PDHonline Course D153 (15 PDH)

SUEZ CANAL: Joining of the Waters

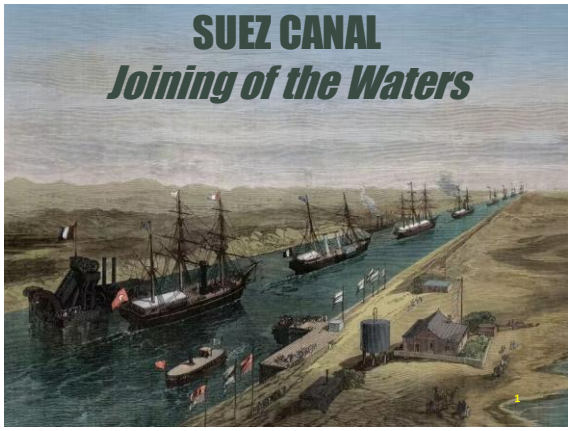
Instructor: Jeffrey Syken

2022

PDH Online | PDH Center

5272 Meadow Estates Drive
Fairfax, VA 22030-6658
Phone: 703-988-0088
www.PDHonline.com

An Approved Continuing Education Provider



1

Table of Contents

2

Part 1

The French Connection

3

Documenting the Event

4

On 17 November 1869, French illustrator Edouard Riou found himself on the coastline of northern Egypt, sketchbook in hand, as European dignitaries converged with locals at the water's edge. After decades of back and forth between the French and the Ottoman rulers of Egypt, the Suez Canal was opening for business, and Ferdinand de Lesseps, the canal's primary developer, had commissioned Riou to create a souvenir album of the event.

apollo-magazine.com, **July 3, 2018**

RE: introduction to an article written by *Mary Pelletier* entitled: "A Brief History of the Suez Canal"

5

Caption: "Plate from *La Tribune des Souverains* by Edouard Riou and Eugène Cicéri (1869)"

6

The Epic of Suez

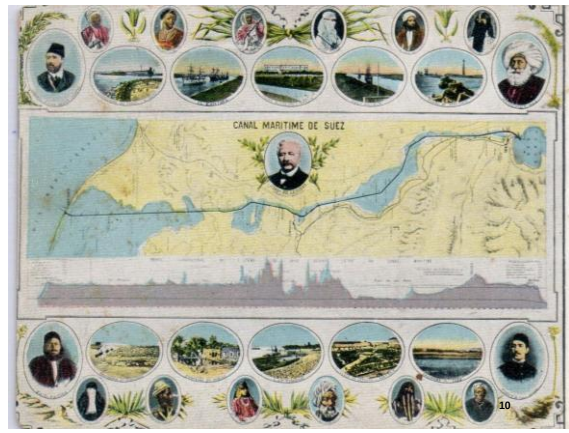
7

"THE inauguration at Port Said was a moment of triumph for De Lesseps, fully captured by Riou's Orientalist watercolours, which were published and shared throughout France at the time. Nearly 150 years later, Riou's illustrations are back in the public eye in Paris, setting the scene at the entrance to the Institut du Monde Arabe's current exhibition 'The Epic of the Suez: From the Pharaohs to the 21st century'…"
***apollo-magazine.com,* July 3, 2018**

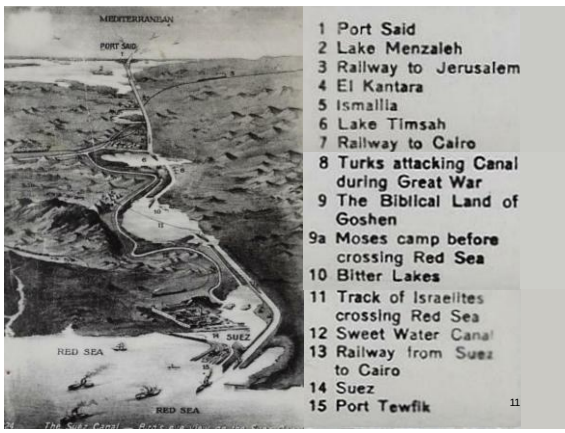
8

"…The enormous and ambitious exhibition covers more than 2,000 years of canal history, uniting Orientalist painting with multi-media installations, and ancient artefacts with modern scale models and historic maps…"
***apollo-magazine.com,* July 3, 2018**

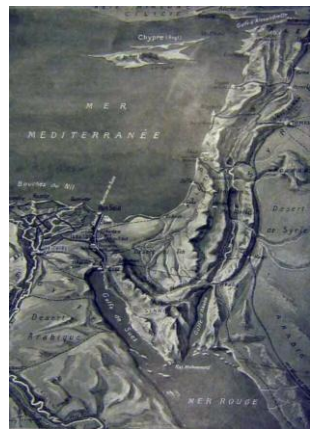
9



10



11



"…Curator Claude Mollard, along with Gilles Gauthier, scientific adviser to the exhibition, decided to begin the journey at this pivotal point in 1869 - a period that has faded from contemporary memory in light of more recent, politicised events surrounding the contentious 193 km waterway, which links the Mediterranean and the Red seas…"
apollo-magazine.com,
July 3, 2018
<u>Caption</u>: "Bird's-eye view of the Suez Canal and the Sinai Peninsula"

12

"…Thirty years after his visit, when excavations around the canal brought the Suez back into the news, Riou revisited the pomp and circumstance of the inauguration in an oversized oil canvas. Imbued with romantic nostalgia, the scene's ostentatious ceremonial tents are rendered in dreamy blues, pinks and tans, while the masts of tall ships fade into the background mist. Lines of men in local dress stride towards the ceremony on foot, wading through sandy tide pools, with a singular, prerequisite camel taking part in the ceremony…"
apollo-magazine.com, **July 3, 2018**

13

Caption: "Ceremonie d'inauguration du Canal de Suez à Port-Saïd (17 November 1869), Edouard Riou"

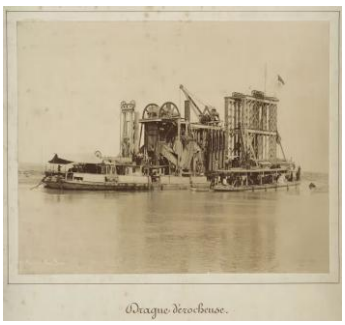
14

"…This painting forms a central part of the exhibition's opening room, which reflects on the grand European colonial ideas of the late 19th century, and the modern and independent desires of Muhammad Ali Pasha, who ruled Ottoman Egypt from the early 1800s to 1848…"
apollo-magazine.com,
July 3, 2018
Caption: "Portrait of Muhammad Ali Pasha (1803), Auguste Couder"

15

"…Backed by the booming soundtrack of Giuseppe Verdi's opera Aida, commissioned by Muhammad Ali's grandson Isma'il Pasha, the extravagant illustrations are offset by early souvenir photographs and black and white views by Polish photographer Justin Kozlowski. His works reveal that the opening of the Suez Canal was ultimately an industrial endeavour…"
apollo-magazine.com, **July 3, 2018**

16



17

The Weight of History

18

"…Leaving the inauguration behind, Verdi fades from earshot and the exhibition backsteps 4,000 years for a quick history lesson in the ancient canal. Artefacts on loan from the Louvre help to illustrate the importance of the Isthmus of Suez, a canal which is believed to have first been dug by Pharaoh Senusret III in the 19th century BC…"
apollo-magazine.com, **July 3, 2018**
Caption: **"Fragment de naos dit Naos Paponot (13th century), Egypt. Musee du Louvre."**

