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SIR DOUGLAS FOX, President,
in the Chair.

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“A Short History of the Engineering Works of the
Suez Canal.”

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OWING to the circumstance that no special account of the Suez Canal has been presented to the Institution since Sir William Denison's Paper in April, 1867,¹ 2½ years before the opening of the Canal, it has been considered that a second Communication on the same important subject brought down to the present time would not be unacceptable to the Institution.

The chief object of this Paper being to give a brief account of the recent enlargement of the Suez Canal, comparatively little space can be devoted to a recital of its general history. As an Introduction to the main subject of the Paper, however, it seems desirable to refer in some slight detail to the principal engineering features of the original work, as well as to certain financial difficulties with which the Canal Company had to contend up to the time of its acknowledged success as the greatest commercial enterprise of the century.

Mean Level of the Red Sea and Mediterranean.—The first idea in modern times of a ship-canal across the Isthmus of Suez was conceived by Napoleon I., but the scheme was abandoned as impracticable when Lepère reported that the surface of the Red Sea was 30 feet higher than that of the Mediterranean—a fallacy which was not exploded until 1847, when a series of levels established the identity of the mean sea-levels at Suez and Port Said.²

¹ Minutes of Proceedings Inst. C.E., vol. xxvi. p. 442.

² The difference in level between ordinary high and ordinary low water at Suez is 3 feet 9 inches; at Port Said 9 inches. The extreme difference, caused by contrary winds, observed at Suez is 8 feet 6 inches, and at Port Said 4 feet 6 inches. The prevailing winds are from north and north-west.

Concession of the Canal to Ferdinand de Lesseps in 1854.—In November, 1854, Ferdinand de Lesseps, the illustrious founder of the canal, obtained a concession from Saïd Pasha for a waterway from sea to sea without locks, and in October, 1855, an International Consultative Commission, selected from among the most celebrated hydraulic engineers in Europe, was appointed to report on the scheme (Appendix No. I.).

Report of the International Consultative Commission of 1855-56.—The final Report of the Consultative Commission, which was framed after a Sub-Commission, consisting of five members, had visited Egypt and had studied the question on the ground, was submitted to and accepted by the Khedive in June, 1856. Its chief resolutions and recommendations were to the following effect:— It rejected the system of indirect routes through the Delta of the Nile, and adopted the principle of a direct route through the Isthmus from Suez to the Mediterranean. It discussed the advantages and drawbacks of a canal with continuous banks, and decided that there should be no embankments where the canal passed through the Bitter Lakes. It expressed the opinion that locks at the two extremities of the canal would not be necessary, as the lakes would have the effect of deadening the tidal currents. It stipulated that the depth of the canal should be 8 metres (26½ feet), and wide enough not only to allow two vessels to pass each other, but to give room for a third line of vessels which might, from any cause, stop on the way; and it was therefore recommended that the canal, between the Red Sea and the Bitter Lakes, should have a width of 210 feet at the bottom, and of 320 feet at the top; and that the channel between the Bitter Lakes and the Mediterranean should be cut to a width of 144 feet at the bottom, and to 262 feet at the top; and, lastly, the Consultative Commission decided on the plan of running out jetties directly seaward at Port Saïd to protect the entrance, rather than at a point 15 miles to the S.E., on the shore of the Gulf of Pelusium, the entrance originally proposed by the engineers of the Khedive. The ultimate choice of the entrance (thanks to the representations of Mr. Larousse, hydrographer of the French navy), although necessarily involving the construction of a considerably longer artificial waterway across the Isthmus, was based on the important consideration that a depth of 8 metres was found at a distance of less than 2 miles from Port Saïd, whereas at the proposed easterly entrance, near the old Pelusiatic mouth of the Nile, the 8-metre contour was fully 5 miles from shore. When it is remembered that the cost of jetties built on a

shallow, sandy coast is nearly in proportion to their length, and that a steep slope of the sea-bed fronting a seaport is a great advantage, it can hardly be doubted that the final decision in favour of Port Said was a wise one.

At Port Said the direction and length of the jetties, as well as their mode of construction, was subsequently adopted on the advice of Mr. Pascal, Inspector-General of Roads and Bridges, whose death in 1896 was so greatly deplored by his old colleagues. At Suez, Port Thewfik, the construction of a single jetty was deemed sufficient, and no difference of opinion existed as to the disposition of the necessary inner harbour works at each end of the canal. The lengths of the west and east jetties at Port Said are 9,800 feet and 6,000 feet respectively. The width between them at their origin is 4,200 feet, and their distance apart at the end of the east jetty is 2,300 feet. The width and depth of channel alongside the west jetty are 330 and 30 feet respectively, and the direction of the channel is N.E. by $\frac{3}{4}$ N.

Formation of the Suez Canal Company in 1858.—The resolutions of the Consultative Commission were widely published, and produced such a favourable effect on the public mind that at the close of 1858 Mr. de Lesseps succeeded, in spite of the then determined opposition of the British Government, in organizing a company to carry on the work. Besides the founders' shares, the total number of ordinary shares of the company was 400,000 of £20 each, of which French investors took nearly three-fifths and the Khedive rather more than two-fifths. Thus the original capital of the company, when all the ordinary shares were allotted, was £8,000,000—the sum named by the Sub-Commission and by the Engineers of the Khedive, Mougel Bey and Linant Bey, as being sufficient to cover the cost of the canal and all the works connected with it.

Topography of the Canal (Figs. 1, 2, 3 and 4, Plate 2).—The construction of the canal was greatly facilitated by the existence of four dried-up depressions which were formerly and have again become lakes of considerable area, namely, the two Ballah Lakes, the Great and Small Bitter Lakes, and Lake Timsah. These low-lying regions have an aggregate length of 27 miles. Excavation was required, however, throughout the Ballah Lakes, Lake Timsah, and the Small Bitter Lake, as well as along a portion of the Great Lake; and, consequently, it was only for a length of about 8 miles of the latter, where the natural depth exceeded that of the canal, that no excavation was necessary.

Said;¹ and immediately after his inspection furnished the British Government, at the request of the British Consul-General for Egypt, with his notes of travel across the Isthmus, accompanied by the expression of his own opinion as to the entire practicability of the scheme, the successful realisation of which, he stated, was but a question of time and money; the reduction of these items being dependent on the substitution of efficient steam-dredgers and other improved mechanical appliances for hand-labour.

At the time of his visit not a fiftieth part of the earthwork of the canal proper had been removed—a condition of affairs due to financial difficulties; to a great paucity of labourers; to the difficulty of providing them with fresh water; to the faulty construction and inefficiency of the steam-dredgers then employed; to the impossibility of keeping open the newly-dredged entrance channel at Port Said before it was protected by the jetties; and especially to the necessity for first of all constructing a fresh-water canal from Cairo to Suez by way of Ismailia, and for laying down duplicate iron pipes from Ismailia to Port Said, so as to insure a constant and ample supply of drinking-water for the workmen along the whole length of the canal.

Accelerated Progress after 1862.—As the work progressed, these difficulties were gradually surmounted, thanks chiefly to the skill and resource of Voisin Bey, the first engineer-in-chief, and his able assistant engineers, Messrs. Laroche, Larousse and Gioia; and to the provision by Mr. Lavalley, the contractor, of a large fleet of powerful dredging-machines, by means of which the dredged material, carried by long and high projecting shoots, was rapidly delivered on either bank of the canal at some distance from the slopes of the cuttings without the intervention of barges. These and other mechanical appliances had the effect of reducing by three-fourths the number of workmen needed to open the canal by the time originally estimated; whilst the completion of the fresh-water canal in 1863 relieved the company of the enormous expense of supplying the workpeople with water brought from the Nile on camel-back. In July, 1862, the Khedive requested Mr. (afterwards Sir John) Hawkshaw to examine the site of the proposed Suez Canal and to report thereon. Accordingly, at the close of that year, Mr. Hawkshaw minutely inspected

¹ At this time Port Said was simply a collection of hovels situated on a narrow belt of dunes separating Lake Menzaleh from the sea. To-day (1900) it is the largest coaling station in the world, with a population of 40,000 souls, of whom 11,000 are of European descent.

the whole length of the canal, and shortly afterwards, in summing up his long and convincing report, addressed to the Egyptian Government, expressed his belief that the canal could be made and could be maintained at a moderate and reasonable expense.

Increase of Capital and reduced width of Canal.—The financial difficulties were overcome:—(1) by decreasing the width of the bottom of the canal to 22 metres (72 feet), *i.e.* less than one-half the width recommended by the International Consultative Commission, it having been found soon after the works were begun that the cost of the work had been greatly under-estimated; (2) by virtually increasing the original capital of £8,000,000 to £17,120,000, thanks to the Emperor Napoleon's award of £3,800,000,¹ and to subsequent loans amounting to £5,320,000.

As some compensation for the greatly reduced area of the canal, "gares" or sidings were provided at every 5 or 6 miles between Port Said and Lake Timsah to allow vessels to bring up either for the purpose of passing each other, or to moor for the night.

In April, 1867, water from the Mediterranean was let into the marshy bed of Lake Timsah, but it was not till March, 1869, that it was allowed to flow into the nearly dry salt-encrusted basins of the Bitter Lakes.

Opening of the Canal.—On the 17th November, 1869, the Suez Canal was inaugurated with great pomp and thrown open to navigation.

Total Cost of the Work up to 31st December, 1869.—On the 31st December following, forty-four days after the opening of the canal, when in several places the depth was less than 20 feet over a width of 60 feet, the cost price was stated in the "Bulletin décadaire," No. 22, as follows:—

	£
General expenses of the constitution of the company, } cost of negotiation, commission, stamps, and ex- } penses as to shares }	561,380
Cost of management for 11 years	567,300
Interest during construction, including sinking fund .	3,316,520
Service of health, telegraph, domain, and transit, } 1868-1869 }	533,530
Cost of construction, including sinking fund to pay } for materials }	11,654,223
Total	£16,632,953

¹ This sum was paid by the Khedive to the Company as indemnification for the loss it would sustain by the withdrawal of forced, or *corvée* labour; for the retrocession of land grants; and for abandonment of other privileges attached to the original concession.

