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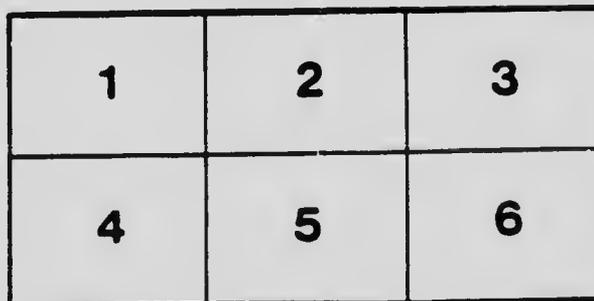
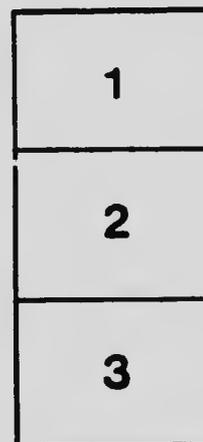
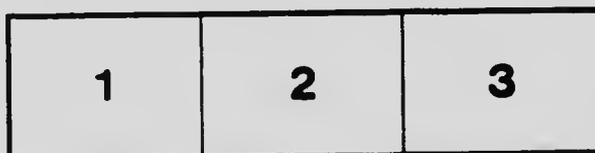
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APPENDIX No. 8
MARINE AND FISHERIES, CANADA

REPORT
ON THE
RIVER ST. LAWRENCE SHIP CHANNEL
FROM
MONTREAL TO QUEBEC
AND
THE TRAVERSE

F. W. COWIE, B.A.Sc., M. Can. Soc. C.E.
Superintending Engineer

OTTAWA
GOVERNMENT PRINTING BUREAU
1906

39/400

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MARINE AND FISHERIES, CANADA.

RIVER ST. LAWRENCE SHIP CHANNEL,
OTTAWA, ONT., December 14, 1905.

SIR,—According to your instructions, I beg to present the following annual report on the operations for the improvement of the River St. Lawrence Ship Channel during the fiscal year ended June 30, 1905.

As this matter appears for the first time in the report of the Minister of Marine and Fisheries, a more detailed and general description of the ship channel, and of the operations for improvement, is given.

The project now includes the work below Quebec, which is to be undertaken in 1907, for which a large dredge is now under construction at Sorel.

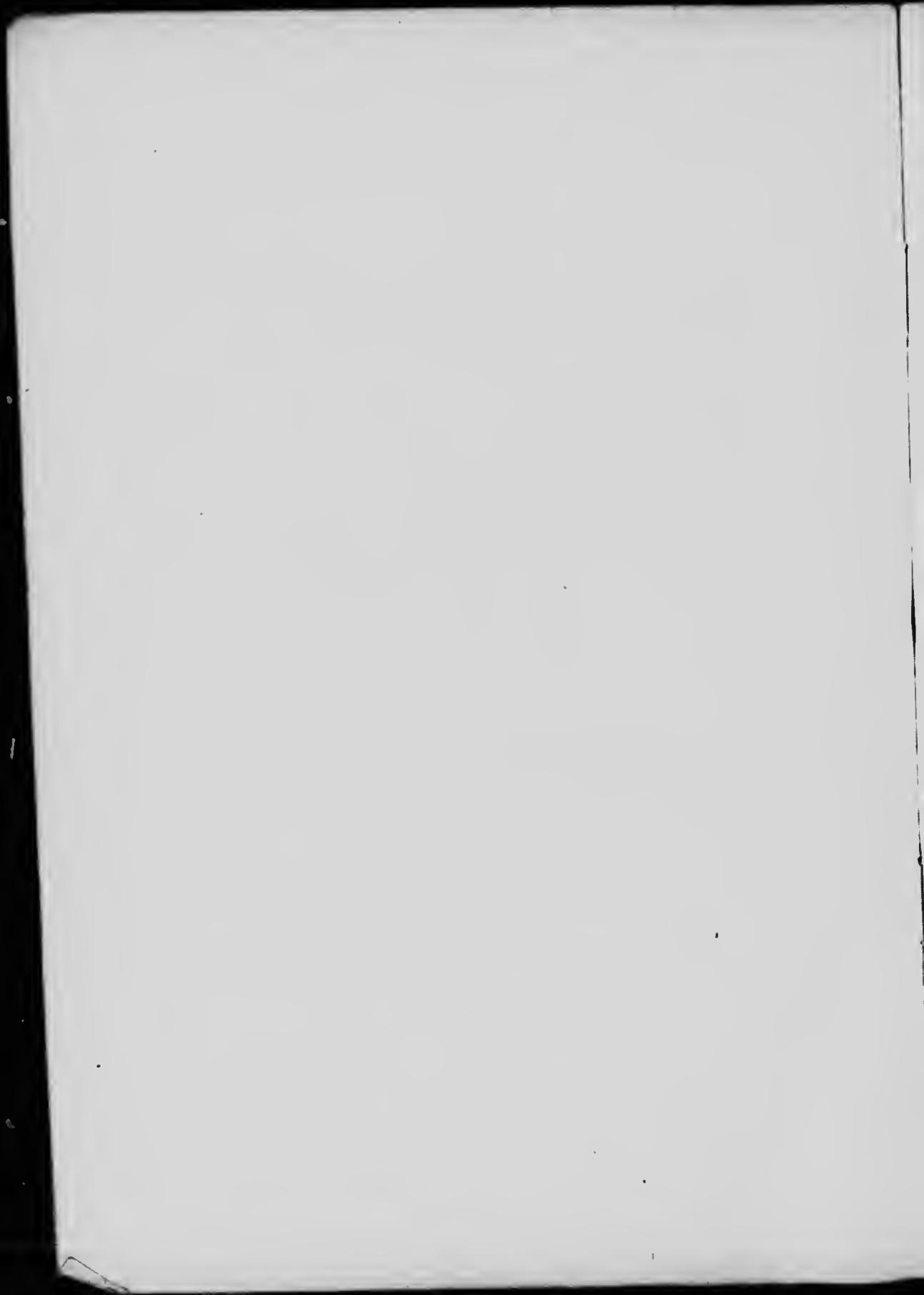
By request, photographic illustrations showing the type and details of the characteristic vessels of the dredging fleet are also given with this report.

I have the honour to be, sir,

Yours obediently,

F. W. COWIE,
Superintending Engineer.

Lieutenant-Colonel F. GOURDEAU,
Deputy Minister of Marine and Fisheries,
Ottawa, Ont.



APPENDIX No. 3.

RIVER ST. LAWRENCE SHIP CHANNEL.

INTRODUCTION.

By Order in Council of March 11, 1904, on a report from the Right Honourable the President of the Privy Council, with a view of systematizing and facilitating the work: the hydrographic surveys, the management and control of the River St. Lawrence Ship Channel together with the dredging and ship-building plant, were transferred at the close of that fiscal year to the Department of Marine and Fisheries, so as to place the supervision of the improvements to navigation on the St. Lawrence Route under the department directly responsible for the Pilotage and Aids to Navigation.

For the first time, therefore, the annual report of the River St. Lawrence Ship Channel appears in the report of the Honourable the Minister of Marine and Fisheries, the work now being conducted under the Department directly pertaining to navigation.

Previous reports, in connection with the ship channel, with the history of the operations, the tables of results and the cost of the work, will be found in the Annual Reports of the Minister of Public Works, the last being Appendix to Part IV, in the report of the Chief Engineer of that department, for the fiscal year ended June 30, 1904.

PHYSICAL FEATURES.

For many years the 'Ship Channel' has been described as being between Montreal and Quebec.

Artificial navigation or dredged channels do not, so far, exist below Quebec. The depth at low tide, however, over the St. Thomas shoals, is only 24 feet and on the Beaujeu Bank only 20 feet.

The improvement, by dredging, of navigation at these localities having been undertaken by the Department, and a more systematic supervision of the contracted river channel down as far as below the St. Roch Traverse, 65 miles below Quebec, having been urged; the limits of the River St. Lawrence Ship Channel have been extended and now include all the River St. Lawrence between Montreal and The Traverse, a total distance of 225 miles.

From Montreal to Three Rivers, 82 miles, there is practically no tide.

From Three Rivers to Batiscan, 20 miles, the tide can always be felt, but owing to uncertainty of time and height, it cannot be depended upon for navigation.

From Batiscan to Portneuf, 22 miles, during six hours out of twelve, half-tide giving an additional depth of from 1½ to 4 feet, may be taken advantage of, by passing during those six hours.

From Portneuf to Quebec, 36 miles, there is a tide of from 9 to 15 feet, giving tidal navigation for about nine hours out of every twelve.

From Quebec to Crane Island, 40 miles, the tide is 13 feet at Springs and 18 feet at Neaps and as there is a depth of 20 feet at the Beaujeu Bank, at extreme low water,

there is navigation, therefore, in this division, of from 33 to 38 feet at high tide or 26½ to 29 feet at half-tide.

The water in the river has a very great annual fluctuation. The average height above ordinary low water is for May, 6½ feet; June, 4½ feet; July, 3½ feet; August, 1½ feet; September, 1 foot; October, ¾ foot; November, ¾ foot.

The current varies throughout. It is strongest at the St. Mary's Current in Montreal Harbour, at Cap à la Roche, at the Richelieu Rapids, and at the St. Roch Traverse. It is quite gentle in Lake St. Peter. The general average is about 2½ miles per hour.

The River St. Lawrence between Quebec and Montreal is usually free from ice about April 10, and closed to traffic about November 25, making the season of navigation about 7½ months.

The river is particularly adapted for improvement. The water is almost free from matter in suspension which may deposit itself in excavated channels and fill them up. The river bottom is almost everywhere of such a character that when a cut is once made it remains unchanged. There are many difficulties such as hard material, strong currents, bad weather; but no dredging work in the world can show better results, or more permanence.

DIVISIONS.

The Ship Channel, for the purposes of organization and details, has been divided into five divisions:—

Division I, Montreal to Sorel.

The eastern limit of that part of Montreal Harbour under the Harbour Commissioners extends to Longue Pointe, about six miles below the Montreal Custom House. Formerly this limit was opposite Ruisseau Migeon at Maisonneuve. Since the extension of Montreal Harbour to Longue Pointe, the dredging of the Ship Channel, as undertaken by the government, commenced at Longue Pointe. The Longueuil shoal situated just below the St. Mary's Current, opposite Maisonneuve, was not therefore included in the Project of 1899, although the dredging at that point, as formerly conducted by the Montreal Harbour Commissioners, was included in the Ship Channel operations.

At the earnest request of the Shipping Federation of Canada, the dredging of this shoal has this year been undertaken by the Department, and included in the work of improvements of the Ship Channel. Owing to strong current and the very hard material, the Harbour Commissioners could not do the work suitably with their own plant, and in order to make available the improved navigation of the Ship Channel, the deepening of Longueuil cut could not longer be delayed.

Last year's announcement of the completion of the work in Division I, must, therefore, now be amended. Work at Longueuil was commenced in August, 1905, and two powerful dredges will be required most of next season to complete it.

The addition of this work will add 1½ mile to the total length formerly given as requiring improvement.

Division II, Sorel to Batiscan.

Except for the addition of the unexpected work at Longueuil, the completion of all the work in this division was expected to have been announced in this report. There remains, however, about three months' work to complete the dredging in this division, which extends to the head of available tide water.

Division III, Lake St. Peter.

The channel through Lake St. Peter is being left entirely to the powerful hydraulic dredge *J. Israël Tarte* (No. 7).

The length of dredging in one stretch is 18 miles. In this distance over 13½ miles have been deepened to 30 feet, with the three important curves widened to 600 feet.

It is expected that before the 30-foot depth is completed at Longueuil it will also be available through Lake St. Peter.

Division IV, Batiscan to Quebec.

From Batiscan to Quebec, a distance of about 60 miles, improvements require to be made over a length of about 10 miles, one mile of which is already completed to the 30-foot depth.

In this division there are about four miles of work to be done, at Cap à la Roche and Cap Charles, mostly in solid shale rock.

This is one of the most important and difficult sections of the Ship Channel work and the organization is now being planned to commence operations there in 1906.

The channel plant is particularly well adapted for this work, the only question being the fact that even with the six elevator dredges the work will not be completed, as was expected, before the arrival of the 15,000 ton ships.

In consideration of the fairly soft character of the shale rock, of the strong current and of the fact that the work must be carried on without interrupting navigation, the elevator dredge is by far the most economical and efficient machine known. A powerful spoon dredge may tear up a certain quantity of soft rock more quickly, without stopping to make a clean even bottom, chisel cutters and blasting plants may break up harder material, but taking everything into consideration the type of plant in the possession of the Department is particularly well designed for good clean work, without interrupting navigation.

The Shipping Federation of Canada is now asking for one or two additional dredges in order to have the whole work of both widening and deepening completed in a proportionately shorter period of time.

THE RIVER ST. LAWRENCE SHIP CHANNEL BELOW QUEBEC.

Division V, Quebec to the Traverse.

The 30-foot channel at low water between Quebec and Montreal is now well on towards completion. In two or three years we will have vessels sailing between these places at all stages of the tide, while below Quebec, until improvements are made, they will require to wait so as to pass the St. Thomas and Crane Island shoals at from half to full tide.

In the spring of 1901, the matter was brought to the attention of the Honourable the Minister of Public Works by the shipping interests of Montreal. The officers of the Marine and Fisheries Department at Quebec, who had an intimate knowledge of this part of the river, strongly recommended for improvement the North Channel, commencing below the Island of Orleans, as being better, more easily navigated and more clear of ice in winter.

Orders were given to the Ship Channel staff to make a survey and examination of the North Channel with a view to reporting on the practicability and cost of improving that route and adopting it for navigation.

In 1902, a similar survey was made of the South Channel, to ascertain what improvements would be required to make a good 30-foot channel on the line of the present route.

A comprehensive report was made on February 24, 1903, to the Acting Chief Engineer of the Public Works Department, on the question of the proposed improvements below Quebec.

It was reported, by the present Superintending Engineer for the Marine and Fisheries Department, that all the improvements required by dredging are, by either the north or south channels, between St. Jean, Ile d'Orléans, and opposite Murray Bay.

The dredger required for either would be practically the same, the material everywhere being soft.

It was estimated that for either route, the cost, including the required plant, to give a 30-foot channel 1,000 feet wide, would be about \$1,000,000, and it was urged that immediate steps should be taken to provide the dredger, which would require a year and a half to build.

The report did not recommend the adoption of either route but advised that the choice should meet with the approval of the Underwriters, the shipping Interests, and the Pilots.

The Transportation Commission visited the locality, going over each channel, and took evidence on the subject. It is hoped that they will go further into the question and give an opinion.

The decision as to the best channel need not be decided at once, but it was gathered from the discussion that it would not be wise to change the route at present.

It has therefore been decided to commence improving the South Channel, by dredging a channel as wide as can be made in one cut and to a depth of 30 feet at extreme low tide, in direct straight tangents which can be marked by powerful range lights. This, it is expected, can be completed in two seasons. By that time it can be finally decided whether to complete the South Channel to a width of 1,000 feet, or to undertake the North Channel, which, it is generally conceded, taking everything into consideration, would make the best route.

The general report of February 24, 1903, on the Proposed Improvements to Navigation below Quebec, covers the following subjects:—

Physical Features.

Present Navigation to Québec.

General Information.

Preliminary Examination.

North Channel—

Survey, 1901, with soundings, borings, &c.

Estimated quantity of sand to be removed, 8,000,000 cubic yards.

Question of Permanence.

Report by Doctor Robert Bell, Acting Director, Geological Survey.

Project of Dredging.

Estimated cost, \$1,000,000.

The Quarantine Station.

South Channel—

Survey of 1902.

Improvements.

Dredging.

Estimated cost, \$1,000,000.

Choice of Route.

Plant and Organization.

Specification of North Channel Improvements.

Specification of South Channel Improvements.

It is proposed to construct the dredge at the Government works at Sorel.

At the last session of parliament an amount was voted, on account of material and labour, towards the construction of a sea-going, steel, twin-screw, suction, hopper dredge, for improvements to the River St. Lawrence Ship Channel below Quebec, to be constructed at the Government Ship Yard at Sorel, at an estimated cost of \$350,000.

The ship channel elevator dredges have a world wide reputation. They have all been designed and constructed at Sorel. One of the reasons for their success is because they are built of massive strength, with good material and careful workmanship. They are not competitive construction, neither are they cheap, but it would be difficult to find another plant that would excavate in one year 6,500,000 yards, some of hard material, at an average of 4 cents per yard.

In designing this new dredge, the features that have given trouble in the other suction dredge have been modified and it is hoped that good results will be obtained.

The hull and general construction has been commenced at the Government's Ship Yard at Sorel.

It is estimated that this dredge will be completed and ready to commence operations in the spring of 1907.

PRESENT NAVIGATION.

The depth of water available for navigation in the ship channel is still governed by the few uncompleted portions of the 30 foot channel, between Montreal and Batis-
can.

From Batiscan to Quebec and outwards the tide is more or less available and by waiting for high tide, as indicated by semaphores, an increased draught may be carried.

Between Montreal and Batiscan, including Longueuil, in the distance of 100 miles, about 53½ miles required dredging. All of this has been deepened to 30 feet at the extreme low water of 1897, except 0·70 mile at Longueuil, 0·50 mile at Sorel, 4·60 miles in Lake St. Peter, 0·20 mile at Champlain curve and 0·60 mile opposite Batiscan.

At Longueuil there is room for only two dredges. The material is very hard and irregular, with seams of rock. It will take almost the whole of next season to complete it.

In the same time the work in Lake St. Peter, by leaving some of the widening, as well as the other small uncompleted portions, can be finished.

Although, therefore, the present depth of water, as given from day to day from the Sorel gauge, indicates the depth over these shoals, the benefit to navigation is very great, as vessels load to the limit and pass the bars very carefully and with engines almost stopped, so that they have very little 'dip,' and make greatly increased speed in the deepened and widened channels.

As the dredging in the different localities is completed, modern, powerful, permanent, range lights and gas buoys are established. This makes the channel safe for a great deal of night running, especially for vessels upward bound. The ships sailing from Montreal usually fix dates ahead and sail in the morning, so as to pass the difficult places during daylight.

Since the completion of the extensive improvements and the establishment of modern lights, many upward bound vessels which, formerly, were obliged to anchor for the night, now continue up to their dock at Montreal. The R.M.S. *Tunisian*, for example, one of the largest vessels on the St. Lawrence route, left Quebec after dark, during the month of October last, and actually reached Montreal shortly after daylight the next morning. Freight ships, with smaller crews, and more time between trips, do not require to take advantage of it so much, but a few hours to a mail and passenger ship and to the coal carriers means a great deal.