19

"…This is perhaps the smallest section in the display, but it accomplishes what the exhibition as a whole sets out to do: reaffirm the Egyptian role alongside the French throughout the saga of the Suez – in this instance, through the sheer weight of history…"
apollo-magazine.com, **July 3, 2018**

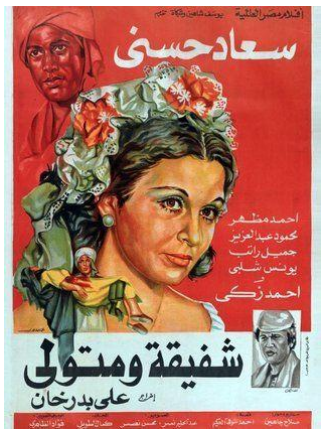
20

Cast of Characters

21

"…From this point, Mollard and Gauthier expertly handle the vast cast of characters at work throughout the subsequent centuries, and the exhibition continues in semi-chronological order to the present day…"
apollo-magazine.com, **July 3, 2018**

22



"…Having already encountered De Lesseps, we witness his relationship with Muhammad Ali's son, Sa'id Pasha, and his successor Isma'il Pasha, through plans, agreements, paintings and maps. When construction on the canal began in April 1859, a corvee system of forced labour was implemented; this is illustrated in cinematic form in an extract from Ali Badrakhan's film 'Shafiqa wa Metwali' (1978), which depicts the dramatic death of an elderly fellahin worker…"
apollo-magazine.com, **July 3, 2018**
Caption: **"The authorities mobilize tens of thousands of youths and force them to work on the Suez Canal. Metwally must leave his sister Shafiqa behind…"**

23

Caption: **"Egyptian workers at a construction site for the Suez Canal in 1860"**

24

Bartholdi's Ideal

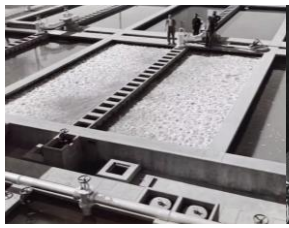
25

"…The relationship between art and mechanisation is also examined midway through the exhibition, with a prototype of Alphonse Couvreaux's excavation system displayed alongside four curiously familiar clay models sculpted by Frédéric Auguste Bartholdi. Bartholdi's idea for a colossal sculpture at the Red Sea outlet of the Suez took the form of a peasant woman holding a torch aloft. When De Lesseps and Isma'il Pasha did not pursue the idea, Bartholdi transformed the sculpted model into what we now recognise as the Statue of Liberty…"
***apollo-magazine.com*, July 3, 2018**
Caption: "Bartholdi's conceptual rendering for Egypt Carrying the Light to Asia. Watercolor."

26

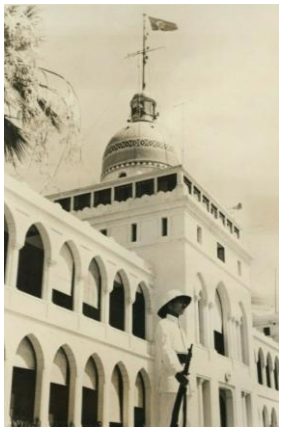
Nationalization

27



"…Photography unsurprisingly plays a large role throughout the show, having developed as a medium alongside the rapid industrialisation of the canal. The exhibition dedicates a section to souvenir architectural photographs of the cities of Port Suez, Port Said and Ismailia, but within earshot of these images, the voice of Gamal Abdel Nasser can be heard announcing the nationalisation of the Canal on 26 July 1956…"
***apollo-magazine.com*, July 3, 2018**
Left: caption: "Water treatment – blowing filters in Ismailia (1900-50)"
Right: caption: "Egyptian President Gamal Abdel Nasser announces the nationalization of the Suez Canal Company in order to use its revenue to build Aswan High Dam, July 26, 1956, in Alexandria"

28



"…From here, the exhibition is an education in the Suez Crisis of 1956, followed by the Arab-Israeli wars of 1967 and 1973. Maps and media reports are nicely balanced by oral histories and extracts from Egyptian films by Hossam Eddine Mustapha and Khaled El Hagar…"
***apollo-magazine.com*, July 3, 2018**
Caption: "An armed guard stands outside the Port Said headquarters of the Suez Canal Company after seizure of the canal and all its facilities by Egyptian President Gamal Abdel Nasser by nationalization decree. From the mast atop the building flies the Egyptian flag - the first time it has flown over the building."

29

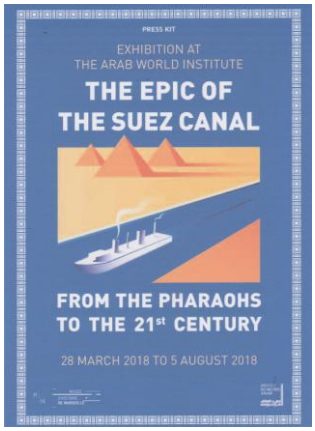
Egypt's Canal

30

"…After such deep immersion in the canal's 19th- and 20th-century history, the exhibition closes abruptly with a glimpse at contemporary statistics detailing its truly global nature. But the inclusion of Mikkel Lorenz's meditateive contemporary video work, shot on the container ship 'Mary Maersk' while in transit down the canal in 2016, gives pause to reflect on Isma'il Pasha's words some 150 years earlier: 'No one is more a canalist than I, but I want the Canal to belong to Egypt, not Egypt to the Canal'…"

***apollo-magazine.com*, July 3, 2018**

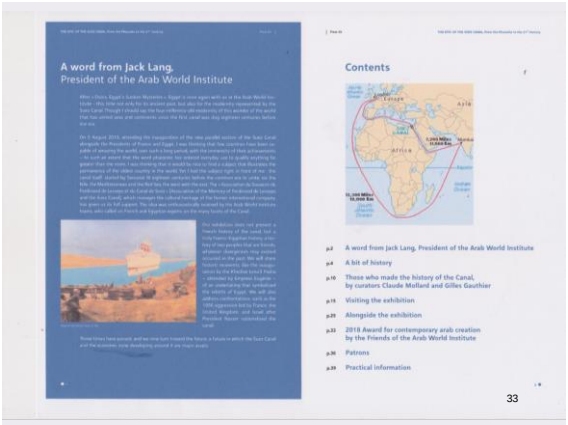
Left T&B: caption: "Obverse and reverse of bronze medal commemorating the inauguration of the Suez Canal, November 17, 1869" 31

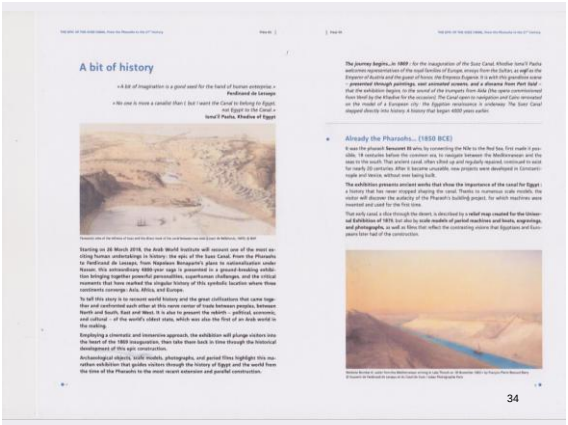


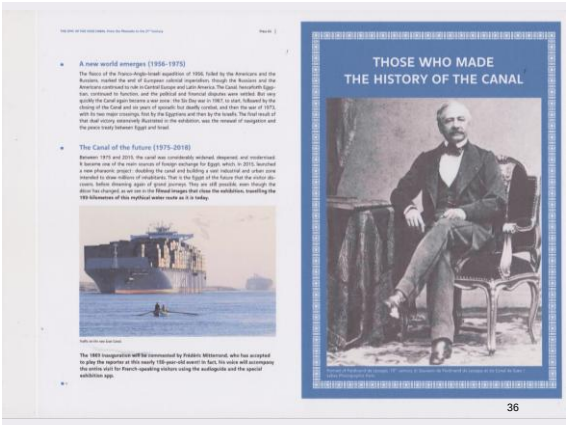
"…'The Epic of the Suez Canal: From the Pharaohs to the 21st century' is at the Institut du Monde Arabe, Paris, until 5 August 2018."

