 170 river stage fail to give an equal increase in the low water channel depth but a return to the lower stages often finds the former low water channel wholly or partly obliterated, and until the scouring effect of the water produces a new low water channel the controlling depth is usually less than it was at an equal stage before the rise.

The new low water channel on the crossings is ordinarily in the same position as before the rise, but often at a considerable distance from its former position. The most injurious effects on the controlling low water depths result from a speedy fall in the river after a considerable rise. The most beneficial effects of scour are produced by a uniform moderate flow of long duration.

7985 The Mississippi River from St. Louis to the
Ex. 170 Gulf is a river with a very unstable bed; that is, one of caving banks and shifting bottom. No river in the world equals it in magnitude of its bed disturbances. Caving banks include eroding banks, slumping banks, sinking banks, and sliding or slipping banks, and these classes of banks differ from each other in
7986 appearance, origin, or both. An eroding bank is
Ex. 170 one where the whole side of the river bank gradually wears away under the scour of the moving water. Erosion is not dependent on high water but may be expected at any stage of water wherever the river current

approaches the bank at a decided angle with the general line of bank in straight reaches and with the tangent to the curve of the bank in bends; but little erosion takes place where the river current is parallel to the straight bank. Erosion increases with the current and with the angle of its approach, and unless an eroding bank is protected any increase of river stage will usually increase the
7988 erosion. The most serious erosion of banks in
Ex. 170 the Mississippi River is that of the submerged banks below the low water line. As the erosion progresses the bank becomes undercut at the water surface until the upper portions collapse and fall into the
7989 river. During erosion a small part of the soil is
Ex. 170 dissolved by the water and remains permanently in solution while a large part is taken up as sediment in suspension, and the balance, the heavier portion, is rolled along the bed of the river until it gets away from the full force of the current, when it piles up on the river bed in the form of a bar. Wherever the current slackens the heavier sediment is deposited to assist in bar formation or to build up the river banks on the non-eroding side of the river. As the river rises the total erosion increases, such increase being due to the increased area exposed as well as to the increased current, but since the high waters are limited in duration, while the low water
7990 erosion continues throughout the year, it is the
Ex. 170 latter which is the most to be feared and which needs the most attention.

The greatest danger to the regimen of a navigable river, due to eroding banks, is when such a bank in one bend approaches another eroding bank on another bend across an intervening neck of land. In such cases the junction of the two eroding banks produces a cut-off of the river by which the end of the intervening neck of land is converted into an island, whereupon the river adopts the cut-off as a new channel. The river length is thus shortened considerably and the river currents are greatly increased. The
7991 injury to the regimen of the Mississippi River
Ex. 170 and to its navigation interests which arises from a cut-off, is very great.

7992 Ex. 170 The shifting bottom of the Mississippi River attracts attention chiefly by the rise and fall of its river bars. An erosion of the bed or change of depth in deep pools between bars seldom affects navigation directly, but the river bars directly limit the draft of passing boats. The river bars on the Mississippi River below St. Louis are mainly deposits of material coming from eroding banks and augmented by material eroding from the river bed itself. (Page 43.)

The bed of the Mississippi changes constantly and reaches a fairly stable condition only in dry seasons and at the end of a long low water season. During such periods the erosion of the banks is at a minimum, and

7993 Ex. 170 the river bars, although generally high, have usually been cut through at some one place with the channel-way of fair depth.

As the water rises the first action is a slight additional scour in the deep water channel across the bar, but the extra depth so gained is generally balanced by the extra amount of rolling material brought down from the eroding banks upstream. As the river rises still farther, the increased current rolls from the river bed, a great deal of the loose material of the bars levelling them down somewhat and filling up the former deep channel across them. As the river rises still farther to a medium stage it gathers up an enormous amount of material and sediment deposited during the low water stage, and it becomes full of material ready to be deposited in new places at the first slacking of the current. Should the river stop rising and commence to fall, the deposit of material is apt to be so rapid as to force the river currents into new channels and to leave the available depth over the new bars hardly, if at all, greater than was the former depth in the regular channel at extreme low water.

7996 Ex. 170 Should the water continue to rise to the top of the natural banks, the upper portion of the dry bank becomes water soaked and bank erosion becomes very active. As the water recedes from a bank full stage, the upper portions of the water-soaked bank slump into the river as the water recedes. It is at this

stage of the river, while the water is falling and the current beginning to slacken, that the suspended material is deposited most rapidly and the river bars are augmented enormously and are changed in location. As the river continues to fall the total deposit increases, new banks are built up on the sides of the river bed away from the main current, and the bars scour off slowly, if at all, so that at a stage of from 8 to 15 feet above low water the channels over the bars are not much better than they were originally at low water. As the water continues to fall to extreme low water the river currents select a single passage across the newly developed bars and deepen this passage-way down to its former good condition. It is at this stage of the river, with the falling water, that the aid of dredges becomes most useful in assisting the river currents to select a proper bar crossing and to hasten the increase in depth. Without the aid of dredges the prevailing depth over the bars from St. Louis to Cairo would hardly exceed five feet; probably not more than four feet; but with the assistance of dredges an eight-foot depth has been maintained for many years throughout the navigation season, with an occasional interruption of a few hours while the dredge was being moved to a newly formed bar; but such short, temporary delays as a rule not interfering with the use of the river by existing boats.

7997
Ex. 170
8018

8020
Ex. 170 The limit of river depth available to navigation in the Mississippi River below St. Louis is due to the height of river bars at channel crossings, and the height of such bars is primarily due to material coming from caving banks; that is, from eroding banks that lead to the formation of bars and that destroy the otherwise good general regimen of such river.

6199
Ex. 1271 Section 12 of the Rivers and Harbors Act of March 4, 1915, repealed the appropriation of June 25, 1910, (36 Stat. 659, 660, Special Master's Report, page 58) before any part of it had been expended or any work done thereunder.

414 The Illinois Act of May 14, 1903, authorized the Sanitary District to construct all such dams, water wheels and other works in the north upper basin of the Illinois and Michigan Canal as might be necessary or appropriate to develop power from the water passing through its main channel and any auxiliary channels then or thereafter constructed. (Ex. 14, Secs. 5 and 6, Act of Illinois Legislature, approved May 14, 1903.)

In 1903 the Sanitary District of Chicago commenced the construction of a power house and transmission lines at the lower end of the drainage canal, which work was completed in 1907. (Ex. 1-E; T. 317-20.)

On May 10, 1907, the Governor of Illinois in a message to the General Assembly with respect to the proposed Illinois Waterway, stated:

Ex. 1351 T. 7511, 7513–14

"In the development of the internal waterways system of the country, the nation at large, and the central and western States in particular, are deeply interested. To further that development, a large number of organizations have been formed in our own and neighboring states to press its claims upon the attention of the various state legislatures and of Congress, for it has become a well-recognized fact that the improvement of the internal waterways of the United States is of vital importance to the growing commercial needs of the country.

Our own State must naturally take a leading part in this program, because Illinois occupies a geographical position of commanding importance in relation to the proposed waterways development, and because no State in the Union will receive larger benefits from such development. The General Assembly of Illinois, furthermore, has by legislative action and appropriation of funds recognized the interest of our State in the whole question.

The national government is now engaged in the construction of the Panama Canal. The commercial relation of our internal waterways to that canal is obvious, and the degree of benefit accruing to the

interior states of the country from the opening of the Panama Canal is largely dependent upon the development of our internal waterways system. In this connection, it may be stated that the government of the United States has been balked for generations in any attempt at realizing a national waterway from the lakes to the gulf by the great cost of cutting through the Chicago Divide. That barrier has been removed by the work of the Sanitary District Canal. This district has an area of but six-tenths of one per cent of the State of Illinois and yet it has expended fifty-three and a half millions of dollars in a canal from Chicago to the near vicinity of Joliet, a channel of the largest cross section of any canal yet built. The length of the channel and improved river provided by the Sanitary District of Chicago is thirty-seven miles. That district now asks permission from the General Assembly to extend its channel three miles further. If this permission is granted, an expenditure of about six millons of dollars will be made in carrying out the project, and forty miles of deep waterway will be available for the national government whenever it shall be ready to accept the gift and show its appreciation by carrying the waterway on to the Mississippi.

In addition to this great contribution to the national waterway, the Sanitary District will as soon as it interferes with the water power of the State in Joliet at dam No. 1, pay into the State treasury $75,000 per annum, to be used in maintaining the Illinois and Michigan Canal and the navigability of the Illinois river, thus relieving the State of a pecuniary burden which it has heretofore been compelled to bear.

In my biennial message I called attention in the following language to other phases of the benefits which will result to the State from the development of a deep waterway:

'In connection with this most prominent feature of the commission's work, the report of the commis-

sion shows many incidental advantages which will accrue to our own State from the construction of the proposed waterway. Among these, is the creation of 120,000 electrical horse power, which can be secured without in any way affecting the use of the waterway as a navigable channel. At the minimum estimate of $25.00 per horse power, this electrical power would afford an annual income of $3,000,000.'"

In 1908 the State of Illinois adopted the following amendment to Separate Section 3 of the Illinois Constitution:

"Provided further, that the General Assembly may, by suitable legislation, provide for the construction of a deep waterway or canal from the present water power plant of the Sanitary District of Chicago, at or near Lockport, in the township of Lockport, in the County of Will, to a point in the Illinois River at or near Utica, which may be practical for a general plan and scheme of deep waterway along a route which may be deemed most advantageous for such plan of deep waterway; and for the erection, equipment and maintenance of power plants, locks, bridges, dams and appliances sufficient and suitable for the development and utilization of the water power thereof; and authorize the issue, from time to time, of bonds of this State in a total amount not to exceed twenty million dollars, which shall draw interest, payable semi-annually, at a rate not to exceed four per cent per annum, the proceeds whereof may be applied as the General Assembly may provide, in the construction of said waterway and in the erection, equipment and maintenance of said power plants, locks, bridges, dams and appliances.

All power developed from said waterway may be leased in part or in whole, as the General Assembly may by law provide; but in the event of any lease being so executed, the rental specified therein for water power shall be subject to a re-valuation each ten years of the term created, and the income therefrom shall be paid into the Treasury of the State."

The Illinois Waterway Act, adopted June 17, 1919, authorized the Department of Public Works & Buildings of the State of Illinois, to construct power plants along the Illinois Waterway, and lease, sell or otherwise dispose of the electrical current thereby generated, or to lease in whole or part the surplus waters of such waterway for power development, subject to revaluation every ten years. (Ex. 1192, Pars. 7 and 21.)

Rivers and Harbors Act (1927), Ex. 214, Tr. 9255:

> "Illinois River, Illinois: Modification of existing project so as to provide a channel with least dimensions of nine feet in depth and two hundred feet in width from the mouth to Utica: Provided, that the State of Illinois transfers to the United States without cost all rights and titles in the two State-owned dams on the Illinois River; and that local interests furnish the United States without cost all necessary areas for the economical disposal of material dredged in creating and maintaining the channel herein and hereby authorized: Provided further, that nothing in this Act shall be construed as authorizing any diversion of water from Lake Michigan: Provided further, that there is hereby authorized to be appropriated for the project a sum not to exceed $3,500,000."

Col. W. V. Judson, in his report on the Illinois and Mississippi Rivers, from Lockport to Cairo, appearing in House Document 2, 67th Congress, 1st Session, transmitted to Congress on November 21, 1921, states that the lower limit of the Illinois waterway ends about one mile above the Utica wagon bridge, while the Federal improvement of the Illinois River ends one mile below La Salle, Illinois, leaving a stretch of 7.4 miles which has never been under improvement by the United States and which was not included in the Illinois waterway. (Ex. 1360, p. 9.)

With respect to the relation of water power to the Illinois waterway and the Chicago Drainage Canal, including navigation on the Illinois River, Col. Judson states:

> "57. *For a 9-foot channel,* with an increment of 4,167 second-feet, the cost either with dams retained

or removed appears almost prohibitive, and the probability that Congress will limit the increment to 4,167 second-feet is, in my opinion, so remote that this hypothesis may be left out of consideration. With increments of 7,500 or 10,000 second-feet the figures show conclusively the advisability of removing all dams. Inasmuch as the Sanitary District of Chicago and the State of Illinois receive practically all of the benefits that accrue from maintaining the flow of 7,500 second-feet from Lake Michigan, the propriety of the dams being removed at the expense of those interests may well be considered.

58. *Water powers.*—The State of Illinois, at a cost of $20,000,000, is engaged in improving that link in the through waterway which will connect the Great Lakes at Chicago with the Gulf of Mexico via Chicago River (6.3 miles), Chicago Drainage Canal (30 miles), 'Illinois Waterway' (60.5 miles), and the Mississippi River (1,300 miles).

59. The link under improvement by the State of Illinois embraces all of that portion of the waterway (except the lower end of the Chicago Drainage Canal where the Sanitary District of Chicago controls a fall of 36 feet) which will afford any profitable development of water power, the fall under control of the State amounting to about 96 feet. The State expects the returns from water power alone to make its investment profitable. The extent of the water powers controlled by the State and the sanitary District depends of course upon the amount of water which is withdrawn from Lake Michigan through the drainage canal.

60. As to whether the through waterway above described will prove of economic benefit to the Nation sufficient to justify the cost to the Federal Government of the additional improvements which it is called upon to make between Utica on the Illinois and Cairo on the Mississippi, is in my opinion a doubtful question. The State will presumably recover the value of its expenditures from water pow-

ers. The sanitary district can perhaps justify its expenditures in excavating the drainage canal by the resulting conveniences afforded for sewage disposal. The United States will be out of pocket if a through waterway is created which does not prove to be an economical avenue of commerce.

61. In my opinion, however, the creation of an 8-foot channel below Utica is justifiable partly on experimental grounds and partly because all Federal agencies which have dealt with the problem have held out promise to the State of Illinois that the United States would provide reasonable depth (say 8 or 9 feet) below Utica if the State would carry a proper channel down to Utica. The full possibilities for navigation of the drainage canal, the 'Illinois Waterway,' and the Mississippi below Cairo, all at least 8 feet deep, cannot be tried out unless the Illinois (in connection with the Mississippi from Grafton to Cairo) be deepened to 8 feet.

* * * * * * *

65. In my opinion, to most reasonably conform to the probable conditions of the future, an 8-foot project should now be adopted, based on a 7,500 second-feet withdrawal for purposes of estimate and with all dams removed. Then should Congress place the limit of the amount of water to be withdrawn from Lake Michigan at 10,000 second-feet, which I deem probable and, under proper conditions, advisable, that increment would of itself increase the depth to 9 feet. The computations show that with all dams removed, an increment of 10,000 second-feet will increase the depth due to the increment of 7,500 second-feet by about 1.25 feet at Utica, about 1 foot at Peoria and Havana, and slightly less than 1 foot at the mouth."