The depth of water in the 27½-foot channel was somewhat lower than last year, the lowest, late in November, having reached one foot below the lowest of last year. Except, however, for two or three days late in November, it did not go below the ordinary low stage, and at no time reached within one foot of the extreme low water of 1897. The depth in the 30-foot channel was consequently never less than 31 feet.

The average depth of water available for navigation with the greatest and least depths in each year, from May to November, since 1890, is given in the following table:—

| YEAR. | AVERAGE DEPTH FOR EACH MONTH. | | | | | | | FROM SOREL GAUGE DURING EACH YEAR, MAY TO NOVEMBER. | |
|-----------|-------------------------------|---------|---------|---------|---------|---------|---------|---|---------|
| | May. | June. | July. | August. | Sept. | Oct. | Nov. | Highest. | Lowest. |
| | Ft. In. | Ft. In. | Ft. In. | Ft. In. | Ft. In. | Ft. In. | Ft. In. | Ft. In. | Ft. In. |
| 1890..... | 35 6 | 35 3 | 31 9 | 30 6 | 30 9 | 29 9 | 30 6 | 37 0 | 29 0 |
| 1891..... | 34 6 | 31 3 | 29 9 | 29 9 | 30 0 | 28 3 | 28 3 | 36 9 | 27 3 |
| 1892..... | 31 0 | 31 9 | 31 6 | 30 6 | 28 9 | 28 3 | 28 3 | 33 6 | 27 3 |
| 1893..... | 36 0 | 34 3 | 30 9 | 29 9 | 29 6 | 28 6 | 28 0 | 37 6 | 27 6 |
| 1894..... | 34 6 | 31 9 | 31 0 | 29 2 | 28 3 | 28 9 | 29 0 | 36 0 | 27 7 |
| 1895..... | 33 3 | 31 3 | 28 3 | 28 3 | 27 5 | 26 9 | 26 9 | 34 6 | 25 10 |
| 1896..... | 33 6 | 30 6 | 28 9 | 28 0 | 27 6 | 27 9 | 29 0 | 37 0 | 27 4 |
| 1897..... | 35 6 | 32 6 | 30 3 | 29 3 | 28 0 | 27 0 | 27 6 | 37 0 | 26 5 |
| 1898..... | 31 6 | 30 9 | 29 8 | 28 6 | 28 2 | 28 3 | 28 6 | 32 1 | 26 9 |
| 1899..... | 36 2 | 31 9 | 30 3 | 28 6 | 27 6 | 28 3 | 27 9 | 37 9 | 26 9 |
| 1900..... | 33 6 | 30 9 | 30 6 | 29 6 | 28 1 | 28 9 | 29 2 | 35 9 | 27 4 |
| 1901..... | 34 3 | 31 10 | 29 2 | 28 3 | 27 7 | 27 4 | 27 3 | 36 3 | 26 6 |
| 1902..... | 32 2 | 32 2 | 32 2 | 29 4 | 28 1 | 28 1 | 29 0 | 34 1 | 27 6 |
| 1903..... | 33 0 | 30 11 | 30 5 | 29 5 | 28 4 | 29 0 | 27 11 | 32 8 | 26 11 |
| 1904..... | 36 3 | 34 5 | 30 9 | 29 5 | 29 5 | 30 4 | 29 3 | 37 4 | 28 1 |
| 1905..... | 31 10 | 30 8 | 29 7 | 29 0 | 28 0 | 28 5 | 28 1 | 33 6 | 27 1 |

ACCIDENTS.

The season of 1905 will be a memorable one on account of the number and seriousness of the casualties.

There are, however, causes for thankfulness and satisfaction in that there was no loss of life and, so far, no total loss of vessel.

Of the accidents to sea-going vessels, not one was in any way due to the Ship Channel proper.

Most of the casualties occurred at places where dredging has not been done or required; owing to unavoidable 'accident,' faulty navigation or machinery.

The following is a list of the accidents in the St. Lawrence, including Montreal Harbour:—

| Name of Vessel. | Date. | Depth of water in Ship Channel at Locality. | Locality. | Remarks. |
|---|-----------|---|---|---|
| | 1905. | Ft. In. | | |
| SS. <i>Tampican</i> | July 12.. | 29 5 | Montreal Harbour | Grounded on shoal. Damage slight. |
| SS. <i>Agnar</i> | " 17.. | 30 9 | " | Grounded near Longue Pointe. No damage. |
| SS. <i>Corinthian</i> | " 27.. | 29 1 | " | Grounded. Hawser of tug breaking. Slight damage. |
| SS. <i>Polino</i> | Aug. 1.. | 29 6 | Ship Channel, Bécancour . . . | Draught 12 ft. Out of course at night. No damage. |
| R.M.S. <i>Victorian</i> | Sept. 1.. | 34 0 | Ship Channel, Cap Charles. | Grounded on edge of dredged cut in fog. |
| SS. <i>Virginian</i> | " 1.. | | Below Quebec, Crane Island. | Grounded and filled. Heavy damage. |
| SS. <i>Wastwater</i> | " 14.. | | Below Quebec, Anticosti. | Grounded in fog, according to reports. |
| SS. <i>Universe</i> vs. barge <i>Bath</i> , in tow of str. <i>Bay State</i> and M.H.C. dredges. | " 29.. | 28 10 | Montreal Harbour. | Collision. M.H.C. dredge was sunk. |
| SS. <i>Euphemia</i> and <i>Tordenskjold</i> . | Oct. 23.. | 50 0 | Ship Channel, St. Antoine. | Collision. Channel $\frac{1}{2}$ mile wide. |
| R.M.S. <i>Bavarian</i> | Nov. 3.. | | Below Quebec, Wye Rock, near St. Thomas | One-half mile south of channel. Pilot suspended. |
| SS. <i>Angola</i> | " 21.. | 27 6 | Montreal Harbour. | Grounded at Longue Pointe in fog. No damage. |

It will be seen that of the 11 casualties to vessels of over 10 feet draught, 5 occurred in Montreal Harbour, 3 in the St. Lawrence Ship Channel between Montreal and Quebec and 3 below Quebec.

Of the accidents in the Harbour of Montreal, 3 occurred at points where the channel does not require dredging, the fourth on the departure of the *Tampican* from her dock to proceed to sea, and the fifth was a collision.

Between Montreal and Quebec, the *Polino* went ashore at night without having a licensed pilot aboard. The *Victorian* went ashore in a fog, under very bad conditions, at one of the very worst places, on a rock bottom, and, by a splendid example of wrecking, she was floated and was able to proceed under her own steam. The third accident was a collision at night at a point where the channel is $\frac{1}{2}$ mile wide and 50 feet deep.

Of the three accidents below Quebec, one was at Anticosti and the other two were within 40 miles of Quebec. In one case the ship struck and filled, but was subsequently floated with heavy damage, and, in the other, the ship went over half a mile out of her course and struck Wye Rock, where she now remains in a dangerous position.

Therefore, with the possible exception that if the channel at Cap Charles had been widened from 300 to 450 feet, as proposed, the *Victorian* would have had more chances of going through in the fog, on a compass course, no amount of dredging would have averted any of the accidents between Montreal Harbour and Quebec. It would therefore appear that the Ship Channel has come in for more than its share of blame, especially when it is considered that over 1,200 sea-going vessels passed both up and down during the season.

GENERAL INFORMATION.

Although, with the exception of some minor shoals at Champlain, there is practically no filling in, and although, since its commencement, no actual boulders have

been known to have been carried into the dredged channel, as such conditions are possible, it has been decided that once a year the dredged and shallow channels shall be swept.

This is a large problem. The work has to be done with very great care and good weather conditions are required.

Mr. N. B. McLean, C.E., with an assistant, were specially detailed for this important work. A twin screw river steamer and a testing scow make up the present sweeping plant. When the channel was 300 feet wide and only 60 miles required sweeping, this plant was sufficient. The work below Batiscan, including Cap à la Roche, where the weather is bad and the current strong, was then left until mid-summer.

As the lower portions of the river are considered most liable to be obstructed, and as vessels were reported to have touched, several cases of additional sweeping have been called for in early spring and late autumn. It is almost impossible to do the work with the present plant. A general purpose steamer, large and powerful enough to carry the sweeping apparatus aboard and to be independent of weather conditions, deep water, and strong current, has been repeatedly asked for to enable the sweeping to be done in the exposed places above and below Quebec. This sweeping tug is also required for other purposes, towing dredges and safeguarding navigation, buoys, &c., in the autumn.

During the course of the sweeping, in 1905, no obstruction of any serious nature was found. Two or three vessels were reported to have touched, both above and below Quebec, but the most careful examination failed to reveal anything in the channel.

Two semaphores, indicating the channel depths in their respective localities, were maintained as usual, the one at St. Jean des Chaillons for the depth in the Cap à la Roche dredged cut, and the other at St. Nicholas for the depth over the undredged St. Augustin Bar.

The season of 1905 was a record one for both the number of vessels, the total tonnage and the maximum size of vessels coming to Montreal.

From the latest information the number of sea-going vessels reaching Montreal, in 1905, was 833, or over 4½ per cent more than last year.

The total ocean-going tonnage for the season reached 1,940,056 tons, also an increase of over 4½ per cent.

The coal traffic from the lower ports to the St. Lawrence also showed a slight increase over last year.

The ocean-going and coasting ships to Montreal, therefore, together numbered over 1,200, or about 7 for each day of the season.

Seven vessels up and seven down, in the Ship Channel, together with the river craft of all sorts, makes quite a substantial traffic, or as much as 50 loaded railway freight trains per day, each way, without counting the passenger traffic.

This on a highway which, with plant, has only cost \$8,500,000, or about \$50,000 per mile, the same as a first-class railroad, and costing at the same time practically nothing for maintenance.

NAVIGABILITY OF THE ST. LAWRENCE.

The extreme lowest water in the Ship Channel to Montreal, in 1905, was 27 feet 1-inch, which occurred during the week of the close of navigation. The lowest average for a month was 28 feet 1-inch also in November. As soon as the 30-foot channel is available, which is expected next autumn, there will be an additional depth of 4 feet.

That will be tidal navigation at least 12 hours out of the 24, up to Quebec and over the St. Augustin Bar. Cap à la Roche will require to be passed at high tide.

Although in dredging an extra foot is made, to allow for slight inequalities, the full draught cannot be carried on account of the 'dip' of vessels. This is greatest in ships built for speed, and increases with the speed, and inversely, to a great extent, with the

body of water in the channel. The bow forces the water ahead, the propeller drives it aft, and the vessel settles down in the trough between the two waves.

Frequently ships have been seen, which left Montreal on a registered draught of 26 feet, drawing in Lake St. Peter, going at less than half speed, 23 feet. In many cases fresh water is taken aboard in large quantities, sometimes unknown to the officers and frequently without the knowledge of the pilot.

The depth of water in the channel at Sorel and Cap à la Roche is reported daily and the port authorities deduct a certain amount to allow for this extra submersion. As it has been known that the water varied from the day of the gauge reading, to the next, when the ship was in the channel, a deduction of 9 inches is made before reporting from the gauges. This occasionally allows the ships, in the low water season, at Montreal, only a draught for clearing of 25½ feet, which is not sufficient. The additional 4 feet expected next year will be greatly appreciated.

It is stated that the average load-line draught of 50 modern vessels is over 30 feet. 'Engineering' states that there are only two, or at most three ports in the world always accessible to them. Six of the most important ports in the world could be reached fairly constantly, while the docks at Havre, Hull, Cardiff, Avonmouth, Glasgow, Antwerp and Boston would only be temporarily accessible.

The same authority states that, though doubtful, Amsterdam might be reached, but Hamburg, Bremen, Dunkirk, or Rotterdam, never.

The situation of the St. Lawrence ports of Quebec and Montreal is therefore most hopeful.

Further improvements to give any reasonable depth by dredging are not only possible but may be obtained at much smaller cost than for many of the rival ports, and requiring a very slight cost for maintenance.

It is stated that the draught of 30 feet will, in all probability, be 'deemed mediocre at no distant date'

On the other hand, considering the great necessary outlay for ports, it is possible that ship builders may take a lesson from the success of the Marine of the Great Lakes. There, the draught is limited to 20 feet or thereabouts, by canals and channels as well as ports, and yet nowhere in the world is freight carried more cheaply. It is to be hoped that at least some attention will be given to the possibility of further developments in tonnage, on the lines of the 12,000 ton freighters on the Great Lakes.

R.M.S. 'VICTORIAN.'

One of the most trying and difficult features that has ever arisen in connection with the construction and maintenance of the River St. Lawrence Ship Channel was the case of the *Victorian*.

Friday, September 1, was a bad day in the history of the St. Lawrence. The premier vessel of the route, the new turbiner *Victorian*, went ashore under bad conditions at Cap Charles. On the same day the large Leyland freighter *Virginian* grounded and filled at Crane Island, about 40 miles below Quebec.

Smoke from forest fires, accompanied by fog, makes the worst possible conditions on the St. Lawrence. These, fortunately, rarely come together.

When it was learned, therefore, that the largest steamship of the route had gone aground under these conditions, at nearly high tide and at one of the worst places between Montreal and Quebec, the most widespread regret was manifested.

The trouble was to float her, and the danger, that she would swing around and block the narrow channel and not only stop traffic for a considerable time but probably be a total loss.

By prompt and direct orders from the Honourable the Minister, the resources of the department were at once placed at the disposal of the *Victorian*, to obviate that danger.

When it is known that with the ebb tide there is a current of over 5 miles per hour, the river bed rock, the channel only 300 feet wide and the ship 540 feet long, some of the dangers and difficulties will be realized. On the bank where the vessel was aground there was a depth, at low water, of 18 feet, and in the dredged cut 9 feet more. The tide gave an additional depth of 7 feet at springs and 4 feet at neaps.

That there was no serious delay to traffic, and that the vessel was successfully floated on September 12, and able to reach Quebec under her own steam, is a matter for some gratification.

The bad effect of this 'marine disaster' was greatly modified therefore by the success of the efforts to float her, by the assistance given by the Government, and by the fact that notwithstanding such a combination of bad conditions, the damage was so much less than could be hoped for.

By a unanimous resolution adopted by the Shipping Federation of Canada on September 18, the Federation expressed their thanks to the Government for the prompt action and valuable services rendered, in connection with the stranding of the R.M.S. *Victorian*, and in relieving a very critical situation in the navigation of the St. Lawrence.

A copy of this resolution in full, bearing the seal of the corporation, was forwarded to the Right Honourable Sir Wilfrid Laurier, Premier of the Dominion of Canada.

PROJECT OF 1899.

In 1899 the dredging plant was in a position to warrant the commencement of an extensive plan of operations, and the 30-foot channel was undertaken.

The low water of 1897, the lowest on record, except the short period of extraordinary low water of 1895, was adopted as the plane of river level at which the channel would be made 30 feet in depth.

It was also decided to make the channel as wide as could be dredged in one cut, viz., 450 feet.

The project of 1899 had for its object the dredging, in the shortest possible time of a ship channel between Montreal and Quebec for safe 30-foot navigation.

The minimum width for the tangents has been fixed at 450 feet, but the bends are widened out to from 500 to even 750 feet. The dredging is being done to give a clear depth of 30 feet at the E.L.W. of 1897.

The average navigable depth in this channel, as being dredged, during the season of 1905, was as follows: May, 35 feet 6 inches; June, 34 feet 4 inches; July, 33 feet 3 inches; August, 32 feet 8 inches; September, 31 feet 8 inches; October 32 feet 1 inch; November, 31 feet 9 inches.

The greatest depth from May to November was 37 feet 2 inches, and the least, at the end of November, 31 feet.

COST OF SHIP CHANNEL TO DATE.

TABLE showing the Total Cost of the Dredging and Plant, and the Quantities dredged up to June 30, 1905.

| | Cost of Dredging. | Expenditure for plant, shops, surveys, &c. | Quantities dredged. |
|--|-------------------|--|---------------------|
| | \$ cts. | \$ cts. | Cubic yards. |
| <i>Montreal Harbour Commissioners—</i> 1851 to 1888. | | | |
| Dredging Montreal to Cap à la Roche to 27½ feet at ordinary low water, and from Cap à la Roche to Quebec to 27½ feet at half tide | 3,402,494 35 | 534,809 65 | 19,865,693 |
| <i>Department of Public Works.</i> | | | |
| Dredging consisting of widening and cleaning up of channel; deepening Cap à la Roche to Cap Charles to 27½ feet at ordinary low water, and dredging at Grondines, Lotbinière and Ste. Croix—1889 to June 30, 1899. . . . | 829,583 08 | 426,971 79 | 3,558,733 |
| Project of 1899—Dredging channel between Montreal and Quebec to 30 feet at lowest water of 1897; also, widening to a minimum width of 450 feet and straightening— | | | |
| Fiscal year 1899-1900 | 100,191 01 | 265,270 78 | 1,107,894 |
| " 1900-1901 | 136,680 83 | 287,040 04 | 2,479,385 |
| " 1901-1902 | 185,429 80 | 479,731 47 | 3,098,350 |
| " 1902-1903 | 255,776 55 | 277,703 50 | 6,544,605 |
| " 1903-1904 | 276,958 59 | 308,765 44 | 4,619,260 |
| <i>Department of Marine and Fisheries.</i> | | | |
| Fiscal year 1904-1905 | 311,087 93 | 266,460 33 | 2,716,220 |
| | 5,498,202 14 | 2,906,753 00 | 43,990,140 |

DREDGES.

Laval (No. 1).—Of the fleet of Ship Channel dredges, this is the oldest. The hull is of wood, constructed in Ottawa, in 1894. The buckets are made of cast steel for work in rock and other hard material.

The details of the operations of this dredge for the fiscal year were as follows:—

From the commencement of the fiscal year until October 19, 1904, the *Laval* worked at widening and deepening the channel between Becancour and Ile Bigot, in hard material consisting of clay, stones and hard-pan. The dredge was then taken up to work on the channel between Sorel and Ile de Grâce, in soft clay, until the end of the season, November 26.

On the opening of the season of 1905, this dredge was laid out on May 14 to widen and deepen the channel at Becancour Traverse, the material being clay and boulders, very hard and difficult to dredge, and requiring the constant services of a stone-lifter. She continued to work there until the end of the fiscal year.

In a total of 173 days during which this dredge was at work, her machinery was in actual operation 63 per cent of the full working time.

The total quantity dredged amounted to 215,925 cubic yards, at a cost of \$39,027.20, or 18 $\frac{1}{100}$ cents per cubic yard.

Laurier (No. 2.)—The hull of this dredge is also of wood, having been constructed at the Government Works at Sorel in 1897. Her buckets were formerly of large size, built up from cast steel bottoms, for working in soft material. As almost all the work in soft material was completed, the buckets were changed during the winter of 1903-04 and replaced by smaller and stronger buckets, having sufficient teeth for working in hard-pan, &c.