***apollo-magazine.com*, July 3, 2018**

Caption: "The Institut du Monde Arabe in Paris has created an exhibition devoted to the epic story of the Canal de Suez, from its origins in prehistory to the present day. Employing a cinematic and immersive approach, the exhibition will plunge visitors into the heart of the 1869 inauguration, then take them back in time through the historical development of this epic construction. Archaeological objects, scale models and period photographs highlight this marathon exhibition that guides visitors through the history of Egypt from the time of the Pharaohs to the recent extension and parallel construction." 32







Those who made the history of the Canal
by Claude Mollard and Gilles Gauthier

On 5 August 2015, when the new canal running parallel to the historic Suez Canal was opened to navigation, it was the continuation of a four-thousand-year epic. In the nineteenth century BCE, under the reign of Senusret III, Egyptian influence extended from Byblos to southern Nubia. Goods and merchants of every origin circulated throughout that zone linking the Middle East to Africa. And it was then that the first canal connecting the Mediterranean to the Red Sea was excavated. The link was not direct, of course ; for part of the route navigation followed the course of the Nile. The canal sometimes silted up, but the masters of Egypt periodically restored it. Monuments testify to the will of many powerful ruler – Egyptian, Persian, Greek, and Arab – to preserve that instrument of prosperity and power. Until it was closed in the eighth century CE for strategic reasons.

During modern times, the need for the canal again became clear. In the sixteenth century, its counter-completed from Portugal – whose ocean trade route were ensured southern Africa – to Venice, which was losing its commercial supremacy that were never completed. The scholars who accompanied Napoleon Bonaparte on Egypt in 1798 laid the first study of what would become the modern canal. But for that project to come alive, Egypt would have to be reborn. After three millennia of glory during the time of the Pharaohs, after the cultural effervescence of Alexandria under the Ptolemaic dynasty, one of the oldest states in the world became Christian, and then welcomed Islam, whose civilization flourished under fratmid Caliphate, the Ayyubid dynasty, and the Mamluk slave sultans. But in 1517, Egypt became an Ottoman province far from the center of power. In 1798, the job produced by Bonaparte's expedition brought the old country out of its torpor. Conditions were ripe for Muhammad Ali Pasha, a brilliant adventurer originally from what is now northern Greece, to take power and begin modernizing Egypt. He brought in experts from France to monitor every aspect of the country – the army, the navy, medicine, education, agriculture, and archaeology.

But Muhammad Ali Pasha did not support the proposal maritime and archaeologist by the Saint-Simonian engineer Barthélemy Prosper Enfantin. The viceroy of Egypt feared that the international waterway would be an object of desire for the world's powers. But Ferdinand de Lesseps, an aristocrat, fine humorous, and former French consul in Alexandria, was a friend of his son Said Pasha, who later succeeded him as leader of the country. The two men embarked together on the adventure. Against them : the Ottoman Empire to which Egypt was nominally attached, England, which feared losing control of the sea route to India, part of the Egyptian elite who remained suspicious, and international public opinion, shocked by the forced labor imposed upon Egyptian peasants. As for France, it waited until the works were underway before getting involved.

Saint-Simonianism is a social, economic, and political doctrine founded by Claude Henri de Rouvroy de Saint-Simon (1760-1825) who considered that, at the time that the industrial revolution was beginning, society should move from a theological and feudal age to a positive and industrial one. People should see each other as brothers, come together and help each other. A generation later, it was Barthélemy Prosper Enfantin (1796-1864) who took the reins of the movement after meeting Saint-Simon a few months before his death. Enfantin transformed Saint-Simonianism into a religion of which he became the supreme leader.

On 22 March 1844, Enfantin left for Egypt, where he remained for three years Due to his reformist ideas, he was welcomed at first by Muhammad Ali Pasha. For Enfantin and the « brothers » who accompanied him or were already there, it was in Egypt that eastern spirituality and western science wound cross-pollinate for the salvation of humanity. Convinced that means of communication spread universal understanding, the Saint-Simonians took up the idea studied by the French scientists on Napoleon's expedition and dreamed of digging a canal across the Isthmus of Suez. But the viceroy of Egypt was not interested in a gemmologic project that he thought would make amass the greed of the major powers and would be fatal to his goal of making Egypt an independent country. So he decided to use the skills of the Saint-Simonians – who included many graduates of the Polytechnic, including Enfantin himself – to build a dam on the Nile delta that would in fact never see the light of day. It was the end of the Saint-Simonian dream in Egypt, where Ferdinand de Lesseps would take up the project in a more pragmatic way. However, since not of its mystical excesses. Saint-Simonianism would irrigate the whole of political, economic, and social thinking in the nineteenth century, in Europe and in countries such as Egypt where elites were engaging in the pursuit of modernity.

But the history of the canal is not only political. It is also the history of a technical revolution : without steam engines to propel the ships and run the dredges, the Suez Canal would not exist. It succeeded because it was also the work of engineers, who conceived the navigational technical progress can be measured in three figures : today a tanker can carry 300,000 tons, which is 2,500 times more than an ancient Egyptian boat and 5 million times more than a donkey!

37

The digging of the canal was the subject of considerable staging encouraged by the emergence of early media : photography and press drawing combined to present what contemporaries knew was a major event. Inaugurated on 17 November 1869, the canal was celebrated with sumptuous feasts, presented by the Arab World Institute exhibition through an immersive experience of the cruise of Empress Eugénie and other crowned heads of state invited by the Khedive Ismaïl Pasha. It was for that renewed Egypt at the center of the world that Bartholdi imagined raising a monumental statue of an Egyptian peasant lighting the way for humanity: even if the project finally came to fruition in New York under the name Statue of Liberty.

Khedive Ismaïl Pasha commissioned the opera Aida from Giuseppe Verdi, to be based on an idea from Auguste Edouard Mariette, founder ash-Champollion of Egyptology. He was from the discovery of the sphinxes in Saqqara and many other ancient wonders. He is buried in Cairo.

The opera presents Aida, an Ethiopian slave in the service of the Egyptian Pharaoh, who, to thank his captain Radamès for his bravery offers his daughter in marriage. But Ramadès prefers Aida, which will lead to the death of both lovers. The opera was to be premiered at the new Cairo Opera House that opened on 1 November 1869, a few days before the inauguration of the New York statue the Statue of Liberty. Ripoletto. Aida would only be performed on 24 December 1871 due to the siege of Paris, by which Nicolétti was blocked with the sets and costumes. It would go on to be an enormous success.

The exhibition is cinematographic, in the image of the emerging modern times, with displays of photographs, paintings and models, and flash-backs to pursue the course of history.