Financial difficulties and Tonnage Question.—It would require many pages to describe in detail the serious pecuniary difficulties of the company from the opening of the canal up to the time when the revenue from dues on shipping began to increase by leaps and bounds. The limits of a short Paper also forbid more than a passing allusion to the burning question which was then under discussion, relative to the claim of the company to its right to levy dues on the gross register tonnage instead of on the net register tonnage of ships, and to a re-adjustment of the tariff. The following summary of facts regarding the tonnage question should be premised by the remark that, in the concession by the Khedive in 1856, it was expressly stipulated that the tariff on shipping passing through the canal was to be the same for ships of all nations, viz., 10 francs per ton, and 10 francs per passenger. According to this understanding, from the opening of the canal to the 1st July, 1872, the transit dues were levied at the rate of 10 francs on the net registered tonnage; but from that date to the 29th April, 1874, notwithstanding the protests of the shipping interest, the rate of 10 francs was levied on the gross registered tonnage. In 1873 the International Tonnage Commission defined the mode of measuring the gross tonnage of a ship, and the deductions to be made therefrom to arrive at the net tonnage, which was declared to be the tonnage on which alone the dues could be levied. At the same time a surtax of 3 francs was recommended and adopted by the Powers which raised the toll from the 10 francs of the original concession to 13 francs per ton, which was to be reduced to 10 francs as traffic increased. By a subsequent convention made in 1876 a modification was made in the terms of reduction by which $\frac{1}{2}$ franc per ton was taken off at fixed dates, being on the 1st January of the years 1877, 1879, 1881, 1882, 1883 and 1884. On the 1st January, 1885, under an agreement with the English shipowners, the rate was reduced to $9\frac{1}{2}$ francs, and under the automatic action provided by that agreement the dues were again lowered on the 1st January, 1893, to 9 francs per ton, at which rate they still remain.

Purchase of Shares by the British Government.—The remarkable episode of the purchase by the British Government in 1875 of the Khedive's shares should not be passed over unnoticed, even in the barest account of the financial vicissitudes of the canal. It should first be remarked that the 400,000 original £20 shares of the company had yielded no surplus whatever over the fixed 5 per cent. till 1875, and that the Khedive had at that time mortgaged till 1894 the interest on the shares held by him.

In 1875 the British Government purchased for the sum of £4,000,000 the 176,602 original shares which belonged to the Khedive. This famous purchase was based in a great measure on the advice of Lieutenant-General Sir John Stokes, K.C.B., Ex-member of the International Tonnage Commission of 1873, and since 1876 one of H.M. Representatives on the Board of Directors of the Suez Canal. The main results of this memorable transaction were concisely stated by the Chancellor of the Exchequer when he informed the House of Commons on the 19th June, 1893, that the total estimated value of the Suez Canal shares purchased by Lord Beaconsfield in 1875 for £4,000,000 was then £17,750,000;¹ that £3,805,000 out of £4,000,000 had been paid off by the sinking fund; that the shares purchased would be entitled to a dividend on the 1st July, 1894; that the amount of the dividends paid by the company for the past three years had been 17, 21 and 18 per cent. respectively, and that the ratio which British tonnage bore to the total tonnage of ships passing through the canal was 75 per cent.

Dredging and Maintenance.—According to the official statistics, made up to the 31st December, 1882, the dredging and excavation work for the maintenance of the canal and basins from November 1869 up to and including 1882, had been 13,600,000 cubic metres (exclusive of 1,800,000 cubic metres for enlargements), and according to the annual statistics of the company for 1897 the amount of dredging required for maintenance pure and simple from 1875 to 1897, both inclusive, had been 31,064,839 cubic metres, distributed as shown in the Table on p. 165. When it is considered that the cost of dredging averages upwards of 1s. per cubic metre, the heavy annual charge incurred for maintenance becomes at once apparent.

ENLARGEMENT OF THE CANAL.

Rapid Increase of the Traffic since 1872.—The events which led to the enlargement of the canal, the first phase of which was virtually completed last year, should now be referred to in some detail. The “Compte Rendu” of the company, from 1869 to 1883 inclusive, showed that in 1872, when the number of ships passing through the canal was 1,082, with an aggregate registered net ton-

¹ At the present market value of £150 per share the actual value of the shares held by the British Government is £26,500,000.

nage of 1,160,000, the receipts were £575,000, as compared with 3,307 ships and a net tonnage of 5,776,000 tons, and receipts of £2,422,000 in 1883. The same Table further showed that whilst in 1870 the average registered tonnage was only 897 tons per vessel, in 1875 it was 1,345 tons, and in 1883 1,740 tons per vessel.

It also appeared by other statistics published by the Company that the average time occupied by vessels in the canal had risen from 39 hours in 1876 to 48 hours and 40 minutes in 1883.

Locality.	1875-1882 (8 Years).	1883-1897 (15 Years).	Total in 23 Years.	Average per Annum from 1883-1897.
	Cubic Metres.	Cubic Metres.	Cubic Metres.	Cubic Metres.
<i>Dredging at Port Said.</i>				
Along the east side of the west jetty	37,898	2,168,248	2,206,146	144,550
In the channel of the Avant Port	2,005,365	2,101,044	4,106,409	140,136
In the basins	356,605	1,203,836	1,560,441	80,259
Seaward of the jetties . . .	1,332,716	3,660,602	4,993,318	224,040
<i>Dredging between Port Said and Suez.</i>				
Port Said section	3,390,621	6,577,597	9,968,218	438,510
Ismailia section	1,178,259	3,051,072	4,229,331	203,405
Suez section	1,283,088	2,717,888	4,000,976	181,192
Total	9,584,552	21,480,287	31,064,839	

Owing to this increased delay in the passage of steamers through the canal since 1876, and to the startling augmentation of traffic since 1872 (resulting principally from the adoption of iron steamers in the Red Sea route to the Far East, and from the great economy of fuel effected by the employment of screw-propellers worked by triple-expansion engines—an economy in transport which was unforeseen when the concession for the canal was obtained), it was universally admitted in 1883 that a radical plan of improvement was imperatively demanded, in order to remove the numerous delays which at that period impeded the passage of a swollen navigation through a restricted waterway.

Constitution of a Second International Consultative Commission 1884-85.—This opinion caused the Directors of the Company, at their annual meeting in May 1884, under the presidency of Mr. Ferdinand de Lesseps, to announce to the shareholders—after reminding them that, under his convention with the British

Government of 1876, a special sum of £1,200,000 had been already voted and partly expended on indispensable improvements—that a second International Consultative Commission, consisting of eight Frenchmen, eight Englishmen, and six members of other nationalities (Appendix No. II.), had been appointed to study the question as to the best means to be employed either to enlarge the present canal sufficiently or to construct a second canal alongside the existing one, with the object of eventually providing ample accommodation for a traffic exceeding 10,000,000 tons a year.

The Consultative Commission met in Paris, and held three sittings in the latter part of June 1884, when, after discussing two alternative schemes presented by the Engineer-in-chief of the canal, Mr. Lemasson (one for the enlargement of the existing channel, and the other for an independent parallel channel), it was decided that eight members of the Commission should act as a Sub-Commission and visit Egypt; in order to make such observations and investigations on the spot as would ultimately enable the Commission to arrive at a final decision on the important question of the best means of preventing delays in the passage between the Mediterranean and the Red Sea, and *vice versa*, and of providing for the expansion of trade.

Sub-Commission of 1884-85.—The Sub-Commission was composed of the following Members:—

France	Messrs. Voisin Bey and Tillier.
Great Britain	Sir John Cooke and the Author.
Germany	Mr. Pescheck.
Austria-Hungary	Mr. Crillanovich.
Italy	Mr. Gioia.
Holland	Mr. Dirks (President).

“Reporter,” Mr. Voisin Bey.

Secretary, Mr. Vicussa.

Projects of Mr. Lemasson.—Before referring more particularly to the doings of the Sub-Commission, reference should be made to the projects of the Engineer-in-chief of the Company. It has already been noticed that he presented two schemes for an improved waterway, and inasmuch as his project for the pure and simple enlargement of the existing waterway was accepted with but few modifications by the Sub-Commission, and eventually by the Directors of the Canal, the main features of that scheme should now be described.

In explaining the details of this project, the execution of which he recommended should be divided into three stages, Mr. Lemasson contended that the waterway should be wide enough

for two steamers to pass each other in motion without danger of collision; and to accomplish this he was of opinion that there should be a space equal to two clear beams between them, and an interval of 12 metres (40 feet) between their outer sides and the lines of buoys. This meant a channel—taking 48 feet as a maximum beam—of about 70 metres (230 feet) broad at the bottom, which he considered would be sufficient for the long straight reach south of Port Said; whilst for the Suez end and for the curves, he proposed to increase the breadth to 80 metres (262 feet). The total cost, including plant, was estimated at £8,118,000 if the depth were kept at 8 metres (26½ feet), or £9,750,000 if increased to 9 metres (29½ feet).

The cost of a parallel canal having a depth of 9 metres was estimated at £11,150,000, but this merely served for the construction of a new channel of the same width as the existing one, and no allowance was made for sidings, nor was any sum included to represent the capitalized value of the great increase of the working expenses which the execution of a second canal would undoubtedly entail.

Visit of the Sub-Commission to Egypt in 1884.—The members of the Sub-Commission, accompanied by Mr. de Lesseps, Mr. Charles de Lesseps, Mr. Anslyn (a Director), and Mr. (now Sir James) Laing (a Director), assembled at Port Said on the 21st November, 1884, and were joined by Mr. Lemasson and the other “Chefs de Service” of the Company, all of whom gave the Sub-Commission every possible assistance during its fortnight’s inspection of the ground.

INFORMATION COLLECTED BY THE SUB-COMMISSION DURING ITS INSPECTION OF THE ISTHMUS.

As one of the principal objects of the mission confided to the Sub-Commission was to ascertain on the spot the opinion of captains of large steamers frequenting the canal, and of experienced pilots in the service of the Company regarding the question of a safe width and depth of waterway to allow the meeting of two vessels in the Canal, both being under way; the Commission drew up a list of questions bearing on this important matter, and submitted it for the consideration and remarks of nine captains of the largest-sized steamers navigating the canal, and to twenty-five of the most skilful pilots of the company.

Opinion of Experts as to the adequacy of the proposed enlarged Canal.—The following answers of these experts to some of the

questions put to them, practically confirmed the sufficiency of the dimensions of the transverse section of Mr. Lemasson's project for the eventual widening of the canal threefold from Port Said to Suez.