During the winter of 1904-05 this dredge was thoroughly overhauled and had the above water parts of the hull rebuilt. Additional quarters were also provided for the crew.

From July 1, 1904, this dredge worked at Port Francis on Force Shoal, widening and deepening, the material being very hard clay with embedded boulders. When this work was completed on July 18, the *Laurier* was taken to work on the channel between Becancour and Ile Bigot, where the material consisted of clay, sand, stones and hard-pan. On November 15, she was also taken up to work on the channel between Sorel and Ile de Grâce, where she continued until taken into winter quarters on November 25. Owing to extensive repairs to hull and machinery the dredge was only taken out on May 15, 1905, and placed to work at Pointe Citrouille, widening and deepening the channel to Champlain, where she continued till the end of the fiscal year, the material being clay and sand.

The number of days during which this dredge was in operation was 165, and the percentage of time at actual work, 52 per cent.

During the fiscal year she removed 149,750 cubic yards at a total cost of \$41,271.38, or 27⁵/₁₀₀ cents per cubic yard.

Lady Aberdeen (No. 3.)—The hull of this dredge is of steel, the vessel complete having been constructed at the Sorel works in 1900. The buckets were originally designed for working in soft material, but were replaced by a complete new set of cast steel buckets especially designed for working in rock or other hard material.

At the commencement of the fiscal year this dredge was working at Port St. Francis, on Iron Shoal, where the material was very hard, consisting of sand, stones and hard-pan. She worked there until November 14, when she was taken up to work on the channel between Sorel and Ile de Grâce, and continued working there until the end of the season.

On the opening of the season of 1905 she was taken back to Port St. Francis on April 26 and laid out to work on Iron Shoal, where she had left last season, and worked there until its completion. The dredge was then taken down to Champlain and laid out to work on the curve, widening and deepening, and was still at work at the end of the fiscal year, the material being sand, clay and stones.

During the year this dredge was at work 181 days with the machinery in actual operation 64 per cent of the full working time.

The total number of cubic yards removed amounted to 295,400 at a cost of \$39,163, or 13²/₁₀₀ cents per cubic yard.

Lady Minto (No. 4.)—Dredge 'No. 4' is of the same type and design as the *Lady Aberdeen*. In the winter of 1903-04, the buckets were changed from those adapted for soft material to a cast steel set for working in hard material.

During the whole of the season of 1904, including the five best months of this fiscal year, the dredge was absent from the Ship Channel, having been removed by the Public Works Department for work at Rivière Ouelle wharf and on the Rivière Saguenay.

The dredge unfortunately met with a serious accident, and when returned to Sorel was in very bad condition, the steel bucket frame having to be practically rebuilt.

The Public Works Department paid for the actual operations of the dredge when absent, but the cost of the extra heavy winter repairs was paid from the Ship Channel appropriation. As the dredge only worked on the Ship Channel for about two months,

and then, in very hard material, the results in yards excavated were small and the extra cost, being divided over one-third of a season, was extraordinarily high.

In the 59 days of work the actual operations were carried on for 65 per cent of the full working time, and 56,200 cubic yards removed at a cost, including the complete winter and extra repairs, of \$25,409.05, or 45²/₁₀₀ cents per cubic yard.

Lafontaine (No. 5).—This vessel is probably the best dredger of her type in the world. The hull is of wood, the work of the Sorel shipyard, completed in 1901. She was fitted out with large, but very strong, built up buckets for soft material, with which she worked during the first half of the fiscal year, but during the winter of 1904-05 these were replaced by a complete new set of cast steel buckets for working in rock and other hard material.

From the commencement of the fiscal year until August 2, the *Lafontaine* worked at the foot of Lake St. Peter, on Nicolet Traverse, in blue clay with some stones. She was then placed at Pointe Citrouille, widening and deepening the channel between Pointe Citrouille, and Champlain, in clay, sand and a few stones, and continued to work there until November 19, and from that date until November 26, when she went into winter quarters, she worked on the channel between Sorel and Ile de Grâce.

On April 25, 1905, this dredge was taken to work on Becancour Traverse where the material was exceedingly tough and difficult to dredge, consisting of hard-pan and embedded boulders. She continued working there until the end of the fiscal year.

The working time of the *Lafontaine* was 181 days, the dredge being in actual operation 61 per cent of the full working time.

The total number of cubic yards removed amounted to 574,000 at a total cost of \$44,237.71, or 77⁰/₁₀₀ cents per yard.

Baldwin (No. 6).—This is the newest vessel of the elevator dredge fleet. The hull is of wood, constructed at the Sorel ship yard in 1902.

During the winter of 1903-04, the buckets were rebuilt and strengthened, and during the winter of 1904-05 sufficient teeth were added to the buckets for working in hard-pan, &c.

At the commencement of the fiscal year, this dredge was working at Becancour in very hard material consisting of hard-pan and embedded boulders. She worked there until August 8, when she was taken up to the foot of Lake St. Peter, on Nicolet Traverse, and laid out to dredge a short piece of hard work that had been left by dredge *Lafontaine*. After completing this work on August 25, she was taken down to Champlain where she remained until November 14, and was then brought up to work on the channel between Sorel and Ile de Grâce, until taken into winter quarters on November 25, 1904.

In 1905, after leaving winter quarters on May 6, the *Baldwin* was laid out to work at Champlain where she had left off last season and continued there until the end of the fiscal year.

The number of days during which this dredge was in operation was 172, and the percentage of time at actual work, 67 per cent.

The total number of cubic yards removed amounted to 301,820 at a cost of \$42,677.59, or 14¹/₁₀₀ cents per yard.

J. Israël Tarte (No. 7).—The hydraulic dredge *J. Israël Tarte* began work only on September 25, on account of having four new marine boilers put in, and also the extensive alterations made throughout the dredge, as well as in the machinery and discharge connections. She thus lost the three best months of the dredging season.

The dredge was placed to work at the head of Lake St. Peter on Ile aux Raisins Traverse, widening and deepening, the material being sand, clay and hard-pan. She finished there on November 24, and went into winter quarters.

At the commencement of the season of 1905, the dredge was placed to work at the foot of Lake St. Peter, at No. 3 curve, on May 18, and continued to work there until the end of the fiscal year, the material being blue clay.

In the 92 days, the dredge was in actual operation 67 per cent of the full working time. The total number of cubic yards removed amounted to 1,123,125 at a cost of \$79,302.02, or an average of 70⁹/₁₀₀ cents per cubic yard.

GENERAL NOTES.

The Ship Channel plant consists of 7 large dredges, 12 tugs, 2 stone-lifters, 4 coal barges and a large number of scows of various dimensions.

During the winter months the whole of this plant is thoroughly overhauled and repairs and renewals made where required, so as to be ready for commencing operations on the opening of navigation.

The dredges are operated 132 hours per week, or steadily from midnight on Sunday until noon on Saturday. Stops are only made for repairs, for shifting from one place to another, bad weather or to give room for passing vessels. Coal is supplied by barges without stopping the work.

The constant steady work in exceedingly hard material, at a depth of from 32 to 42 feet, is very hard on machinery. Only the very best designed and well constructed plant can stand it. Traffic must not be interrupted and the work must always be carried on in the more or less swift current.

The material is increasing in hardness from year to year, as the work nears Quebec. All the soft material, except the remainder of the work in Lake St. Peter, is now completed. A dredge that can remove 6,000 yards per day in soft material, without trouble, is more fatigued by dredging 1,000 yards of hard-pan in which boulders are imbedded.

The work of 1905 has been harder than during any of the previous seasons. The dredges, when taken into winter quarters late in November, showed broken teeth and twisted buckets and general signs of the exceedingly hard work to which they were subjected.

The dredging plant is owned and operated directly by the government.

The first dredges were designed and the machinery built in Scotland, the home of elevator dredges.

Since 1872, all of the plant has been designed and constructed in Canada, and many improvements in dredge machinery have been made by the skilled engineers who have from time to time been connected with this work.

The best and most efficient plant is an absolute necessity.

All the superintendence and management devolves on the officers of the department.

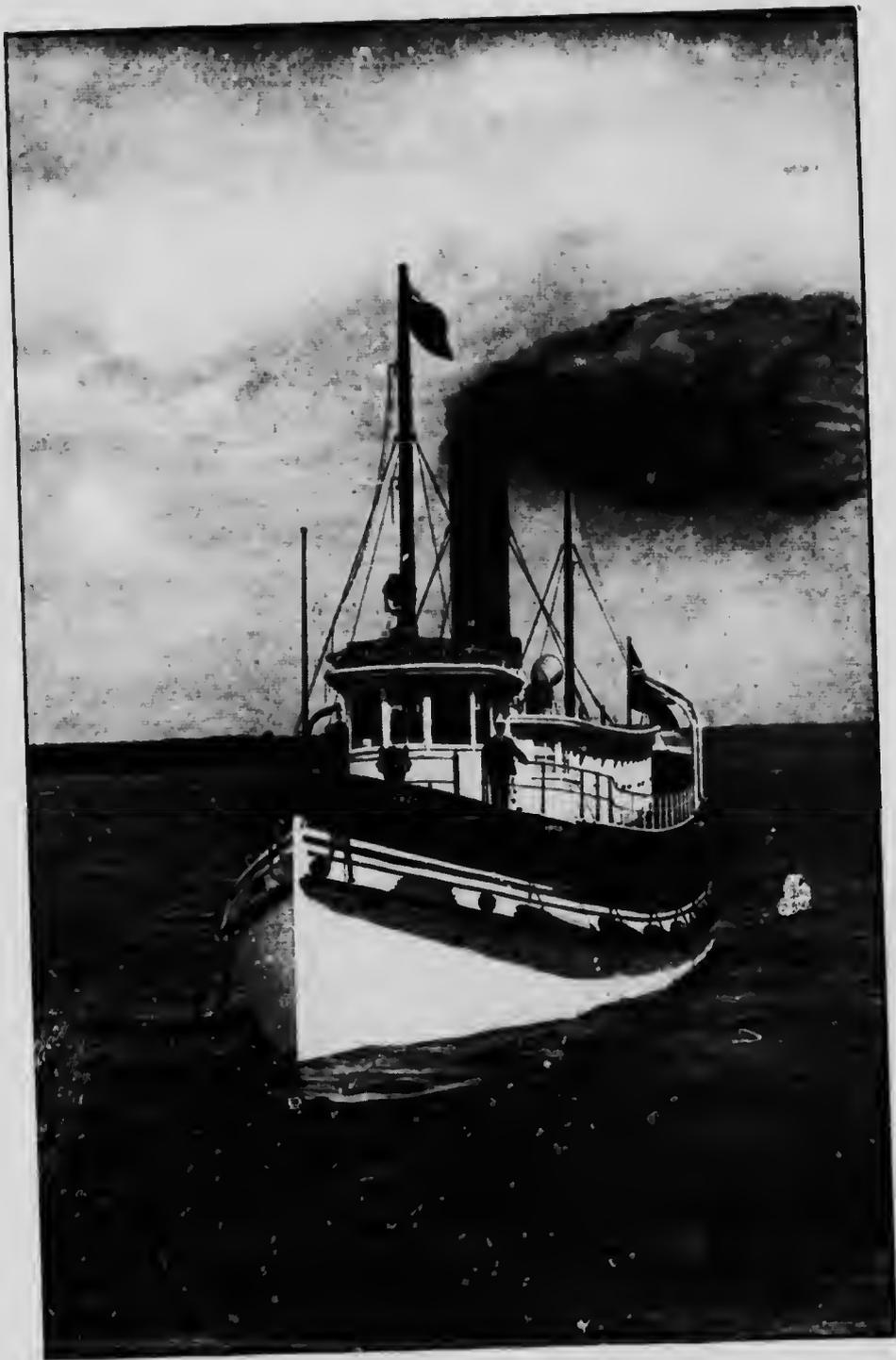
The construction and repairs and the management of the Sorel works are in charge of Mr. G. J. Desbarats, C.E., Director of the Ship Yard at Sorel.

The design of the improvements, the engineering branch, as well as the superintendence of the operations are directly under the Superintending Engineer.

The work of the very efficient staff and the details of the placing of the dredges are conducted by Mr. V. W. Forneret, C.E., in a very able manner.

About 400 men are employed in connection with the dredging operations. Those men, all sailors, were born and brought up at Sorel or at some of the parishes bordering on the River St. Lawrence. Most of them have been trained to the service from boyhood. The senior captain of the fleet makes the statement that he has never earned a cent in any other service. A great deal of the success of the operations is due to this good training. The work requires extraordinary care and great patience, the machinery being forced to the utmost and passing vessels requiring to be constantly watched for.

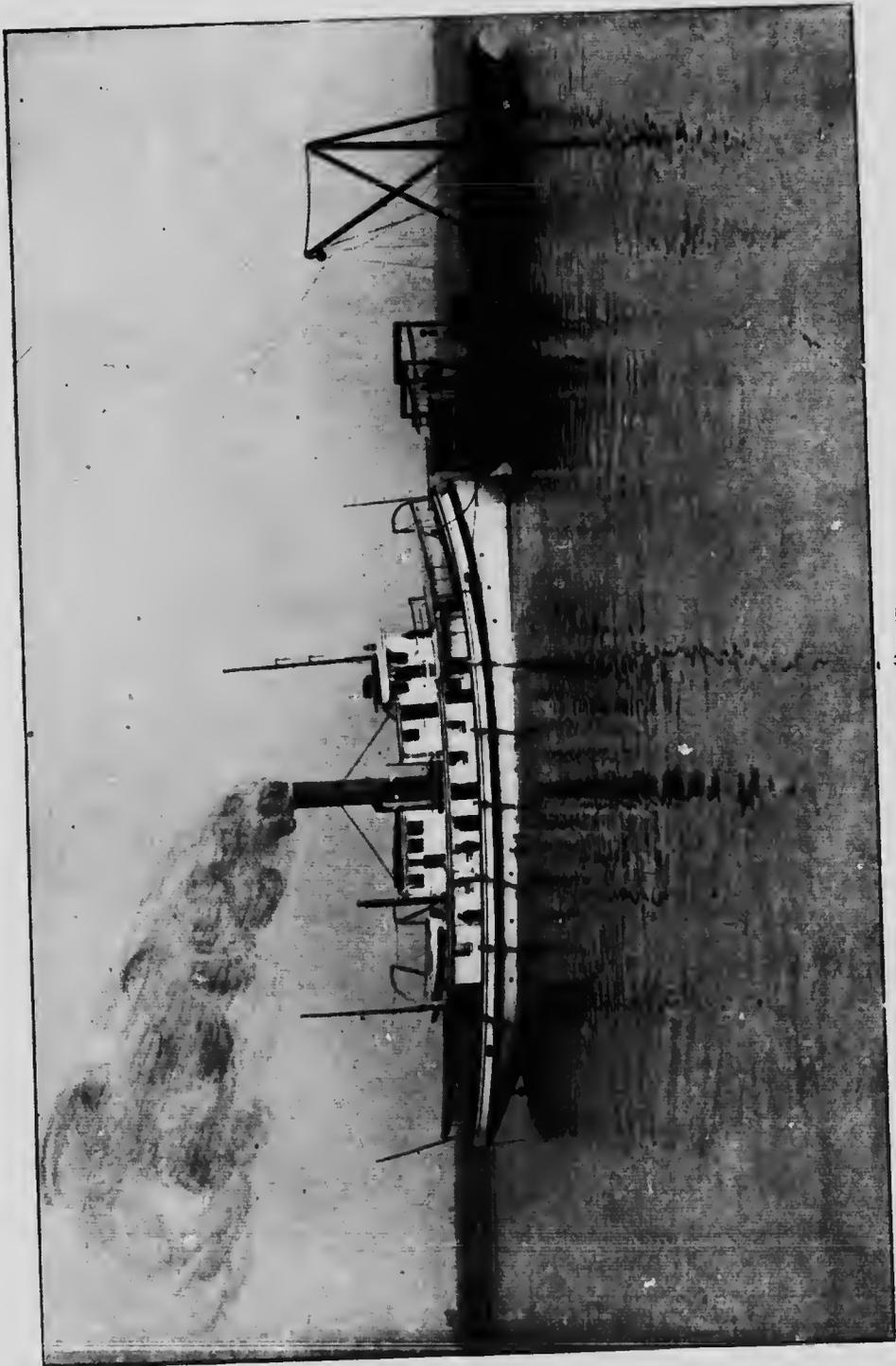
A captain and an engineer are in general charge respectively of the vessel and machinery. The remainder of the crew is divided into 2 watches, and works in shifts of 6 hours. At noon on Saturday the work stops.



INSPECTION TUG "FRONTENAC."

21-6c





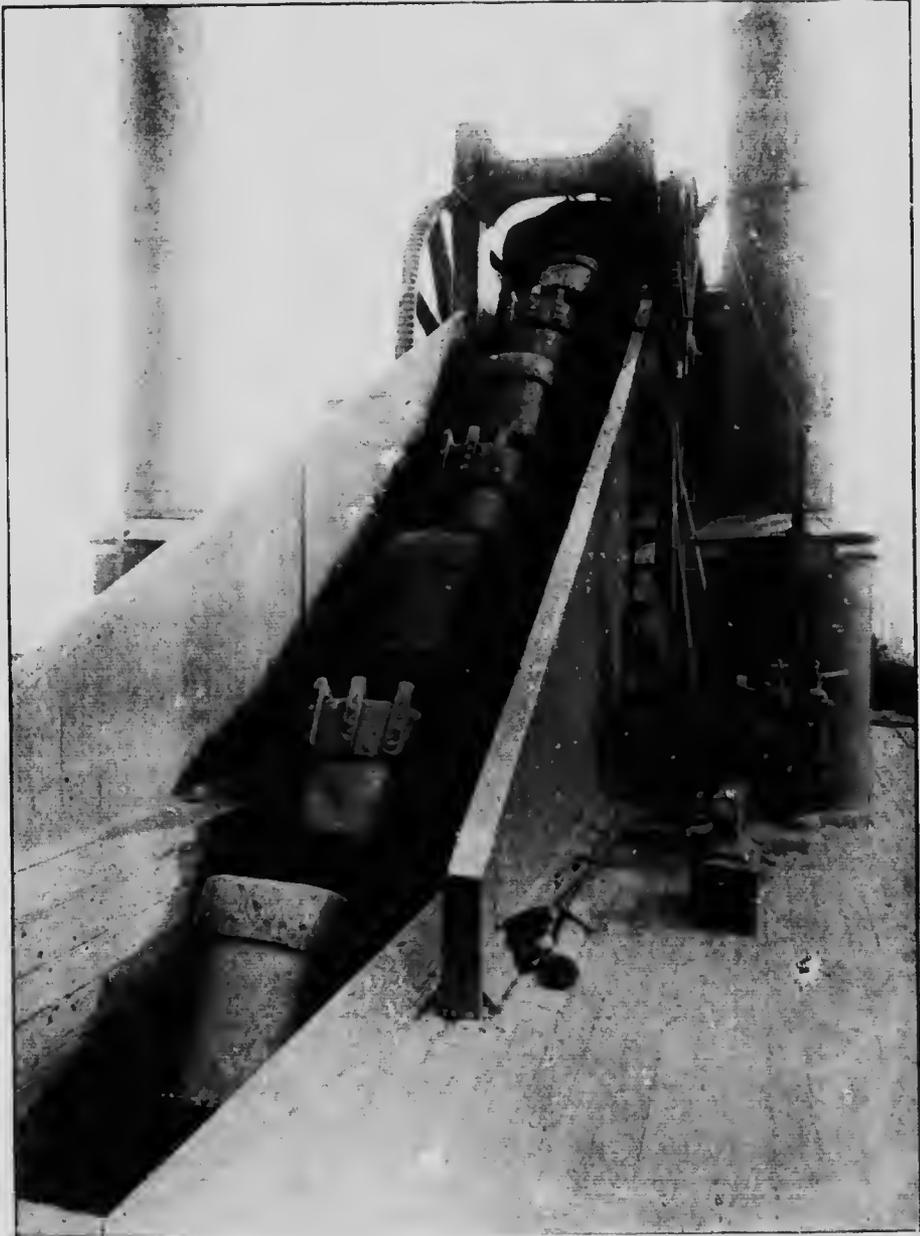
SWEETING OFFIT.