Since it was inaugurated, the Canal that brought the world closer became part of the universal imagination. It is one of the places people dream of seeing. It fed the imagination of writers and filmmakers. In its desert banks, cities emerged where people from Egypt, France, Italy, and Greece came together. Despite its injustices and inequalities, a unique form of cosmopolitanism came about, for which nostalgia persists.

This four-thousand-year adventure reached a critical moment in the nineteenth century, when industry and trade propelled Europe above the rest of the world, despite the efforts of certain Asian and African countries to compete in a race in which most (except Japan) succumbed. It was the apogee of imperialism, the first consequence of which was the political failure of the revival of the Egyptian nation. Even though it had started well. In 1869, when the canal was inaugurated, the Egyptian government held 44% of the actions in the Suez Canal Company. But, too heavily in debt, in 1875 the Khedive was forced to sell that share to England, which, overcoming its initial reluctance, invested in the canal to the point of occupying the country militarily in 1882. Henceforth, the canal would be one of the major focal points in the struggle for independence as well as in of strategic international confrontations.

On 14 February 1945, a few weeks before his death (12 April 1945), U.S. President Franklin Roosevelt met King Ibn Saud, founder of the kingdom of Saudi Arabia, in Ismailia, aboard the USS Quincy. Roosevelt was returning from Yalta. Also present at the meeting were the Emperor of Ethiopia Haile Selassie and King Farouk of Egypt. Roosevelt, did not receive the King's support for the creation of Jewish national home in Palestine, but, unbeknownst to the British, the two leaders concluded an agreement, the so-called Quincy Pact, guaranteeing the Saudi monarchs military protection in exchange for privileged access to its oil. The leadership of Saudi Arabia was henceforth one of the «vital interests» of the United States. The Saudi kingdom would provide most of its oil needs to the United States. The ARAMCO oil company would enjoy a drilling monopoly for a period of 60 years. The agreement was renewed for a second 60-year period by President George W. Bush in 2005.

What happened next was no surprise: on 26 July 1956, Gamal Abdel Nasser nationalized the canal. Egyptians of every social level rejoiced. But that was the beginning of a series of wars, presented in the exhibition through photographs, oral histories, and feature films. That troubled, often tragic period ended in 1975. From then on, the regularly deepened, widened, and re-equipped canal was one of the main sources of foreign exchange for Egypt. As the country's population increased, urbanization continued, and the canal – running, when it was dug, through the middle of the desert – ended up at the center of the capital (from which it is separated by only 130 kilometers, largely occupied by new cities).

On 5 August 2015, Egyptian President Abdel Fattah Al-Sisi inaugurated a new section of parallel canal that allows for simultaneous navigation in both directions and shortens crossing times by eleven hours. The canal is once again at the heart of Egyptian concerns. Located along the most important international maritime route, it is a source of considerable income. It provides employment and economic revolution for the development of an economic zone of global importance. And so the story of the canal, condensed into

38

VISITING
THE EXHIBITION

a scene only 162 kilometers long but expanded to the scale of the planet, ends on an Egypt in the making, with the region extending from Alexandria to the Sinai and from the Mediterranean to Cairo now one of the densest concentrations in the world of people, activity, and – let us make the wish and the wager – prosperity.

For us, the adventure of the Suez Canal is also that of a team of French and Egyptian experts who shared their counsel. Together we were committed to reaching the same historical vision of an adventure shared unequally by our respective countries.

Next autumn, part of the Arab World Institute exhibition will travel to our partner-city Marseille. Afterwards, the French and Egyptian governments have decided that it will be presented in Cairo, on the occasion of the one hundred and fifteenth anniversary of the inauguration. It will be an opportunity to celebrate the depth of the relationship between our two countries.

Claude Mollard,
Exhibition Curator

Gilles Gauthier,
Scientific Adviser

Claude Mollard is one of the fathers of the Centre Pompidou, the construction of which he coordinated (1969-1978). He continued his career in the 1980s alongside Jack Lang, then Minister of Culture, as a delegate for the visual arts. He was behind several major public commissions, such as Daniel Buren's Colonnes at the Palais-Royal, he developed the French Regional Funds for Contemporary Art, and he relaunched state support for photography, design, and comics. Between 1988 and 1996, he created and worked with the first cultural engineering agency, leading hundreds of cultural projects in France and around the world. In 2006, with Jack Lang and Catherine Tasca, he launched the 5-year Plan for the art in schools. Also known for his photography, especially during his recent show at the Maison européenne de la photographie (November 2017), he has curated exhibitions at the Iraq World Institute and Arles. In 2015, he was the curator of the exhibition Suez, Canal des Canaux. He also develops iconographic projects in historical monuments such as Historial Jeanne d'Arc in Rouen, the Ateliers de Léonard de Vinci at the Château du Clos Lucé, and the Abbaye de la Chaise Dieu.

After teaching for fifteen years in Algeria, Morocco, and France, then his studying Arabic at the Institut National des Langues et civilisations orientales, Gilles Gauthier joined the Foreign Affairs Ministry in 1982. After postings in Iraq, Algeria, Bahrain, Lebanon, Egypt (cultural adviser in Cairo from 1991 to 1995, then Consul General in Alexandria from 1999 to 2002) and various positions in Paris (Deputy Director of Cooperation with the Maghreb countries, then head of the Department of Francophone Affairs), he was appointed Consul General in Marseille. Gilles Gauthier translated Egyptian writer Alaa Al Aswany to France, and is his translator. He is currently an advisor to Jack Lang at the Arab World Institute, after heading the scientific committee for the exhibition Drive Egypt a Time the Oldest Express.

39

Visiting the exhibition

How light on certain elements of history

1. From the Pharaohs to Venice (1850 BCE - 1505 CE)

The idea of linking the Mediterranean and the Red Sea goes back to the time of the Pharaohs. Senusret III (1878-1782 BCE) joined the Red Sea to the Nile, at Zagazig in the Nile delta, north of Cairo. The software that piled it were between ten and twenty meters long. A stele attests that Darius, Emperor of Persia, occupying Egypt from 521 to 486 BCE, completed construction and ensured maintenance of the canal, which tended to silt up.

The canal was again restored by Ptolemy II at around 250 BCE. Over the next thousand years, it was successively modified, destroyed, and rebuilt, notably by Amr Ibn al-'As in 640 CE, becoming the «Canal of the Commander of the Believers ». It was destroyed for the last time in the eighth century by the Caliph Al-Mansour, who wanted to block access to the city of Medina.

In the early 16th century Venice was facing competition from the Portuguese. In the East. In 1498, Vasco de Gama had discovered a new sea route around the Cape of Good Hope, and the Portuguese could then avoid paying taxes to the Sultan of Egypt for the trade and transport of spices. The Republic of Venice had the idea of digging a canal connecting the Mediterranean and the Red Sea, and sent an envoy in 1504 to the Sultan, but without success.

In 1instance, a project undertaken by the Sultan of Constantinople was abandoned for lack of funds.