First Question.—In a canal three times larger at the bottom than the present one in its straight parts and without currents, and three and a half times wider in the curves and where currents exist, could two large vessels in motion pass each other in safety? ¹

Replies.—Thirty-two replied in the affirmative, and two demanded a width of 76 metres and 80 metres respectively.

Second Question.—How much water should a large vessel have under her keel to enable her to steer well at a speed of 8 knots an hour?

Replies.—The answers varied from a minimum of 6 inches to a maximum of 6 feet under the keel, but the average depth demanded by the captains was $3\frac{1}{2}$ feet, and by the pilots 3 feet.

Third Question.—At what speed could large vessels steam through an enlarged canal, with a sufficient depth under their keels?

Replies.—Eight estimated a speed of 7 knots, twelve of 8 knots, and the remainder of about 10 knots an hour; the estimated average of all the experts being 8 knots.

Fourth Question.—At what distance from each other should vessels begin to slacken speed in an enlarged canal?

Replies.—Eight captains and seventeen pilots demanded 1 mile, and one captain and eight pilots demanded 2 miles.

Fifth Question.—What should be the speed of each vessel at the moment of passing the other?

Replies.—Seven captains and twenty-one pilots were of opinion that the speed of each vessel should be as slow as possible, and the remainder considered that they could pass each other safely at speeds ranging from $2\frac{1}{2}$ knots to 4 knots an hour.

Sixth Question.—At the meeting of two vessels in motion what should be the distance between them?

Replies.—Six captains and seventeen pilots demanded a distance of $1\frac{1}{2}$ times the beam of a vessel, and the remainder of from $\frac{1}{2}$ to $1\frac{1}{2}$ times the beam.

¹ Between Suez and the Bitter Lakes the current ranges from $\frac{1}{2}$ knot to 2 knots an hour. Between the Bitter Lakes and Port Said there is practically no current.

Experiences of the Sub-Commission, during the Inspection of the Canal.—In addition to obtaining the opinion of competent persons on the spot, the members of the Sub-Commission had several opportunities of judging for themselves, during their close inspection of the canal, how best to provide increased facilities of transit, not only for the time being, but for many decades to come.

On board the s.s. "Austral."—The limits of this Paper, however, will only permit reference in anything like detail to certain experiences on board the Orient Company's s.s. "Austral," which, at that time, was the largest steamer that had passed through the canal. The "Austral" has a length of 456 feet, a beam of 48 feet, a gross tonnage of 5,665 tons, and a draught of 27 feet when fully loaded. Her actual draught aft in navigating the canal was 24 feet 6 inches (7 metres 50 centimetres), the maximum immersion then allowed by the canal company, and consequently, with this limited draught, she could only load up with half her full complement of coal. On the 26th November, 1884, the "Austral," on her arrival at Lake Timsah from Port Said, was boarded by the Sub-Commission, after she had cleared the Timsah bend by the aid of warps, an operation which took 40 minutes to perform, as the radius of the curved channel at that spot was then only 3,000 feet.¹ In the straight part of the canal, after leaving the lake, she steamed at the regulation pace of $5\frac{1}{2}$ knots (10 kilometres) an hour to the curve at Toussoum, where her speed was slackened to 4 knots. Thence she resumed the maximum regulation speed as far as the "Déversoir" siding, where she again slackened speed to pass a couple of large steamers lying moored to the bank within the siding. Here, as on several other occasions, the Commission noticed the attraction of the moored vessels towards the passing steamer; in other words, at the moment a vessel in motion passed a vessel moored to the bank, the latter was invariably drawn towards the passing vessel; the amount of the disturbance being proportional to the speed of the passing ship.

The distance of 8 miles between the north and south lighthouses of the Great Bitter Lake was accomplished at the rate of 13 miles an hour. The "Austral" then passed through the Little Bitter Lake, where the bottom had already been widened from 22 metres to 40 metres. She then stopped at the seventy-first milepost in order to allow four vessels coming from Suez to enter the siding

¹ The radius of this curve was originally only 300 metres. Many years since the radius was increased to 4,100 feet, over a width at the apex of 700 feet.

at Chalouf at the seventy-fifth milepost. This siding had been formed by a widening of 15 metres on each side of the channel over a length of 750 metres; and here, as in all the other sidings between the Bitter Lakes and Suez, the passage was frequently made without difficulty between two ranks of vessels moored to the bank within the sidings.

After a stoppage of 70 minutes, the time required for the mooring of the four vessels, the "Austral" continued her voyage, passing the four shunted steamers at the rate of 3 miles an hour with a clear width of 60 feet of empty space on each side; and finally came to anchor in the roadstead of Suez after a passage of 8 hours 35 minutes (deducting the time lost at Chalouf), which is equal to a mean speed of 5 knots an hour, with a tide from the Bitter Lakes of about half a knot an hour in her favour.

Before taking leave of the "Austral," it should be remarked (as illustrating in a striking manner the retarding effect of friction on the speed of large vessels navigating a restricted channel) that the "Austral," in passing through the straight reaches of the canal between Lake Timsah and Suez, only made 5 knots an hour with 43 revolutions of her screw; whereas in the open sea with the same number of revolutions (43) she made 11 knots, and with 68 revolutions 16 knots an hour.

Condition of the Canal in 1884.—In order to ascertain the condition of the canal-banks, and to test the effect produced on the revetted and unrevetted slopes by passing steamers, the Commission had a powerful steam-tug placed at its disposal with a view to facilitate its task.

Revetments.—Between Port Said and El Guisr, and throughout the Suez plain, the upper parts of the slopes, down to depths varying from 3 feet to 9 feet below the water-line, were being gradually protected at the time of the inspection with smooth-faced masonry in hydraulic mortar, laid at inclinations at from 2 to 1 to 5 to 1, according to the nature of the ground, and it was observed that throughout these portions of the canal the banks had been severely attacked and eroded, notwithstanding the various methods that had been employed to protect them from the wash of the waves generated by steam-vessels. These methods consisted of revetments of riprap in moderately solid ground, of dry rubble disposed in steps supported by piling in soft ground, and by a pavement of masonry where the banks consisted of stiff clay.

In the cuttings of El Guisr and Serapeum the slopes above the

water-line were found to be sufficiently protected by continuous plantations of tamarisks, reeds, and similar plants, and the submerged slopes of these long and deep cuttings—where the surface width of the canal was barely 200 feet, as compared with the surface width of 320 feet between Port Said and Kantara and elsewhere—were also found to be in excellent condition.

With regard to the effect produced on the slopes by the waves which followed the run of vessels in motion, the Commission invariably found that wherever the slopes were abnormally flat and the submerged benchings were inordinately wide, the waves oscillated to mid-channel, and broke heavily on the banks, thus acquiring a movement of translation, and that under this double action the upper parts of the slopes, where unprotected, were rapidly shorn down and swept away; and that even the stone revetments were not infrequently either damaged or partially destroyed.

On the other hand, it was observed that in the regions of the canal where the submerged slope prolonged itself to the water-line (and was, therefore, without a benching of any kind, as at El Guisr), the waves broke lightly and seemed to have no destructive force. At the same time, however, it was apparent that this immunity from damage was not a little due to the plantations at the water-line having the natural effect of deadening the action of the waves without injury to the yielding and well-rooted plants which at El Guisr border the waterway along both banks.¹

Electric Light Experiments in 1884.—The Commission, before completing its inspection of the works, had also the opportunity of taking part in one of the night experiments which were then being made by the chief executive officers of the Company on board a steamer carrying a 1,600 candle-light at a height of 18 feet above the water-level, in view of the contemplated illumination of the whole length of the canal by means of electricity. On the occasion referred to, the experiments were made in a part of the canal where the buoys were disposed in pairs at intervals of 500 metres; the width of channel between the two lines of buoys being 34 metres.

The Commission found that at the moment of passing a pair of buoys, but not till that moment, the following pair of buoys became distinctly visible, and owing to this circumstance it was considered desirable that the pairs of buoys should be placed at

¹ The question of the best type of cross-sections for canals in general, and especially for the Suez Canal, is discussed at length in Mr. Conder's Paper on "Speed on Canals," Minutes of Proceedings Inst. C.E., vol. lxxvi. p. 160.

intervals of only 250 metres in order that a vessel might always have two pair in view—an indispensable condition to insure a proper direction in navigating a contracted waterway. At this period no one ventured to predict that in less than five years' time the result of these early experiments would have the effect of virtually doubling the carrying capacity of the canal, independently in a great measure of additional engineering works.

Final Meetings of the Sub-Commission.—The members of the Sub-Commission, having completed their labours on the ground, held several subsequent meetings in Egypt and Paris before submitting the result of their proceedings to the judgment of their colleagues in the International Consultative Commission.

Resolutions of the Consultative Commission in 1885.—On the 11th February, 1885, all the members of the full Commission reassembled at Paris, and unanimously adopted the following resolutions in favour of an enlarged canal:—Concerning the choice of methods to be adopted for the enlargement of the waterway, the Commission gives unqualified preference to the system of a pure and simple enlargement of the canal, from the Mediterranean to the Red Sea.

As to the dimensions of the enlarged canal:—

1. As to the depth, the Commission is of opinion that the project for the works and estimate of cost should comprise a final deepening of the canal to a depth of 9 metres (29 feet 6 inches) below the level of low water of ordinary spring tides at every point; but at the same time the Commission thinks that the programme for the successive execution of the work should be fixed with the object of first obtaining a depth of 8·50 metres (27 feet 10 inches); the complementary deepening of 0·50 metre (1 foot 7 inches), being the last phase of the execution of the projected improvement.

2. As to the widths of the canal and the easing of the curves, the Commission is of opinion that the canal should have the following widths at the depth of 8 metres (26 feet 3 inches) below the level of low water of ordinary spring tides, that is:

A. Along the portion of the canal between Port Said and the Bitter Lakes:

In straight reaches, a width of 65 metres (213 feet). In curves of more than 2,500 metres (8,200 feet) radius, a width of 75 metres (246 feet), measured at the apex of the curve adjusted gently to the normal width of the canal; and, lastly, in curves of 2,500 metres (8,200 feet) and less radius, a width at the apex of at least 80 metres (262 feet).