JOHN W. WOERMANN, FOR DEFENDANTS.

4102 La Salle, Illinois, has been the head of navigation for Federal improvement of the Illinois River, but the Illinois Waterway stops six miles above that—at Utica. It had been presumed that the United States would extend its portion of the improvement up to Utica.

4216 The State of Illinois planned to install power plants into each of the four lower locks of the Illinois waterway. The Sanitary District has a power plant installed at the first lock. In order to have water power in connection with this waterway on a slack-water system, it is necessary to have surplus water over and above what
4217 is needed for lockage. The stretch of waterway from the lakes to the Mississippi River which is under improvement by the State of Illinois includes all available commercial power sites between Lake Michigan and the Mississippi River. Below the southwesterly end of the section proposed to be improved by the State of Illinois there are no further water power sites. The im-
4218 provement by the State of Illinois commences at the first available water power site after leaving Lake Michigan, which is the one now operated by the Sanitary District of Chicago. These water power sites would be quite valuable if there is a large flow of water from Lake Michigan. If the flow of water from Lake Michigan were limited to the quantity needed for lockage purposes, these water power sites would not have any value. In a general way, the value of these water power sites to the State of Illinois depends upon how large a flow of water can be obtained from Lake Michigan.

M. G. BARNES, FOR DEFENDANTS.

Direct examination:

5871 The plans in Exhibit No. 1242 in a general way show the location of the power structures, elevation of the water at each pool, the general size of the structures, and the amount of power that could be developed under different flows in the river. With development on efficiency

of 85%, which can be accomplished, the four state dams will develop 72,600 horsepower, with 10,000 feet of flow per second from Lake Michigan. In addition to this, there is 11,500 horse power at the Marseilles dam now claimed by the private interests on the opposite side of the river.

5872 There can be developed at least 34,800 horse power at the Lockport dam which gives a grand total of 118,900 horse power. This would be divided into three parts: the Sanitary District development of 34,800 horse power at Lockport; the Marseilles development of 11,000 horse power; and the development at other points by the State of Illinois of 72,600 horse power. The latter power could be developed at a cost of about $7,500,000.

5873 Twenty-five dollars per horse power is a very conservative estimate of the rental value of this water power, including the maintenance and operation of the plant by the lessees; in fact, this estimate may be said to be too low. The annual income to the State of Illinois

5874 from its share of this water power would be not less than $1,815,000. On this basis, capitalized at 4%, the capital value of this power development to the State of Illinois, after deducting the cost of the development, is $37,875,000.

Cross-examination:

6797 I think that the voters of Illinois, in approving the Constitutional amendment providing for the Illinois waterway, were influenced by the prospect of obtaining a net annual income for the State of Illinois of $3,000,000 by the abstraction of waters from Lake Michigan.

7008 The first power site between Chicago and the Mississippi River is at Lockport where the upper end of the Illinois waterway begins. Proceeding thence downward toward the Mississippi River, the last power site is located at Starved Rock. The Illinois waterway ends at Starved Rock at about the lower end of the lock. The interest

7009 of the State of Illinois did not terminate at the last available power site, but extended throughout the entire valley.

The part selected for improvement by the State of Illinois was fixed by what the Government had previously undertaken to develop and control. The Sanitary District had carried the navigation improvement down to Lockport. The Federal Government carried the improvement up to La Salle. That left a stretch of 72 miles unimproved. The State undertook to develop that portion that had not been taken under control by the Federal Government or the Sanitary District. In our conferences with the district engineers, it was agreed if the state would carry the de-
7010 velopment to or in the vicinity of the Utica bridge, the Government could very fairly extend its program up to that point.

When the Illinois waterway was planned, there was no one who had supervision of any improvement between the dam at Lockport and the end of the Federal project at La Salle. The State of Illinois did not undertake the improvement of the whole section down to connect with the Federal project, but only about a mile or a mile and a half beyond the last power site at the Utica bridge. The State did not undertake the improvement of the 7 miles between the Starved Rock lock, dam, and power site and the head of the Federal improvement at La Salle.

7011 It is not strictly true that there must be surplus water over and above that needed for slack water navigation on the waterway from Lockport to and including Starved Rock before there can be any water power because you can have water power in the off navigation season or in the navigation season when there is little traffic. Of course if the water was not used for power, it would not be needed in the closed navigation season, or if there were little or no traffic.

The natural flow of the river is very low and the development of the natural flow of the stream has not been feasible because of its small quantity. With the addition of even enough to provide lockage and with structures built for canal purposes, then it does become feasible to construct power sites for the flow of the river, exclusive of diversion from other streams.

Insofar as water from Lake Michigan is concerned, none of that water would be available for power unless there was a surplus above that actually needed for the operation of the waterway. The more water that could be obtained from Lake Michigan above the amount needed for the operation of the waterway, up to at least 10,000 second-feet, the more power can be produced.

The power site of the Sanitary District at Lockport has an annual net value of $870,000, with a capitalized value of 4% of $18,000,000 or $19,000,000. If the diversion at Lockport were limited to the actual lockage water used for navigation, this power site would have no value.

The state power site at Brandon Road would not have any value if there were no diversion from Lake Michigan except what was actually used for navigation, because the flow in the Des Plaines River at that point would not be sufficient to justify the construction of a power plant. Without any diversion and without any canal, this power site would have no value. If there were a canal from Lake Michigan, I think we could put in a small power house and we could operate profitably with the natural flow of the stream, but not if you appropriated all of the flow of the Des Plaines River to navigation purposes and merely took such extra water from Lake Michigan as was needed.

Some power could be developed at the lower dam even though the diversion from Lake Michigan were limited to lockage water, because the locks below Lockport have a lower lift and do not require so much water to operate. In addition, the streams further down have a greater natural discharge so that the power would become more available. If the lockage water were pumped, witness does not know what the situation would be. If there is no diversion, there can be no Illinois Waterway. If the diversion is limited to that used for navigation purposes, power down stream is practicable because the locks have a lower lift.

7020 I think that there can be practicable development of the power sites at Brandon Road lock, Dresden Island, Marseilles and Starved Rock without any diversion from Lake Michigan, but I cannot tell how much power would be developed.

7021 The flow of the stream could be developed, which is quite considerable for 8 or 9 months in the year. The low water flow at Starved Rock is about 500 second-feet. The natural low water flow at Brandon Road is nill. All of the water flowing out from the power house indicated in Exhibits 1175 and 1273 is surplus water not needed for navigation at those points. (T. 7008–22.)

HORACE P. RAMEY, FOR DEFENDANTS.

Direct examination:

3282 Reside at Chicago, Illinois; am civil and hydraulic engineer; assistant chief engineer of the Sanitary District; been such since 1922. Graduate of University of Michigan 1907; specialized in hydraulic engineering; degree of Bachelor of Science in civil engineering; 1917 was given degree of Civil Engineer by University of Michigan;
3283 was instructor in surveying at that institution in 1906. In 1907 entered the employ of the Sanitary District, and have been in its employ ever since.

3284 Have worked on the design, construction and oper-
3285 ation of the various plants and works of the Sanitary District constructed and operated during said period.

Cross-examination:

4338 During 1926 the Sanitary District diverted less water than the quantity it could have diverted and
4339 less than the permit allowance. We took all we could get through the channel, except for a period in the fall from about the middle of September until the latter part of October. But through ten and one-half
4340 months of the year we diverted through the channel
4342 all that we could. The flow of water has not been manipulated primarily for power. The flow has va-

ried in years. The load would vary with the flow. It did not vary with the power demand directly, and if there was variation in the flow that coincided with the power demand, I would not say that was accidental. If the operators in the power house were carrying the bulk of the flow through the power house and the load dropped off like it might between the hours of 12:00 o'clock noon and 1:00 o'clock, they might not open the dam for that one hour to let over the amount of water that was shut out of the power house due to the automatic shutting down of some of the ma-
4343 chinery. So the record for that hour would show a low discharge from the end of the channel. The reason we diverted less during September and October, 1926, was because of very bad floods in the lower Illinois, and under the instructions of Col. Schultz, the District Engineer at Chicago, we cut the flow in the canal down as low as we possibly could, that is, during September and October.

4344 Page 9 of Complainants' Exhibit 145 shows that between 4:00 and 5:00 P. M. on that day, the flow at Lockport jumped from 269,000 cubic minute feet
4346 to 589,000 cubic minute feet and that the power production jumped from 9,900 kilowatts to 21,600 kilowatts. This was the time of day in December when our power demand was the heaviest because of the overlapping of the day and night power loads. Our night loads are very much heavier than the day loads independently of this overlapping.

4347 Page 9 of Exhibit 145 shows that this increase continued throughout the night until about 7:00 the next morning. This manipulation of the flow was to get as much power as possible, but at the same time there was a
4348 flow over the dam.

Exhibit 145 shows that this variation between day and night flow prevailed in each year up to 1925. In that
4349 year the Sanitary District power plant was tied in continuously with the power plants of the Commonwealth Edison Company, and that is the reason that an almost constant flow can now be maintained in the channel. A constant flow could have been maintained before

4350 if there had been no manipulation of the flow for power purposes.

4352 Exhibit 153, covering power output and flow at Lockport by half hour averages during each month of 1916, shows that the hour of the day when this doubling of the flow started varied with the season of the

4353 year, being dependent upon the time when the street lighting load of Chicago came on the system. This particular variation of the flow was for the purpose of generating power, and was carried on continuously up to 1925, when the continuous connection was made with the Commonwealth Edison Company. But in that year there was passed through the power house only 85% of the total flow through the channel.

The electrical engineer in the plant at Lockport regulated the flow for the purpose of operating the plant as a power house.

Redirect examination:

4405 To change the flow, for instance, throughout the channel from 5,000 second feet to 9,000 second feet, would take more than sixteen hours, probably around twenty-four hours. The half hourly readings at Lockport, the lower end of the channel, merely represents a discharge there at the instant at which the reading is taken. In order to determine what the flow is throughout the channel, it is necessary to have the average of the discharge at the end of the channel for a long period of hours. In all the

4406 years the power house has been in operation, there has been considerably more water flowing through the channel than flowed through the power house; that is, spilling over the dam at the site of the power house. The only time that the flow has exceeded at the end of the

4407 channel 9,700 or 9,800 second feet, has been in times of flood when we wanted to get the level of the canal at Lockport dropped down so that it could discharge the flood waters, and since the date of the permit the monthly average has never exceeded the permit allowance, and at no time prior to that has the monthly average flow exceeded the dilution ratio of 20,000 cubic feet per minute for each

100,000 of the population. The so-called manipulation of flow mentioned on cross-examination means merely that at times there is a storing of water in the fore bay at the end of the channel, and the surplus thus stored is then run off in two or three hours after the night load comes on. So the change of flow mentioned in cross-examination at Lockport never lasted long enough to become established clear back into the Chicago River. And I doubt if such
4408 changes have any or very much effect on the flow throughout the channel in any way, and would not affect the average daily flow, and the so-called manipulation of flow if it did have any effect, would only tend to reduce the average daily. The so-called manipulation of flow would have no effect upon the use of the water for
4410 navigation in the Des Plaines and Illinois Rivers below. The so-called manipulation of flow above mentioned would have no effect upon the use of the water for dilution or oxidization of the sewage. So the only purpose of manipulating the flow was to conserve the energy, as I understand it.

4480 Further Cross-examination:

The drawing off of the surplus water in the early evening hours is taking off water from the storage at the lower end of the channel. In years past the draw-
4481 ing off started in the evening hours, and continued so long as the city's street lighting load is on the line. As it takes from sixteen to twenty-four hours to establish the change of flow in the Chicago River, the flow in that river by reason of the carrying of the night lighting load would be changed slightly, but it would not be altogether changed. There would perhaps be a substantial in-
4482 crease, and the increase would continue for some hours after the heavy discharge at Lockport was shut
4483 off. No effect of the change would be felt in the Chicago River for four hours, when a slight change would be observed, until at the end of twenty-four hours you would probably have 80% of the change in the Chicago River. At the upper end of the Chicago River at the end of fourteen hours the change would not be substan-

4484 tial. It might increase the flow in the Chicago River at the end of fourteen hours by approximately 50%. The maximum effect would be felt in the morning when the controling gates were raised at Lockport and would continue for three or four hours from that time. I do not think the change in the flow at Lockport to take care of the night load ever caused considerable trouble in navi-
4485 gating the Chicago River, and I do not think the current would have been increased to an amount greater than one and a quarter miles an hour as fixed by the Government permit of 1901. The change would not reflect back in the Chicago River for hours. The change in flow
4487 at Lockport would have some effect upon the current in the Chicago River. The storage water at the southern end of the channel hinders to some extent the drawing off of storm waters from the Chicago area,
4488 and from that standpoint it is better to have the canal lower at Lockport.

GEORGE M. WISNER, FOR DEFENDANTS.

3666 Direct examination:

Resides at Chicago, Illinois, consulting engineer for the Sanitary District, civil engineer connected with the
3669 Sanitary District since July, 1892, in capacities ranging from rod man to chief engineer and later consulting engineer; degree of Bachelor of Science in Civil Engineering from the University of Michigan.

3756 Cross-examination:

The power plant of the Sanitary District was built under my direction. Practically all of the power was sold excepting only what the District used. The District made a profit in the beginning on the commercial load but
3757 no profit on the municipal load, in fact, I think it lost money. It cost about $26.40 per horse power to generate the power, which was sold for $55.00 per horse power, making a profit of about $29.00 per horse power.

In 1870 the State of Illinois adopted a new constitution which provided in Separate Section 3, that the General

Assembly should "never loan the credit of the State, or make appropriations from the Treasury thereof, in aid of railroads or canals." This provision of the Constitution was, however, amended in 1908 as above set forth.