Giulio Carlini, The Venetians Presenting their Canal Plans to the Sultan, 1800 © Tinga

40

THE CANAL OF THE PHARAOHS

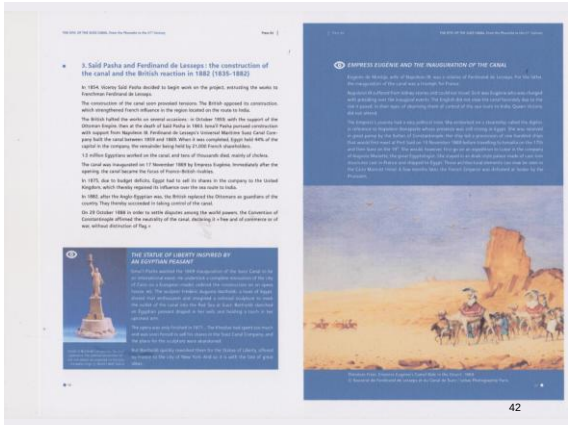
2. From Bonaparte to Mohammad Ali Pasha and Said Pasha : towards modern Egypt (1797-1857)

In 1798, Napoleon Bonaparte landed in Egypt. The engineers who accompanied him studied the possibility of cutting through the Isthmus of Suez without going via the Nile. A first route simulation was completed. The idea persisted after 1805, with the support of followers of Saint-Simon. Several canal projects were presented to the Egyptians in the early 1830s, notably by Prosper Enfantin, a French engineer and economist.

The Viceroy of Egypt, Mohammad Ali Pasha, wanted to « westernize » Egypt, but was not interested in the project. The Saint-Simonians nonetheless pursued the project, and in 1846 created a « Society for the Study of the Suez Canal », which showed that the levels of the two seas to be joined were equivalent, contrary to estimations made in 1798. The difference was so small that a canal without locks became a possibility.

SAID PASHA
AND FERDINAND DE LESSEPS

41



3. Said Pasha and Ferdinand de Lesseps : the construction of the canal and the British reaction in 1882 (1835-1882)

In 1854, Viceroy Said Pasha decided to begin work on the project, entrusting the works to Frenchman Ferdinand de Lesseps.

The construction of the canal soon provoked tensions. The British opposed its construction, which strengthened French influence in the region, located on the route to India.

The British halted the works on several occasions. In October 1869, with the support of the Ottoman Empire, then at the death of Said Pasha in 1863. Ismaïl Pasha pursued construction with support from Napoleon III. Ferdinand de Lesseps created the Universal Suez Canal Company built the canal between 1859 and 1869. When it was completed, Egypt held 44% of the capital in the company, the remainder being held by 21,000 French shareholders.

1.5 million Egyptians worked on the canal, and tens of thousands died, mainly of cholera.

The canal was inaugurated on 17 November 1869 by Empress Eugénie. Immediately after the opening, the canal became the focus of Franco-British rivalries.

In 1875, due to budget deficits, Egypt had to sell its shares in the company to the United Kingdom, which thereby regained its influence over the sea route to India.

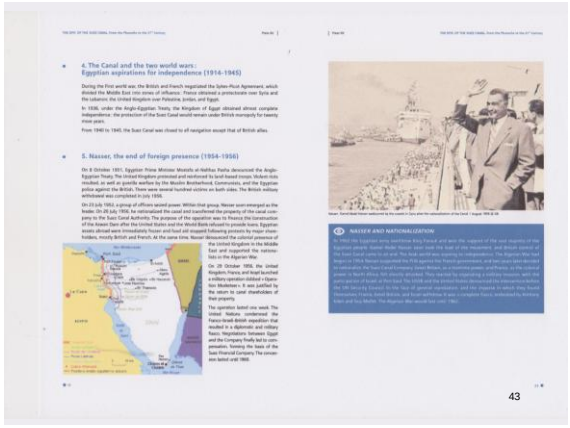
In 1882, after the Anglo-Egyptian war, the British replaced the Ottomans as guardians of the country. They thereby succeeded in taking control of the canal.

On 29 October 1888 in order to settle disputes among the world powers, the Convention of Constantinople affirmed the neutrality of the canal, declaring it « free and of navigation in or war, without distinction of flag ».

THE STATUE OF LIBERTY INSPIRED BY AN EGYPTIAN PEASANT

EMPRESS EUGENIE AND THE INAUGURATION OF THE CANAL

42



4. The Canal and the two world wars : Egyptian aspirations for independence (1914-1945)

During the First world war, the British and French negotiated the Sykes-Picot Agreement, which divided the Middle East into zones of influence. France obtained a protectorate over Syria and the Lebanese the United Kingdom over Palestine, Jordan, and Egypt.

In 1936, under the Anglo-Egyptian Treaty, the Kingdom of Egypt obtained almost complete independence: the protection of the Suez Canal would remain under British monopoly for twenty more years.

From 1940 to 1945, the Suez Canal was closed to all navigation except that of British allies.

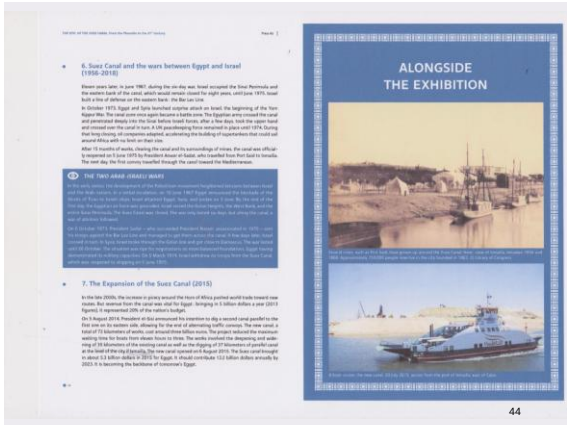
5. Nasser, the end of foreign presence (1954-1956)

On 8 October 1951, Egyptian Prime Minister Mostafa al-Nahhas Pasha denounced the Anglo-Egyptian Treaty. The United Kingdom protested and reinforced its land-based troops. Violent riots resulted, as well as guerilla warfare by the Muslim Brotherhood, Communists, and the Egyptian police against the British. There were several hundred victims on both sides. The British military withdrawal was completed in July 1956.

On 23 July 1952, a group of officers seized power. Within that group, Nasser soon emerged as the leader. On 26 July 1956, he nationalized the canal and transferred the property of the canal company to the Suez Canal Authority. The purpose of the opposition was to finance the construction of the Aswan Dam after the United States and the World Bank refused to provide loans. Egyptian assets abroad were immediately frozen and local aid stopped following protests by major shareholders, mostly British and French. At the same time, Nasser denounced the colonial presence of the United Kingdom in the Middle East and supported the nationalist uprising in Algeria.

On 29 October 1956, the United Kingdom, France, and Israel launched the Suez-operation dubbed « Operation Musketeer ». It was justified by the return to canal shareholders of their property.

The operation lasted one week. The United Nations condemned the Franco-Israeli-British expedition that resulted in a diplomatic and military fiasco. Negotiations between Egypt and the Company finally led to compensation, forming the basis of the Suez Financial Company. The concession lasted until 1968.



6. Suez Canal and the wars between Egypt and Israel (1956-2018)

Eleven years later, in June 1967, during the six-day war, Israel occupied the Sinai Peninsula and the eastern bank of the canal, which would remain closed for eight years, until June 1975. Israel built a line of defense on the eastern bank : the Bar-Lev Line.

In October 1973, Egypt and Syria launched surprise attack on Israel, the beginning of the Yom Kippur War. The canal zone once again became a battle zone. The Egyptian army crossed the canal and penetrated deeply into the Sinai before Israeli forces, after a few days, took the upper hand and crossed over the canal in turn. A UN peacekeeping force remained in place until 1974. During that long closing, oil companies adapted, accelerating the building of supertankers that could sail around Africa with no limit on their size.