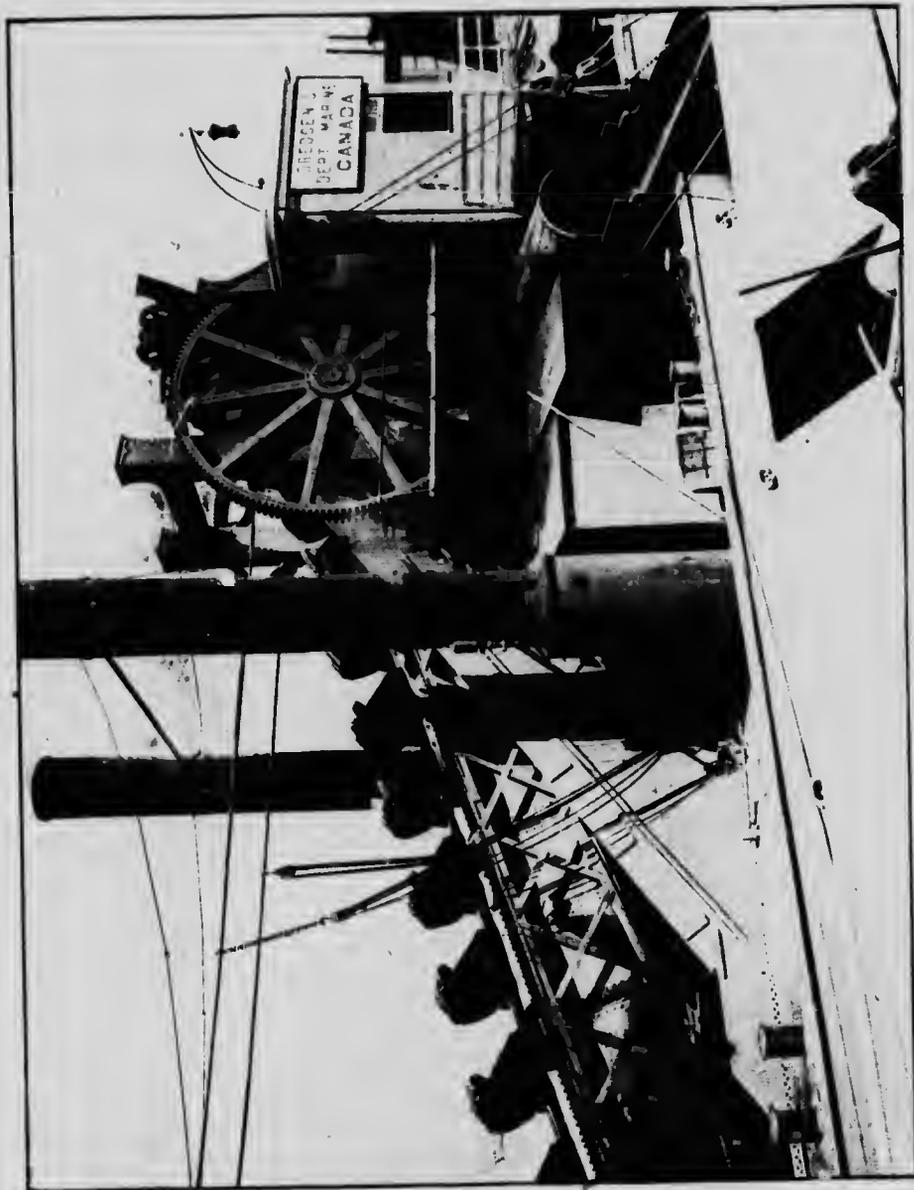


ELEVATOR DREDGE, SHOWING MANNER OF FLOATING BOW CABLE TO PERMIT OF WIDE RADIAL CUT BEING MADE,

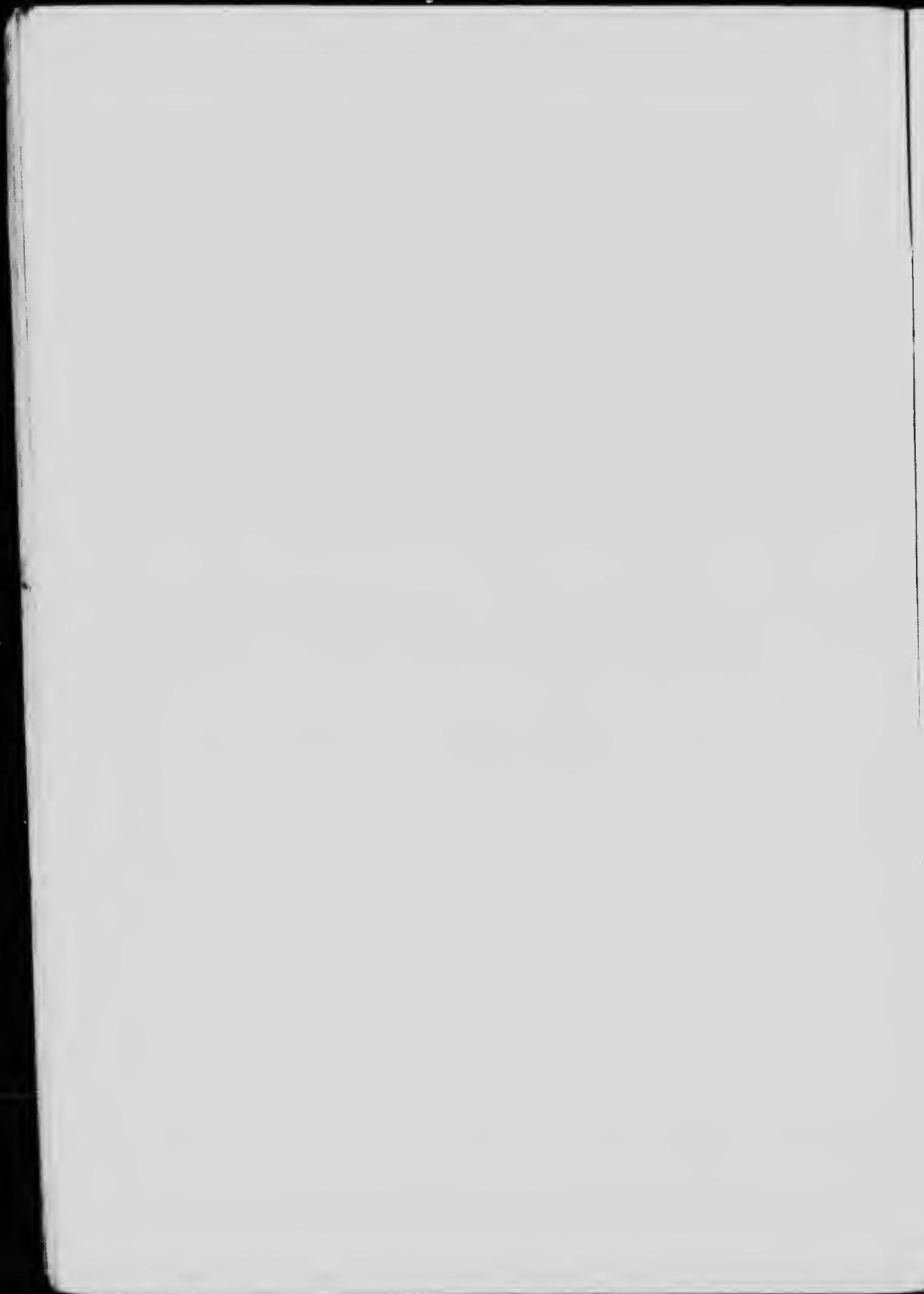


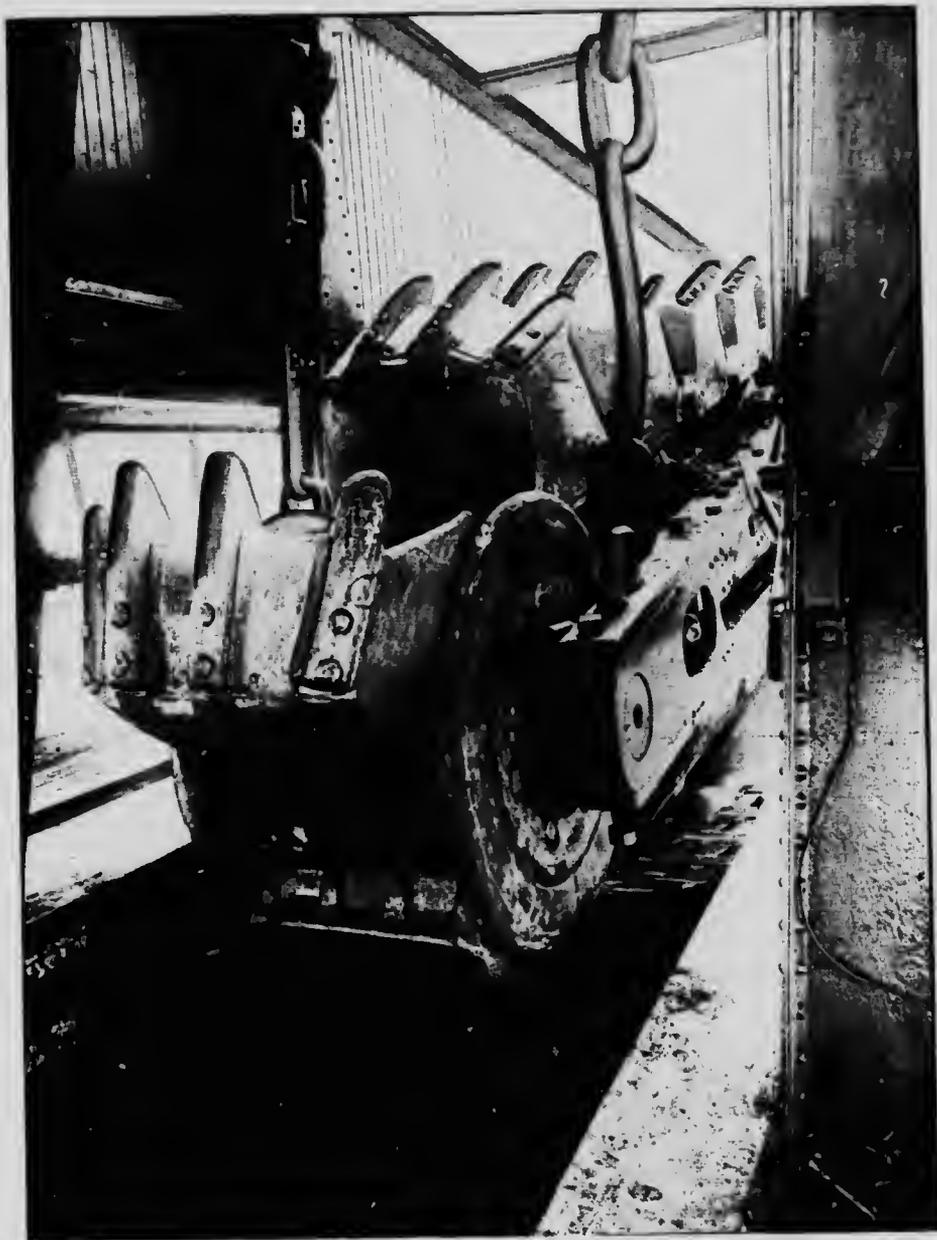


ELEVATOR DREDGE "LAURIER," NO. 2, SHOWING BUCKETS FOR ORDINARY HARD MATERIAL.

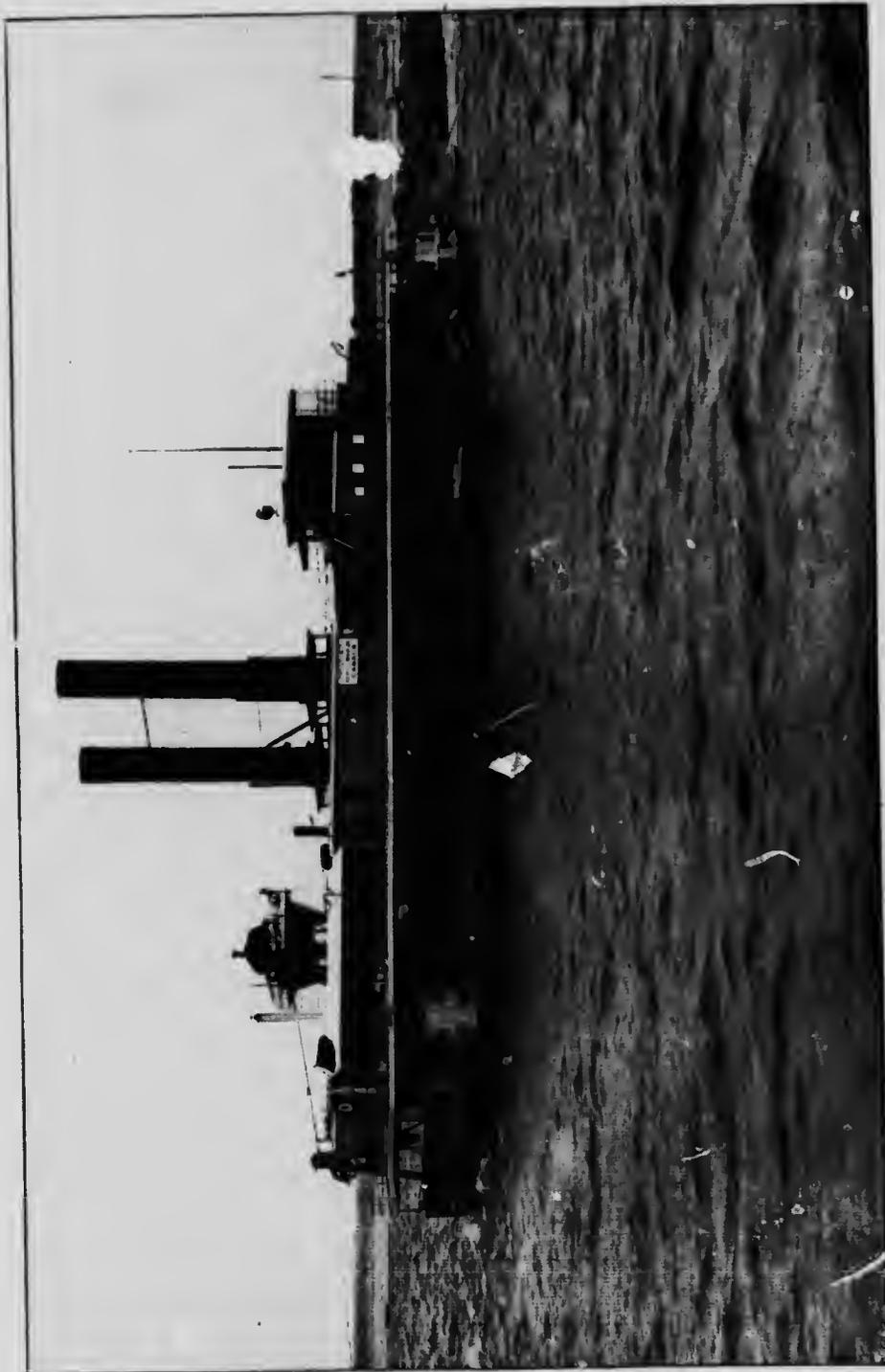


STEEL ELEVATOR DREDGE, No. 3

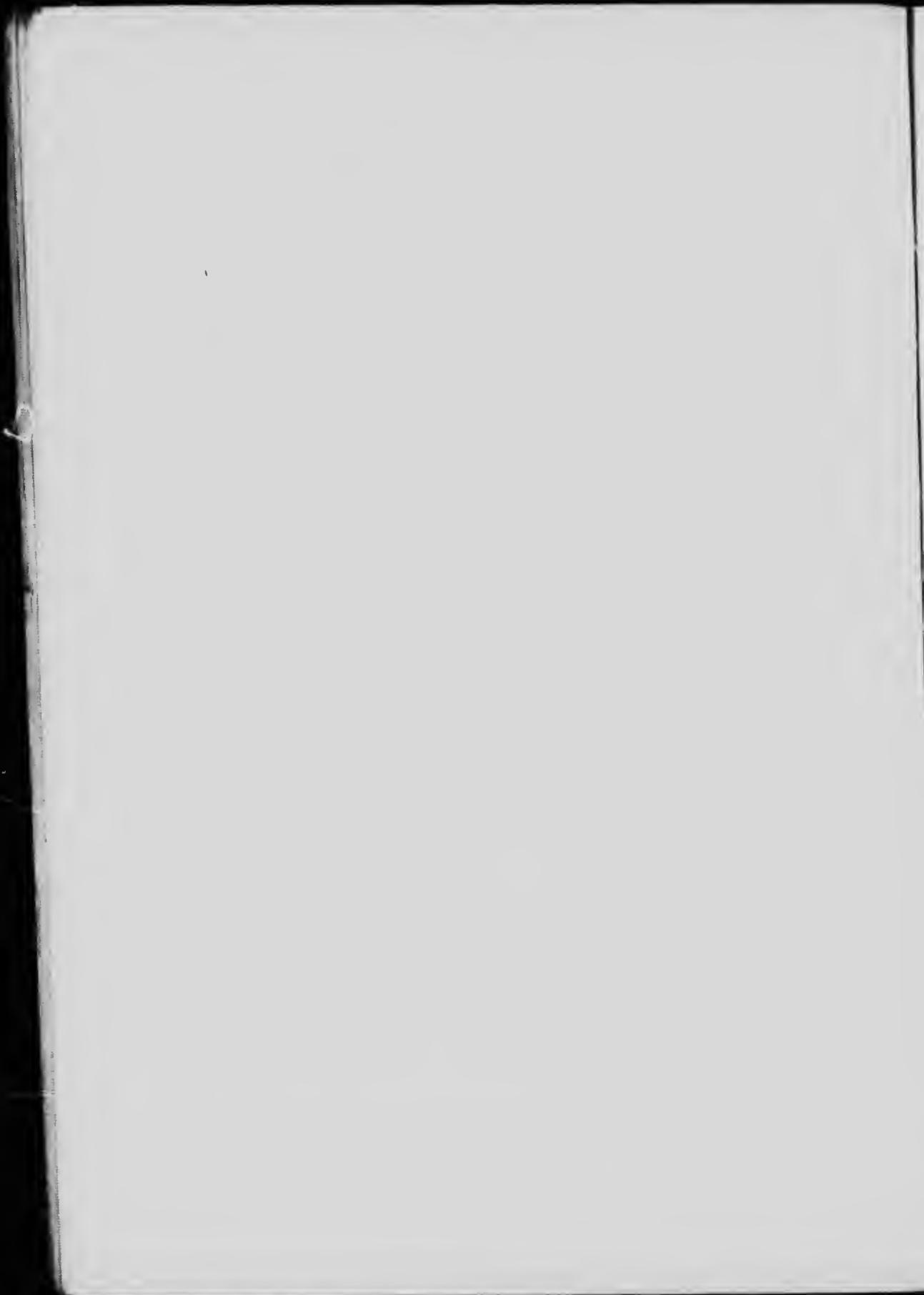




ELEVATOR DREDGE, SHOWING CAST STEEL BUCKETS FOR WORK IN SOFT ROCK, LOWER
TUMBLER AND CONNECTIONS.