B. Along the portion of the canal between the Great Bitter Lakes and Suez :

In straight reaches, a width of 75 metres (246 feet). In the curves, a width of 80 metres (262 feet) at the apex.

As to the curve in the Timsah Lake, to increase its radius to 1,250 metres (4,100 feet), and to begin its correction without loss of time.

3. As to the harbour of Port Said, the Commission approves of the reduction of the width of the Asiatic island between the coaling dock and the Ismail dock, and of the rectification of the curve at the first milepost to a radius of 3,000 metres (9,843 feet).

Concerning the typical sections of the canal, the Commission is of opinion that it is necessary to include the protection of the canal banks against erosion in the project for the completion of the canal. The Commission, moreover, thinks that this protection of the banks is not indispensable in the first instance, and is only necessary throughout the Menzaleh and Ballah Lakes and between the small Bitter Lakes and Suez.

Among the different types of protection works already employed, the Commission would prefer (wherever the nature of the ground allows its application) a stone pitching in mortar laid at as steep a slope as possible in favourable ground, reaching down to 2 metres (6 feet 6 inches) below the level of low water of ordinary spring tides, resting on a benching of a width just sufficient to insure a solid base for the work, and rising to a height of about 1 metre (3 feet 3 inches) above the level of high water of ordinary spring tides.

Lastly, the Commission thinks that the typical sections drawn up by the Engineer-in-chief of the company in conformity with the above indications should be definitely accepted. The past, present and proposed cross sections are shown respectively in Figs. 7, 8, and 9, Plate 3.

These recommendations were signed by all the members of the Consultative Commission, and were accepted soon afterwards by the President and Directors of the Suez Canal Company.

Bases on which the Recommendations of the Consultative Commission were made.—It is impossible within the limits of a short Paper to give anything like an adequate account of the grounds on which the Consultative Commission of 1884–85 arrived at the above-mentioned decisions. Sufficient space, however, must be found to allude briefly to the following important elements which naturally came prominently to the front in the final discussions at the meetings of the Sub-Commission at Ismailia, before the conclusion of its labours in Egypt.

1. QUESTION OF PRINCIPLE AS TO THE BEST MEANS OF DOUBLING THE CARRYING CAPACITY OF THE WATERWAY.

It was considered that the enlargement pure and simple of the canal was incontestably the best solution:—Because an enlargement could speedily be made of the same width as the existing sidings, so as to provide passing-places in the canal from end to end; a disposition which would realize almost the same conditions of passage as could be afforded by two separate canals, whilst at the same time—owing to the larger sectional area of a widened canal—vessels would be able to accomplish their transit with more speed and safety than by means of two separate channels each having the same area as the existing canal. Because, eventually, by increasing the width threefold in the straight reaches and fourfold in the curves, steamers in motion would be able to pass each other in safety, at a reduced speed, at any part of the canal; and, finally, because the cost and maintenance of a double canal of the same dimensions as the existing waterway would be very much greater than the cost and maintenance of a single canal of the dimensions proposed by the Engineer-in-chief.

2. DIMENSIONS OF THE PROPOSED ENLARGED CANAL.

Difference of opinion on the relative merits of Widths and Depths of an enlarged Canal.—Long discussions took place at the final sittings of the Sub-Commission as to the relative values of widths as compared with depths of channel, owing to the circumstance that, according to the estimates of Mr. Lemasson, the adoption of a depth of 9 metres instead of 8 metres would involve an extra outlay of £1,500,000, unless the bottom widths were considerably reduced in order to meet the cost of the extra depth proposed.

With regard to the merits of this important question there was a marked difference of opinion; certain members of the Sub-Commission attaching the utmost importance to a notable increase of depth, even at the expense of a diminished width, and other members holding to the opinion that any additional depth was unnecessary. The two English delegates and Mr. James Laing, who took a leading part in the discussion on this important matter, expressed their opinions strongly in the former sense, and endeavoured, but with only partial success, to convince their dissenting colleagues of the supreme importance of affording a free passage to vessels of a draught of 27 feet with $2\frac{1}{2}$ feet under the keel; whilst, on the contrary, certain other members of the Commission contended that

there was no necessity to provide vessels with a greater draught than $7\frac{1}{2}$ metres (24 feet 6 inches) with $\frac{1}{2}$ a metre under the keel.¹

Finally, in order to come to a unanimous vote on the question, it was decided without a dissentient voice that the project and estimate for the enlargement of the canal should (whilst retaining the widths recommended by Mr. Lemasson) include a final deepening to the depth of 9 metres (29 feet 6 inches) below the level of low water of ordinary spring tides; but at the same time the Sub-Commission agreed, as a compromise, to recommend that the programme of the successive stages of the execution of the works should be regulated with the view of realising a depth of 8.50 metres (28 feet) in the first instance; the complement of 0.50 metre (1 foot 7 inches) being comprised in the last stage of the enterprise.

Estimated Cost of the Enlargement Works.—The estimated cost of the enlargement works recommended by the Consultative Commission and sanctioned by the directors was as follows:—

	Estimated Cost.
	£
First phase—Excavation and dredging 21,064,000 cubic metres	2,449,600
Second „ „ „ „ 43,569,000 „	5,190,200
Third „ „ „ „ 4,992,000 „	660,200
Totals	8,300,000
Deduct sale of plant	182,000
Total	£8,118,000

The excavation and dredging of 69,625,000 cubic metres comprised 310,000 cubic metres of gypsum in the Port Said section, and 743,279 cubic metres of rock in the Suez section. The total expense also includes a sum of £314,000 for stone revetments.

Reconstitution of the Consultative Commission of 1884–85.—The enlargement works were commenced in 1887, when all the members of the Sub-Commission who had visited Egypt in 1884 were invited by the Board of Directors to serve as members of a new Consultative Commission (“Commission Consultative Internationale des Travaux”), whose duty it should be to meet annually

¹ The Author strongly advocated the adoption of a depth of 9.50 metres (31 feet) from end to end of the canal, so as to allow steamers drawing from 8.50 metres (28 feet) to 9 metres (29 feet 6 inches) to pass freely through the improved waterway with a sufficient depth under the keel, on the completion of each phase of the proposed widening.

in Paris to discuss all important matters connected with the improvement of the canal.

The ex-Sub-Commission having (with the exception of Mr. Tillier, appointed chief of the transport service of the canal, and of Mr. Dirks, removed by death) accepted this invitation, the first meeting of the newly-constituted Commission, reinforced by the addition of six new members,¹ was held in Paris on the 4th and 5th of November, 1887, and has so continued to meet every autumn up to this time. The British representatives on the new Consultative Commission of 1887 are Sir John Wolfe Barry, K.C.B., and the Author, the former having been appointed by the British Government in 1892, on the death of Sir John Coode, and the latter in 1884, as already stated. It should also here be remarked (1) that, after a residence of nearly thirty years in Egypt, Mr. Lemasson was basely assassinated at Ismailia in 1894 by a discontented workman during a prolonged strike, and that since this deplorable and universally regretted event, his functions have been admirably performed by Mr. Quellenec, a distinguished engineer of the roads and bridges of France; (2) that Voisin Bey, on his appointment in 1893 as a director of the company, resigned, to the great regret of all his colleagues, his post as President of the International Consultative Commission, being succeeded in the latter capacity by Mr. Laroche, inspector-general of roads and bridges; (3) that the vacancies by death since the reconstitution of the Sub-Commission of 1884-85 of Admiral Jurien de la Gravière and Messrs. Pascal and Larousse, and the resignation of Voisin Bey, have been filled up by Admiral Lefont and Messrs. Guérard, Oppermann, and Pérouse (Appendix No. III.).

Changes in the Chairmanship of the Canal since 1893.—It should further be recorded that, on the demise in 1894 of Count Ferdinand de Lesseps, Mr. Jules Guichard was elected President of the Suez Canal Company, to be succeeded in his turn, owing to his premature death in 1896, by Prince Auguste d'Arenberg, the present able and highly esteemed President of the company.

Execution of the First Stage of the Enlargement Works.—The first phase of the enlargement was completed in December 1898 from a width of 22 metres to 37 metres (121 feet 4 inches), and from a depth of 8 metres (26 feet 3 inches) to 8½ metres (27 feet 10 inches), or 12 years from the commencement of the work; a much longer time than was originally specified, owing to financial

¹ Admiral Jurien de la Gravière and Messrs. Laroche, Larousse and Pascal representing France; Mr. Saavedra, Spain; and Captain Alexiéeff, Russia

considerations and to the circumstance that the increased capacity of the canal for traffic, owing to its illumination by electricity, rendered it unadvisable, in the opinion of the Directors, to carry on the work as expeditiously as was at first intended.

The execution of the work comprised in the first stage, the details of which have already been described, calls for no special remark, neither, for want of space, can anything be said here concerning the comparatively unimportant modifications which were recommended by the Consultative Commission during the progress of the work. It should be recorded, however, (1) that the type of revetments recommended by the Consultative Commission of 1885 have, as a rule, been adopted in practice—the precise locality and details of the work in connection with the nature of the ground to be dealt with being left to the discretion and appreciation of the Engineers-in-chief; (2) that the leisurely manner in which the improvements contemplated by the Directors in 1885 have been carried out up to this time, has had the beneficial effect of reducing to a minimum the many inconveniences to traffic which are inseparable from the execution of extensive dredging and revetting operations in a crowded channel; and (3) that it is a matter of congratulation, thanks to the skill and forethought of the engineers of the company, that the actual excavation and dredging (21,638,700 cubic metres) removed during the first stage of the work has only been $2\frac{1}{2}$ per cent. in excess of the quantity originally estimated.

Increased Draught of Vessels since 1890.—The advantage to trade by increasing the limit of the draught of steamers on the 15th April, 1890, from 7·50 metres (24 feet 6 inches) to 7·80 metres (25 feet 7 inches) is proved by the fact that, whilst in 1891 the percentage of vessels passing through the canal drawing from 24 feet 6 inches to 25 feet 7 inches was only 3·20 per cent. compared with the total number, the proportion in 1897 amounted to 13·1 per cent. (391 vessels in 2,986).

Second Stage of Enlargement.—For many years past the dimensions, especially the beam of steamers, have been greatly augmented. Thus, since 1893, a large number of cargo vessels, with lengths of 460 feet to over 520 feet and beams from 60 to 70 feet, have passed through the canal for the first time, whereas in 1835 the maximum length and beam of trading vessels frequenting the canal did not exceed 460 feet and 48 feet respectively.