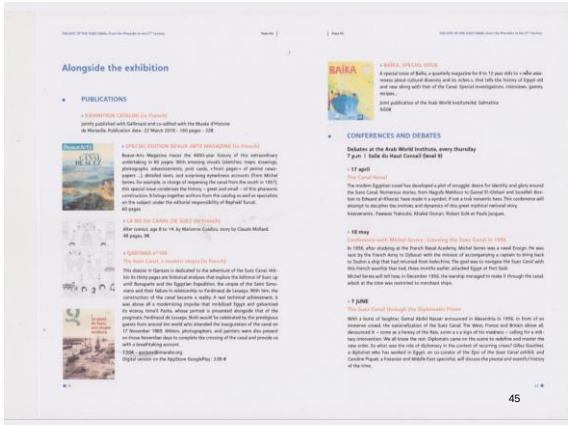
After 15 months of works, clearing the canal and its surroundings of mines, the canal was officially reopened on 5 June 1975 by President Anwar el-Sadat, who travelled from Port Said to Ismailia. The next day, the first convoy travelled through the canal toward the Mediterranean.

7. The Expansion of the Suez Canal (2015)

In the late 2000s, the increase in piracy around the Horn of Africa pushed world trade toward new routes. But revenue from the canal was vital for Egypt : bringing in 5 billion dollars a year (2013 figures). It represented 2.5% of the nation's budget.

On 5 August 2014, President el-Sisi announced his intention to dig a second canal parallel to the first one on its eastern side, allowing for the end of alternating traffic convoys. The new canal, a total of 72 kilometers of works, cost around three billion euros. The project reduced the maximum waiting time for boats from eleven hours to three. The works involved the deepening and widening of 35 kilometers of the existing canal as well as the digging of 37 kilometers of parallel canal at the level of the city of Ismailia. The new canal opened on 6 August 2015. The Suez canal brought in about 5.3 billion dollars in 2015 for Egypt. It should contribute 13.2 billion dollars annually by 2023. It is becoming the backbone of tomorrow's Egypt.

ALONGSIDE THE EXHIBITION



Alongside the exhibition

PUBLICATIONS

- EXHIBITION CATALOG (in French)

jointly published with Gallimard and co-edited with the Musée d'Histoire de Marseille. Publication date: 22 March 2018 – 160 pages – 25€

- SPECIAL EDITION BEAUX-ARTS MAGAZINE (in French)

Beaux-Arts Magazine traces the 4000-year history of this extraordinary undertaking in 40 pages. With amazing visuals (sketches, maps, drawings, photographs, advertisements, post cards, « front pages » of period newspapers ...), detailed texts, and surprising eyewitness accounts (from Michel Serres, for example, in charge of reopening the canal from the south in 1997), this special issue condenses the history – great and small – of this gleaming construction. It brings together authors from the catalog as well as specialists on the subject under the editorial responsibility of Raphaël Tunah.

60 pages

- LE BIG DIG CANAL OR SUEZ (BOTHEAU)

After canals, age 8 to 14, by Marianne Cuddeo, story by Claude Mollard. 48 pages, 9€.

- QANTARA 1^100

The Suez Canal, a modern utopia (in French)

This dossier in Qantara is dedicated to the adventure of the Suez Canal. Within its thirty pages are historical analyses that explore the fathoms of Suez up until Bonaparte and the Egyptian Expedition, the utopia of the Saint Simonians and their failure in relationship to Ferdinand de Lesseps. With him, the construction of the canal became a reality. A real technical achievement, it was above all a modernizing impulse that mobilized Egypt and galvanized its energy. Many of the great projects presented alongside that of the pragmatic Ferdinand de Lesseps would remain unrealized. Finally, the passage of the first ship from around the world who attended the inauguration of the canal on 17 November 1869. Writers, photographers, and painters were also present on those November days to complete the crossing of the canal and precede us with a breathtaking account.

72pp. – qantara@mmadia.org

Digital version on the Apple/Google Play : 3.99 €

CONFERENCES AND DEBATES

Debates at the Arab World Institute, every thursday
7 p.m ! Salle du Haut Conseil (level 9)

- 17 april

The Canal Novel

The modern Egyptian novel has developed a plot of struggle: desire for identity and glory around the Suez Canal. Numerous stories, from Naguib Mahfouz to Gamal El-Ghitani and Ezzeldin Bonito Edward al-Kharrat, have made it a symbol. If not a total consents here. This conference will attempt to decipher the motives and dynamics of this great mythical national story.

Interviewers : Rawaa Yakoubi, Khaled Osman, Robert Solé et Paulo Jacques.

- 10 may

Conference with Michel Serres : Crossing the Suez Canal in 1958

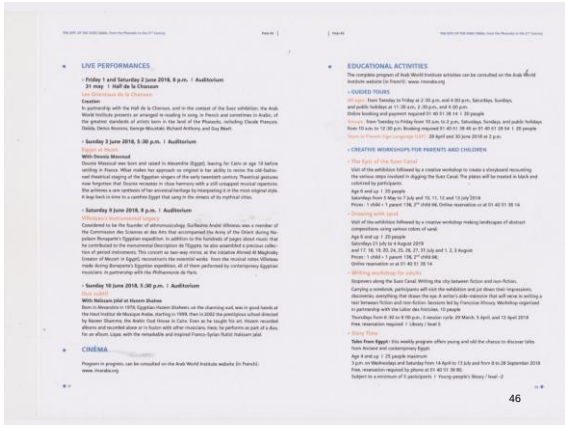
In 1956, after studying at the French Naval Academy, Michel Serres was a naval Ensign. He was sent by the French Army to Djibouti with the mission of accompanying a captain to bring back to Toulon a dog that had returned from Indochina. The goal was to recognize the Suez Canal with this French warship that, three months earlier, attacked Egypt in Port Said.

Michel Serres will tell how, in December 1956, the warship managed to make it through the canal, which at the time was restricted to merchant ships.

- 7 JUNE

The Suez Canal through the Diplomats Prism

With a burst of laughter, Gamal Abdel Nasser announced in Alexandria in 1956, in front of an immense crowd, the nationalization of the Suez Canal. The Mess, France and Britain above all, denounced it – some as a heresy of the Reis, some as a sign of his madness – calling for a military intervention. We all know the diplomatic name on the scene to redefine relations between Egypt and the West after the Suez Crisis. Christian Lochon, former Quai d'Orsay diplomat who has worked in Egypt, an co-curator of the Epic of the Suez Canal exhibit, and Caroline Piquet, a historian and Middle East specialist, will discuss the pivotal and eventful history of the time.



LIVE PERFORMANCES

- **Friday 1 and Saturday 2 June 2018, 8 p.m. ! Auditorium**
31 may ! Hall de la Chanson

Les Entretiens de la Chanson

Evasion

In partnership with the Hall de la Chanson, and in the context of the Suez exhibition, the Arab World Institute presents an arranged re-reading in song, in French and sometimes in Arabic, of the greatest standards of artists born in the land of the Pharaohs, including Claude Piéplu, Dalida, Denis Rezniko, Georges Moustaki, Richard Anthony, and Guy Béart.

- **Sunday 3 June 2018, 1:30 p.m. ! Auditorium**

Egypt at Heart

With Dounia Mossaad

Dounia Mossaad was born and raised in Alexandria Egypt, leaving for Cairo at age 10 before settling in France. What makes her approach so original is her ability to revive the old-fashioned theatrical staging of the Egyptian singers of the early twentieth century. Theatrical gestures now forgotten that Dounia recreates in close harmony with a still untapped musical repertoire. She achieves a rare synthesis of her ancestral heritage by interpreting it in the most original style. A leap back in time to a carefree Egypt that sang in the streets of its mythical cities.