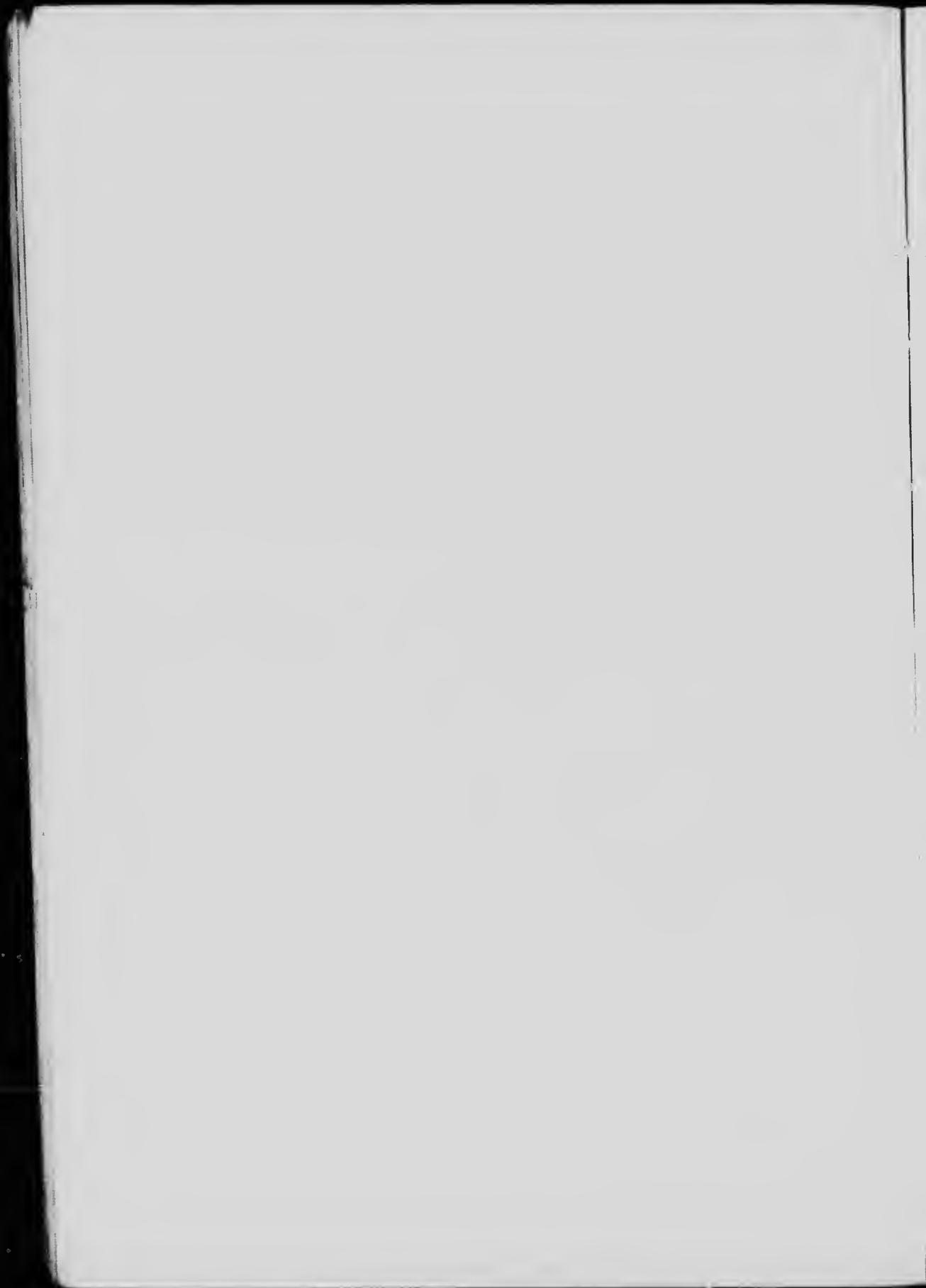


HYDRAULIC DREDGE "J. ISRAEL TARTE," No. 7, WORKING IN LAKE ST. PETER.



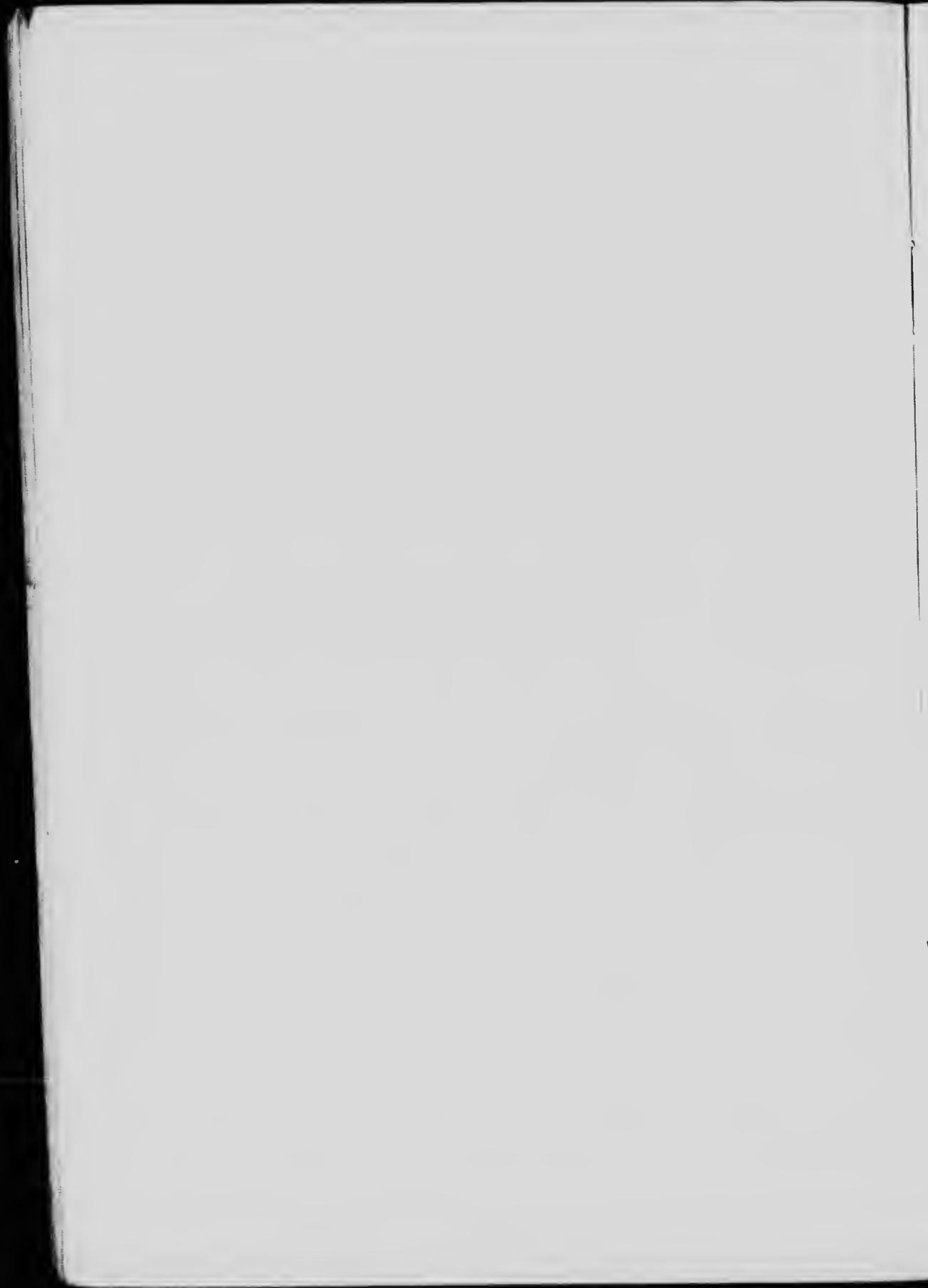


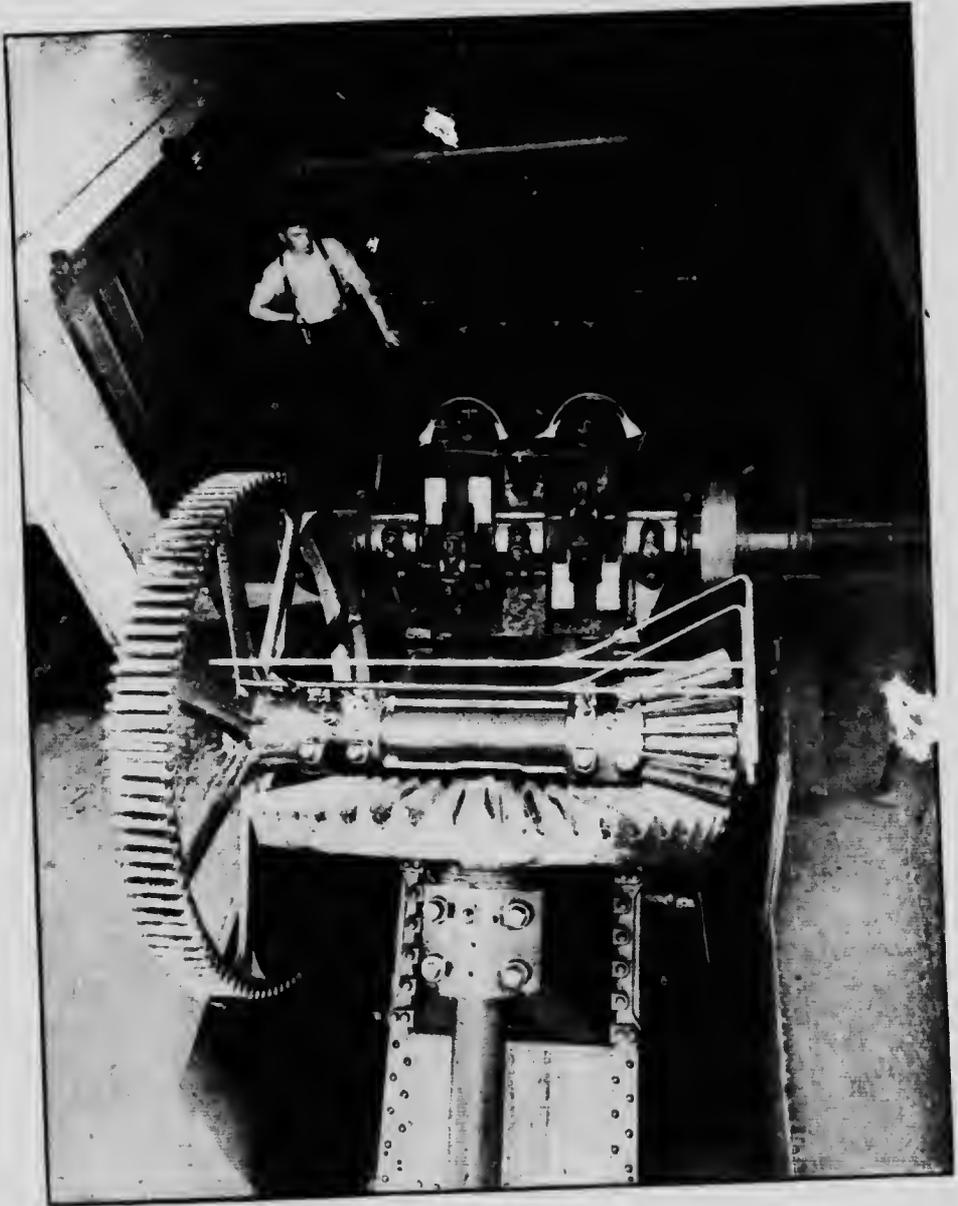
ART OF DISCHARGE PIPE, HYDRAULIC DREDGE NO. 7, SHOWING BALL-AND-SOCKET SPRING JOINT BETWEEN EACH LENGTH OF 100 FEET.





CUTTER-HEAD OF HYDRAULIC DREDGE No. 7, SHOWING 4 KNIVES AT APEX AND 8 AT THROAT.

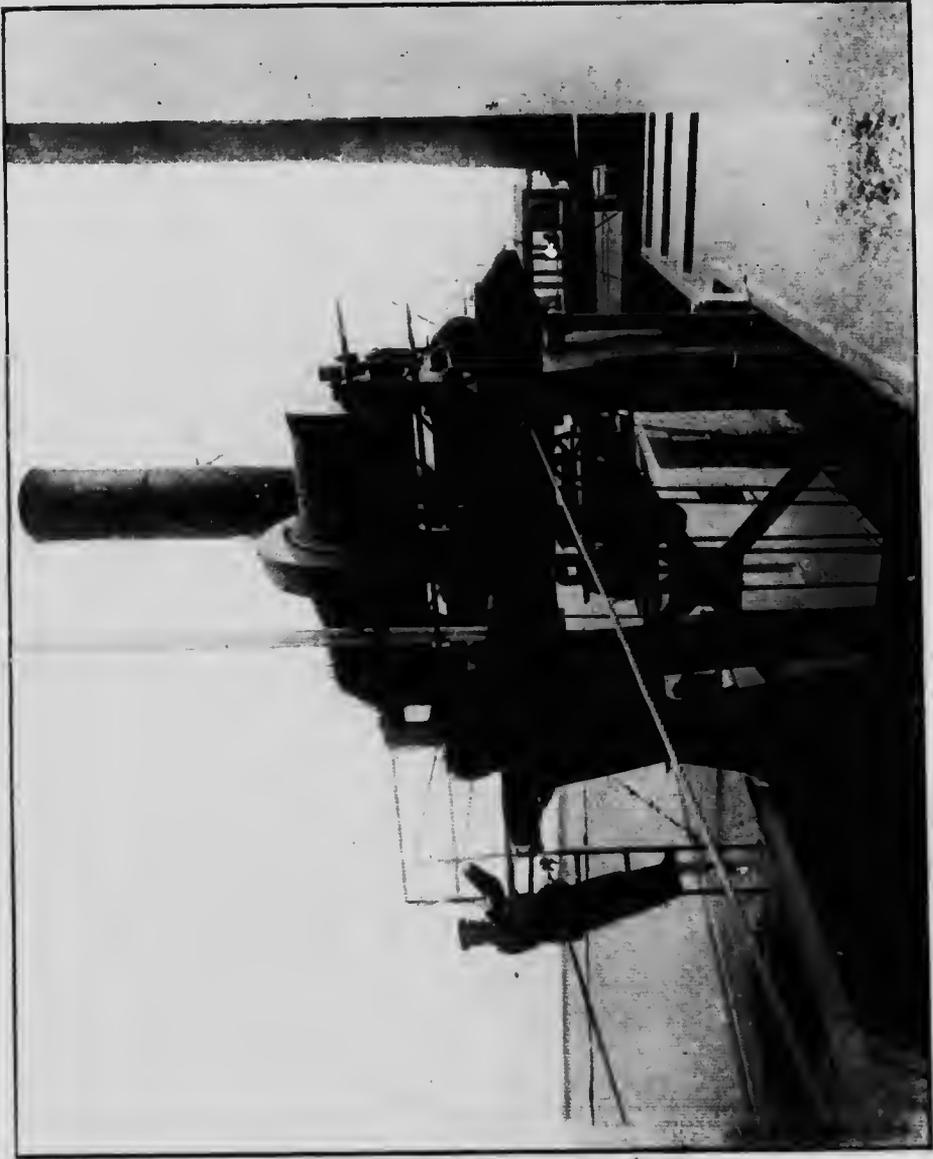




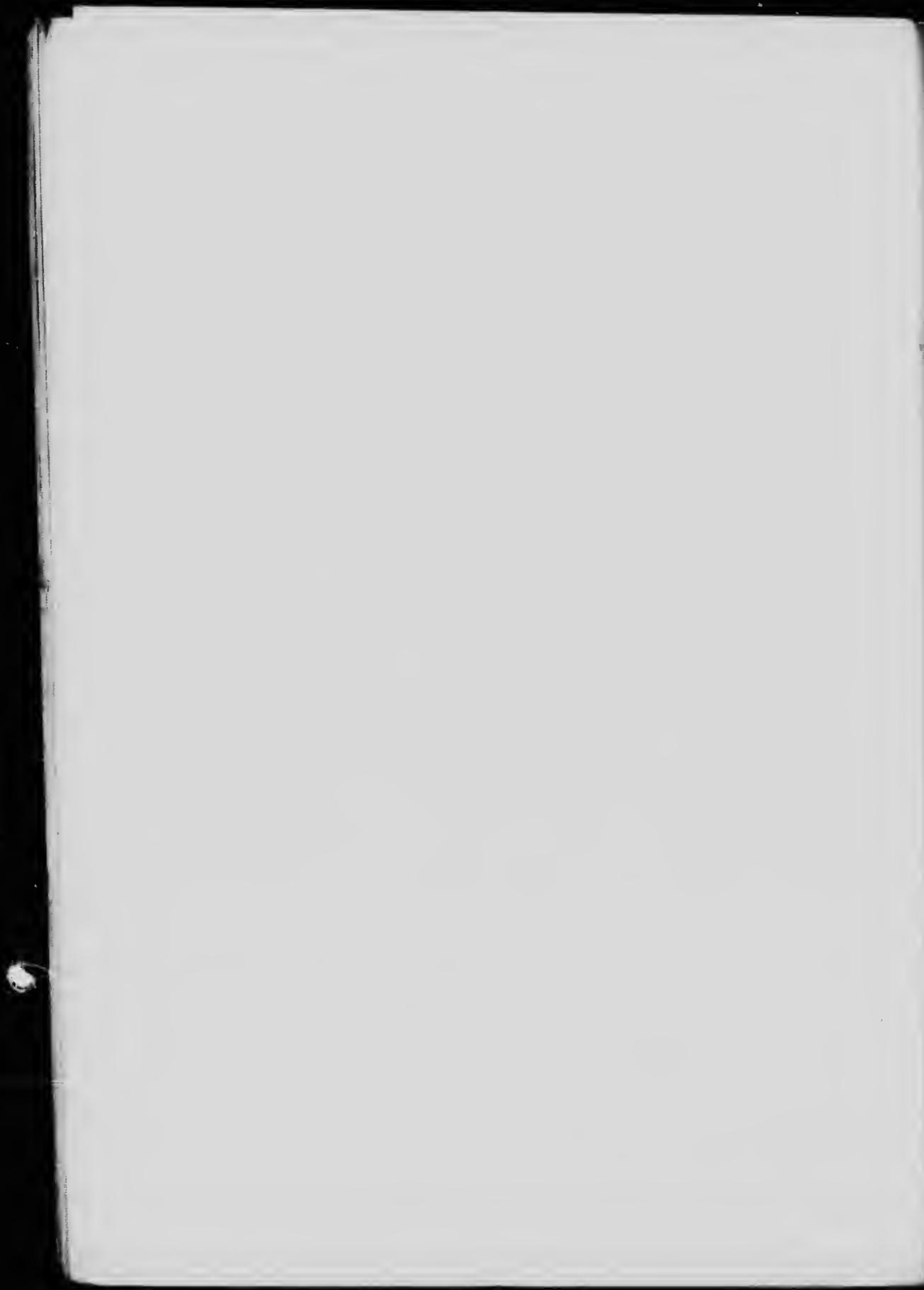
CUTTER-HEAD ENGINE, HYDRAULIC DREDGE, No. 7.