New Sidings.—In view of this remarkable augmentation of the dimensions of trading ships in so short a time, the Directors, in 1897, decided on the creation of nine new sidings, 15 metres

(49 feet) wide, and 750 metres (2,460 feet) in length, in order to facilitate the passage through the canal of steamers of the greatest beam. These new sidings, seven of which are established between Port Said and Sheikh Ennedek, 46 miles from the former place, and two between the Bitter Lakes and Suez, are now completed to their full width and give great satisfaction to the navigation.

Further Widening and Deepening of the Canal.—A constantly growing traffic will probably at no distant period demand a reconsideration of the question of practically carrying out the recommendations of the Consultative Commission of 1884–85 with regard to the further widening of the canal, after taking into account the course of proceeding suggested by the light of experience.

Meanwhile, it seems to the Author highly desirable, in the interest of commerce, that a sufficient depth should be provided, as soon as practicable, for vessels of a draught of 8·50 metres (27 feet 10 inches), instead of limiting it to 7·80 metres (25 feet 7 inches) as at present; and, further, that eventually the canal and its sea approaches should be deepened to 10 metres (32 feet 9 inches), so as to give an available depth of 9·50 metres, and thus not only to provide a receptacle for deposit (“chambre d’apports”) $\frac{1}{2}$ a metre deep throughout the canal, but also to permit vessels drawing up to 9 metres (29 feet 6 inches) to pass safely from sea to sea with a minimum of $\frac{1}{2}$ a metre of water under the keel.¹

Present and Prospective Depths at Port Said.—In October, 1894, the Consultative Commission decided on recommending the Directors of the Company to arrange for the maintenance, by means of dredging, of a channel 10 metres deep and 200 metres wide at the sea entrance to Port Said. Although this has not yet been attained, strenuous efforts have since been made, and are now being applied, notably by the provision of a very powerful marine bucket-and-hopper dredger, to establish the desired depth and width of channel at the Mediterranean entrance, as well as to continue the systematic dredging of the channel within the shelter of the west jetty, which has been in operation since 1886. In order to maintain a minimum depth of 9 metres

¹ The largest ocean steamers have now lengths of from 600 to 700 feet, beams of from 60 to 70 feet, and draughts when fully laden of from 27 to 31 feet. The Amsterdam Ship Canal and the Baltic Canal (from Kiel to the Elbe) have been recently deepened to nearly 30 feet. At Liverpool, New York, and Antwerp, the depth is now over 30 feet at low water; and at many other first-class ports channels equally deep either have been provided or are projected.

(29 feet 6 inches) at Port Said, 663,140 cubic metres were dredged between, and to seaward of, the jetties in 1898, and, in addition, 181,370 cubic metres of deposit were removed from the inner basins, exclusive of a cube of 565,800 cubic metres dredged from the canal itself between Port Said and Suez (Port Thewfik).

Actual and Prospective Depths in the Canal.—On the 1st January, 1899, there was an available depth of 9 metres (29 feet 6 inches) over an aggregate length of 90 kilometres, and by continuing to dredge down to 9·50 metres (31 feet) as at present practised, the engineers of the company hope by 1902 to obtain the latter depth throughout the whole length of the canal. It should here be explained that this contemplated depth of 9·50 metres in 1902 includes the provision of a receptacle for deposit $\frac{1}{2}$ a metre deep over the entire bottom width of the canal from end to end.

Depth at Suez.—At the Suez entrance, at the present time, a vessel drawing 7·80 metres (the maximum draught allowed) has a depth of 1 metre under her keel at ordinary low water of spring tides, and a minimum of 40 centimetres under her keel at an extraordinary low tide.

Changes in the Contours of the Shore and Sea-Bed at Port Said (Fig. 5, Plate 2).—Regarding the changes that have taken place in the position of the shore line and the contour lines of soundings facing Port Said since 1859, there is only space to summarize the results of the latest investigations that have recently been made on this important subject.

These results are deduced from a chart of comparative contours in 1859, 1875, and 1898, prepared under the direction of Mr. Quellennec. Between 1859 and 1875 the construction of the West Jetty naturally caused a serious disturbance in the condition of the shore line and sea bottom at Port Said, and on this account no special reference need here be made to the abnormal advance of the contours adjacent to Port Said between these two dates. On the other hand, since 1875, the changes produced by the projection of the jetties having been regular in their action, the following remarks refer exclusively to the variations in the position of the shore and deep-water contour lines in 1875 and 1897.

Changes West of the West Jetty.—The shore line advanced seaward from 200 to 250 metres immediately adjacent to the jetty, but thence the shore contours of 1875 and 1897 approached each other as they trended westward, and finally met at a point about $4\frac{1}{2}$ kilometres from the jetty. The 7-metre contour line of 1897 was almost identical with the 7-metre contour of 1875. The

8-metre contours of 1875 and 1897 frequently intersected to a distance of $3\frac{1}{2}$ kilometres west of the jetty, but from that point to a further distance of 8 kilometres the advance of the 8-metre contour of 1897 averaged 500 metres.

Changes in the Face of the Canal Entrance.—Between 1875 and 1897 the stability of the 10-metre contour directly in face of the Canal over a width of 4 kilometres was remarkable. During this period, however, the advance of the 11-metre contour over the same limited width of 4 kilometres averaged 800 metres, whilst its maximum advance exceeded 1,200 metres. The sudden inflection of the 9-metre and 10-metre contours facing the entrance to the Canal was obviously due to the dredging operations in that locality.

Changes East of the West Jetty.—The shore line was eroded by the sea to the extent of from 200 to 300 metres for a distance of more than 5 kilometres from the jetty. The variations in the contour depths of from 4 to 9 metres in a region extending to a distance of 4 kilometres east from the jetty, were principally due to the deposit over a long period of sand and silt dredged from the Canal.

The facts (1) that, thanks to constant dredging, the position of the 10-metre contour over a distance of 2,000 metres to the west, and the same distance to the east of the entrance channel, was in effect the same as in 1875; and (2) that the dredging operations in the roadstead, and along the east side of the west jetty, have hitherto maintained an excellent channel, 9 metres in depth (notwithstanding the general advance of the 11-metre contour at the rate of 40 metres a year since 1875), encourages the belief that the maintenance of a channel of the desired depth of 10 metres can be assured at a reasonable cost, by means of an improved system of persistent dredging, unaided, for many years to come, by an extension of the West Jetty.

SUBSIDIARY WORKS OF IMPROVEMENT.

The special works of improvement not included in the enlargement of the canal, recommended by the Consultative Commission in 1884–85, are as follows:—

1. Additional harbour accommodation at Port Said.
2. Extension of the fresh-water canal from Ismailia to Port Said
3. Plantations along the banks of the fresh-water canal.
4. Construction of a Tramway from Port Said to Ismailia in connection with the railway to Cairo and Suez.

5. Establishment of substantial mooring posts at frequent intervals along the whole length of the maritime canal.

These highly useful subsidiary works, of which only a bare mention can here be made, are now satisfactorily completed.

GRADUAL INCREASE OF TRAFFIC FROM THE END OF DECEMBER, 1873,
TO THE 31ST DECEMBER, 1898.

Increase of Traffic since 1873 in Quinquennial Periods.—The following Table, deduced from the “Comptes rendus” of the Company, shows the quinquennial increase of traffic through the canal, and also the quinquennial increase of the revenue from the 31st December, 1878, to the 31st December, 1898 :—

Years.	Number of Vessels.	Net Tonnage.	Percentage of Quinquennial Increase of Tonnage.	Average Tonnage per Vessel.	Revenue exclusively from Taxes on Shipping.	Percentage of Quinquennial Increase of Revenue.
1873	1,173	1,367,767	..	1,170	£ 324,430	..
1874-78	7,471	10,363,330	..	1,390	5,410,265	..
1879-83	12,735	20,308,201	96	1,600	9,071,886	67
1884-88	16,585	30,518,765	194	1,770	11,700,000	116
1889-93	17,921	37,743,145	263	2,000	14,038,254	169
1894-98	16,684	42,185,817	306	2,270	15,124,595	180
1898	3,503	9,238,603	..	2,640	3,306,290	..

An analysis of this Table shows (1) that the number of vessels passing through the canal in the quinquennial period 1894-98 was almost precisely the same as in each of the quinquennial periods 1889-93 and 1884-88; (2) that the increase of net tonnage in the four quinquennial periods ending the 31st December, 1898, as compared with the quinquennial 1874-78, was 96 per cent., 194 per cent., 263 per cent. and 306 per cent. respectively; and (3) that the increase of revenue from shipping only during the same four quinquennial periods was 67, 116, 169 and 180 per cent. respectively; (4) that the revenue derived from shipping in 1898, a record year, amounted to £3,306,290;¹ and (5) that comparing 1898 with 1873 the tonnage has increased sevenfold in 25 years. (*Fig. 6, p. 182.*)

¹ In 1898 the total revenue was £3,516,250, including revenue derived from the waterworks, the tramway, the sale of land and the tax of 10 francs per head on 219,554 passengers.

The result of this investigation is instructive, and seems to indicate clearly that during the next decade the execution of still further important works of enlargement will be found necessary in order to keep pace with the legitimate requirements of a constantly increasing trade.

Fig. 6.

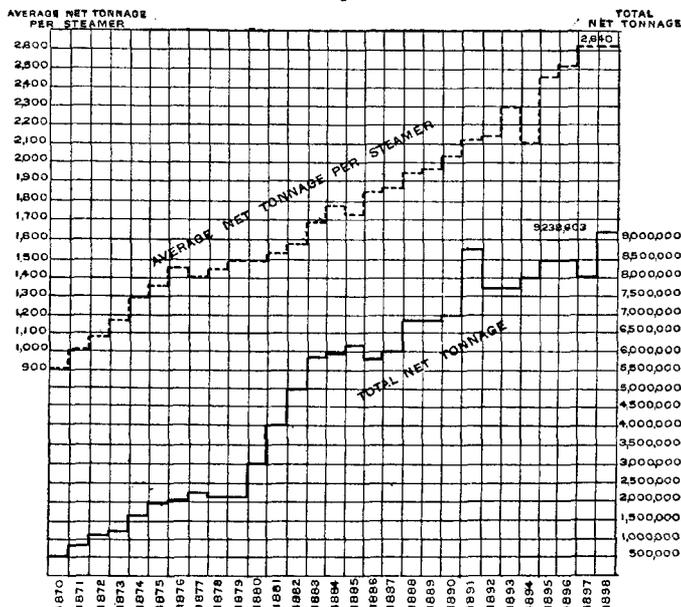


DIAGRAM SHOWING THE GROWTH OF TRAFFIC AND THE INCREASED TONNAGE CAPACITY OF STEAMERS FROM 1870 TO 1898.