The Illinois Legislature by resolution of 1881, provided for the installation of pumps at Bridgeport, the northern terminus of the Illinois and Michigan Canal, with a capacity of at least 1,000 cubic feet per second, for the purpose of drawing more water from Lake Michigan through the Illinois and Michigan Canal. This resolution is in part as follows (Def. Ex. 1057, Rec. 2617):

> "Whereas, The State of Illinois, in General Assembly, did on the sixteenth day of February, 1865, grant and authorize the City of Chicago in the State of Illinois, to deepen the Illinois and Michigan canal for the purpose of, and with the intent to better the system of sewerage of the said City of Chicago by permitting a free flow of water from Lake Michigan through the Chicago River and said canal to the Des Plaines and Illinois Rivers; and the City of Chicago did perfect said improvement in conformity with said permission; and,
>
> Whereas, the great fire in the said City of Chicago on the eighth and ninth days of October, A. D. 1871, did so greatly damage the assessable property of a very large number of its citizens and taxpayers, and the people of the State of Illinois did, by its General Assembly, refund to the said City of Chicago the amount of the cost of deepening the Illinois and Michigan Canal, said sum refunded being in gross two million nine hundred and fifty-five thousand three hundred and forty dollars; and,
>
> Whereas, The deepening of the canal as aforesaid has proved to be totally inadequate for the purposes intended, and the large amount of sewage of the City of Chicago, being far greater than the capacity of the canal and the water now passing through it to deodorize and render innocuous; and,

Whereas, the foulness of the water annually causes the death of millions of fish in the Des Plaines and Illinois Rivers, that float to the shores and decay; and,

Whereas, Said sewage, in an entirely undecomposed and putrid mass, is carried by the current of the canal into the Des Plaines River, and thence into the Illinois River, and in its foulest condition is thus transported to and below the City of Peoria, in said State, rendering the air at all points along its passage so impure and foul as to be exceedingly offensive and taking with it germs of disease of all kinds prevalent in the City of Chicago, and thus spreading them broadcast through the entire Des Plaines and Illinois River valleys, causing thereby much illness as well as poisoning of the blood, and debilitating the systems of 200,000 people; and,

Whereas, Careful investigation leads our people to fear that an epidemic may spread over said section of the State of Illinois from the causes above stated; and

Whereas, in addition to the above distress, there has been a great loss of property, business industries, and to the communities in said region, by reason of the causes herein mentioned; and,

Whereas, Prior to the deepening of said Illinois and Michigan Canal, the water necessary for all purposes of navigating said canal and propelling of machinery was obtained from the Des Plaines River and the Calumet feeder, through Lane's Lake; and,

Whereas, The bed of the Des Plaines River, at the summit and thence westward along the line of and adjacent to the canal is, at a low stage of water, eight (8) feet above the surface level of the canal, and will average a supply of water sufficient for all canal and power purposes during the seasons of navigation; and,

Whereas, The supplying of the canal from these sources will so dilute and weaken the sewage of the

City of Chicago, as to greatly relieve it of its foulness and stench to the great delight, relief and health of the people near to and bordering upon the line of the canal, the Des Plaines and Illinois Rivers; therefore, be it

Resolved, By the Senate, the House of Representatives * * * if said city shall proceed without delay to cause a flow into the canal from the Chicago River sufficient to dilute and purify the waters and thus remedy the evils complained of, said flow to be not less than 60,000 cubic feet per minute, including the ordinary flow into the canal from the Chicago River, or so much thereof as in their judgment said canal can carry, and if this shall be accomplished by the first day of September, 1881, the commissioners shall accept it in lieu of obtaining a supply of water from the other sources named: Provided, further, that said commissioners are hereby directed to take care of 60,000 cubic feet per minute above contemplated, if so furnished by the City of Chicago."

210–214 Ex. 6 In 1887 the Legislature of Illinois adopted two joint resolutions with reference to the Chicago sewage and drainage system, reciting the plan of Chicago to transfer its sewage into the Des Plaines and Illinois Rivers and expressing the opinion that such a plan was dangerous to the people of the Illinois Valley by reason of sewage pollution and by reason of disastrous overflows, and providing for the appointment of a committee to investigate and report.

214–219 Exs. 7 & 8

Later the Joint Resolution of the General Assembly of Illinois of May 28, 1889, and the Sanitary District Act of May 29, 1889, were passed as shown in the Master's Report. (P. 14-16.)

In 1923 Major Rufus Putnam made a report on Diversion of Water from Lake Michigan, summarizing the work of the Sanitary District in the Chicago River and its branches, as follows:

Rec. P. 33–35 Ex. 1

"That the sanitary district had recognized the difficulty of flowing enough water through the Chicago River was evidenced some years before the Secretary of War had indicated his disapproval of producing obstructive currents. On April 21, 1891, the trustees proposed a resolution providing that they 'forthwith enter upon, use, widen, deepen, and improve the Chicago River from its mouth at Lake Michigan * * * so as to make the same a proper and sufficient supply channel * * *'.

A start was made on this work in 1897 for certain improvements between Harrison and Quincy Streets and a permit for this short piece of work was issued by the Secretary of War on November 16, 1897. However, it was not until April 26, 1900, that the sanitary district made application to the Secretary of War for a permit to widen, deepen, and straighten the whole of South Branch of the Chicago River so as to provide the discharge capacity desired without introducing obstructive currents. A permit was issued by the Secretary of War on July 11, 1900 (Appendix 14), allowing the sanitary district to proceed with this work covering that section of the river between Twelfth Street and Ashland Avenue.

On January 17, 1902, a permit was issued for the rest of the work on the South Branch from Twelfth Street to Lake Street (Appendix 15). Work under these permits was under way for a period of years. Efforts were directed toward obtaining a channel of a minimum width of 200 feet with a depth of 26 feet for the middle 100 feet, shoaling to 16 feet at the dock faces. Up to December 31, 1917, a total of over $12,000,000 was expended by the sanitary district for right of way, dredging, and construction of bridges. At the present time the desired channel improvements have been finished throughout the entire stretch from Lake Street to Robey Street. There are a few bridges yet to be replaced.

It can not be said that all of the results expected from improving the channel have been obtained. Through this portion of the channel the discharge

is fairly constant, averaging in the neighborhood of 8,000 cubic feet per second. The effect of withdrawing maximum amounts at the power house at Lockport is equalized by the storage capacity of the channel between Lockport and Lake Michigan, so that the variations which occur near the source of supply result largely from fluctuations in the level of the lake. Deliberate efforts on the part of the Sanitary District of Chicago to establish and maintain a uniform flow of 10,000 cubic feet per second through the Chicago River have been unsuccessful. While these attempts were experimental, they indicate that the stream is still too crooked and narrow to permit that volume of discharge under ordinary conditions of head.

The east and west arms of the South Fork of the South Branch were dredged in 1913 by the sanitary district for the stockyard interests to 20 feet in the former arm and to 18 feet in the latter as far as Ashland Avenue, and to 13.5 feet above that street. The portion above Ashland Avenue has since been filled. This deepening was for the purpose of providing an adequate discharge channel for the sewage from Packingtown.

The sanitary district straightened the channel of the North Branch for 2 miles northward from Belmont Avenue, providing 12 feet depth and 90 feet width to the north side of Lawrence Avenue. In 1917 they dredged to Roscoe Street from Belmont Avenue to a depth of 15 feet for a width of 20 feet in mid-channel; also a turning basin along the west dock north of Roscoe Street, about 500 feet long, 50 feet wide, and 15 feet deep. These improvements facilitated the discharge of water through the North Branch by way of the North Shore Channel."

Statement of Chief of Engineers, General A. McKenzie, at p. 10 of H. D. 263, 59th Congress, first session, as follows:

"Although the primary object of the Chicago
6212 Drainage Canal was the discharge of Chicago sew-

age, its function as a channel for navigation was kept in view from the beginning."

231–232 Ex. 12 Doc. 2 On June 24, 1896, the United States District Engineer at Chicago, in his report recommending the granting of the application to enlarge the capacity of the Chicago River for drainage purposes upon the conditions subsequently embodied in the permit of July 3, 1896, stated:

> "As far as the work itself is concerned there can be no objection to it, as in every case the navigable channel of Chicago River will be improved, and at this stage I am unable to do otherwise than to recommend the granting of the authority sought.
>
> The question that must come up later for the action of the War Department, towit, whether the improved channel of Chicago River will be sufficient to carry 300,000 cubic feet of water per minute without lessening or destroying the navigability of Chicago River, or whether the City of Chicago will be allowed by the United States and Great Britain to take any water at all from the Great Lakes, with the inevitable result of lowering their levels, is not now under investigation, and is one that will not probably be settled or decided by executive officers. It is, or may rather be considered an international question."

234-235 Ex. 12 Doc. 3 The Chief of Engineers concurred in the foregoing recommendation of the District Engineer.

237-239 Ex. 12 Doc. 5 The permit of the Secretary of War dated November 16, 1897, for the construction of by-passes and docks, was conditioned that it should not be interpreted as approval of the plans of the Sanitary District of Chicago to introduce a current into the Chicago River.

243-248 Ex. 12 Doc. 7 On April 24, 1899, the United States District Engineer at Chicago, pursuant to direction, made a report upon the application of the Sanitary District of Chicago to open the Drainage Canal and reverse the Chicago River, of which the material parts are as follows:

"It is a strange fact that this city has expended, or will expend, over $30,000,000 with the intention of diverting an apparently unlimited amount of water from the Great Lakes to the Mississippi drainage area for sanitary purposes without finding out whether such diversion would be allowed by the great interests of the United States and the Colonies of Great Britain along the chain of Great Lakes in the navigation of the rivers and harbors of the Great Lakes. Now they ask the authority of an executive officer of the United States to open a channel that will to some unknown extent lower the levels of all the Great Lakes below Lake Superior and of their outlets, introduce a current also unknown and not to be ascertained otherwise than by actual experiment, in Chicago River, the most important navigable river of its length on the Globe, but which is already obstructed by bridges, masses of masonry and bends, and of difficult navigation at best.

The possible effects of this diversion are not known, further than that to some unknown degree they will be injurious. Whether the amount of this injury will be so small as to be accepted by the interests affected in view of the manifest advantages to and apparent necessities of their neighbors, cannot be determined by other than the interests themselves.

It is clear to me that I am not competent to make a recommendation as to what should ultimately and definitely be done.

The matter of what effect the opening of this channel would have on the levels of the Great Lakes has been heretofore submitted to a Board of Engineers. That Board reported that the Great Lakes would be lowered, but that there was not sufficient data to determine the exact effects of the proposed discharge, and recommended extended investigations, which it is believed are being carried on now by the Deep Waterways Commission, or Board. They have not reported. In my opinion the abstraction of from 300,000 to 600,000 cubic feet per minute will permanently

lower Michigan, Huron and Erie from 3 to 8 inches; not more than 8 nor less than 3 inches, corresponding to an extreme reduction of from 160 to 466 tons in carrying capacity of the large vessels of the Lakes, and that it will take from three to four years for this full effect to be attained. But the State law is unlimited in its requirements. 20,000 cubic feet per minute must be taken from Lake Michigan for each 100,000 population of the district; already nearly 400,000 c. ft. must be taken, and at the same ratio of increase for a few decades, in a very short time there must be taken 1,000,000 c. ft. per minute under this indefinite law. The amount should be limited and the injurious effect stopped somewhere.

The mean current to be introduced in Chicago River upon the opening of the canal is estimated by the engineers of the Drainage Board at one and one-fourth miles per hour or 110 ft. per minute. This is simply an assumption that with such velocity in an unobstructed river, the amount of 300,000 cubic feet per minute can be discharged through Chicago River —but I have seen this River so jammed with vessels, drawing all the water that is in it, that by leaping from deck to deck I could cross the river. What the velocity would be in such conditions with Lake Michigan on one side and a great fall on the other side of such vessels, no one knows. But it is a simple mathematical problem to determine the effect on steel-plate vessels of from 2,000 to 4,000 tons mass drifting upon or striking stone piers with a velocity of near two feet a second. They will go to the bottom.

* * * * * * *

Individually I have to say that I am in entire sympathy with this people in their effort to purify their water supply. I have lost my only son from typhoid fever, produced, I believe, from drinking water polluted by defective drainage at Chicago, which this channel will correct. In every proper way I have aided the officers of the Drainage district. I would

like further to aid them, but I believe this question to be entirely out of my sphere, and too great and important for me even to venture an opinion or make a recommendation about. I yet may venture to suggest that the entire subject be referred to Congress for final solution, and that a conditional permit or authority be granted to the authorities of the Chicago Sanitary District by the War Department, awaiting action by Congress, to open their channel, and under the following conditions:

* * * * * * *

'With 300,000 cubic feet per minute discharge it will take one year to lower the level of Lake Michigan and Huron one-tenth of a foot, and several years to reach the maximum permanent effect of this discharge, which will not probably much exceed three inches, so that the main injury to navigation, if any, that can be expected before action by Congress, will be in Chicago River, and that can be at once abated.'

I believe their channel will be entirely under control and that if the discharge be injurious it can be at once and at any time shut off, and it is evident that the War Department should reserve the right to control the current and discharge through the controlling works at this channel."

249-250
Ex. 12
Doc. 8 The Chief of Engineers concurred in the foregoing opinion and recommendations of the District Engineer.

255-257
Ex. 12
Doc. 10 On June 14, 1901, the Chicago River Improvement Association protested against the diversion of water from Lake Michigan through Chicago River and the Chicago Drainage Canal because of the interference with navigation occasioned by the swift current introduced into the Chicago River.

257-263
Ex. 12
Doc. 11 Pursuant to direction, the Federal District Engineer at Chicago reported upon the protest of the Chicago River Improvement Association to the Chief of Engineers, recommending the is-

suance of an order to the Board of Trustees of the Sanitary District of Chicago to regulate the discharge so that the flow through the Chicago River should not produce dangerous currents without specifying any arbitrary limit because of the difficulty of determining the quantity which could be abstracted without injuring navigation in the Chicago River, and suggesting that a larger quantity might be permitted during the closed season of navigation.

In this report the District Engineer stated:

> "The Sanitary Trustees themselves recognize the dangers to navigation from increased discharge under the present conditions, for a special Commission has been created to formulate plans for the enlargement of the Chicago River, and preliminary estimates for several projects have been prepared involving very large expenditures, and probably additional legislation. * * * Early action is desirable as navigation will open within a few days."

264-267 Ex. 12 — On April 4, 1901, in reviewing the foregoing report of the District Engineer, the Chief of Engineers recommended the issuance of an order restricting the flow to 200,000 cubic feet per minute for the protection of navigation and property interests along the Chicago River and its South Branch.

268-270 Ex. 12 Doc. 13 — Under date of July 15, 1901, the Sanitary District of Chicago made application for permission to flow 300,000 cubic feet of water per minute between the hours of 4:00 P. M. and 12:00 o'clock midnight, on the ground that such an increased flow during the hours in question would not injure navigation as the effect upon the currents in the Chicago River would be confined to a period extending from about 12:00 o'clock midnight to 6:00 A. M. of the following day, during which there was no navigation.