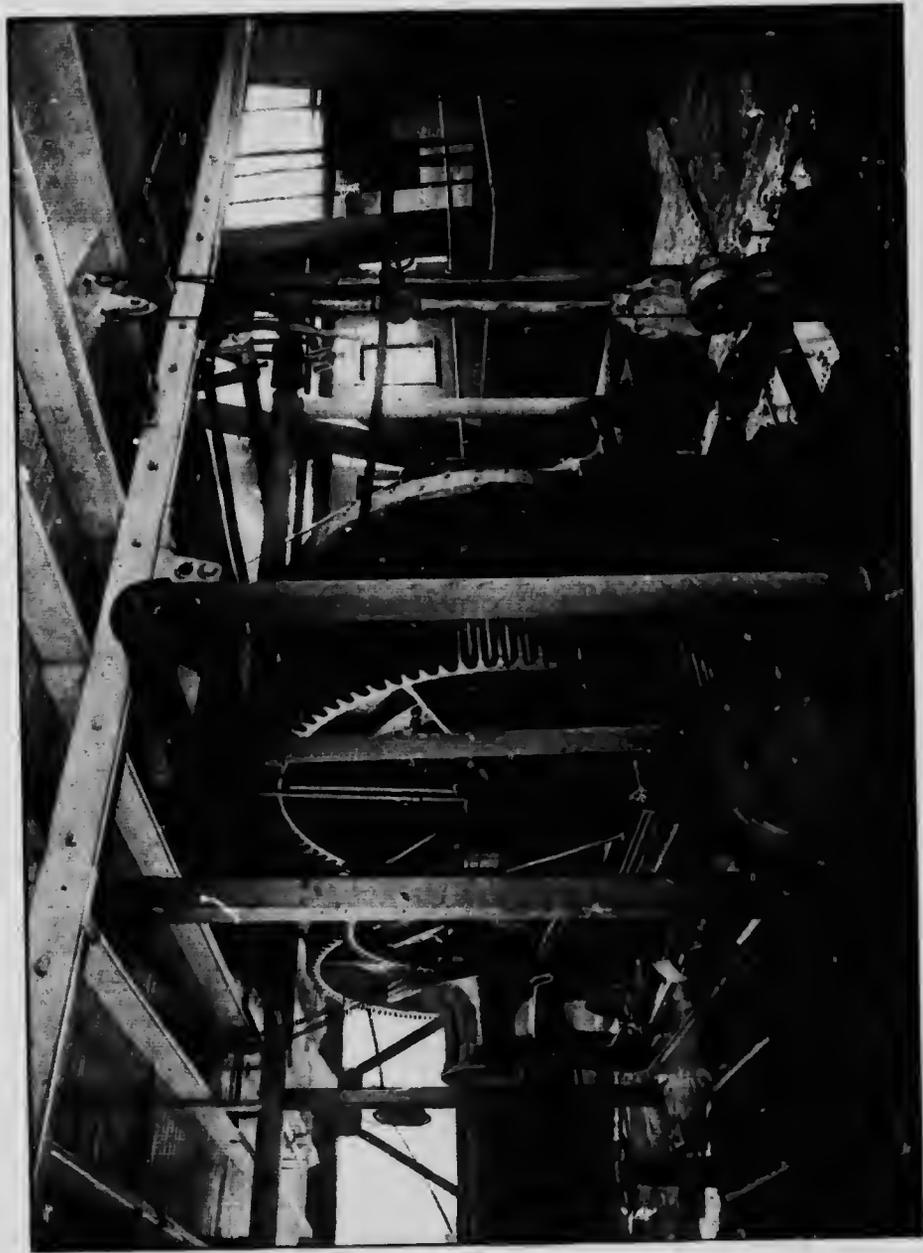
11
12

13
14



HOISTING WINCH, HYDRAULIC DREDGE NO. 7.





DOUBLE BOW-BREASTING WINCH ON MAIN DECK, USING STEEL WIRE CABLES, HYDRAULIC DREIPEE No. 7.



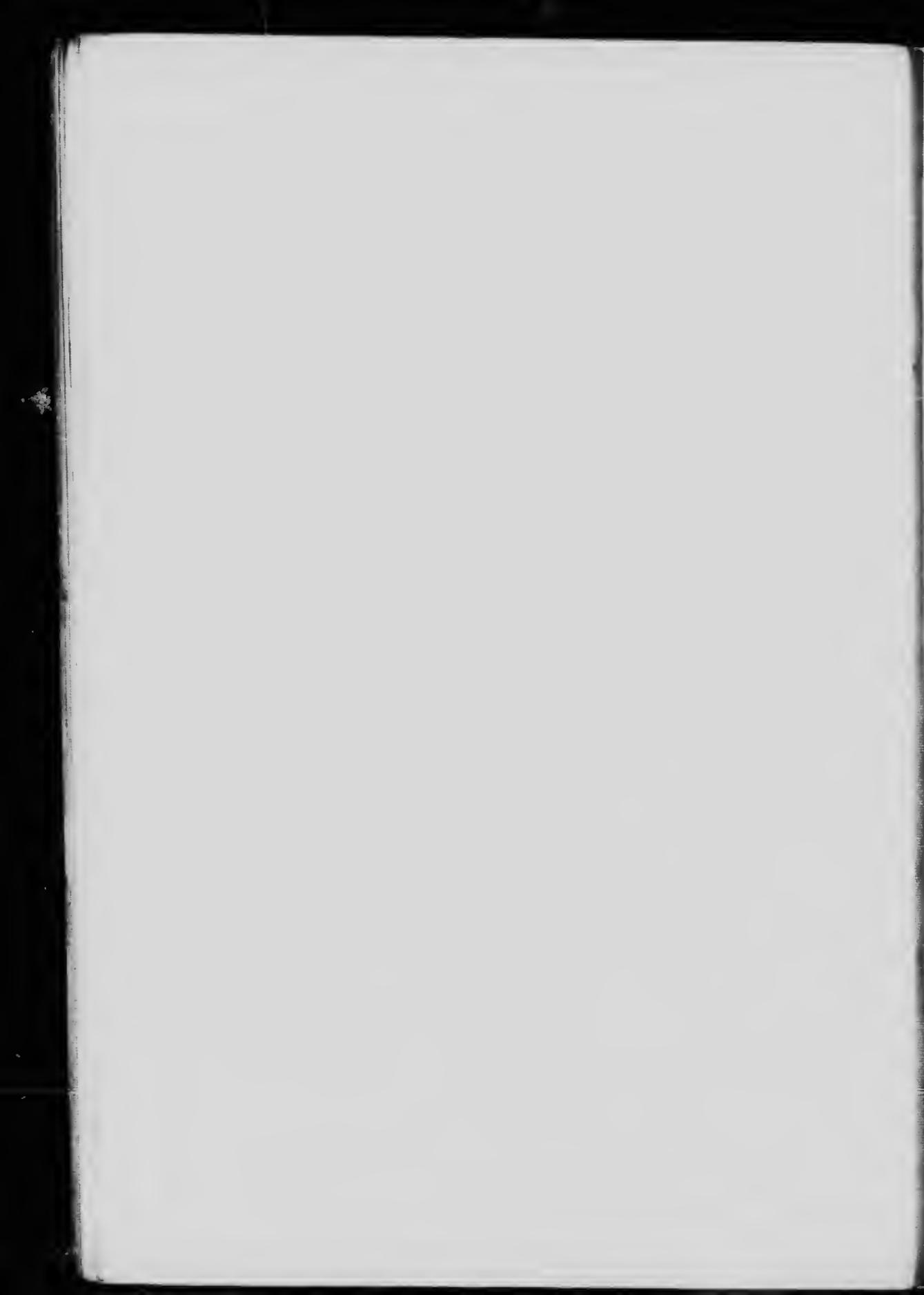


ELEVATOR DREDGE NO. 3, SHOWING BUCKET FRAME, CAST STEEL BECKETS, DRIVING GEAR AND CHUTE.





ELEVATOR DREDGE, WOODEN HULL, WITH SCOW AND TUG.





ELEVATOR DERRICK, SHOWING DOUBLE BOW-BREASTING WINCH.



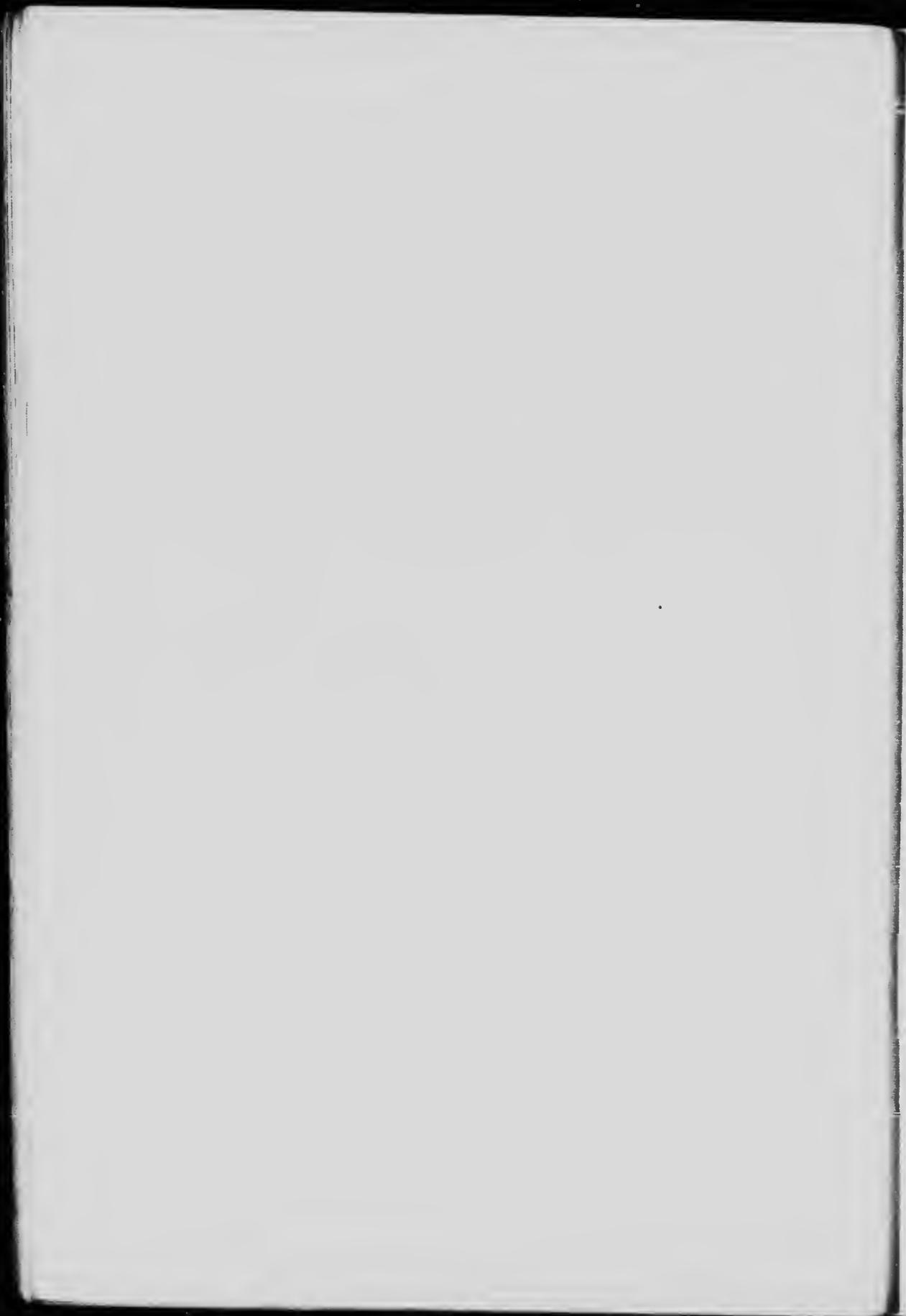


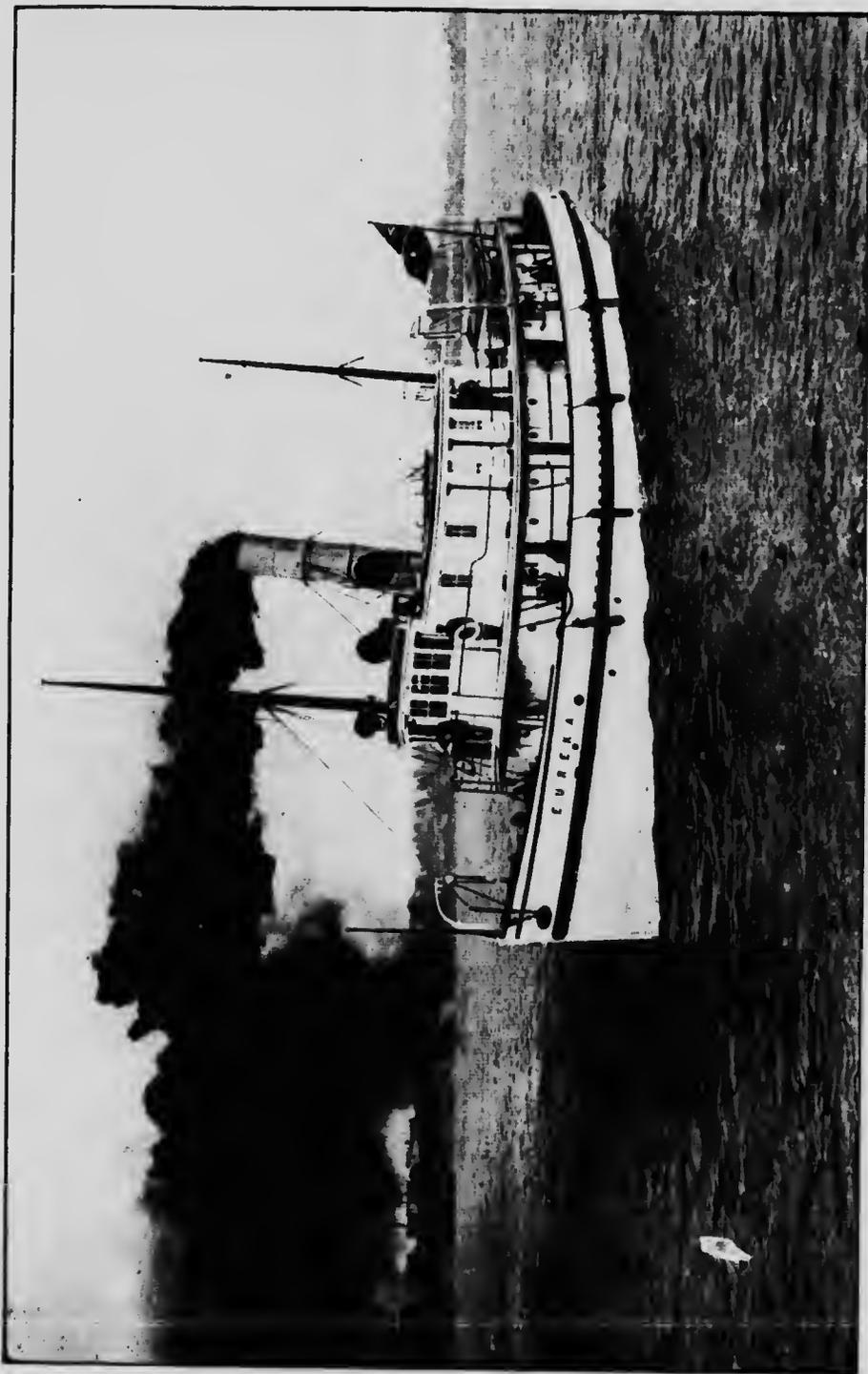
STONE LIFTER NO. 3, SHOWING GRIPS CAPABLE OF LIFTING BOULDER WEIGHING 30 TONS.