Distribution of Profits.—On the 31st December, 1898, the balance in favour of the company for the year was 46,618,000 francs, (£1,864,700). The apportionment of that sum was as follows:—

	Per Cent.
Shareholders	71
Egyptian Government	15
Founders	10
Directors	2
Employees	2

Trade of different Nationalities compared.—In connection with the traffic of last year, attention should be drawn to the following Table, giving the relative net tonnage of 3,503 vessels belonging

to twenty different nationalities making use of the canal in the year ending the 31st December, 1898.

Nationality.	Number of Vessels.	Net Tonnage.	Percentage of Tonnage.
British	2,295	6,297,743	66
German	356	969,598	11
French	221	571,517	6
Dutch	193	381,866	4
Austrian	85	213,020	2½
Japanese	46	183,325	2½
Russian	48	153,191	2
Spanish	49	149,306	2
Italian	74	137,294	1½
Eleven other nationalities	136	181,743	2½
	3,503	9,238,603	1001

With regard to British trade, it may be pointed out that whereas in 1892 the tonnage was 75 per cent. of the total traffic of the canal, it had fallen to 66 per cent. in 1898; on the other hand, the British tonnage of last year (6,297,743 tons) exceeded the total tonnage of the canal (5,903,025 tons) in 1887.

Electric Light.—It has already been observed that the introduction of electric light has had the effect of virtually doubling the carrying capacity of the canal; but before concluding this Paper something more should be said, owing to the great importance of the subject, on the practical application of the system of lighting now in vogue for effecting the night navigation of the canal with ease, economy, and safety.

At the close of 1885 it was decided to make use of electric light in such a manner as to ensure a safe passage by night through the canal, the Company hoping in this way to diminish the traffic by day and thus to render the navigation less difficult till the full enlargement of the waterway was accomplished. A system of leading marks, supplemented by Pintsch light buoys, was therefore established along the banks of the canal in order that the navigable channel might be clearly indicated.

It was soon recognised, however, that this system would be insufficient to ensure perfect safety, and thereupon it was decided that every vessel in motion during the night should itself be provided with the necessary apparatus to illuminate her own passage through the canal. Accordingly, it was arranged that every vessel passing by night should carry four lights, to one of which should be applied a powerful reflector, capable of spreading

light 4,000 feet ahead of the vessel. Of the other three lights, one should be placed astern and one on each side of the ship.

The Mangin reflector is generally used. Men-of-war and large postal steamers carry their own apparatus. Smaller vessels generally use a portable apparatus, which they hire on entering the canal, returning it on leaving. The apparatus consists of a reflector, a dynamo and a motor. Besides the "Mangin," several other kinds of reflectors are used with more or less efficiency.

The system of navigating by night as at present practised leaves nothing to be desired, inasmuch as the narrowness of the canal compels the adoption of the single line or block system in the transit of vessels from sea to sea. Some other mode of lighting would, however, require to be arranged to ensure the safe passing of vessels under way by night if the canal should ever be enlarged to the full dimensions contemplated by the Directors in 1885; as the traffic managers of the canal are convinced by experience of the impracticability of two vessels in motion, carrying electric projectors, passing each other in contrary directions without danger, owing to the dazzling effects of the travelling lights on the vision of the pilots.¹

The first vessel that effected the through passage by night was the P. and O. steamer "Carthage" in 1886, the time of transit being 18 hours. In 1888, 46 per cent. of the total shipping took advantage of the permission to steam through the canal day and night as compared with 71 per cent. in 1889; the result being that for the whole navigation, the average passage for all vessels was reduced from 30 hours 45 minutes in 1888 to 26 hours 44 minutes in 1889. In 1898, 94 per cent. of the total shipping made part of their passage by the aid of the electric light, the average duration of transit being 17 hours 22 minutes, and the minimum duration only 16 hours 36 minutes, whereas the average time taken by steamers navigating by day was 28 hours 20 minutes.

These figures prove that the passage of the Suez Canal by night has become almost universal, to the immense relief of the navigation.

The Paper is accompanied by diagrams, from which Plates 2 and 3 and the Figure in the text have been prepared.

¹ At the present time, steamers passing the Canal by night are subject to the rules embodied in the "Regulations for Navigation in the Suez Canal" issued 1st January, 1899. (Appendix No. IV.)

APPENDIXES.

APPENDIX I.

THE first International Consultative Commission was constituted in October, 1855. Austria was represented by Mr. de Negrelli, Inspector-General of Railways; Italy by Mr. de Paléocapa, Minister of Public Works; Spain by Mr. Montesino, Director of Public Works at Madrid; Holland by Mr. Conrad, Director-General of the Waterstaat; Prussia by Mr. Lentzé, Engineer-in-Chief of the Vistula; France by Mr. Renaud, Inspector-General of Roads and Bridges, Admirals Rigault de Genouilly and Jaurès; and England by Messrs. Rendel, Maclean and Manby, Civil Engineers, and Captain Harris, who had made seventy voyages in the Red Sea.

Messrs. Linant-Bey and Mougel-Bey, engineers of the Viceroy, met the Commission in Paris and returned thither in November with Messrs. Conrad, Maclean, de Negrelli, Reynaud and Lissou, a sub-committee of five members, who had been deputed by their colleagues to make a careful study of the ground between the two seas in order to convince themselves of the entire feasibility of the scheme proposed by Mr. Ferdinand de Lesseps.

APPENDIX II.

The "International Consultative Commission of 1884-85" was composed as follows (copied from the official statement published in the "Revue-Gazette Maritime et Commerciale" of the 30th May, 1884):—

MEMBRES REPRÉSENTANT LA FRANCE.

Messrs. LÉFÈBRE DE FOURCY, inspecteur-général des ponts et chaussées (Président).

Le Vice-Amiral JURIEU DE LA GRAVIÈRE, membre de l'Institut.

PASCAL, inspecteur-général des ponts et chaussées.

VOISIN-BEY, inspecteur-général des ponts et chaussées (Rapporteur).

LAROCHE, ingénieur-en-chef des ponts et chaussées (Rapporteur-adjoint).

LAROUSSE, ingénieur hydrographe.

TILLIER, lieutenant de vaisseau, capitaine des Messageries Maritimes.

DUMONT, officier de la Compagnie nationale de Navigation de Marseille.

MEMBRES REPRÉSENTANT LA GRANDE-BRETAGNE.

Major-General Sir ANDREW CLARKE, du Génie Royal Britannique (Vice-Président).

Sir CHARLES HARTLEY, ingénieur-en-chef de la Commission Européenne du Danube, et membre de l'Institut des Ingénieurs civils d'Angleterre.

Sir JOHN COODE, vice-président de l'Institut des Ingénieurs civils d'Angleterre. Captain CHITTY, de la Marine Royale Britannique.

THOMAS SUTHERLAND, président de la Compagnie de Navigation à vapeur Péninsulaire et Orientale.

JAMES LAING, président du Comité des Armateurs de steamers engagés dans le commerce de l'Orient.

WILLIAM MACKINNON, président de la Compagnie de Navigation "British India."

ROBERT ALEXANDER, Armateur.

MEMBRES REPRÉSENTANT LES AUTRES PUISSANCES MARITIMES ÉTRANGÈRES.

Allemagne.—M. PESCHECK, inspecteur du service des voies fluviales en Prusse, attaché à l'Ambassade d'Allemagne à Paris.

Autriche-Hongrie.—M. BLASIUS CRILLANOVICH, capitaine du Lloyd austro-hongrois.

Espagne.—EDUARDO SAAVEDRA, ingénieur-en-chef de première classe des ponts, canaux et chaussées, membre du Comité supérieur facultatif de la Marine à Madrid.

Italie.—Le Commandeur EDOUARD GIOIA, ingénieur-en-chef, Rome.

Pays-Bas.—M. DIRKS, ingénieur-en-chef du Waterstaat (Vice-Président).

Russie.—ALEXÉIEFF, capitaine de frégate, attaché à l'Ambassade de Russie à Paris.

M. VIEUSSA (France), chef du service des travaux de la Compagnie à Paris, Secrétaire.

At the final meetings of the Consultative Commission at Paris on the 9th and 11th February, 1885, the following gentlemen connected with the Company assisted at the meetings :—

FERDINAND DE LESSEPS, Président-Directeur de la Compagnie.

E. DAUPRAT, CHARLES-A. DE LESSEPS, MOURETTE, Vice-Présidents.

V. DELAMALLE, MOTET BEY, E.-J. STANDEN, BARON J. DE LESSEPS, Administrateurs, Membres du Comité de Direction.

ANSLYN, LE BARON A. DE CETERS, A. DE CLERCQ, J. GUICHARD, J. HERBETTE, C.-J. MONK, A. PEGHOUX, le Colonel Sir JOHN STOKES, Sir C. RIVERS WILSON, DE MONDÉSIR, Administrateurs ; (Directors).

MARIUS FONTANE, Secrétaire-général de la Compagnie.

LEMASSON, Ingénieur, chef du service de l'entretien en Égypte.

GRINDA.

LE CAPITAINE JACKSON, de la Marine Royale anglaise, de l'État-Major du Major-général Sir Andrew Clarke.

V. DAUZATS, chef des travaux à Paris.

P. A. SAVOUILLAN, Chef des études de la Compagnie à Paris.

APPENDIX III.

LIST OF MEMBERS OF THE INTERNATIONAL CONSULTATIVE COMMISSION AS
CONSTITUTED IN 1899.

France—

Mr. LAROCHE (President).
Admiral LAFONT.
Mr. GUÉRARD.
Mr. OPFERMANN.
Mr. PEROUSE.

Great Britain—

Sir JOHN WOLFE BARRY.
Sir CHARLES A. HARTLEY.