270-272 Ex. 12 Doc. 14 — On July 16, 1901, the District Engineer at Chicago reported on the foregoing application, advising that the requested change would only affect the current in the Chicago River between 12

o'clock midnight and 6:00 A. M., during which time there was practically no navigation in the river, that the Sanitary District would give navigation interests notice of such increased night flow by publication, if granted, and recommended that the increase be granted for the preservation of health in the Sanitary District and in the Illinois River Valley, subject to revocation in case the increase was found dangerous to navigation.

274-275 Ex. 12 Doc. 15 On July 25, 1901, the Chief of Engineers concurred in the foregoing report of the District Engineer.

275-278 Ex. 12 Doc. 16 On October 16, 1901, the Sanitary District of Chicago applied for permission to increase the diversion, on the ground that improvements in the Chicago River would permit a flow as great as 300,000 cubic feet per minute without injury to navigation but limiting the request to 250,000 cubic feet per minute until the close of navigation, in order to give the greatest consideration to the navigation interests.

279-285 Ex. 12 Doc. 17 On November 5, 1901, Col. Ernst, the Division Engineer of the Northwest Division, pursuant to directions, reported to the Chief of Engineers upon this application, and among other things stated that the question was solely one of the requirements of water for sanitation purposes, that only one-ninth of the necessary work for the improvement of the Chicago River to permit the desired flow of the Sanitary District had been completed; that complaints had been loud and repeated of the damage to navigation interests by reason of the discharge through the Chicago River; that no increase should be granted in excess of the necessities shown for sanitary purposes, and that a permit should be issued regulating the discharge so as not to exceed 250,000 cubic feet per minute throughout the 24 hours of the day, conditioned upon the Sanitary District being responsible for all damages inflicted upon navigation interests, and that any furthere increase should await its necessity for sanitary purposes. This report further stated:

"The enlargement of the Chicago River has been begun by the Sanitary District under a systematic plan and able management. It has made good progress, as shown by the list of improvements, but it is very far from complete. * * * There are three tunnels under the river which are among the worst obstructions of all. No steps for the removal have been taken. * * * A large amount of widening has to be done. The project contemplates an expenditure of about $9,024,000. * * * Roughly speaking, then, the improvement is about 1/9th completed.

* * * * * * *

It is, in my judgment, quite too late to discuss the question of shutting off the flow entirely and turning the sewage of Chicago back into the lake. The grave necessity which impelled the people to undertake work upon which they have expended over $35,000,000, has increased rather than diminished with the advance of time. In the face of that necessity a temporary, or even a permanent, injury to the navigation interest becomes of secondary importance. If, as I believe, the Drainage Canal must be accepted as an accomplished fact, the question is narrowed down to the one, how much flow is required to make it harmless to the people below.

* * * * * * *

It is, of course, possible to so enlarge the Chicago River that any reasonable amount of water can be passed through it without unduly obstructing navigation. A very important enlargement has been begun and further enlargements can be made in the future if needed. These works are costly and slow, and the use of the Canal cannot await their completion."

287-288 Ex. 12 Doc. 18

The Chief of Engineers concurred in the foregoing recommendation of the Division Engineer upon the condition that the permission should be subject to modification if dangerous to navigation.

In 1902 Colonel O. H. Ernst, United States Engineer at Chicago, made a report, appearing in Report of the Chief of Engineers for 1902, App. K. K. p. 2097:

> "Since the flow of the Chicago River has been reversed through the South Branch by the discharge into the sanitary canal, the slope has also been reversed from the lake upstream and the depth correspondingly reduced. This loss in navigable depth will be more than restored in the main stream and in the South Branch by the excavations of the sanitary district, which, in order to facilitate the flow of the large volume of water required for the dilution of the sewage discharged into the drainage canal, has undertaken to enlarge these portions of the Chicago River to a width of 200 feet and central depth of 26 feet. These dimensions have no relation to the draft of vessels using the river, and if maintained as they should be for drainage purposes will furnish a navigable depth in excess of the requirements. The south fork of the South Branch and the North Fork, however, do not share in these benefits. In the South Fork particularly the dimensions of channel obtained by the operations of the Government were seriously impaired by the change of slope. The sanitary district has undertaken to restore these dimensions, and will no doubt do so, though it has been prevented from fully accomplishing the work by some difficult rock excavation. But it has not undertaken as yet to maintain them."

296–298 Ex. 12 Doc. 21

Shortly prior to January 17, 1903, the Sanitary District applied to the Secretary of War for permission to increase the discharge through the Chicago River and Drainage Canal to 350,000 cubic feet per minute, on the ground that the navigation season

being then closed, navigation interests would not be injured by such increase.

301 Ex. 12 Doc. 23 The District Engineer recommended the granting of the foregoing application during the closed season of navigation, until March 31, when it should be reduced to 250,000 cubic feet per minute. The Chief of Engineers concurred in this recommendation.

330–333 Ex. 12 Doc. 31 On January 16, 1907, the Chief of Engineers made a report upon the first application of the Sanitary District to construct the Calumet-Sag Channel, of which the material portions read as follows:

* * * * * * *

"The essence of section 10 is contained in the first clause, and its obvious purpose is to prevent the erection of any structures, the execution of any work, or the doing of any act, that would tend to obstruct, injure, diminish, or destroy the navigable capacity of any of the navigable waters of the United States, without the explicit assent of Congress.

To better accomplish this purpose, the section makes it unlawful to commence the construction of any structure, or in any manner to alter or modify the course, location, condition of capacity of any navigable water, unless such work has been previously approved or authorized by the Chief of Engineers and the Secretary of War. The effect of this latter is to necessitate the submission of every project of this kind to the Chief of Engineers and the Secretary of War for their consideration, and to impose upon them the duty of determining whether such project will or will not obstruct navigation or injure the navigable capacity of public waterways. The powers delegated to these officials are merely conservative, and intended to facilitate the execution of work that, in their judgment, would be an aid to commerce, Congress having expressly reserved to

itself the power to authorize impediments and to determine to what extent the interests of commerce and navigation may be sacrificed or yielded in favor of other interests.

The above interpretation of the provisions of section 10 of the act of March 3, 1899, has been uniformly held by the Department, and it would seem that in considering the application of the Sanitary District of Chicago the first question to be determined should be as to the effect of the project upon the navigable waterways involved.

If, in the opinion of the Deartment, the project is one which fairly and directly tends to obstruct, that is (using the language of the Supreme Court), interfere with or diminish, the navigable capacity of any public stream or waterway, the Department has no power to grant the application, and the applicant should be remitted to Congress.

The project involves the abstraction and diversion of water from Lake Michigan, and while it is impracticable to state with exactness the effect of this diversion, it is impossible to escape the conclusion that it will cause a lowering of lake levels to a considerable extent, and that this will fairly and directly tend to diminish the navigable capacity not only of the lakes themselves, but of their connecting waters, and of the vast and growing commerce contiguous to these waters.

In view of the foregoing, no executive officer can authorize the execution of the proposed work, and the action of the Department on the application should be limited to advising the applicant that the project is one that requires the sanction of Congress."

345–347 Ex. 12 Doc. 33 On January 10, 1910, the Sanitary District again applied for a permit to construct the Calumet-Sag Channel on revised plans, reverse the Calumet River and divert a total of 10,000 c. s. f. through all its diversion channels.

On March 1st, 1910, the Chief of Engineers reported to the Secretary of War upon the foregoing application, pointing out that the most important question involved was the diversion of water from Lake Michigan; that the Chief of Engineers, in 1907, had declined to recommend favorable action on a similar application because of the probable injurious effect upon the levels of the Great Lakes and because any project contemplating the permanent and continuous abstraction of water from Lake Michigan should have the special sanction of Congress before being approved by the War Department, and further stating as follows:

353–357
Ex. 12
Doc. 35

> "The project now submitted contemplates a further diversion which, inclusive of the aforesaid withdrawal through the main channel, is not to exceed 10,000 cubic feet per second. While this amount of water might possibly be withdrawn from Lake Michigan by the Sanitary District, through its various channels, without injury to navigation in Chicago and Calumet rivers and without lowering the levels of Lakes Huron and Michigan more than 6 inches, nevertheless, in view of the results of even a slight reduction in the levels of these lakes, I believe that the question is one that merits the attention and consideration of Congress, and that until Congress has indicated a policy, either special or general, with respect to it, the War Department will not be justified in granting any permission or in approving any project which contemplates the permanent and continuous abstraction of water from Lake Michigan. I am therefore constrained to adhere to the views of my predecessor, and to recommend that so much of the project as covers the diversion, be not given favorable consideration, until sanctioned by Congress. As that body is now in session, a favorable opportunity is presented to obtain its action."

367-369
Ex. 12
Doc. 38

On February 5, 1912, the Sanitary District applied for permission to increase the diversion to 10,000 c. s. f. pending the investigation of methods and devising of plans for the treatment of sewage,

with the view of requiring less water for its safe dilution in the future.

383-389 Ex. 12 Doc. 40 On February 28, 1912, the Chief of Engineers reported to the Secretary of War upon the foregoing application, as summarized in report of the Special Master on pages 61 and 62; and further stated:

> "From the above it is evident that it is of the greatest importance to the United States that the diversion of water from Lake Michigan into the Illinois River should be limited to merely such amount as is actually indispensable to sanitation."

371-382 Ex. 12 Doc. 39 On March 11, 1912, the District Engineer at Chicago, pursuant to verbal instructions of the Secretary of War, reported upon the foregoing application, as summarized by the Special Master on page 62 of his report; and further stated:

> "The jurisdiction of the Secretary of War over the navigable waters of the United States is derived from special and general legislation. The general legislation is found in the River and Harbor act approved March 3, 1899, which defines the duties of the Secretary of War and determines the extent of his jurisdiction. It may be inferred that the jurisdiction of the Secretary of War is limited to the items named in that act. Under that act he may order the removal of bridges obstructing navigation, remove wrecks interfering with navigation, establish harbor lines when essential to the preservation and protection of harbors, authorize the creation of obstructions and the alteration of navigable channels in the navigable waters of the United States. Under the river and harbor act of August 18, 1894, it is the duty of the Secretary of War to prescribe rules and regulations for the use, administration and navigation of any and all canals and similar works of navigation that are now or may hereafter be owned and operated by the United States. He is also authorized

to prescribe regulations covering the speed and movement of vessels and the opening of draw bridges. The acts of May 9, 1900, and March 3, 1905, further increase the jurisdiction of the Secretary of War over navigable waters. Section 10 of the act of March 3, 1899, may perhaps be interpreted to confer upon the Secretary of War the necessary authority to grant the application of the Sanitary District, although if it be shown that the granting of the application will create an obstruction 'not affirmatively authorized by Congress' the Secretary has no authority in the case.

It would appear that the War Department entertained a doubt as to its authority from the language used in the two permits issued under date of July 11, 1900 (E. D. 35041/17 and 18), granting permission to the Sanitary District of Chicago to change, alter and improve the Chicago river. Condition 1 of both of these permits states:

That it be distinctly understood that it is the intention of the Secretary of War to submit the questions connected with the work of the Sanitary District of Chicago to Congress for consideration and final action and that this permit shall be subject to such action as may be taken by Congress.

* * * * * * *

The right of the State of Illinois to use water from Lake Michigan for purposes of navigation in its Illinois and Michigan Canal, connecting Lake Michigan and the Illinois River, has not been questioned, but the quantity used is practically nothing. Whether the diversion of water for navigation purposes in the Illinois and Michigan waterway in sufficiently large quantities to injure navigation on the Great Lakes would be legal or proper remains to be determined.'

390-409 Ex. 12 On January 8, 1913, the Secretary of War rendered an opinion denying the foregoing appli-

Doc. 41 cation. In addition to the portions of such opinion set forth on pages 62-66 of the report of the Special Master, the Secretary stated:

* * * * * * *

Rec. P. 390-409 Ex. 12 Doc. 41 "The Sanitary District of Chicago applies to the War Department for permission to increase the amount of water it is authorized to withdraw from Lake Michigan from 4,167 cubic feet per second, the amount now authorized, to 10,000 cubic feet per second.

The Chicago Drainage Canal was opened in January, 1900. It reverses the flow of the Chicago River, which formerly emptied into Lake Michigan, and as a result a portion of the waters of that lake, instead of following their former course through Lakes Huron, Erie and Ontario into the St. Lawrence, are now carried across the watershed into the Illinois River, and through that to the Mississippi and the Gulf of Mexico. The canal thus serves as a system of drainage for the City of Chicago, carrying the sewage of that city southward to the Mississippi, and thus protects the water supply of that city, which is taken from Lake Michigan.

Permission to divert water from Lake Michigan was first granted by my predecessor, Secretary Alger, on May 8, 1899. He permitted a flowage of 5,000 cubic feet per second, but his permit contained the following conditions:

* * * * * * *

On March 14, 1907, an application made for permission to divert an additional 4,000 cubic feet per second for the purpose of reversing the current of the Calumet River and flowing that river also through the canal to drain the southern portion of Chicago was denied by Secretary Taft in an opinion in which he referred once more to the desirability of submitting 'this question of capital and national importance to the Congress of the United States.'

"It is clear that even under the conditions heretofore manifested on these applications, the proposition to divert the waters of Lake Michigan into another watershed has not been entertained without hesitation and careful restriction by my predecessors. The propriety of obtaining congressional sanction for the project has been pointed out from the beginning; and the form in which the permit has been granted, even for the moderate amount of diversion permitted, has been so phrased as to indicate that the permission was predicated upon the absence of any substantial injury to commerce.

The Sanitary canal has never received the direct sanction of Congress. It was built solely under the authority of the State of Illinois, as given in its 1889 general act for creating sanitary districts. And although pursuant to the suggestion of my predecessors the question of the propriety of its diversion of water from Lake Michigan was presented urgently in the reports of the Chief of Engineers for the years 1899 and 1900 as transmitted to Congress, no action upon the question has ever been taken by that body. In the argument before me it was urged that the present canal represented the growth and development of a national policy expressed in two acts of Congress, 1822 and 1827, which authorized the construction of a canal 'to connect the Illinois River with Lake Michigan,' thus connecting the two watersheds. (Acts of Mar. 30, 1822 and Mar. 2, 1827.) But these statutes authorized a canal for the purpose of navigation and not sanitation. (*Missouri* vs. *Illinois*, 200 U. S. 526.) The Illinois and Michigan Canal, actually constructed under their authority, derived its water for navigation purposes from the Calumet, Des Plaines and Chicago Rivers, and not from the Lakes. And although in the latter part of its existence it was used to a very slight extent to help purify the waters of the Chicago River and thus sanitate the City of Chicago, such a purpose could not have been dreamed of at the time its construction was authorized by Congress, 90 years ago. I

cannot see that its authorization and construction offer the slightest congressional sanction for the great canal now under discussion, which was not even contemplated until much more than half a century later. Even at the time when the present canal was constructed and opened it is very evident that its ultimate possible effect upon the navigation of the Great Lakes was not clearly realized by those interested in that navigation. The evidence before me indicates that the withdrawal of water from Lake Michigan at Chicago would require about five years to produce its full effect upon the levels of the Great Lakes (see report of International Waterways Commission on Chicago Drainage Canal, p. 7) and that this effect would be still further obscured by periodic oscillations in the lake levels. These facts may easily explain any inaction on the part of the Nation and their representatives to this withdrawal of water and make it clear that any argument of implied acquiescence must be scrutinized with unusual care.