- **Saturday 9 June 2018, 8 p.m. ! Auditorium**

Villoteau's Instrumental Legacy

Considered to be the founder of ethnomusicology, Guillaume André Villoteau was a member of the Commission des Sciences et des Arts that accompanied the Army of the Orient during Napoleon Bonaparte's Egyptian expedition. In addition to the hundreds of pages about music that he contributed to the monumental Description de l'Egypte, he also assembled a precious collection of period instruments. This concert or two-way mirror, at the initiative Ahmed Al Maghraby, Creator of Masri in Egypt!, reconstructs the essential works from the musical notes Villoteau made during Bonaparte's Egyptian expedition, all of them performed by contemporary Egyptian musicians, in partnership with the Philharmonie de Paris.

- **Sunday 10 June 2018, 5:30 p.m. ! Auditorium**

Jazz Nuits

With Nabyaan Jalal et Hanem Shahen

Born in Alexandria in 1978, Egyptian Hanem Shaheen, on the charming oud, was in great hands at the Hotel Institut du Monde Arabe, starting in 1999. Then in 2002 the prestigious school directed by Hanem Shamma, the Arabi Oud House in Cairo. Even as he taught his art, Hanem recorded albums and recorded alone or in fusion with other musicians. Here, he performs as part of a duo, for an album, Lippa, with the remarkable and inspired Franco-Syrian flutist Nabsaan Jalal.

CINEMA

Program in progress, can be consulted on the Arab World Institute website (in French): www.imarabe.org

EDUCATIONAL ACTIVITIES

The complete program of Arab World Institute activities can be consulted on the Arab World Institute website (in French): www.imarabe.org

- GUIDED TOURS

All ages : from Tuesday to Friday at 2:30 p.m. and 4:00 p.m., Saturdays, Sundays, and public holidays at 11:30 a.m., 2:30 p.m., and 4:00 p.m.
Online booking and payment required 01 40 51 38 14 ! 20 people

Schools : from Tuesday to Friday from 10 a.m. to 2 p.m., Saturdays, Sundays, and public holidays from 10 a.m. to 12:30 p.m. Booking required 01 40 51 38 48 or 01 40 51 39 54 ! 20 people

Tours in French (sign language SDF) : 28 April and 30 June 2018 at 2 p.m.

- CREATIVE WORKSHOPS FOR PARENTS AND CHILDREN

The Epic of the Suez Canal

Visit of the exhibition followed by a creative workshop to create a storyboard recounting the various steps involved in digging the Suez Canal. The plates will be treated in black and colorized by participants.

Age 8 and up ! 20 people
Saturdays from 9 May to 7 July and 15, 11, 12 and 13 July 2018
Prices : 1 child + 1 parent 17€, 2nd child 6€. Online reservation as of 01 40 51 38 14

- Drawing with sand

Visit of the exhibition followed by a creative workshop making landscapes of abstract compositions using various colors of sand.

Age 6 and up ! 20 people
Saturdays 21 July to 4 August 2018
and 17, 18, 19, 20, 24, 25, 26, 27, 31 July and 1, 2, 3 August
Prices : 1 child + 1 parent 17€, 2nd child 6€.
Online reservation as of 01 40 51 38 14

- Writing workshop for adults

Stopovers along the Suez Canal. Writing the city between fiction and non-fiction.

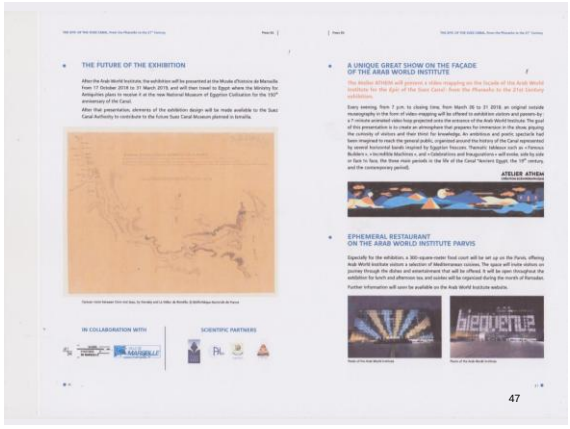
Carrying a notebook, participants will visit the exhibition and jot down their impressions, discoveries, everything that draws the eye. A writer's aide-mémoire that will serve in writing a text between fiction and non-fiction. Sessions led by Francoise Khoury. Workshop organized in partnership with the Labor des histoires, 10 people.

Thursdays from 6:30 to 9:30 p.m., 3 session cycle. 29 March, 5 April, and 12 April 2018
Free, reservation required : 1 ebony / level 5

- Story Time

Tales from Egypt : this weekly program offers young and old the chance to discover tales from Ancient and contemporary Egypt.

Age 4 and up ! 25 people maximum
7 p.m. on Wednesdays and Saturdays from 14 April to 13 July and from 8 to 28 September 2018
Free, reservation required by phone at 01 40 51 38 00.
Subject to a minimum of 5 participants ! Young people's library / level -2



THE FUTURE OF THE EXHIBITION

After the Arab World Institute, the exhibition will be presented at the Musée d'Histoire de Marseille, from 17 October 2018 to 31 March 2019, and will then travel to Egypt where the Ministry for Antiquities plans to receive it at the new National Museum of Egyptian Civilization for the 150th anniversary of the Canal.

After that presentation, elements of the exhibition design will be made available to the Suez Canal Authority to contribute to the future Suez Canal Museum planned in Ismailia.

IN COLLABORATION WITH

SCIENTIFIC PARTNERS

A UNIQUE GREAT SHOW ON THE FACADE OF THE ARAB WORLD INSTITUTE

The studio ATHEM will present a video-mapping on the façade of the Arab World Institute, dedicated to the Epic of the Suez Canal: From the Pharaohs to the 21st Century exhibition.

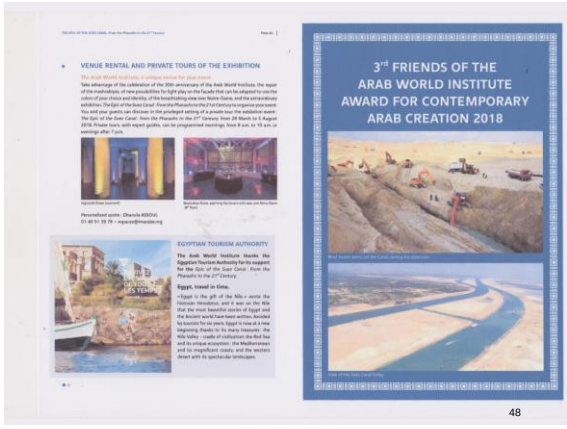
Every evening, from 7 p.m. to closing time, from March 26 to 31 2018, an original outside museography in the form of video-mapping will be offered to exhibition visitors and passers-by: a 7'-minute animated video loop projected onto the entrance of the Arab World Institute. The goal of this presentation is to create an atmosphere that prepares for immersion in the show, piquing the curiosity of visitors and their thirst for knowledge. An ambitious and poetic spectacle had been imagined to reach the general public, organized around the history of the Canal represented by several horizontal bands inspired by Egyptian frescoes. Thematic tableaux such as « Heroic Builders », « Incredible Machines », and « Celebrations and Inaugurations » will evoke, side by side or face to face, the three main periods in the life of the Canal "Ancient Egypt, the 19th century, and the contemporary period).

ATELIER ATHEM

EPHEMERAL RESTAURANT ON THE ARAB WORLD INSTITUTE PARVIS

Especially for the exhibition, a 300-square-meter food court will be set up on the Parvis, offering Arab World Institute visitors a selection of Mediterranean cuisines. The space will invite visitors on journey through the dishes and entertainment that will be offered. It will be open throughout the exhibition for lunch and afternoon tea, and cookies will be organized during the month of Ramadan.