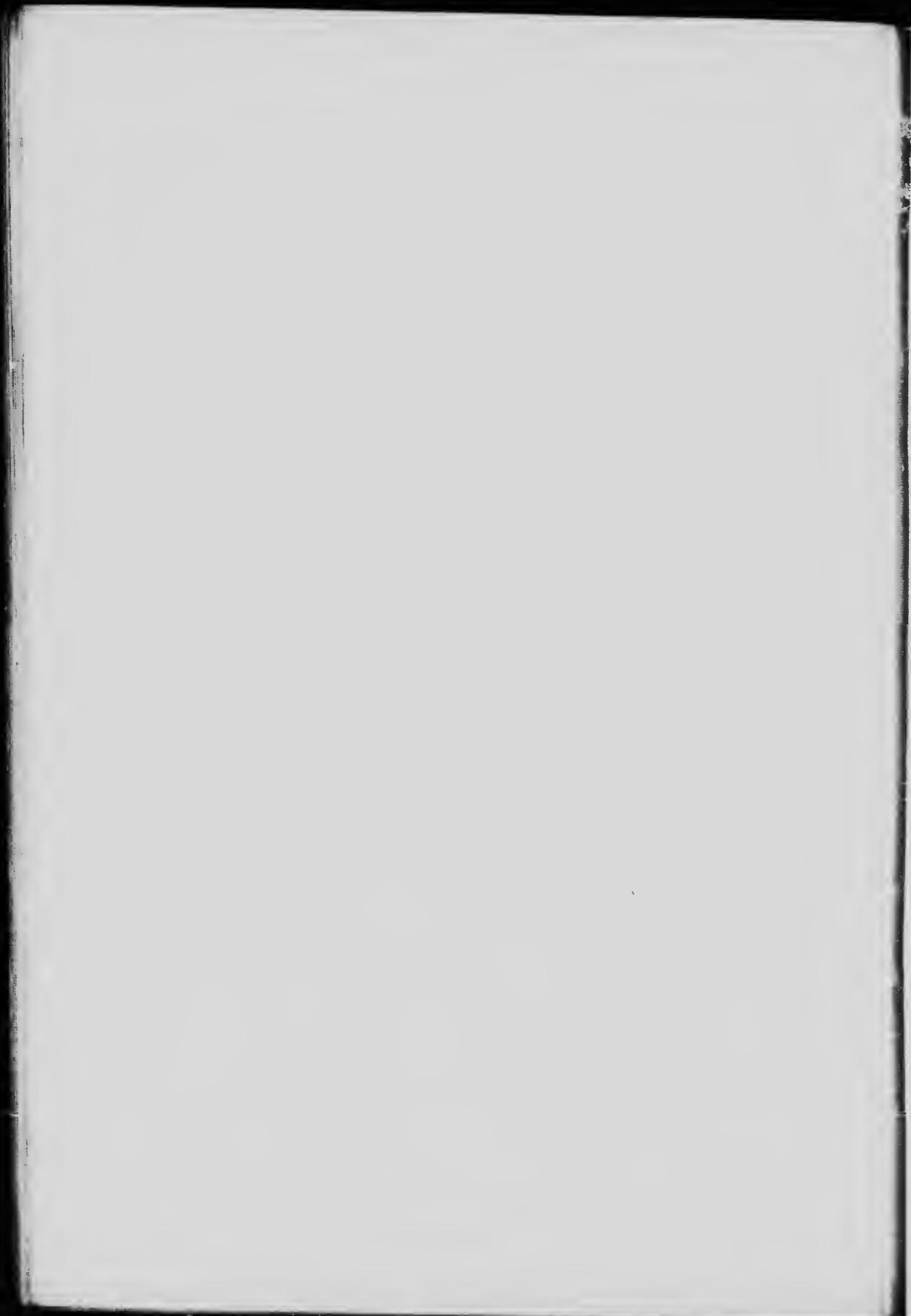


DREDGE TUG "PORTNEUF."





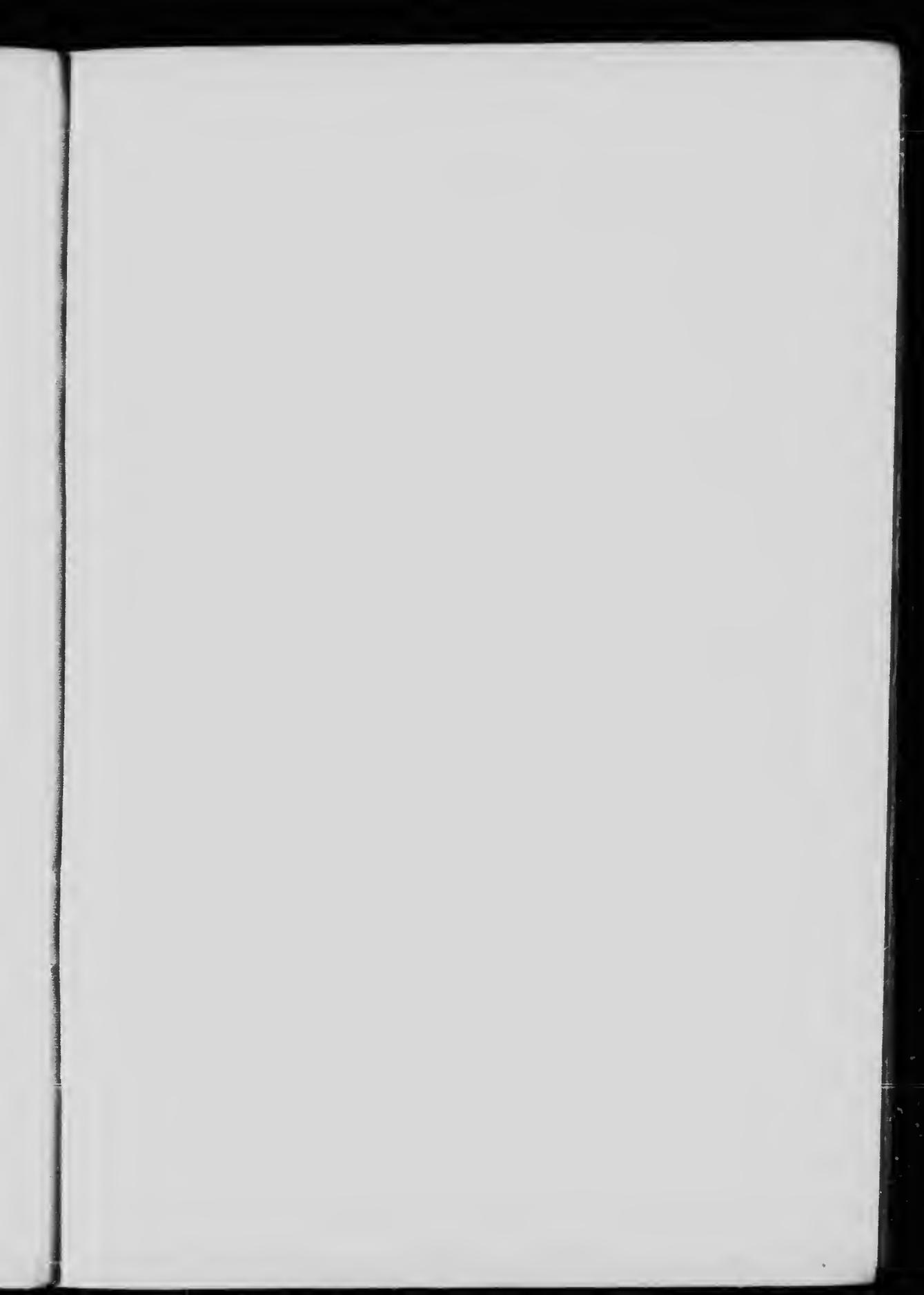
TUG "EUREKA."





TYPE OF PASSING STEAMER







Only two holidays, Dominion Day and Labour Day, are given throughout the season. The boarding of the men is done by contract with the captain of the vessel, at so much per man.

In making up the cost of the work of dredging everything is included, except interest on the capital expenditure and depreciation. The principal items of cost are wages, fuel, board, stores and repairs, as well as general expenses and superintendence. The item of repairs includes keeping the plant in constant good order, but not new improved machinery. The cost of operating an elevator dredge with its attendant plant amounts to between \$30,000 and \$40,000 per annum. The cost of operating the hydraulic dredge amounts to about double that sum.

The Total cost of the dredging operations on the Ship Channel for the fiscal year ended June 30, 1905, was \$311,087.93 and the total number of cubic yards dredged 2,716,220, making the cost per yard 11⁴/₁₀₀ cents.

The heavy cost, this year, and the reduced quantities excavated, require some explanation.

The dredge *Lady Minto* was absent for 5 months and her extra repairs, added to the ordinary winter repairs, being divided over 2 months of ship channel work made an abnormal cost, both for that particular dredge and for the complete returns of the fleet.

The hydraulic dredge *J. Israël Tarte* was also at the ship yard, putting in new boilers at a heavy cost, with the loss of July, August and September, the three best months of the season. This also not only greatly effected the returns for that dredge but the general results.

The wages have also been somewhat raised, but as will be seen from the table of classification of cost, the great increase is in the cost of supplies and repairs.

The operations, as well as the organization and plant, are attracting widespread interest. Many inquiries for information are received, and during the past season the channel was inspected by several representative officials and noted engineers from foreign countries.

Mr. Quellennec, so well known as Chief Engineer of the Suez Canal, and at present a member of the International Board of Consulting Engineers for the Panama Canal, after a careful inspection, expressed in a letter to the minister that he knew personally every great artificial waterway in the world and that, in his opinion, both the St. Lawrence Ship Channel and the plant were unique, as to the magnificence of the channel and the success of the operations.

It takes ten years to give an increase of depth of three feet. In much less than that time the maximum size of the ships using the channel has increased from 6,000 to 12,000 tons. Now 15,000 ton vessels are proposed.

That the channel of to-day will accommodate the commerce of ten years hence is not to be expected by even the most unimaginative, and it is recognized that we must build for the future. The capacity of the River St. Lawrence for navigation should grow with the country, as even now, to a large extent, the size of the vessel decides the economy of transportation.

The following tables show in a concise form the progress to date, the details of the operations of the different dredges, the classification of the expenditure, the cost per yard in each locality and the expenditure at Sorel in connection with new plant and the ship yard generally :—

PROGRESS of the Dredging Operations at the date of writing, the close of the season of 1905.

| Locality. | Distance English Miles. | Total Length Requiring Dredging. | Length Dredged in 1905. | Total Length of 30 Feet Channel Dredged. | Length yet to be Dredged. |
|--|-------------------------|----------------------------------|-------------------------|--|---------------------------|
| | | Miles. | Miles. | Miles. | Miles. |
| Division 1:— Montreal to Sorel. | 45 | 22.30 | 0.40 | 22.20 | 0.70 |
| Division 2:— Sorel to Batiscan. | 36 | 12.45 | 2.40 | 10.90 | 1.55 |
| Division 3:— Lake St. Peter. | 20 | 15.00 | 2.10 | 7.70 (5.70) | 4.60 |
| Division 4:— Batiscan to Quebec. | 59 | 10.00 | ..... | 0.00 | 9.10 |
| Division 5:— Quebec to The Traverse. | 60 | 6.65 | ..... | ..... | 6.05 |
| | 220 | 70.00 | 5.40 | 47.40 | 22.60 |

* Not widened. * Widened.

PROGRESS of the Dredging Operations at the date of writing, the close of the season of 1905.

| Locality. | LENGTH OF DREDGING. | | Cubic yards yet required to be done. |
|---|---------------------|--------------|--------------------------------------|
| | Remaining | Done. | |
| | Miles. | Miles. | |
| Division 1— | | | |
| Longueuil Shoal..... | 0.70 | 0.40 | 100,000 |
| Longue Pte. to Pte. aux Larmes (en haut)..... | | 0.07 | |
| Ile Ste. Thérèse..... | | 1.00 | |
| Varennnes to Cap St. Michel..... | | 0.00 | |
| Cap St. Michel to Vercheres..... | | 0.50 | |
| Vercheres Traverse..... | | 1.10 | |
| Vercheres to Contrecoeur..... | | 1.00 | |
| Contrecoeur Channel..... | | 0.50 | |
| Total | | | 100,000 |
| Division 2— | | | |
| Sorel to Ile de Grace..... | 0.50 | 0.00 | 150,000 |
| Stone Island..... | | 0.10 | |
| Ile aux Raisins..... | 0.25 | | 40,000 |
| Lake St. Peter (see Div. 2)..... | | | |
| Port St. Francis..... | | 0.50 | |
| Three Rivers..... | | 0.50 | |
| Cap Madeleine de Bécancour..... | | 1.55 | |
| Bécancour to Champlain..... | | 2.25 | |
| Champlain to Pte. Citrouille..... | 0.20 | 1.10 | 150,000 |
| Batture Ferron..... | 0.60 | | 450,000 |
| Total | 1.55 | 10.90 | 790,000 |
| Division 3— | | | |
| Lake St. Peter..... | 4.60 | *7.70 | 11,200,000 |
| | | †5.70 | |
| Total | 4.60 | 13.40 | 11,200,000 |
| Division 4— | | | |
| Batture to Cap Lévyard..... | 1.00 | | 1,300,000 |
| Cap à Roche Channel..... | 2.00 | | 1,200,000 |
| Pouil Royer..... | 1.20 | | 500,000 |
| Cap Charles..... | 0.90 | | 500,000 |
| Grondines..... | 0.80 | | 200,000 |
| Lotbinier..... | | 0.40 | |
| Cap St. Pierre..... | | 0.20 | |
| Ste. Cécile..... | 0.60 | 0.30 | 150,000 |
| St. Augustin..... | 0.60 | | 150,000 |
| Total | 9.10 | 0.90 | 4,000,000 |
| Division 5— | | | |
| Quebec to Champlain..... | 6.65 | | 5,000,000 |
| Total | 6.65 | | 5,000,000 |
| Totals | 22.60 | 47.40 | 21,090,000 |
| Cubic yards done | | | 43,990,140 |
| Total | | | 65,080,140 |

* Not widened.

† Widened.

RIVER ST. LAWRENCE SHIP CHANNEL

ABSTRACT of work of Dredging Fleet during the fiscal year ended June 30, 1905.

| Dredge. | Locality of Dredging. | Time of Service. | Nominal working time, 24 hours per day. | Hours Actual Dredging. | Number of Scows filled. | Number of Cubic Yards dredged (scow measure). | Depth of Dredging at Low Water, ft. | Width. | Character of Soil. | Remarks. |
|------------------------------|---------------------------------------|------------------|---|------------------------|-------------------------|---|-------------------------------------|------------|----------------------------|--|
| | | Days. | Hours. | | | | Ft. In. | Feet. | | |
| <i>Laval</i> (No. 1). | Becancour..... | 143 | 2,872 | 1,776½ | 883 | 134,725 | 30 0 | 450 | Clay, stones and hardpan | C pt. R. Matte. |
| | Sorel to Ile de Grace..... | 30 | 575 | 388 | 534 | 81,200 | 30 0 | 450 | Clay..... | |
| | | 173 | 3,447 | 2,164½ | 1,417 | 215,925 | | | | |
| <i>Laurier</i> (No. 2). | Port St. Francis..... | 13 | 246 | 146½ | 56 | 11,200 | 30 0 | 500 | Clay, sand and stones. | Capt. C. Gendron. |
| | Becancour..... | 101 | 1,935 | 944½ | 328 | 65,600 | 30 0 | 450 | Clay, stones and hardpan | |
| | Sorel to Ile de Grace..... | 10 | 195 | 105 | 84 | 16,800 | 30 0 | 450 | Clay..... | |
| | Champlain..... | 41 | 900 | 496 | 280½ | 56,150 | 30 0 | 450 | Clay and sand..... | |
| | | 165 | 3,275 | 1,692½ | 748½ | 149,750 | | | | |
| <i>Lady Alverton</i> (No. 3) | Port St. Francis..... | 149 | 2,956 | 1,902½ | 1,234 | 246,800 | 30 0 | 550 | Sand, stones and hardpan | Capt. N. Dauphinais. |
| | Sorel to Ile de Grace..... | 12 | 250 | 140 | 125 | 25,000 | 30 0 | 450 | Clay and sand..... | |
| | Champlain..... | 20 | 444 | 282 | 118 | 23,600 | 30 0 | 450 to 750 | Clay, sand and stones..... | |
| | | 181 | 3,630 | 2,324½ | 1,477 | 295,400 | | | | |
| <i>Lady Minto</i> (No. 4). | Becancour..... | 59 | 1,296 | 846½ | 281 | 56,200 | 30 0 | 450 to 750 | Clay, stones and hardpan | Capt. B. Lachance (5 months absent at River Saguenay). |
| <i>Lafontaine</i> (No. 5) | Lake St. Peter, Nicolet Traverse..... | 27 | 515 | 245½ | 418 | 125,400 | 30 0 | 350 | Blue clay and stones..... | Capt. A. Marcotte. |
| | Champlain..... | 91 | 1,745 | 1,041 | 1,258 | 377,400 | 30 0 | 450 | Clay sand and stones..... | |
| | Sorel to Ile de Grace..... | 6 | 115 | 74½ | 55 | 16,500 | 30 0 | 450 | Clay..... | |
| | Becancour..... | 57 | 1,248 | 852 | 182 | 54,700 | 30 0 | 450 | Clay, stones and hardpan | |
| | | 181 | 3,623 | 2,213 | 1,913 | 574,000 | | | | |

RIVER ST. LAWRENCE SHIP CHANNEL BETWEEN MONTREAL AND QUEBEC.