In this respect the situation is now very different. The present application was opposed by representatives of 23 cities and 6 states interested in harbors and commerce upon the Great Lakes, notably the cities of Duluth, Milwaukee, Toledo, Cleveland and Buffalo. It was opposed by representatives of the navigation interests engaged on the Chicago River as well as on the Great Lakes; and by the official representatives of the Canadian Government as well as private Canadian interests engaged in the navigation of the Lakes and the St. Lawrence River, including representatives of the cities of Kingston and Montreal.

A very careful consideration of the voluminous evidence and statements submitted, as well as a consideration of the reports of other commissions and boards of engineers who have investigated the subject, leaves no doubt in my mind that the withdrawal of 10,000 cubic feet per second would substantially interfere with the navigable capacity of the Great

Lakes and their connecting rivers. The Chief of Engineers, whose statutory authority in passing upon this application is concurrent with and independent of my own, and whose opinion upon such a question of scientific conclusion must be given especial weight, so states in his recommendation. His conclusions are corroborated by the authority of other boards of investigation, notably the report of the International Waterways Commission of January 4, 1907.

Careful observations and calculations conducted under the offices of the United States Lake Survey and reported through the Chief of Engineers, covering observations for the last 46 years, indicate that a withdrawal of 10,000 cubic feet per second would reduce levels at various places as follows:

	Inches.
Lakes Huron and Michigan	6.9
Lake St. Clair	6.3
Lake Erie	5.4
Lake Ontario	4.5
St. Lawrence River and Rapide Plat	4.8 Plus

The foregoing effects would be produced at mean lake levels; the lowering effects would be much greater at low-water periods—the precise time when any additional shortage would be most keenly felt. This reduction would create substantial injury in all of the American harbors of the Great Lakes and in the St. Marys, St. Clair and Detroit Rivers. It would produce equal injury in Canadian harbors on the Great Lakes, and a still greater injury on the lower St. Lawrence, the Canadian officials claiming a probable lowering effect of 12 inches at Montreal at low water.

The United States has improved about 106 harbors and rivers on the Great Lakes affected by this diversion and has spent on such improvement over ninety millions of dollars. The Canadian Government has improved over 50 harbors on Georgian Bay and Lakes Huron, St. Clair, Erie and Ontario.

By treaty, American vessels are accorded equal rights of navigation with Canadian vessels in all these waters, including the St. Lawrence River. The reduction of the water in these harbors and channels would diminish to just that extent the amounts of these improvements, and would nullify to just that extent the effects of the moneys which have been appropriated for that purpose by the respective Governments. Connecting various portions of these waterways are the two canals at the Sault Ste. Marie, the Welland Canal, and a number of canals on the St. Lawrence River. The available depth of water over one or all sills of each of these canals would be affected, and in some cases reconstruction might even be made necessary.

The enormous lake traffic which uses these harbors and these rivers is increasing with great rapidity, both in gross volume and in the size and average draft of the vessels employed therein. The Chief of Engineers reports that to lower the water surface 6 inches would reduce the permissible load of one of the large modern vessels by from 300 to 550 tons, with a consequent loss of from $3,600 to $7,500 in freights for such vessel per season. The International Waterways Commission reported that it would be a conservative estimate which would make the loss to the navigation interests resulting from a reduction of 6 inches in the depth of water as $1,500,000 per annum, or a sum which, capitalized at 4 per cent, would amount to a loss of $37,500,000 (see third progress report of International Waterways Commission of Dec. 1, 1907, p. 24). The lowest careful estimate of injury to American vessels alone is reported by the Chief of Engineers at $1,000,000 per year.

The argument was made before me that, owing to the well-known fact that the levels of the lake vary, owing to winds and change of barometric pressure, by amounts even greater than the reduction which would be caused by this canal, therefore the pro-

posed reduction is of no consequence. This argument is well disposed of in the report of the International Waterways Commission of January 4, 1907, on page 8 as follows:

> 'It is evident that the average level of the lake may be lowered considerably without the change becoming immediately apparent, and that fact has been used as an argument to prove that the lowering caused by the Chicago Drainage Canal is of no consequence to those interested in navigation. Since they cannot see it they will not know it and will not feel it. The argument is fallacious. It is true that they cannot see it immediately, but they will soon feel it and will know it through the most costly means of acquiring knowledge—the injury to their material interests. The oscillations will remain the same as before, but low water will fall lower and high water will rise less high. The average draft of vessels must be diminished by the amount that the average level is lowered unless the depth be restored by remedial works.'

* * * * * * *

* * * I do not for one moment minimize the importance of preserving the health of the great City of Chicago; but when a method of doing this is proposed which will materially injure a most important class of the commerce of the nation and which will also seriously affect the interests of a foreign power, it should not be done without the deliberate consideration and authority of the representatives of the entire nation. The growth of Chicago is phenomenal and its representatives are quite unwilling to put any final limit to the demand which may be made upon the waters of Lake Michigan for its sanitation under the system now in use. I have before me the report of 1911 of the president of the sanitary district in which he says:

'I am of the opinion that the presumption that our water supply is to be limited to 10,000 cubic feet per second, or 600,000 cubic feet per minute, is gratuitous and mischievous and should not be voiced by the officials of this district. I believe that we should have the volume requisite to our needs as they appear and are justified.'

* * * * * * *

In my view of the proper exercise of my discretion in this matter the foregoing considerations are sufficient for a decision of this case. Having reached the conclusion that the proposed diversion of the waters of Lake Michigan would substantially injure the interests of navigation on the Great Lakes which it is my legal duty to protect, it would clearly follow that the present application should be denied.

* * * * * * *

It remains only to consider certain special arguments that have been pressed upon me. It has been urged that the levels of the lakes, even if lowered, could be restored by compensating works. To a certain extent that is true. But the very nature of this consideration offers another illustration of the importance of having the whole question passed upon by Congress. Such compensating works can only be constructed by the authority of Congress and at very considerable cost. It is not a matter which is in the hands of the Secretary of War. Permission to divert water which will at one and the same time nullify the effect of past appropriations and make necessary similar expenditures in the future, should be granted only with the express consent of the body in whose hands the making of such appropriations and the authorization of such works rest.

Furthermore, in most cases such compensating works could only be constructed with the joint con-

sent of our neighbor Canada. The United States Government alone would be unable, even if it were willing to spend its own funds, to compensate for the damage done through the lowering of these levels, unless Canada were willing to join in constructing the portion of such works which would necessarily stand upon Canadian soil.

The question therefore becomes not merely national but international, and this leads me to the consideration of the arguments which were urged by both sides in reference to the treaty with Great Britain in respect to Canada of January 11, 1909. A careful consideration of that treaty fails to indicate to me that it is in any way controlling upon the question now before me. It gives to the citizens of both countries certain mutual rights of navigation in the waters of the Great Lakes and their connecting rivers; but beyond that the question of the right of this diversion at Chicago seems to me to have been carefully excluded. The applicants for the permit have urged upon me that article 8 of the treaty gives a preference to the uses of water of the lakes for domestic and sanitary purposes over the uses of such water for navigation. Article 8, however, applies only to future cases brought before the International Joint Commission; and furthermore I am clarly of the opinion that the domestic and sanitary purposes referred to in that article were intended to be the 'ordinary' uses of such waters for domestic and sanitary purposes referred to in article 3. It would be quite contrary to our own national policy to give such a preference to an extraordinary sanitary use of such a character as to create a substantial injury to navigation. The matter has been before our own Supreme Court in the case of *the United States* vs. *The Rio Grande Dam & Irrigation Co.* (174 U. S. 690). In that case the Supreme Court held that a company which proposed to take the water of the Rio Grande river for the purpose, among others, 'of supplying water to cities and towns for domestic

and municipal purposes' could be prevented from so doing when the result would be a substantial injury to the navigability of the Rio Grande river farther down. In its opinion the court said:

> 'The question always is one of fact, whether such appropriation substantially interferes with the navigable capacity within the limits where navigation is a recognized fact. In the course of the argument, this suggestion was made, and it seems to us not unworthy of note, as illustrating this thought. The Hudson river runs within the limits of the State of New York. It is a navigable stream and a part of the navigable waters of the United States, so far at least as from Albany southward. One of the streams which flows into it and contributes to the volume of its waters is the Croton river, a non-navigable stream. Its waters are taken by the State of New York for domestic uses in the City of New York. Unquestionably the State of New York has a right to appropriate its waters, and the United States may not question such appropriation, unless thereby the navigability of the Hudson be disturbed. On the other hand, if the State of New York should, even at a place above the limits of navigability, by appropriation for any domestic purposes, diminish the volume of waters, which, flowing into the Hudson, make it a navigable stream, to such an extent as to destroy its navigability, undoubtedly the jurisdiction of the National Government would arise and its power to restrain such appropriation be unquestioned; and within the purview of this section (act of Sept. 19, 1890, ch. 907) it would become the right of the Attorney General to institute proceedings to restrain such appropriation.'

The treaty, however, contains provisions in its article 10 by which 'any question or matters of differ-

ence arising between the high contracting parties involving the rights, obligations, or interests of the United States or of the Dominion of Canada, either in relation to each other or to their respective inhabitants, may be referred for decision' to an international joint commission established by the said Treaty. The hearing before me brought forth the fact that the Government of Canada regards the proposal contained in this application as one which affects the material interests of that country. The establishment by formal treaty between the two countries of a tribunal with jurisdiction to decide just such questions seems to me to afford an additional reason against the assumption of jurisdiction to decide the question by an administrative officer of one of those countries."

In the Warren Report, the Board of Engineers for Rivers and Harbors report states:

Ex. 3
P. 55 "114. Diversions for water-supply and sewage purposes have already been discussed and, with the exception of the diversion of the Chicago sanitary district, they have been disposed of. We, therefore, revert to this important permanent diversion at Chicago. The case is so well known and the information in the report so full as to call for little further discussion of its merits. Granting that disposal by dilution was the most practicable plan at the time of its adoption, the fact remains that the Chicago sanitary district has for practically 20 years been on notice that the United States was unwilling to allow the district to divert more water than the limit set in the permit of 1903, namely, 4167 cubic feet per second. Notwithstanding this, the district has since then greatly expanded its boundaries and enlarged its plans, and from year to year, in the face of the opposition of the United States, has diverted more and more water, until in 1917 the yearly average diversion was 8,800 cubic feet per second, which is more than twice the lawful amount.

115. The district can no longer fairly plead the absence or the impracticability of other safer methods of handling sewage and of protecting its people from water-borne diseases. Certainly, for the past 20 years, expert opinion has held disposal by dilution to be inferior to other methods of treating sewage, and enlightened public opinion has condemned a policy which, in effect, is the transfer of a nuisance from our own front door to that of our neighbor. Large cities on the Great Lakes cannot safely drink raw lake water, nor should they discharge unscreened and unfiltered sewage either into the lakes or into tributary streams. In 1915, the Chicago Real Estate Board employed three experts, of whom two were of acknowledged eminence in England, and the third a New York expert of well-known authority, to investigate the sewage problem of Chicago and to present their views as to the best way of solving it. Their report entitled 'A Report to the Chicago Real Estate Board on the Disposal of the Sewage and the Protection of the Water Supply of Chicago, Illinois', by Messrs. Soper, Watson and Martin, has been printed, and its conclusions are, therefore, well known to the public in general, and particularly to the people of Chicago whom they advised substantially in accordance with the views above expressed. Chicago is, therefore, debarred from any claim for indulgence as to work done and expenditures incurred in recent years. If, in defiance of the opposition of the Government, and in open disregard of the law, the officials of the Chicago Sanitary District have continued to expend the money of their constituents in the prosecution of unwise and illegal plans, these officials and their constituency are to blame, and they should expect no great indulgence from the general public whose government they have ignored and whose interests they have disregarded.

116. Quite recently, at the end of many years of delay, a decision in the suit of the United States to

restrain the sanitary district from the diversion of more water than was authorized in its permit of 1903, has been made public. As was expected, the judge has felt constrained to uphold the authority of the United States, but it is not believed that any injunction has issued against the district. Also, recently, the district, as noticed earlier in this report, has admitted the damage done to navigation by the diversion at Chicago, and is understood to be prepared to install and pay for remedial works, contingent upon the grant by the United States of authority permanently to divert 10,000 cubic feet per second. The views of the division engineer as to this matter are summarized in paragraph 183 (2) of his report. We agree with him except that we believe that the diversion should be limited to 6,800 cubic feet per second, and that, as the use of the water for developing power is more or less an incident to its use for dilution, we regard as inadvisable the tax that he proposes, though we concede that such a tax would be equitable. It would, however, be difficult to assess correctly and it might prove onerous. Apparently, the public interest would be sufficiently satisfied were assurance given that all the power derived from this diverted water, a possible 70,000 to 80,000 horse-power, would be conserved and administered for the benefit of the people of Illinois, and therefore not alienated to any individual or corporation operating solely for private profit. His recommendations that the diversion shall be supervised by the United States at the expense of the sanitary district, and that provision be made at the earliest moment for the installation of a method of sewage disposal other than by dilution, are excellent, and we concur in them. We believe, further, that the Chicago water supply should receive such treatment as will render it at all times safe. The diversion above recommended would permit 2,000 cubic feet per second to be taken by way of the Calumet River, 4,800 cubic feet per second

by the Chicago River, and allow the operation of all power-generating machinery now installed at Lockport, Ill. It would also afford the statutory dilution of 3⅓ cubic feet per second per 1,000 of population for a total of 2,100,000 people."

417-18 Ex. 12 Doc. 42 The application of the Sanitary District of Chicago, dated January 31, 1925, upon which the permit of March 3, 1925, was subsequently issued, stated:

"The Sanitary District of Chicago hereby applies for permission to divert an annual average of ten thousand cubic second feet of water from Lake Michigan through the channels of the Sanitary District of Chicago, for the purpose of preserving the lives and health of all of its people, and of the millions of others in constant, daily contact with them.