Germany—

Mr. PESCHECK.

Austria-Hungary—

Captain CRILLANOVICH.

Spain—

Mr. SAAVEDRA.

Italy—

Mr. GIOIA.

Holland—

Mr. CONRAD.

Russia—

Captain SHEIN.

Secretary, Mr. VIEUSSA.

Engineer-in-Chief of the Suez Canal Company, Mr. QUELLENNEC, C.M.G.

Chief Traffic Manager, Captain TILLIER, C.M.G.

APPENDIX IV.

REGULATIONS FOR THE NAVIGATION OF THE SUEZ MARITIME CANAL.

Issued January, 1899.

ART. 1.

On receiving a copy of the present regulations captains of ships shall bind themselves to abide by and conform themselves to these rules in all points, to obey all signals therein mentioned and satisfy any requisition made in view of the execution of these regulations.

ART. 2.

The transit through the Suez Canal is open to ships of all nationalities, provided that their draught of water does not exceed 7 metres 80 centimetres (25 feet 7 inches English), and that they conform to the following conditions:—

Sailing vessels above 50 tons gross are bound to be towed through.

Steam vessels may pass through the Canal by means of their own steam power or be towed subject to the conditions hereinafter notified.

Of course the towage of steamers through the Canal is not compulsory on the Company; it will only be performed in so far as they have unengaged tugboats.

ART. 3.

The maximum speed of all ships passing through the Canal is fixed at 10 kilometres, equal to 5½ nautical miles per hour.

ART. 4.

Every vessel measuring more than 100 tons gross must take on board either for entering or clearing the ports of Port Said and Port Thewfik, or for passing through the Canal, a pilot of the Company, who will furnish all particulars as to the course to be steered.

The captain is held responsible for all groundings and accidents of whatsoever kind, resulting from the management and manœuvring of his ship by day or by night.

Pilots place at the disposal of captains of vessels their experience and practical knowledge of the Canal; but as they cannot be specially acquainted with the defects or peculiarities of each steamer and her machinery, in stopping, steering, etc., the responsibility as regards the management of the ship devolves solely upon the captain.

ART. 5.

When a ship intending to proceed through the Canal shall have dropped anchor either at Port Said or Port Thewfik, at the berth appointed by the harbour master, the captain must enter his ship at the Transit Office and pay all dues for passage, and when there is occasion, for pilotage,¹ towage and berthing; a receipt for the same shall be delivered to him, which will serve as a voucher whenever required.

The following written information must be handed in by the captain:—

Name and nationality of the ship, to be identified by exhibiting the ship's papers respective thereto.

Name of the captain.

Names of the owners and charterers.

Port of sailing.

Port of destination.

Draught of water.

Number of passengers as shown by the passage list.

Statement of crew as shown by the muster roll and its schedules. (Sailors occasionally taken on board of vessels passing through the Suez Canal are not considered as forming part of the crew and are taxed in conformity with paragraph 6 of art. 11 of the present regulations.)

Capacity of the ship according to the legal measurement ascertained by producing the special Canal certificate, or the ship's official papers established in conformity with the Rules of the International Tonnage Commission, assembled at Constantinople, in 1873.

ART. 6.

The Company determine the hour of departure of each ship, and all subsequent stopping and re-starting, as well as all other movements of the ship in such manner as to give full security for the navigation as well as to ensure as much as possible the rapid passage of mail steamers.

Therefore no ship can demand as a right an immediate passage through the Canal, neither will any claim be admitted in connection with any delay originating from the foregoing causes.

¹ For pilotage dues into and out of Port Said harbour, see art 13.

Since the 1st of July, 1884, and until further orders, the pilotage dues for the journey through the Canal are not charged.

Unless otherwise ordered, ships engaged upon mail service, under the conditions specified in the next paragraph, happening to be at anchor or stopped in Lake Timsah or at the South Light or North Light berths, at the same time with other ships, whether ships of war or merchant ships, are authorized to pass such other ships and to continue their journey first, in their respective order of arrival in the Lakes.

Mail steamers, viz., steamers performing a regular mail service under contract with a government, at fixed dates appointed in advance and having been duly vouched for as such, shall carry at the foremast head by day a blue signal with the letter P cut out in blank in the centre, and by night a white light.

ART. 7.

All ships ready to enter the Canal must have their yards braced forward, their jib-booms run in and their boats swinging in board. In addition to their two bow anchors, they must carry at the stern ready for letting go at the request of the pilot a strong kedje with a stout hawser bent on sufficient to hold the ship.

ART. 8.

§ 1. Every ship must, during her passage through the Canal, have either in tow or ready to float a fitted-out boat carrying a hawser in readiness to be run out at once and made fast to one of the mooring posts on either side of the Canal.

§ 2. The captain must set a watch both by day and night; the men to be in readiness to ease away or cut hawsers, as may be required.

All ships, whether made fast in a siding, or moored at any point, or aground in the Canal, shall ease their hawsers in order to give free passage to tugs, steam launches, hopper-barges and any other craft of a light draught, that may have to pass them.

§ 3. All steamers, tugs included, must blow their whistles when approaching the curves of the Canal, also when approaching in either direction boats or lighters, dredgers or any craft afloat. They must stop when the channel is not clear and pass at a reduced speed all sidings, stone or earth-work yards; they must also slacken speed and have their two bow anchors ready for letting go when passing vessels made fast or under way, hopper-barges, dredgers or any other craft.

§ 4. Whenever a collision appears probable, no ship must hesitate to run aground and thus avoid the collision. The expenses consequent upon grounding under these circumstances shall be defrayed by the ship in fault.

§ 5. Ships proceeding in the same direction are not allowed to pass each other under way in the Canal.

In the case of a ship being allowed to pass another one ahead of her, she must conform with the Company's directions to that effect.

§ 6. Navigation of sailing craft of every description at night is entirely forbidden.

§ 7. Steamers intending to go through the Canal at night must first satisfy the agents of the Company in Port Said, or Port Thewfik, that they are provided :

1. With an electric search-light or search-lights showing the channel 1,200 metres ahead and so constructed as to admit of rapid splitting up of the beam of rays into two separate segments with a dark sector in the middle.

2. With electric lights powerful enough to light up a circular area of about 200 metres diameter around the ship.

The agents of the Company will decide whether the apparatus fulfil the requirements of the regulations so that ships provided with them may, without inconvenience, be authorized to navigate the Canal at night.

Night transit may, however, be suspended in case of failure or want of power in the lights.

§ 8. While navigating by night-time, ships must carry their usual lights and have a man on the look-out forward.

Whenever a vessel navigating by night has made fast, whether in a siding or in the Canal, she must thereupon at once extinguish her search-light or search-lights, and lights above stated, as well as her course lights.

All ships navigating at night in the Large Bitter Lakes between the North and South Lights must extinguish their search-light or search-lights.

Any ship coming into Port Said at night from the South must extinguish her search-light or search-lights when making the curve from the Canal into the harbour.

§ 9. Whenever a ship navigating at night is accidentally stopped on her way, her white light astern must at once be replaced by a red light. In case other vessels are following her she must, at the same time, sound her steam-whistle four or five times in close succession, repeating this at a few moments' interval until the ship following her repeats this signal, which shall be taken as an order to slacken speed at once with a view to stopping, if need be.

§ 10. Whenever a ship makes fast, enters a siding, or gets aground, the captain must give immediate notice thereof by means of the signals specified in the appendix to these regulations.

§ 11. Navigation by night-time by steamers unprovided with electric light is only authorized under exceptional circumstances, the captain accepting entire responsibility in writing for any delay, mishap and damages that may happen to his own ship, as well as for any similar accidents he may cause to other ships in transit or to the Company's craft and plant happening to be in the Canal. Ships navigating under these conditions remain subject to all other rules regarding night transit.

ART. 9.

In the event of grounding, the agents of the Company alone shall have the right to direct all operations by which a vessel is to be floated off again, to unload and tow the vessel as may be necessary (by means of the plant, and stock which the Company has at hand), at the expense of the vessel, unless it be regularly proved that there was an insufficient depth of water in the Canal, or that erroneous direction by the pilot had caused the grounding.

The aforesaid costs of floating, towing, discharging and reloading, etc., must be paid conformably with a statement or estimate drawn up by the Company, before the departure of the ship from Port Said or Port Thewfik.¹

¹ From the 1st October, 1883, and until further orders, whenever a ship going through the Canal happens, except in the roads and ports, to ground or stop in consequence of an accident independent of collision, the Company, in order to remove the obstruction in the fairway with all possible speed, and to hasten the restarting of the grounded or stopped ship, will not claim from the captains, the consignees, or the shipowners, the reimbursement of whatsoever expenses incurred in refloating the ship, and, if deemed necessary, for towing her as far as the next siding. If from such siding the ship continues her journey in

All manœuvres with the object of helping grounded vessels to get off are formally prohibited to other ships in transit.

ART. 10.

The following prohibitions are hereby notified :

1. The overloading of the deck, before entering the Canal, with coals or other merchandise which might alter the general stability of the vessels or would interfere with navigation ;

2. The anchoring of a ship in the Canal except through unavoidable circumstances, and then only with the consent of the pilot ;

3. Throwing overboard in the ports and during the journey from sea to sea and at any point whatever of such journey, earth, ashes, cinders or material of any kind ;

4. Picking up, without the direct intervention of the Company's agents, any thing that may have fallen into the Canal.

Should any material of whatever kind fall overboard, the circumstances are to be immediately made known to the pilot, who is instructed to transmit such information to the Company's agent at the nearest station.

The recovery of all articles dropped into the Canal, in whatever way such salvage is effected, shall be carried out at the expense of the captain to whom such articles will be restored against reimbursement of the said expense ;

5. It is expressly forbidden, and on penalty of legal proceedings, to masters of ships while in the Canal or in the ports or sidings thereunto appertaining, to allow any guns to be fired from on board their ships ;

6. They are forbidden to sound their steam-whistle in the ports of the Canal, except as an alarm signal in case of serious danger ;

7. Burial in the banks of the Canal is forbidden.

ART. 11.

1. The net tonnage resulting from the system of measurement laid down by the International Commission of Constantinople, and inscribed on the special certificates issued by the competent authorities or on the ship's official papers, is the basis for levying the special navigation due, which is at present 9 francs.