DETAILS of Dredging, Locality and Cost per Cubic Yard for Fiscal Year ended June 30, 1905.

| Dredges. | Total Cost of Operations of each Plant during Fiscal Year. | Number of Days in Operation, each Dredge. | Cost per Day, Operations of Dredge and Plant. | Days working each Locality. | Cost of Work, each Locality. | Total Cost of Operations of each Dredge. | Number of Cubic Yards dredged, each Locality. | Total Cubic Yards for each Dredge. | Cost per Cubic Yard, each Locality. | Average Cost per Cubic Yard for each Dredge. | Kind of Material Dredged. | Locality of Dredging. |
|--------------------------|--|---|---|-----------------------------|------------------------------|--|---|------------------------------------|-------------------------------------|--|---------------------------|------------------------------------|
| | \$ cts. | | \$ cts. | | \$ cts. | \$ cts. | | | Cts. | Cts. | | |
| Laval (No. 1)..... | 30,027 30 | 173 | 225 59 | 143 | 32,250 43 | 39,027 20 | 134,225 | ..... | 29 4/10 | ..... | Clay, stones and hardpan | Becancour, Sorrel to Ile de Grace. |
| Laurier (No. 2) | 41,271 36 | 165 | 250 13 | 13 | 3,251 68 | 39,027 20 | 11,200 | 215,925 | 18 1/10 | ..... | Clay, sand and stones. | Port St. Francis |
| Lady Aberdeen (No. 3) | 39,163 00 | 181 | 216 37 | 149 | 32,239 15 | 41,271 36 | 246,800 | 149,730 | 27 1/10 | ..... | Clay, stones and hardpan | Becancour, Sorrel to Ile de Grace. |
| Lady Minto (No. 4)..... | 25,409 05 | 59 | 430 66 | 59 | 25,409 05 | 39,163 00 | 25,000 | 235,400 | 18 1/10 | ..... | Clay, sand and stones. | Port St. Francis |
| Lafontaine (No. 5) | 44,237 71 | 181 | 244 41 | 12 | 2,506 44 | 25,409 05 | 25,000 | ..... | 10 1/10 | ..... | Clay and sand | Sorrel to Ile de Grace. |
| Baldwin (No. 6) | 42,677 59 | 172 | 248 13 | 27 | 6,508 97 | 25,409 05 | 56,200 | 56,200 | 45 3/10 | ..... | Clay, sand and stones | ChAMPLAIN. |
| | | 181 | 244 41 | 91 | 22,241 11 | 25,409 05 | 125,400 | ..... | 5 3/10 | ..... | Clay, stones and hardpan | Becancour. |
| | | 244 | 244 41 | 6 | 1,466 41 | 44,237 71 | 377,400 | ..... | 5 1/10 | ..... | Blue clay and stones | Lake St. Peter, Nicolet Tray. |
| | | 244 | 244 41 | 57 | 13,931 22 | 44,237 71 | 16,500 | ..... | 8 1/10 | ..... | Clay, sand and stones | ChAMPLAIN. |
| | | 172 | 248 13 | 32 | 7,939 96 | 42,677 59 | 54,700 | 574,400 | 25 1/10 | 7 1/10 | Clay, stones and hardpan | Sorrel to Ile de Grace. |
| | | 248 | 248 13 | 15 | 3,721 81 | 79,302 02 | 30,000 | ..... | 26 1/10 | ..... | Clay, stones and hardpan | Becancour. |
| | | 248 | 248 13 | 114 | 28,286 52 | 79,302 02 | 23,700 | ..... | 15 1/10 | ..... | Clay, sand and stones | Lake St. Peter, Nicolet Tray. |
| | | 248 | 248 13 | 11 | 2,729 30 | 79,302 02 | 33,900 | ..... | 13 1/10 | ..... | " | ChAMPLAIN. |
| J. Israel Tarte (No. 7) | 79,302 02 | 92 | 861 98 | 92 | 79,302 02 | 42,677 59 | 1,123,125 | 301,820 | 14 1/10 | 14 1/10 | Clay | Sorrel to Ile de Grace. |
| | | | | | | 79,302 02 | 1,123,125 | 1,123,125 | 7 1/10 | 7 1/10 | Soft blue clay | Lake St. Peter. |
| | 311,067 95 | 1,023 | ..... | 1,023 | 311,067 95 | 311,067 95 | 2,716,220 | 2,716,220 | ..... | ..... |  |  |

DREDGING PLANT.

The following is a description of the dredging plant owned and operated by the Department of Marine and Fisheries in connection with the River St. Lawrence Ship Channel:—

DREDGES.

The Elevator Dredge 'Laval' (No. 1) wooden hull.

Length over all, 150 feet.
 Breadth of beam, 30 feet.
 Depth of hold, 14 feet.
 Average draught, 11 feet.
 Greatest working depth, 43·5 feet.
 Hull built in Ottawa in 1894.
 Steel buckets.
 Working capacity per day in hard material, 1,000 to 2,000 cubic yards.

The Elevator Dredge 'Laurier' (No. 2), wooden hull.

Length over all, 168 feet.
 Breadth of beam, 32 feet.
 Depth of hold, 14 feet.
 Average draught, 10 feet.
 Greatest working depth, 42·5 feet.
 Built at Sorel shipyard in 1897.
 $\frac{3}{4}$ cubic yard buckets for hard-pan.
 Working capacity per day in fairly stiff clay, 2,000 to 3,000 cubic yards.

The Elevator Dredge 'Lady Aberdeen' (No. 3), steel hull.

Length over all, 148 feet.
 Breadth of beam, 32 feet.
 Depth of hold, 13 feet.
 Average draught 8·5 feet.
 Greatest working depth, 42·5 feet.
 Built at Sorel shipyard in 1900.
 Steel buckets.
 Working capacity per day in hard material, 1,000 to 2,000 cubic yards.

The Elevator Dredge 'Lady Minto' (No. 4), steel hull.

Length over all, 148 feet.
 Breadth of beam, 32 feet.
 Depth of hold, 13 feet.
 Average draught, 8·5 feet.
 Greatest working depth, 42·5 feet.
 Built at Sorel shipyard in 1900.
 Steel buckets.
 Working capacity per day in stiff clay and stones, 1,000 to 2,000 cubic yards.

The Elevator Dredge 'Lafontaine' (No. 5), wooden hull.

Length over all, 168 feet.
 Breadth of beam, 32 feet.

Depth of hold, 14 feet.
 Average draught, 9 feet.
 Greatest working depth, 45 feet.
 Built at Sorel shipyard in 1901.
 Steel buckets.
 Working capacity per day in hard material, 1,000 to 2,000 cubic yards.

The Elevator Dredge 'Lafontaine' (No. 5), wooden hull.

Length over all, 165 feet.
 Breadth of beam, 34 feet.
 Depth of hold, 14 feet.
 Average draught, 8 feet.
 Greatest working depth, 45 feet.
 Built at Sorel shipyard in 1902.
 1 cubic yard buckets strengthened for fairly hard material.
 Working capacity per day in medium material, 2,500 to 3,500 cubic yards.

The Hydraulic Dredge 'J. Israel Tarte' (No. 7), steel hull.

Length over all, 160 feet.
 Breadth of beam, 42 feet.
 Depth of hold, 12:5 feet.
 Average draught, 6 feet.
 Length of suction frame, 80 feet.
 Greatest working depth, 50 feet.
 Built at the Polson Iron Works, Toronto, in 1902.
 Working capacity per day in soft material, 12,000 to 20,000 cubic yards.

Discharge Pipe and pontoons of Dredge 'J. Israel Tarte' (No. 7).

23 lengths of pipe, 36 ins. diameter by 100 feet long.
 1 length of pipe, 36 ins. diameter by 35 feet long.
 23 pairs of pontoons for floating pipes, 42 ins. diameter by 90 feet long.
Winch Scow 'No. 3' for Dredge 'J. I. Tarte' (wooden hull).
 Length over all, 60 feet.
 Breadth of beam, 18 feet.
 Depth of hold, 6 feet.
 Built at Sorel shipyard in 1902.

Winch Scow (wooden hull) for Dredge 'J. I. Tarte (with steam boiler and steam winch).

Length over all, 75 feet.
 Breadth of beam, 25 feet.
 Depth of beam 5:5 feet.
 Built at Sorel shipyard in 1902.

TUGS.

The Tug 'Frontenac (composite hull).

Length over all, 113 feet.
 Breadth of beam, 23 feet.
 Depth of hold, 10 feet.

Average draught, 9 feet.
Built at Sorel shipyard in 1901.

The Tug 'Eureka' (steel hull).

Length over all, 100 feet.
Breadth of beam, 22 feet.
Depth of hold, 12 feet.
Average draught, 11 feet.
Built in Glasgow, Scotland, in 1893.

The Tug 'James Howden' (wooden hull).

Length over all, 100 feet.
Breadth of beam, 21 feet.
Depth of hold, 10 feet.
Average draught, 7.5 feet.
Built at Sorel shipyard in 1903.

The Tug 'St. Jean-Iberville' (steel hull).

Length over all, 90 feet.
Breadth of beam, 18 feet.
Depth of hold, 12 feet.
Average draught, 10 feet.
Built at Sorel shipyard in 1897.

The Tug 'Lac St. Pierre' (wooden hull).

Length over all, 100 feet.
Breadth of beam, 21 feet.
Depth of hold, 10 feet.
Average draught, 7.6 feet.
Built at Sorel shipyard in 1901.

The Tug 'St. Francis' (wooden hull).

Length over all, 80 feet.
Breadth of beam, 17 feet.
Depth of hold, 10.8 feet.
Average draught, 9 feet.
Built in 1875.

The Tug 'Cartier' (wooden hull).

Length over all, 84 feet.
Breadth of beam, 18 feet.
Depth of hold, 9.5 feet.
Average draught, 8 feet.
Built at Sorel shipyard in 1893.

The Tug 'Emilia' (wooden hull).

Length over all, 84 feet.
Breadth of beam, 17 feet.
Depth of hold, 9 feet.
Average draught, 7.5 feet.
Built at Sorel shipyard in 1898.

The Tug 'Champlain' (wooden hull).

Length over all, 84 feet.
 Breadth of beam, 17 feet.
 Depth of hold, 9 feet.
 Average draught, 7.5 feet.
 Built at Sorel shipyard in 1901.

The Tug 'Jesse Hume' (wooden hull).

Length over all, 72 feet.
 Breadth of beam, 17.3 feet.
 Depth of hold, 10 feet.
 Average draught, 8.5 feet.
 Built in Buffalo in 1878.

The Tug 'Montcalm' (wooden hull).

Length over all, 80 feet.
 Breadth of beam, 23 feet.
 Depth of hold, 8 feet.
 Average draught, 6.5 feet.
 Built at Sorel shipyard in 1903.

The Tug 'Carmelia' (wooden hull).

Length over all, 84 feet.
 Breadth of beam, 17 feet.
 Depth of hold, 9 feet.
 Average draught, 7.5 feet.
 Purchased in 1903.

COAL BARGES.

The Coal Barge 'No. 1' (wooden hull).

Length over all, 120 feet.
 Breadth of beam, 24 feet.
 Depth of hold, 10 feet.
 Built at Sorel shipyard in 1893.

The Coal Barge 'No. 2' (wooden hull).

Length over all, 125 feet.
 Breadth of beam, 25 feet.
 Depth of hold, 11 feet.
 Built at Sorel shipyard in 1900.

The Coal Barge 'No. 3' (wooden hull).

Length over all, 93 feet.
 Breadth of beam, 28 feet.
 Depth of hold, 12 feet.
 Built at Sorel shipyard in 1902.

The Coal Barge 'No. 4' (wooden hull).

Length over all, 98 feet.
 Breadth of beam, 28 feet.
 Depth of hold, 12 feet.
 Built at Sorel shipyard in 1903.

Stone-lifter 'No. 2' (wooden hull).

Length over all, 80 feet.
 Breadth of beam, 25 feet.
 Depth of hold, 9.8 feet.
 Rebuilt at Sorel shipyard in 1897.

Stone-lifter 'No. 3' (wooden hull).

Length over all, 108 feet.
 Breadth of beam, 34 feet.
 Depth of hold, 14 feet.
 Built at Sorel shipyard in 1903.

Sounding Scow (wooden hull).

Length over all, 60 feet.
 Breadth of beam, 25 feet.
 Depth of hold, 6 feet.
 Built at Sorel shipyard in 1898.

Coal Scow 'No. 2' (wooden hull).

Length over all, 54 feet.
 Breadth of beam, 18 feet.
 Depth of hold, 4 feet.
 Built at Sorel shipyard in 1892.

Six Lodging Scows (wooden hulls).

Rebuilt from old dump scows and fitted out as lodging scows for crews of dredges and tugs of ship channel fleet, at Sorel shipyard in 1899, 1901, and 1902.

HOPPER SCOWS.

1 Hopper Scow (wooden hull) with hydraulic power for closing gates.

Length over all, 97 feet.
 Breadth of beam, 24.5 feet.
 Depth of hold, 9 feet.
 Capacity, 200 cubic yards.
 Built at Sorel shipyard in 1897.

2 Hopper Scows (wooden hulls) with hydraulic power for closing gates.

Length over all, 90 feet.
 Breadth of beam, 18 feet.
 Depth of hold, 7 feet.
 Capacity, 150 cubic yards.
 Built at Sorel shipyard in 1898.

4 Hopper Scows (wooden hulls) with hydraulic power for closing gates.

Length over all, 97 feet.

Breadth of beam, 24 feet.

Depth of hold, 9 feet.

Capacity, 200 cubic yards.

Built at Sorel shipyard in 1899 and 1901.

5 Hopper Scows (wooden hulls) with hydraulic power for closing gates.

Length over all, 98 feet.

Breadth of beam, 24 feet.

Depth of hold, 9.5 feet.

Capacity, 300 cubic yards.

Built at Sorel shipyard, 2 in 1901, 3 in 1902.

2 Hopper Scows (wooden hulls) with hydraulic power for closing gates.

Length over all, 97 feet.

Breadth of beam, 24.5 feet.

Depth of hold, 9 feet.

Capacity, 300 cubic yards.

Built at Sorel shipyard in 1903.

SOREL SHIP YARD.

The work done at the Sorel shipyard during the fiscal year ended June 30, 1905, as reported by Mr. G. J. Desbarats, Director of Ship Yard, was as follows:—

NEW CONSTRUCTION.

Dredge 'W. S. Fielding.'—This is a steel, twin screw, hopper dredge constructed for the Department of Public Works. The hull is 250 feet long by 42 feet beam by 13 feet depth. She is equipped with a chain of elevator buckets and with a suction pipe and is designed to dredge in 60 feet of water.

During this year the plating of the hull was finished, the upper works were built, the buckets were made and placed, the engines were put into position and all the piping and connections for steam and hydraulic work were installed. The dredge was fully equipped by the end of the fiscal year and ready for her trial, which took place in July, 1905.

Tug 'Storm King.'—This is a sea-going tug belonging to the Department of Public Works. She was rebuilt at the Sorel shipyard during the year. The woodwork of the old hull was cut down to about the water line and rebuilt, the shape of the hull and her draught of water being changed.

A new Scotch marine boiler, 11 feet 6 inches diameter by 8 feet 6 inches in length with 3 furnaces 32 inches diameter, was built at the Sorel shipyard and installed in this boat.

The engine was taken out, thoroughly overhauled and strengthened, and replaced again in the vessel.

A new surface condenser was installed with an entire new system of piping. All the inside of the vessel was repaired and new cabins were built.

A steam steering gear and steam winch were installed and the vessel left Sorel in the spring of 1905 and has been working satisfactorily since that time.

Tug 'Portneuf.'—This is a wooden vessel 85 feet long over all, 17 feet 3 inches beam with a depth of 9 feet 9 inches. The main engine was compounded from the single cylinder engine of the dismantled tug *St. Francis*. It is a steeple compound with high pressure cylinder 11 inches diameter, low pressure cylinder 20 inches diameter, stroke 20 inches. A new marine cylindrical boiler 8 feet 6 inches diameter by 8 feet 6 inches long with 2 furnaces 31 inches diameter was built at the shipyard for this vessel. She has accommodation for both day and night crew. This vessel was begun in February 1905, and was well advanced at the end of the fiscal year, being finished in August 1905. She is to be used in connection with the dredging fleet of the River St. Lawrence Ship Channel.

Dump scows.—The dump scows 93 feet long by 25 feet beam, with a depth of 9 feet and a capacity of 200 cubic yards, were built for the use of the St. Lawrence Ship Channel dredging fleet. These scows were built of Douglas fir and are provided with hydraulic cylinders for opening and closing the doors of the hoppers.

Machine shop scow.—A scow 100 feet long by 24 feet beam and 9 feet depth was built to serve as a floating machine shop with the St. Lawrence Ship Channel fleet. The hull of this scow was completed by the end of the fiscal year but the house had not yet been built and the machinery had yet to be installed.

REPAIR WORK.

Dredge 'J. Israël Tarte' (No. 7.)—This is the hydraulic dredge belonging to the St. Lawrence Ship Channel fleet.

Four marine cylindrical boilers were installed in this dredge. Two of them were made by the Bertram Engine Works, of Toronto, and two by John Inglis & Son, also of Toronto.

Two of these boilers were received in the month of July and two at the end of August. They were installed on the dredge, a new system of steam piping connected to them, the smoke stacks erected and the cabin work finished. These boilers gave a good deal of trouble and heavy repairs had to be made to them during the winter.

Dredge 'Laurier' (No. 2.)—This is a wooden dredge belonging to the St. Lawrence Ship Channel. The hull was rebuilt from the water line up and cabin accommodation was added for the night crew.

Tug 'Cartier.'—This is a tug belonging to the dredging fleet. The cabin work was rebuilt so as to add accommodation for the night crew.

NEW BUCKETS.

A complete set of new solid steel rock buckets was built for dredge *Lafontaine* (No. 5) including new links, upper and lower tumblers, rollers, &c. The buckets of dredge *Baldwin* (No. 6) were rebuilt and new buckets, tumblers, &c., were furnished for the other dredges.

MAINTENANCE OF FLEET.

A large part of the work done at the Sorel shipyard consists in the maintenance of the vessels of the St. Lawrence Ship Channel dredging fleet. The hulls and machinery of these vessels were maintained in good condition during the fiscal year 1904-05, and all necessary repairs were made to them.

REPAIR WORK FOR DEPARTMENT OF PUBLIC WORKS.

Several of the vessels belonging to the dredging fleet of the Public Works Department were repaired at the Sorel shipyard during the year 1904-05.

The dredge *International* had a storm deck constructed over her machinery to enable her to be sent to the Lower St. Lawrence. Her spuds were changed and her broken crane repaired.

The dredge *St. Louis* and her dump scows and the tugs *Ottawa* and *Daisy* were hauled out and repaired during the year.

HAULING OUT.

The slip ways of the shipyard were kept busy during the year, hauling out various vessels of the dredging fleet for repairs.

During the winter 1904-05, the following vessels were hauled out and kept out for the winter for heavy repairs:—Dredge *Nithsdale*, Lake St. Peter lightship No. 1, tug *Daisy*, tug *Champlain*, tug *Ottawa*, two dump scows belonging to dredge *St. Louis*, tug *St. Francis*, two lodging scows.

HYDROGRAPHIC SURVEY.

The steamer *de Lévis* attached to the hydrographic survey of the River St. Lawrence, was also kept in repair.

Three boats for survey work, each 30 feet long, were built at the shipyard.

LIGHTHOUSE SERVICE.

Four steel, light towers were built for the lighthouse service between Montreal and Quebec.

Fuel and materials were furnished to the vessels engaged on this service and necessary repairs to these vessels were effected.

SUCTION HOPPER DREDGE FOR BELOW QUEBEC.

Work was begun on the plans of a steel, twin screw, hopper, suction dredge for the feet of the St. Lawrence Ship Channel. Some preparatory work was done on the scaffolding for the building of this dredge, and some steel was ordered.

IMPROVEMENTS TO SHIPYARD.

Plans were drawn out for an electric sub-station for the shipyard. This sub-station is to be used to convert the alternating current, received at high voltage from the Sorel Electric Company, into low potential alternating current and direct current suitable for power and lighting purposes in the shipyard. Work was begun on the construction of this power house.

A new wharf was begun to take the place of the old railway wharf which existed at the lower end of the shipyard. This old wharf had become dangerous and had to be replaced. The new wharf will be 250 feet long and will add greatly to the conveniences of the shipyard.

All the buildings of the shipyard were painted and all the machinery was maintained in a good state of efficiency.