We have prepared a brief statement of facts in support of this application, which we present herewith for your consideration, all of which is respectfully submitted."

Part of said application was Exhibit 1156, entitled: "Statement of Facts in support of the application of the Sanitary District of Chicago for permission to withdraw, through its channels, from Lake Michigan an annual average of 10,000 cubic second feet of water."

4414–4419 Exhibit 1156 recited that the Sanitary District was organized in 1889 as a municipal corporation having no legal connection with or control over the City of Chicago or any of the other forty-nine cities and villages within its boundaries; that the Sanitary District was authorized to construct and maintain drainage canals, outlet sewers, sewage pumping stations and appurtenances; that at the time the Sanitary District was organized to divert drainage and sewage within its boundaries from Lake Michigan to the Des Plaines River, the only practicable method by which sewage could be disposed of, was by dilution, which method was used at that time by all large cities

in the United States, and in 1924 it was the method used by eighty-eight per cent of all the cities of the United States having a population of 100,000 or more; that the statute under which the Sanitary District was organized required a dilution ratio of three and one-third cubic feet per second for each one thousand of population; that the said ratio is necessary to prevent nuisance; that in 1889 the population of the Sanitary District was 1,140,000; that the population and trade waste equivalent by 1945 is estimated to be 6,785,000; that the population and trade waste equivalent of the Sanitary District at the time of the application, was 4,864,000; that 10,000 cubic second feet of water diversion from Lake Michigan is necessary for the purpose of eliminating offensive conditions in the Illinois River, as well as for the purpose of keeping the Chicago River reversed at all times, so that at no time even during storm periods would it empty its sewage into Lake Michigan; that the dry weather run-off of the Chicago River drainage area was approximately 1,200 cubic feet per second; that the maximum flood run-off for the same area was approximately 10,000 cubic feet per second; that the run-off from the drainage area of the Chicago River exceeds 4,167 second feet seven to eight times per year, 5,000 c. f. s. from five to six times per year, 7,500 c. f. s. from three to four times per year, 9,500 c. f. s. about one time per year; that if the flow of 4,167 feet per second were maintained through the Chicago River from Lake Michigan the sewage would flow into Lake Michigan about seven times per year, and a similar condition would exist but not so frequently for the other flows above mentioned; that a heavy storm may concentrate the run-off in the Chicago River in approximately six hours, discharging 10,000 cubic feet per second; that it takes more than twelve hours to effect any appreciable increase in the flow through the Chicago River by manipulation of the control gates at Lockport; that since 1892 the Sanitary District has expended in the construction of its Sanitary and Ship Canal, widening, deepening and improving the Chicago River, construction of bridges and other channels and appurtenances, approximately $130,000,000; that the operation of the Sanitary District's canal has ma-

terially affected the death rate from typhoid fever and has generally improved the health conditions of Chicago; that the Sanitary District had during the period beginning with the year 1908, carried on extensive experimental work in artificial sewage treatment, and had expended on such artificial sewage treatment works up to the end of the year 1924, approximately $30,000,000; that the Sanitary District had laid out a program to artificially treat sewage by the installation of works which would require the expenditure by 1945 of the sum of approximately $95,000,000; that this program by 1945 contemplated eight-five per cent or complete treatment for a population of 1,917,000, ninety-four per cent treatment for equivalent population of 1,725,000, thirty-three and one-third per cent treatment for a population of 3,140,000, which would be equal to one hundred per cent treatment for a population of 4,300,000; that cost of carrying out this program would be about $95,000,000.

The said Defendants' Exhibit 1156 further set forth the then financial resources of the Sanitary District, its bonding power, taxing power, income from other sources and the moneys required to be expended for its various corporate purposes, and that:

> "In October, 1924, the Sanitary District engaged twenty-eight consulting sanitary and hydraulic engineers from all parts of the United States, leaders in their profession and of outstanding experience and reputation, to make an exhaustively complete study of the sanitary situation in this community.
>
> This Engineering Board of Review, after upwards of four months of intensive study, has just completed its labors and presented a report with findings and recommendations, in two printed volumes, copies of which are submitted herewith.
>
> The report of this board was unanimous and its recommendations cover the subjects which must necessarily be considered by the War Department in arriving at a proper solution of the questions now under consideration, and it is respectfully urged

that this report, with findings and conclusions, be
4420 given careful consideration."

Exhibit 1120 submitted to the said Secretary of War as part of the said application for the permit of March 3, 1925, is entitled "Recommendations including Brief Statement of Findings and Conclusions of the Engineering Board of Review of The Sanitary District of Chicago on the Lake Lowering Controversy and a Program of Remedial Measures, Chicago, Illinois, December 20, 1924".
3555 The said Defendants' Exhibit 1120 stated in its introduction the following:

"1. The Chicago Drainage Canal was authorized by the Illinois Legislature in 1889, and opened in 1900. It reversed the flow of the Chicago River, diverting Chicago's sewage from Lake Michigan; improved the City's only source of water supply; ended severe water-borne epidemics; provided one of the chief links in a waterway from the Great Lakes to the Gulf, a project long promoted by the National and State Governments; led to a remarkable development of bathing beaches, and incidentally supplied power for public needs.

2. Dilution was the best method then in use for large-scale sewage disposal, and the Canal was a vital factor in Chicago's phenomenal growth.

3. The City's growth already has exceeded the limits considered when the Canal was built, and the Chicago Sanitary District, after scientific research, has planned and has under construction extensive plants for the treatment of sewage by recently developed methods, at a rate to provide additions for approximately 300,000 persons each year. This program should be continued. Its cost can be reduced by the elimination of water waste, but in any event will involve an increase in tax rates. However, a large diversion of lake water will still be required to produce satisfactory conditions.

4. The Chicago diversion has lowered the Great Lakes about 5 inches, while diversions elsewhere, improvements of outlet channels, and climatic conditions, have caused a lowering of 2 to 3 feet. Reduced lake levels have damaged navigation and harbor works.

5. Lake fluctuations can be largely eliminated, and the lakes held near the highest desirable levels, by works constructed near their outlets. Such works are necessary regardless of the Chicago diversion, and their cost will be but slightly affected by it. They will protect all interests involved, increase low water flow, greatly improve navigation and harbor conditions, allow more efficient use of water for power, and make possible the restoration and protection of the scenic beauty of Niagara Falls.

6. Diversion of water at Chicago is necessary for sewage disposal; it prevents gross pollution of the lake; it improves navigation in the waterways from the Great Lakes down the Illinois and Mississippi Valleys; and it makes available hydro-electric energy in a region where needed. With lake and river regulatoin it will confer these benefits without damage to navigation in the Great Lakes and connecting waters; without affecting navigation conditions in the St. Lawrence River; and for years without reduction of power at Niagara along the St. Lawrence River."

* * * * * * *

It was recommended by said Engineering Board of Review in said Exhibit 1120, that the Sanitary District carry out a program for artificial treatment of sewage, such as was mentioned in said Exhibit 1156; that the City of Chicago be requested to reduce water consumption by the installation of meters; that the Sanitary District cooperate with all authorities interested in forwarding the Lakes-to-the-Gulf waterway, including the dredging of the little Calumet River; that the Sanitary District offer to

contribute its proper share of the cost of lake regulating works; that the District apply to Federal authorities for permission to divert from Lake Michigan an annual average of 10,000 feet of water per second.

Among the findings and conclusions of the said Engineering Board of Review (Exhibit 1120, Tr. 3561), were the following:

> "20. The Main Drainage Canal draws water from Lake Michigan by reversing the flow of the Chicago River and discharges it into the Des Plaines-Illinois River for the purpose of diluting Chicago's sewage and diverting it from the lake. In addition to this use, the water will also play an important part in the operation of the 9-foot waterway now under construction from the Great Lakes to the Gulf of Mexico.
>
> 21. The maximum capacity of the Main Drainage Canal was determined largely by the necessity that it should carry at least 10,000 cubic feet per second, to prevent the flood flow resulting from occasional heavy rainfalls over the Chicago River drainage area from flushing sewage and accumulated sewage deposits into the lake.
>
> 22. The Illinois Legislature made mandatory that the sewage entering Chicago River should be diluted with at least 3⅓ cubic feet of water per second per 1,000 population. The channel was therefore intended to serve a population of not more than 3,000,000.
>
> * * * * * * *
>
> 27. The plan for sanitary improvements authorized in 1889 and executed at a capital cost to date of approximately $100,000,000 was not only sound but the best that could have been devised. It has been a success. The typhoid fever death rate has been reduced from a maximum of 174 per 100,000 inhabitants in 1891 to less than 2 per 100,000 in 1917; since

then it has remained consistently below 2, with an average of less than 1.2 per 100,000 inhabitants.

* * * * * * *

35. To abandon the Main Drainage Canal and again discharge the sewage into Lake Michigan, even though the most effective means be provided for purification of the sewage and the water supply, would be a serious backward step in sanitation. Failure to take reasonable and proper advantage of natural and artificial conditions would not be justified.

* * * * * * *

38. To maintain the Des Plaines-Illinois River in a satisfactory condition will require a substantial flow of lake water, even after all the sewage shall have been treated by the most effective practicable means now available.

39. While a diversion of 10,000 cubic feet per second, and at times more, is necessary for sanitary purposes during the warmer portion of the year, the amount may be diminished at other times without seriously reducing the dilution efficiency of the Canal. Authorization of the full amount is necessary, however, to reduce the danger of the reversal of Chicago River during heavy rainfalls, and to provide for contingencies.

* * * * * * *

45. The extensive and growing use of the lake front of Chicago by bathers has directly resulted from the diversion of sewage from the lake, and is of great benefit to the public.

48. Accepting the conclusion that the diversion of lake water at Chicago has contributed to the present low stages of the lakes, the Sanitary District made an offer to the United States to pay the cost

of remedial works to compensate for the lowering caused by its diversion, these works to be designed by the United States Army Engineers, and to be built under their direction.

49. The Great Lakes rise and fall 3 to 5½ feet during long periods. The present low stages are due partly to natural variations in rainfall, evaporation, and ice conditions; and partly to diversions through the Chicago Drainage Canal, the Welland Canal, the Black Rock Canal, and the improved Erie Canal, and for water power at Niagara; to storage of water in Lake Superior; and to the enlargement of the channels of the St. Clair and Detroit Rivers for navigation purposes.

50. With a diversion of 10,000 cubic feet per second at Chicago, and without regulation of the outflow from Lake Huron and Erie, the United States Army Engineers report that such a diversion would ultimately lower Lakes Michigan and Huron 5½ inches. This Board accepts this figure.

51. The outflow from the Great Lakes can be controlled at moderate cost by works of simple character. By these works, the lakes can be held at as high stages as prevailed in the period from 1883 to 1887, regardless of the amount of water diverted from the lakes and connecting rivers.

52. There is a distinction between 'compensation works,' such as submerged weirs, by which lake levels may be raised, and 'regulating works' by which both the level and the discharge can be so controlled that the surplus of water in cycles of large yield can be conserved in storage for increase of outflow in years or seasons of scant water supply.

53. Regulating works are neither experimental nor are their effects problematical. This is well illustrated by the works at the outlet of Lake Superior, which have successfully raised and controlled the level of that lake for the past eight years.

54. A reduction of the diversion at Chicago to 4,167 cubic feet per second would raise the lake levels only 3 inches; whereas proper regulating works would raise these levels ten or more times as much, even with an annual average diversion of 10,000 cubic feet per second at Chicago.

* * * * * * *

58. The water diverted from Lake Michigan, formerly wasted through the control works at the outlet of the Main Drainage Canal at Lockport, is now utilized to develop hydro-electric power, and the surplus power not required for the works of the Sanitary District is sold to the City of Chicago and other cities in the District for municipal lighting and pumping, and to industries.

60. By reason of the demand for power and its higher market value, a cubic foot of lake water is now worth as much for power production in Illinois as at Niagara, even were the full available head between Lakes Erie and Ontario utilized. There is no present economic loss to the country at large by using lake water for power in Illinois instead of at Niagara.

61. Furthermore, under present treaty restrictions, the water diverted at Chicago does not now and will not prevent the development of all the water power which it is possible to develop at Niagara by diversions now allowed by treaty.

62. On the Upper Illinois River the natural low water flow is approximately 500 cubic feet per second. Any additional water diverted by the Drainage Canal from Lake Michigan would meet a future demand for condensing water in steam power plants located near the coal mines of the Illinois Valley, and would thereby facilitate the production of power by such plants.

* * * * * * *

66. There are no treaty restrictions as to the use of the St. Lawrence water for power, but less than 10 per cent of the available power is utilized. There will be no economic loss of power on either the Niagara or St. Lawrence River by reason of the diversion of water from Lake Michigan until 95 per cent of the available power at each location has been developed.

67. The diversion of 10,000 cubic feet per second of water at Chicago, with regulating works proposed, would in no way interfere with the establishment of a deep waterway from the Great Lakes to the ocean by any one of the several routes that have been proposed. For the deep water route down the St. Lawrence, regulating works will be required, which can be operated in the same manner as those proposed for the Great Lakes, and would eliminate the effect of any diversion at Chicago.

* * * * * * *

68. For more than 100 years both the United States and the State of Illinois have proceeded on a policy of improving the navigation facilities of the country by connecting the Great Lakes through Chicago with the Gulf of Mexico. Construction work is now in progress on a modernization of this waterway.

69. The State of Illinois is spending $20,000,000 in building the most expensive section of a 9-foot barge waterway. The United States already maintains 6 to 8-foot navigation over the remaining distance to the Gulf, and has outlined a 9-foot project.

70. An average annual diversion of 10,000 cubic feet per second at Chicago would reduce the cost of completing and operating the 9-foot waterway from the lakes to the Gulf of Mexico, would improve navigation conditions down to and below Memphis, and would dispense with four of the nine locks which

would be required with a diversion of 1,000 or 2,000 cubic feet per second. This would make feasible a 9-foot channel without locks from the Gulf of Mexico to within 100 miles of Chicago.

* * * * * * *

72. The improved Illinois waterway will adequately connect the Mississippi Valley with the Great Lakes. Such a connection will encourage navigation, and will give the Middle West and Gulf States a better opportunity to share in the benefits to be derived from ample and desirable facilities for water-borne commerce between the Gulf and the Lakes. Such a waterway is of international importance, and with the completion of the improvements in the Illinois River is a possibility within three or four years."