In levying the dues, any alteration of net tonnage subsequent to the delivery of the above-mentioned certificate or papers shall be taken into account ;

2. The Canal authorities may ascertain whether cargo or passengers are carried in any spaces which, as shown by the certificate of tonnage, have not been included in the gross measurements, or which were allowed as deductions for

tow, she must pay towage charges according to rates annexed to the present regulations.

It is moreover well understood that ships will have to bear all expenses incurred for the necessary repairs or putting into condition with a view to remedy such damages as might interfere with their restarting, whatever be the time at which these damages may have occurred, and that the said ships will remain responsible for the damages which may be the consequence of their grounding.

The Company will continue to perform the work of refloating the grounded ships under the supervision of their officers exclusively, and will use first the means available on board, and afterwards or simultaneously, the machinery or appliances belonging to the Company.

the accommodation of the crew after measurement, or which, being within the engine, boiler or bunker space, form no part of the net tonnage shown on the certificate;

And generally may verify whether all the spaces which ought to be included in the tonnage are entered on the certificate and are exactly determined thereon.

3. Every vessel not provided with a special certificate or official papers giving the net tonnage laid down by the Constantinople Commission shall be measured by the Company's agents in conformity with the Constantinople rules, and shall pay her dues according to such measurement, until she produces a special certificate from the authorities of her own country.

4. Until further orders, ships in ballast will be allowed a reduction of 2 francs 50 centimes per ton on the tariff for transit.

5. Any ship carrying mails or passengers, or having in her holds coals or other merchandise in whatever quantity, is not considered as being in ballast.

6. The charge of ten (10) francs per passenger above twelve years of age or of five (5) francs per passenger from 3 to 12 years old, as well as the transit dues, must be prepaid on entering the Canal at Port Said or Port Thewfik.

7. The berthing or anchorage dues at Port Said, Ismailia and opposite the Company's embankment at Port Thewfik, are fixed at 0 franc 02 centime per day per ton, after a stay of twenty-four (24) hours at the berth assigned to the ship by harbour master and whatever be the duration of her stay. These dues will be collected every ten days.

8. Claims for errors in the declaration of tonnage or in the levying of the dues must be sent in within a month after the ship's passage through the Canal. After this delay, rectifications will not be admitted; no erroneous application of the tariff can ever be brought forward as a precedent against the Company.

ART. 12.

§ 1. In the case of ships either towed or convoyed by the Company's tugs no other division than that of one half of the length of the Canal shall be allowed; from Ismailia to Port Said being considered one half on one side and from Ismailia to Port Thewfik the other half, on the other side.

The charges for towage in the Canal by the Company's tug service are fixed as follows:—

For sailing vessels measuring 400 tons and under, 1,200 francs; for sailing vessels measuring above 400 tons, 1,200 francs for the first 400 tons and 2 francs 50 centimes for every surplus ton.

For steamers measuring above 400 tons, 2 francs per ton, without any distinction, upon their whole tonnage, but on the condition that they use their propelling power or keep it in readiness for assisting the tug.

Steamers measuring under 400 tons, also steamers not intending to give the assistance of their propelling power, will pay the same as sailing vessels.

For the towing of monitors, loaded or empty lighters, vessels not requiring the services of a first class tug, and all floating craft of any exceptional description, arrangements by contract to be made by private agreement.

It is hereby provided that when a tug shall only have accompanied or towed a vessel one half the length of the Canal, 600 francs shall be levied for the return trip of a first class, and 400 francs for a second class tug, and one half only of the total towage or tender dues shall be charged.

All ships towed must furnish their own warps.

§ 2. The charges for towage in the roads by the Company's tug service to ships applying for tugs, are fixed at 0 franc 25 centimes per ton of net tonnage at

Port Said for the distance between the inner docks and the end of the jetties and conversely; at Port Thewfik the distance between the docks and the roads and conversely, the minimum charge to be 50 francs.

For towage to a greater distance, the amount shall be settled by private agreement.

§ 3. When a ship shall require a tug to act as a tender the charge for such services will be 1,200 francs a day, if a tug of the first class be employed, and 800 francs a day for a tug of the second class. In the event of stoppage, the tug will render assistance in getting the vessel under way, each time that it may be necessary. If the vessel is towed by the tender any distance exceeding that of one station from another, the charge for towage may be demanded in lieu of the tariff fixed for acting as a tender.

§ 4. In all other cases, tug hire will be invoiced according to tariff rates annexed to the present regulations.

§ 5. Shipowners are authorized to have their vessels towed and accompanied by their own steam-tugs, all responsibility connected with such acts devolving upon themselves.

Such tugs are to be approved of by the Canal Company.

Ships towed or accompanied by tugs belonging to their owners will pay 0 franc 50 centimes (fifty centimes) per ton as towage dues.

Such tugs, whenever they shall tow or accompany vessels belonging to their own proper owners, will be free of any tax whatever.

Whenever they go through the Canal for the purpose of meeting vessels of their owners which they are entitled to tow or accompany, or when returning to their usual berths after having towed or accompanied them through, said tugs shall not be submitted to payment of the special navigation dues, but they must take a pilot on board.

Any transport of goods or passengers is prohibited to them; the fact of having on board passengers or goods would entail upon them the payment of all dues and charges to which ships in transit are subject.

Whenever the said tugs shall be used for towing or accompanying vessels not belonging to their own proper owners the same dues and charges shall be levied on them as on ships in transit.

Besides the special treatment specified by the present article, tugs belonging to private owners shall be subject to the strict observance of the present regulations concerning vessels berthing or in transit.

ART. 13.

Pilotage charges for entering Port Said harbour and leaving the same are fixed as follows for ships not going through the canal:—

Pilotage by daytime—

Steamers	25 francs.
Sailing ships	10 „

Pilotage by night-time, before sunrise and after sunset—

Steamers	50 francs.
Sailing ships	20 „

The payment of the pilotage charge for entering Port Said harbour and leaving the same is compulsory on every ship measuring 100 tons gross and upwards.

Whatever length of time ships may stay in the harbour of Port Said and whatever commercial operations they may transact there, total remission will be made of the pilotage charges for day-time entrance, or remission of half the charge for night-time entrance, if they decide to go through the canal.

The pilotage charge for entering or leaving Port Said harbour at night-time is fixed as follows for ships going through the canal:—

Steamers	25 francs.
Sailing ships	10 „

Twenty francs per day is levied for a pilot kept on board in case of berthing.

ART. 14.

Provisionally and until further orders, ships, barges, lighters and other craft, either coming in ballast or empty from Port Said under orders for Ismailia or returning from Ismailia to Port Said with cargoes of native produce; or bringing from Port Said to Ismailia cargoes bound to districts of Lower Egypt next to the Canal, and returning empty or in ballast from Ismailia to Port Said, shall be exempted, either outward or homeward bound whether they be empty or in ballast, from the special navigation dues, and shall only be subject to the payment of 2 francs 60 centimes per ton, for their passage when loaded outward or homeward bound.

Such toll is to be prepaid when said ships, barges, lighters or other craft, enter the Canal, in ballast or empty, to go and take cargo of native produce at Ismailia as well as when loaded.

As regards dues or charges other than the special navigation dues, said ships, barges, lighters or other craft, are bound to pay them in full.

ART. 15.

Charges of every description prescribed in these regulations must be paid in cash. Payments may be tendered either at the Company's Cashiers' Offices in Egypt, or at the Head Office in Paris, or in the hands of any of the agents of the Company appointed to that effect.

In the case of any amounts tendered otherwise than at the Company's Cashiers' Offices in the Isthmus, *receipts* are delivered to shipowners or consignees which the captain may hand as cash to the Company's agents in Egypt appointed to collect the dues.

In case of payments not being effected in time to admit of *receipts* being sent to captains, the Company will inform by telegraph their agents in Egypt of the amounts so paid. The cost of telegrams to be defrayed by the shipowners.

Whenever amounts thus paid in advance shall be insufficient for the discharge in full of all charges and incidental expenses due by ships, the balance must be paid in Egypt at the Company's Cashiers' Offices.

Paris, December 5th, 1898.

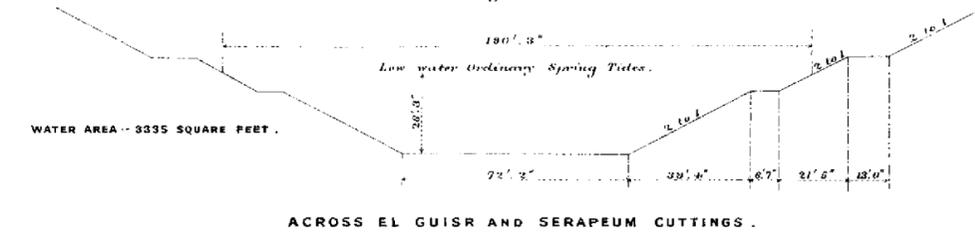
(Signed)

PRINCE AUGUSTE D'ARENBERG,
President.

THE SUEZ CANAL.

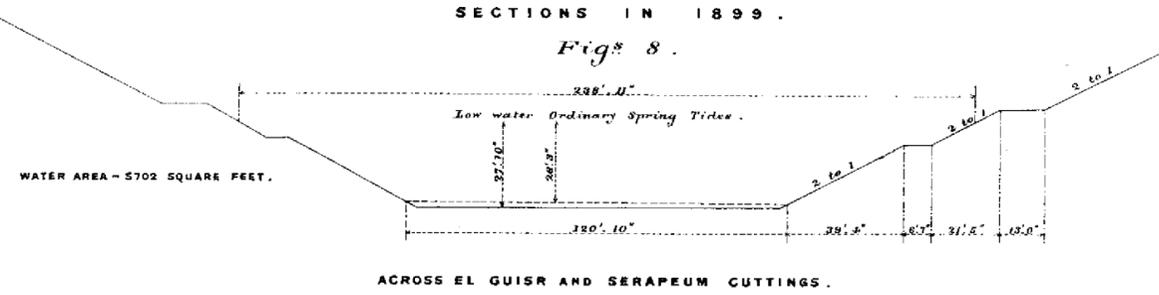
SECTIONS IN 1885.

Fig^s 7.



SECTIONS IN 1899.

Fig^s 8.



PROPOSED FINAL SECTIONS.

Fig^s 9.