* * * * * * *

Exhibit 1157 (Tr. 4415) entitled "Report of Engineering Board of Review of the Sanitary District of Chicago on the Lake Lowering Controversy and a Program of Remedial Measures—Part II—The Technical Bases for the Recommendations of the Board of Review," submitted as part of said application for permit, is as indicated by its title, a more detailed description of the various projects mentioned in Exhibit 1120, the Engineering Board of Review's first report, and describes in greater detail the effect of the diversion upon the levels of the waters of the Great Lakes and their connecting channels and remedial works that may be installed, including also the benefits of the diversion to the waterway from the Great Lakes to the Gulf of Mexico.

Exhibits 1120, 1156 and 1157 were each admitted in evidence over the objection of the complainants on the ground that they and each of them had been submitted to the Secretary of War.

Pursuant to the request of the Secretary of War, the attorney general of the United States on February 13, 1925,

rendered an opinion to the effect that the Secretary of War on the recommendations of the chief of engineers, had the power to issue a permit fixing the diversion from Lake Michigan by the Sanitary District of Chicago at an amount greater than the 4,167 cubic seconds feet theretofore authorized by the Secretary of War. (Ex. 1205, Tr. 5701.)

On March 2, 1925, the District Engineer at Chicago made a report upon the foregoing application, in which he stated:

> "U. S. Engineering Office, Chicago, Ill.,
> March 2, 1925.
>
> To the Chief of Engineers, Washington, D. C.
>
> 1. This is an application from the Sanitary District of Chicago, a municipality created under the laws of the State of Illinois, to divert 10,000 cubic feet per second of water from Lake Michigan, for the purpose of keeping the sewage of that locality from contaminating its water supply and for reducing the sewage by dilution.
>
> 2. This question of the diversion of water from Lake Michigan has been so thoroughly investigated by the Department and discussed at such great length in various reports that it is not believed advisable to enter into any description or historical review before presenting the recommendations which are to follow. Detailed information of this character may be found in the report entitled 'Diversion of Water from Lake Michigan,' which was submitted by this office on November 1, 1923.
>
> 3. This application is prompted by the action of the United States Supreme Court on January 5, 1925, by which it sustained the position taken by the local United States Court, requiring adherence to the limitations placed by the Secretary of War on the amount of the diversion. The local authorities are faced with the alternative of a reduction in the amount of diversion to 4,167 cubic feet per second

by March 5, 1925, or relief from Congress or the War Department.

4. In the issuance of a permit, the exact meaning of the word 'diversion' should be understood. In the recommendations which follow, by diversion is meant the amount of water which is actually withdrawn from Lake Michigan by the Sanitary District of Chicago through its main drainage canal and auxiliary channels, and is not inclusive of the amount flowing in the channels which come from the sewers of the locality. In other words, 'diversion' is taken to be the gross flow at Lockport, less the amount of water used by the City of Chicago for domestic purposes.

5. It is recommended that a permit be issued to the Sanitary District of Chicago, covering a period of five years, to divert from Lake Michigan through its main drainage canal and auxiliary channels, an amount of water not to exceed an annual average of 8,500 cubic feet per second; the instantaneous maximum not to exceed 11,000 cubic feet per second. This permit should be made conditional upon the following:

(1) The Sanitary District of Chicago shall carry out a program of sewage treatment by artificial processes which will provide the equivalent of the complete (100%) treatment of the sewage of a human population of at least 1,200,000 before the expiration of the permit.

(2) The Sanitary District shall pay its share of the cost of regulating or compensating works to restore the levels or compensate for the lowering of the Great Lakes system, if and when constructed, and post a guarantee in the way of a bond or certified check in the amount of $1,000,000 as an evidence of its good faith in this matter.

(3) The Sanitary District shall submit for the approval of the Chief of Engineers and the Secre-

tary of War plans for controlling works to prevent the discharge of the Chicago River into Lake Michigan in times of heavy storms. These works shall be constructed in accordance with the approved plans and shall be completed and ready for operation by July 1, 1929.

(4) The execution of the sewage treatment program and the diversion of water from Lake Michigan shall be under the supervision of the U. S. District Engineer at Chicago, and the diversion of water from Lake Michigan shall be under his direct control in times of flood on the Illinois and Des Plaines Rivers.

(5) If, within six months after the issuance of this permit, the city of Chicago does not adopt a program for metering at least ninety per cent of its water service and provide for the execution of said program at the average rate of ten per cent per annum thereafter, this permit may be revoked without notice.

(6) The average diversion from Lake Michigan during 1924 by the Sanitary District has been approximately 8,500 cubic feet per second. This diversion, combined with the discharge from the sewers of the locality, produced a total flow at Lockport of about 9,700 cubic feet per second. This so closely approximates the flow necessary to safeguard against reversals of the river into the Lake in times of storm (10,000 cubic feet per second) that a permit for diversion of 8,500 cubic feet per second will suffice in this regard. * * * No obligation appears to rest with the Department to prevent any increase in pollution of the Illinois and Des Plaines Rivers; the maintenance of status quo as regards amount of diversion will place the burden of relieving the lower river situation upon the Sanitary District. Until the controlling works (Condition 3) are completed, ample protection against the dangers of a reversal of the river is provided by the

authority to divert an instantaneous maximum of 11,000 cubic feet per second.

(7) Condition (1) as proposed provides for the execution of a sewage treatment program which will relieve the load on the Drainage Canal by the equivalent of a population of 1,200,000. * * * Compliance with this condition will make possible a reduction in amount of diversion to 7,250 cubic feet per second, or lower, by the end of 1929. This condition looks to a reduction to 4,167 cubic feet per second by 1935.

* * * * * * *

12. Condition (3) is considered necessary to permit an ultimate reduction of the diversion to 4,167 cubic feet per second. Controlling works of some sort will be required to keep the Chicago River from discharging into Lake Michigan in times of flood, and at least two types have been suggested which are believed to be practical.

13. The provision with reference to metering of the water service of the City of Chicago is included for three reasons:

(a) There will be a substantial saving in the cost of construction and operation of sewage treatment plants due to the decreased amount of sewage to be treated.

(b) There will be a substantial reduction in the amount of lake water used for domestic purposes.

(c) It will be possible for the city of Chicago to finance a filtration system for its water supply when its water consumption is reduced to a reasonable amount. When the water supply is filtered, the dangers incident to an occasional reversal of the Chicago River will be entirely eliminated.

14. A shorter time limit for the permit is not recommended as results produced by the end of

1927, for instance, will not permit a reduction in the amount of the diversion, which it is believed should be required in any renewal, no matter when it is made. Furthermore, sufficient performance can not be prescribed for a shorter period to insure completion of a larger program looking to a reduction in diversion to 4,167 cubic feet per second by 1935."

The following is all that appears in the transcript of record concerning the offer in evidence of and the ruling of the Master upon Exhibit 1158.

4447 "Mr. Adcock: I ask to have marked for identification the document which I hold in my hand entitled 'Diversion of Water by the Chicago Drainage Canal, Hearing before the Secretary of War, Washington, February 21st, 1925, Pechin and Dismukes, Shorthand Reporters, Washington, D. C.'

(The document referred to was thereupon marked Defendants' Exhibit for Identification No. 1158.)

The title that I just read appears on the cover. This purports to be a stenographic transcript or a copy of a stenographic transcript of the proceedings before the Secretary of War held on the date mentioned, and I understand that the court reporter who took the proceedings and transcribed them was selected by the Honorable John W. Weeks, or his office, to take the proceedings. I have no other copy.

The Special Master: Do you propose to offer that in evidence?

4448 Mr. Adcock: I wish to offer it in evidence for the purpose only of showing what took place before the Secretary of War, and with no notion that the other side should be bound by anything that our representatives said, although we are to be bound by what our representatives said, nor do we wish to be responsible for the truth of the statements made by parties to that proceeding.

4448 The Special Master: I cannot conceive that you can make evidence of a lot of statements made before the Secretary of War at a hearing of that description. You may show that the Secretary of War had a public hearing. The Secretary of War acted on the recommendation of the Chief of Engineers. He was acting on the application made by the Sanitary District. I have allowed you to put in all the facts, the application itself, and what formed a part of it, which invited the official action of the Secretary of War.

The Secretary of War, in his discretion, although I am not aware that the statute required it, seemed to have held a public hearing at which, I suppose, in accordance with the statement of counsel, a good many people attended and a good many statements were made. In view of the many official reports that are in evidence, and in view of the amount of testi-
4449 mony we have had about everything pertinent to that transaction, I do not see any necessity and, from the strict standpoint of competency, I do not see the propriety of introducing a lot of statements made at such a hearing. If there is any particular matter there which can be regarded as an official statement of fact by the Sanitary District, in addition to the statement in the former papers, you may point it out to me and I will consider it. You may also have the matter marked for identification, and if at any time there should be disagreement by the court with my ruling you can point out what has been excluded, but I shall not receive it. This is subject, of course, to your pointing out something which the Sanitary District presented officially on that hearing, as supplemental to what they presented in the papers, that I should be inclined to think might be pertinent.

Mr. Adcock: Perhaps I should have mentioned to your Honor the fact that this public hearing was held on February 20th and 21st 1925, and that there were present beside the Secretary of War the Chief of Engineers, Major Putnam, I believe, and Gen-

eral John A. Hull, Judge Advocate General. I also wish to point out that the date of the recommendation of the Chief of Engineers was March 2nd or March 3rd 1925, which was after this hearing.

4450 The Special Master: We have his report, and it shows what he considered. I should think it would be extremely dangerous to make evidence out of any statement that might be made in a hearing of that sort. I know I would not consider such a statement, unless competently proved.

Mr. Adcock: I limited my offer only for the purpose of showing what took place.

The Special Master: And only what took place without the statement given when that took place does not seem to me to be a very definite offer.

Mr. Adcock: The entire transcript would go in, but simply for the purpose of showing what was said and done.

The Special Master: Simply for the purpose of having it in. I do not think it is competent. But to repeat, I do not debar you from showing what is essentially a part of this official application of the Sanitary District. I assume we have that in the papers that were submitted.

* * * * * * *

4453 Mr. Lynde: May I say a word, your Honor, in connection with this exhibit for identification No. 1158? This transcript will disclose—and, of course, in making this statement I am not trying to get anything into the record, but I am merely describing the situation—that there was a representative there on behalf of the commercial interests of Chicago,
4454 and I desire to call the court's attention in connection with the offer that the logical position, very briefly stated, in reference to the value of the Chicago water for navigation on the Illinois River and the Mississippi was presented for the information of the Secretary of that hearing; and in addition to the statement made for the record as I presented

it at that time, I can produce also a written statement which was filed with the Secretary. It seemed to me pertinent in connection with the offer to call attention to the fact that these elements which the Mississippi Valley States are here to present were called to the Secretary's attention in connection with this permit.

The Special Master: Is there any question but what all the various matters which have been presented here on both sides of this proposed action were the subject of a public hearing before the Secretary of War

Mr. Adcock: That was one reason that I desired to present that transcript; to show that practically every argument that has been presented by the complainants was presented to the Secretary of War and by representatives of these various states and that there was no question of whether the Secretary of War had jurisdiction or not. It was assumed that he had jurisdiction and they were all presented there.

4455 The Special Master: Of course, Mr. Adcock, that sort of a presentation cannot add to his actual authority. If he did not have authority it would make no difference. On the other hand, if he did have authority and exercised it, that exercise draws to it presumptions of a very large degree of knowledge and information with regard to all questions which possibly could be considered. That is the presumption we have with regard to all legislative and executive acts, that they are performed, perhaps not with omniscience, but with honest purpose and an understanding of all the revelant facts. That is one thing. It is quite different to have a lot of particular statements introduced as facts themselves.

Mr. Adcock: I am not offering them for that purpose. They show that at the time the Secretary was very ill he held this painstaking hearing for two days and at which he heard practically everybody.

Mr. Lynde: May it be understood, your Honor, that the Mississippi Valley States join in this offer

for the purpose merely of showing that these con-
4456 tentions were presented for your consideration?

The Special Master: Certainly. I have no objection at all to receiving the evidence, and I understand that is virtually submitted without any contest; that there was a public hearing, and that you and your clients appeared at that hearing.

Mr. Lynde: No; pardon me. I misrepresented the situation if I stated that. I appeared at that time on behalf of the commercial interests of Chicago. I do not want a misstatement of facts in the record.

The Special Master: I shall assume on what has been said here that all the various parties in interest were heard before the Secretary of War; and I may add that I do not think it makes much difference whether they were or not, so far as any actual conclusion upon his authority and construction of his action that he finally took are concerned. It simply shows his desire to be fair in the matter and not to act in ignorance of what people complained about."

Condensation of Excerpt of Defendants' Exhibit 1158 (Transcript 4455-4456).

This exhibit is a transcript of the proceedings of a public hearing before the Secretary of War at the time of the application by the Sanitary District of Chicago for the permit of March 3rd, 1925. The excerpt printed is a portion of the statements made at that hearing to the Secretary of War by Mr. Lynde on behalf of the Chicago Association of Commerce condensed as follows:

> "We believe the water through that Canal is of great assistance for use in navigation in the Illinois River and almost a necessity for any proper development of navigation on the Mississippi River between Grafton and Cairo. * * * One of the Government Engineer Reports in 1907, contains statements as to the low water flow of the Mississippi at St. Louis, and the curve there shows that the

low water at St. Louis was 33,000 second feet. The actual diversion of Lake Michigan at that time was between 7,000 and 8,000 cubic feet per second, included, of course, in that 33,000 second feet at St. Louis. It has always been our understanding that in navigation on the Mississippi where the desired depth is difficult to maintain under present conditions, the subtraction of a material amount of water is certainly not going to increase the facilities for navigation. * * * The Secretary is concerned with this matter from a broad national standpoint. The Congress of the United States in Section 500 of the Transportation Act laid down a declaration of policy in favor of the development of water transportation. Congress has gone further than that. It has put the Mississippi-Warrior Barge Line on a permanent basis. The Secretary is the agent of Congress in those particulars. * * * The water going out of Lake Michigan is of great assistance to the development of this full waterway route from the Gulf to the Lakes. Congress by the expenditure of public funds, to which the Mississippi Valley has contributed, created the Panama Canal. This has upset the equality of transportation conditions in this country. A full development of waterways in the interior portion of the country will tend to equalize the inequality produced by the Panama Canal route. Industries located in the Atlantic seaboard have available a route for transportation to the Pacific coast. A cheaper method of transportation. Industries in the interior have to depend on rail transportation and are at a great disadvantage. If they are given this water transportation down the rivers, they are more or less equalized. * * * The transportation on a waterway, of course, is dependent upon the depth of the water. The present depth in the Mississippi and Ohio is a 9 foot project, and we want that same depth maintained."

The report entitled "Diversion of Water from Lake Michigan," dated November 1, 1923, filed with Secretary

of War April 18, 1924, referred to in the above quotations from Doc. 43 (Comp. Ex. 12), is Exhibit 1 for identification. This report among other things described the early navigation on the Chicago River and the outer harbor or entrance thereto, the improvements from time to time made for navigation purposes on the Chicago River and branches, the amounts of diversion from time to time by the Sanitary District and the works installed and operated by it, including also the deepening and widening by the Sanitary District of the south branch and west fork of the south branch of the Chicago River, 200 feet in width at all points, and 26 feet in depth throughout.

3519 The report further stated:

"As far as the navigation of the Chicago River and the Drainage Canal is concerned, if the flow at Lockport were entirely throttled and the power house gates closed so as to permit no diversion from Lake Michigan, conditions would be decidedly improved. The current which now averages 1½ miles per hour, and in some bridge draws is as high as 4, would be practically eliminated, making navigation considerably simpler, especially for the larger vessels whose passage through a narrow bridge draw is apt to increase the current materially.

The Illinois Waterway is only about 15% completed, and at the present rate of progress will not be ready for use for some time to come. The question of flow is entirely unaffected by any immediate needs of this waterway. The amount of flow to be expected when the enterprise is finished has a definite bearing on the plans of the structure, but as Part IV deals with immediate needs, a study of the amount of water necessary for the operation of the waterway some 10 years from now will be left for later consideration.

The low-water widths of the Mississippi River immediately below the mouth of the Illinois are between 1,500 and 2,000 feet; at bank-full stages the widths are between 2,500 and 4,500 feet

Under present conditions the estimated extreme low-water flow is about 30,000 cubic feet per second including that diverted from Lake Michigan. (See H. Doc. No. 22, 67th Cong., 1st Sess.)

The diversion of 8,000 second-feet from the Lake constitutes slightly over one-fourth of the low-water flow in the Mississippi River. An inspection of the discharge curve of the river at St. Louis indicates that an increment of 8,000 cubic feet per second produces an increased depth of 1.4 feet (Plate VIII). No other discharge curves are available for that portion of the river between Grafton and Cairo.

It would not be unwise to assume that the average raising of the water surface amounts to about 1 foot, but due to the hydraulics of the Mississippi River, where the elevation of the tops of the bars fluctuates with the height of the surface of the water, it is doubtful if the actual depths are materially increased. For this reason it is impossible to evaluate the benefit if there is any.

* * * * * * *

On the improved portions of the Illinois River depths have been materially benefited by the intro duction of Lake Michigan water. The present project contemplates the completion of a 200-foot channel 7 feet deep based on a diversion of 4,167 cubic feet per second. If the project were completed the flow could be reduced to 4,167 cubic feet per second and cause no injury to navigation. It is estimated that about 1,700,000 cubic yards of material would have to be dredged to complete the project. This would require from three to four years' time with a 15-inch suction dredge such as is contemplated for the river. With the expenditure of about $973,000, inclusive, of funds available, the project will be completed by 1928. A reduction in diversion to 4,167 cubic feet per second could not be made without detriment to navigation before that time."

Complainants objected to evidence relating to the alleged effect of the increment from Lake Michigan upon the depth of the Mississippi River, on the ground that intervening States, none of them, had any legal interest in any artificial enrichment of the Mississippi River, if there be any, from any diversion from Lake Michigan.

441-443 Ex. 17 In reply to a communication from the Government at Canada, through the British Embassy, the Secretary of State, under date of November 24, 1925, advised the British Embassador as follows:

> "Referring further to your Embassy's note No. 813 of September 15, 1925, bringing to my attention certain remarks and inquiries of the Canadian Government in regard to the diversion of water from Lake Michigan by the Sanitary District of Chicago, I take pleasure in submitting the following statements:
>
> The Sanitary District of Chicago to which the permit of March 3, 1925, was issued by the Secretary of War, is a municipal corporation separate and distinct from the City of Chicago. The operations of the Sanitary District are conducted under direct authority of the legislature of the State of Illinois without reference to the operations of the municipal government of the City of Chicago. Diversion of water for domestic consumption in the City of Chicago being purely a function of the municipal government of the city, it is considered that the authority granted the Sanitary District could not be made to apply to or include this other diversion as well. The case before the Secretary of War for action involved the granting of a permit for diversion of water for sanitary purposes only, and the instrument of authority was worded accordingly.
>
> On the other hand, it seemed to the Secretary of War that the diversion of water for domestic consumption by the City of Chicago was larger than it should be, and that the amount wasted was not a negligible portion of the gross diversion. He also considered that this excessive diversion for domes-

tic purposes made the cost of sewage treatment, plant construction and operation unnecessarily high and consequently added to the length of the construction period and the difficulties of financing. For these reasons the Secretary of War took cognizance of the diversion for which the City of Chicago is responsible, in a restrictive way, rather than by permissive means, and included a condition in the permit making the instrument voidable in case the City of Chicago fails to take specified steps looking to a curtailment in the amount of water diverted for domestic purposes.

In the judgment of the Secretary of War the average diversion which should be authorized for sanitary purposes under the conditions known to exist should be not less than 8,500 cubic feet per second. The safety of the lives and health of citizens of the locality cannot be disregarded, and until the conditions of the permit of March 3, 1925, have been complied with no substantial reduction in the amount of diversion could be made without endangering health if not life.

The expression 'measured at the intakes' used to designate the places where the total actual flow should not exceed that specified in the permit, is hypothetical as it is impracticable to measure the diversion at the numerous intakes with accuracy. For this reason, the practical enforcement of the limitation placed upon the diversion will be carried out at Lockport. Measurements taken there will determine the gross diversion, sanitary and domestic, and, as accurate information is available in regard to the amount of water pumped by the City of Chicago for domestic purposes, the sanitary diversion may be computed by subtracting the domestic diversion from the gross flow at Lockport.

* * * * * * *

The Canadian Government is correct in concluding that no immediate reduction in diversions has

been provided, but its conclusion that no definite reduction is assured and that the effect of the permits will actually be to authorize a greater diversion than is now being made cannot be confirmed. The gross flow at Lockport will not exceed an average of 9,700 cubic feet per second, and by the time the permit of March 3, 1925, has expired the gross flow may be reduced to 8,000 cubic feet per second and probably to 6,700 cubic feet per second. The sewage treatment program of the Sanitary District has been arranged, so as to make it possible to effect a reduction to a gross flow of 4,167 cubic feet per second by the year 1935 or before."

The Joint Board of Engineers appointed by the governments of the United States and Canada on the St. Lawrence Waterway in their report dated November 16, 1926, stated:

"Question 6 (d):

Without considering compensation by the present relative diversions of water from the Niagara River and from Lake Erie and without prejudice to a future consideration thereof, what works, if any, could be constructed to recover on the St. Lawrence River the amounts of power determined under Section 6 (c), and what would be the cost of such works?

244. Answer—The board finds that after the St. Lawrence River has been fully developed for power production, no works can be constructed which would recover on the St. Lawrence the power lost by the diversion of water from the watershed." (Ex. 147, p. 44, 6 (d))"

Evidence with respect to compensating works in the Great Lakes was admitted over objection of complainants. (T. 3390-3182; 3902-04; 5702)

Portion of Complainants' Exhibit 146 is as follows:

2067 "Sanitary District of Chicago
Maximum or Peak Flow and K. W. Output
1920 to 1926 Inclusive.

* * * * * * *

Items 4 and 5.			K. W.	Total C. F. S.
1925	Nov. 16	5 P. M.	25,000	13,415
1926	Sept. 23	4:30 P. M.	17,600	12,765

Minimum Flow on Days of Maximum Flow 1920-1926.

* * * * * * *

1925	Nov. 16	8 A. M.	10,300	5,615
1926	Sept. 23	2:30 A. M.	12,100	6,700

Based on record of flow at Lockport, Ill."

The amount shown above for maximum and minimum flow includes the water diverted from Lake Michigan, as well as the domestic sewage or pumpage by the City of Chicago, amounting to 1,338 cubic second feet for the year 1925 and 1,395 cubic second feet for the year 1926. (Master's Report, p. 23)

HORACE P. RAMEY, FOR DEFENDANTS.

4385 Cross-examination:

I do not think the flow through the channel has ever exceeded the figure authorized by the permit since March 3, 1925, the date of the permit. Nor has the instantaneous maximum ever exceeded that amount. Referring to November 16, 1925, and to the figure of 13,415 cubic second feet, I do not think that the flow was ever that
4386 amount through the channel. What you are referring to is probably the record of a discharge from the end of the channel. I know that that much flow has not passed through the channel. It is true that the flow is measured at Lockport, but the discharge from the end of the channel is not the same for any given half hour that the flow through the channel might be, and as I recall the wording the permit is "instantaneous flow through the channel".

On redirect examination on this subject, Mr. Ramey testified (Tr. 4405-09; see infra p. 123).

Document 4, 69th Cong., 1st Sess., Committee on Rivers and Harbors, submitted to the Committee by the Chief of Engineers on March 29, 1926, (Ex. 18) states at p. 17:

> "26. Due to low lake levels, however, it is physically impracticable with existing works to withdraw more than about 8,250 cubic feet per second at Lockport. The city is withdrawing all that it can, this being within the terms of the permit, so that the figure of 8,250 cubic feet per second represents the instantaneous maximum that can be withdrawn at the moment, and also approximates the annual average that is being withdrawn."

741-43 COL. EDWARD M. MARKHAM, FOR COMPLAINANTS.

Graduate of the United States Military Academy, serving in the Engineer Corps from February 15, 1899, to date; on River and Harbor work in Florida, surveying on coal deposits in Philippine Islands, as Assistant Engineering Commissioner of District of Columbia, four years on the Improvement and Control of the Mississippi River and as Federal Engineer in charge of the Detroit District from 1919 to 1925. Author of House Document 270, 69th Congress, 1st Session.

746 From my study of the ton mile rates by land and water I estimate the annual saving from the use of water transportation on Lake Superior traffic to be
747 $120,000,000 per year and the annual saving for the whole lake trade at over $150,000,000 per year.

Ex. 144 November 29, 1926, the United States Shipping Board issued the following statement on the Great Lakes Commerce:

> "The magnitude of water-borne traffic on the Great Lakes is shown in statements prepared by the Bureau of Research, United States Shipping Board, in co-operation with the Board of Engineers for Rivers and Harbors, War Department, indicating that more than 210,300,000 cargo tons of freight were handled through Great Lakes ports in 1925, an

increase of 31,000,0000 tons, 11.8% over the total of the preceding year. Nearly 44% of the total water-borne commerce of the United States was conducted on the waters of the Great Lakes. The 197,500,000 tons of coastwise commerce of Great Lakes exceeded the total coastwise trade of ocean ports by more than 30,000,000 cargo tons, and the 12,800,000 tons of foreign commerce passing through Great Lakes ports constituted 13.8% of the total foreign commerce of the United States in 1925.

In the relative standing of all United States ports by volume of cargo tonnage handled, Duluth-Superior, with a total of 45,600,000 tons, ranks second to New York. Fifteen other Great Lakes ports handled more than 5,000,000 tons of freight each. The total cargo tonnage passing through these sixteen ports exceeded 172,900,000 tons and included 82.4% of the coastwise traffic as well as 78.3% of the United States foreign trade conducted on the Great Lakes in 1925."

Ex. 1134. 3647. This exhibit is a transcript of a portion of the oral argument before the Supreme Court of the United States on the motions to dismiss in this case, as follows:

"Mr. Justice Sutherland (interposing): Is the city of Chicago or the Sanitary District doing anything now that they are not permitted to do by the order of the Secretary of War?

Mr. Baker: So far as I know, they are not, sir.

Mr. Justice Sutherland: So that really your attack is on that permit?

Mr. Baker: In part, yes, sir; and I say 'in part' only because what we contend is that the Secretary of War has never made a regulation that had anything to do with navigation.

Mr. Justice Sutherland: But whatever they are doing is done by virtue of his permit?

Mr. Baker: Yes, sir.

Mr. Justice Sutherland: And they are not going beyond that?

Mr. Baker: I think that is so, and I think they are living up to the conditions that the Secretary of War imposed under that permit.

Mr. Justice Sutherland: And what you are really asking this Court to do is to review the order of the Secretary of War?

Mr. Baker: I suppose that is so."

NOTE.—The "Mr. Baker" above referred to is Mr. Newton D. Baker, a Special Attorney General for the State of Ohio. This exhibit was not admitted as against the complainants, Michigan and New York.

Respectfully submitted,

JOHN W. REYNOLDS,
Attorney General of Wisconsin.

HERMAN L. EKERN,
Special Assistant Attorney General of Wisconsin.

R. T. JACKSON,
Special Assistant Attorney General of Wisconsin.

HERBERT H. NAUJOKS,
Assistant Attorney General of Wisconsin.

ALBERT F. PRATT,
Attorney General of Minnesota.

EDWARD C. TURNER,
Attorney General of Ohio.

NEWTON D. BAKER,
Special Assistant Attorney General of Ohio.

T. J. BALDRIDGE,
Attorney General of Pennsylvania.

WILLIAM W. POTTER,
Attorney General of Michigan.

WILBER M. BRUCKER,
Assistant Attorney General of Michigan.

ARTHUR E. KIDDER,
Assistant Attorney General of Michigan.

ALBERT OTTINGER,
Attorney General State of New York.

ALBERT J. DANAHER,
Assistant Attorney General of New York.

RANDALL J. LEBOEUF, JR.,
Solicitor and of Counsel for New York.

OSCAR E. CARLSTROM,
Attorney General, State of Illinois.

CYRUS E. DIETZ,
HUGH S. JOHNSON,
Special Counsel for Illinois.

MACLAY HOYNE,
Attorney, The Sanitary District of Chicago.

JAMES M. BECK,
JAMES HAMILTON LEWIS,
GEORGE F. BARRETT,
LOUIS J. BEHAN,
EDMUND D. ADCOCK,
Solicitors for Defendant, Sanitary District of Chicago.

PERCY SAINT,
Attorney General of Louisiana.

NORTH T. GENTRY,
Attorney General of Missouri.

H. W. APPLEGATE,
Attorney General of Arkansas.

RUSH H. KNOX,
Attorney General of Mississippi.

FRANK E. DAUGHERTY,
Attorney General of Kentucky.

L. D. SMITH,
Attorney General of Tennessee.

CORNELIUS LYNDE,
DANIEL N. KIRBY,
Solicitors and of Counsel for Mississippi Valley States.