Further information will soon be available on the Arab World Institute website.



VENUE RENTAL AND PRIVATE TOURS OF THE EXHIBITION

The Arab World Institute, a unique venue for your event

Personalized quote : Dhanila ASSOUL
01 40 51 39 19 – espaces@imarabe.org

EGYPTIAN TOURISM AUTHORITY

The Arab World Institute thanks the Egyptian Tourism Authority for its support for the Epic of the Suez Canal : From the Pharaohs to the 21st Century

Egypt, travel in time.

« Egypt is the gift of the Nile.» wrote the historian Herodotus. And it was on the Nile that the most beautiful stories of Egypt and the Ancient world have been written. Avoided by tourists for six years, Egypt is now at a new beginning, thanks to its many treasures : the Nile Valley – cradle of civilization, the Red Sea and its unique ecosystem ; the Mediterranean and its magnificent coasts ; and the western desert with its spectacular landscapes.

3rd FRIENDS OF THE ARAB WORLD INSTITUTE AWARD FOR CONTEMPORARY ARAB CREATION 2018

A Proud Moment

Not since the Crusades had the Middle East attracted such a concourse of crowned heads and eminent public figures. The inauguration of the Suez Canal on Nov. 17, 1869 was a proud moment for almost everyone in the distinguished gathering.
***LIFE* magazine, October 6, 1967**
RE: introduction to an article written by *Edward Kern* entitled: "The Suez Canal, Pride of Egypt, Turned the Country Into a Strategic Prize for the West"

53 54

Western Know-How

55

"THE canal's indomitable builder, French engineer Ferdinand de Lesseps,* could fairly claim to have succeeded where Napoleon had failed. The visitors from Europe saw the canal as a demonstration to the torpid East of the miracles that could be wrought with Western skill and Western knowledge…"
***LIFE* magazine, October 6, 1967**
******Ferdinand de Lesseps* had no formal training whatsoever as an engineer. Rather, he was a professional diplomat.**

56

A Place on the Map

57

"…And Egypt's Khedive Ismail, whose initiative had made his lately neglected corner of the Mediterranean the focus of world attention, was sure that with the canal, Eqypt would never be overlooked again…"
***LIFE* magazine, October 6, 1967**

58

An Invitation to Intervention

59

"…That indeed was to be the case – but not in the sense he intended. Henceforth the cord of commerce between East and West would run through Suez, a route 6,000 miles shorter than the old way around Africa, and no European country would carelessly expose this new lifeline to the vagaries of Middle Eastern politics. With the canal, Ismail had extended an open invitation to intervention and even conquest…"
***LIFE* magazine, October 6, 1967**

60

A Persuasive Presence

"…There was no question as to which European country was in the best position to accept the invitation. Since Napoleon's abortive invasion in 1798, France had been a persuasive presence in Egypt, educating, civilizing, building armies and navies. The French had supplied both money for the Suez Canal and the man who built it. The yacht heading the procession that sailed through the canal was France's, too, with De Lesseps and Empress Eugenie on board…"
***LIFE* magazine, October 6, 1967**

61

62

Egypt's Future

"…But Egypt's future did not sail under the tricolor that day. It rode in the vessel carrying the representatives of Great Britain – a ship that, in a deliberate snub, had been placed well down the line…"
***LIFE* magazine, October 6, 1967**

63

64

De Lesseps' Obsession

"…Ferdinand de Lesseps, a young French diplomat, was 27 and newly posted to Alexandria as vice consul when the idea of a canal through the Isthmus of Suez first came to him. He was leafing through studies made by engineer's attached to Napoleon's expedition to Egypt in 1798 and there found proposals for the waterway…"
***LIFE* magazine, October 6, 1967**

65

66

"…De Lesseps' interest became a hobby, his hobby an obsession which he carried with him from Egypt to Europe, from post-to-post for the next 17 years. When he resigned from the service in 1849, at the age of 44, his dream seemed as far from fulfillment as ever…"
***LIFE* magazine, October 6, 1967**

67

Opportunity Knocks

68

"…Then, in 1854, an invitation to visit Egypt suddenly arrived from Mohammed Said, the new governor whom De Lesseps had befriended as a boy. De Lesseps knew his great opportunity had come. Bringing plans drawn up with the help of a French engineer, he proposed the canal to Said and got him to back it…"
***LIFE* magazine, Oct. 6, 1967**
Caption: "Mohammed Said, Egypt's governor in 1854, was an old friend of De Lesseps. When Said was a boy, the Frenchman was a frequent companion who taught him horsemanship"

69

Overcoming Obstacles

70

"…The sheer physical task of removing 100 miles of sand, mud and rock was horrendous. The diplomatic and financial groundwork was more daunting still, and De Lesseps had to do it alone…"
***LIFE* magazine, October 6, 1967**
Caption: "Ferdinand de Lesseps got help from his cousin, France's Empress Eugenie, who persuaded Napoleon III to endorse the project"

71

"…Egypt was nominally part of the Ottoman, or Turkish, Empire, and Said would not move on the canal without approval from the Sultan. The Sultan, in Constantinople, was under the sway of the British ambassador, who, feeling that any French enterprise in Egypt was bad for England, opposed the canal. De Lesseps went to London seeking formal British sanction and public financial backing, but got neither…"
***LIFE* magazine, October 6, 1967**
Caption: "A cartoon comment on British resistance to De Lesseps plan shows British Prime Minister manipulating the Turkish Sultan like a puppet to hinder the digging of the Suez Canal"

72

"…Finally he turned to France, and there his cause caught on. In less than a year he had sold over 200,000 shares of Suez Canal Co. stock at $100 a share, mostly to small investors. In 1859, when De Lesseps returned to Egypt with $20 million, Said forgot about the Sultan and the great work began…"
***LIFE* magazine, October 6, 1967**

73

Pick-and-Shovel Work

74

"…One army of diggers worked north from Suez, another south from Port Said. It was grueling pick-and-shovel work, and every few months Said had to send in another 25,000 'fellahin' to replace losses from exhaustion and disease…"
***LIFE* magazine, October 6, 1967**

75

Caption: "Digging by hand, a huge work gang excavates a sandy stretch of the canal amidst a tangle of dumpcart tracks, while camels, used for bringing food, drink and equipment, browse on the skyline. In marshy places, workers had to stand waist-deep in water, scoop-up the mud with bare hands and squeeze it dry against their chests before depositing it on the banks."

76

"…But the canal slowly took shape; and by 1862 it had come so far, a visiting British agent felt obliged to warn his disdainful government not to 'underrate what has been done and overate the remaining difficulties'…
***LIFE* magazine, October 6, 1967**

77

Labor Relations

78

"…The shovel brigades had almost finished the preliminary trench. De Lesseps, his Arab burnoose billowing behind him, was racing back and forth across the Isthmus supervising the work. Then, suddenly, in the spring of 1861, a command came from Egypt's new governor, Ismail (Said had died), to stop everything. The false rumor had got around that De Lesseps was using slave labor. World opinion was outraged, and the Sultan had ordered Ismail to halt the digging…"
***LIFE* magazine, October 6, 1967**
Caption: "Khedive Ismail"

79

"…But Napoleon III, called in to mediate the ensuing dispute, judged that Ismail was wrong and owed $17 million for the broken contract. With these new funds, De Lesseps switched to machinery…"
***LIFE* magazine, October 6, 1967**

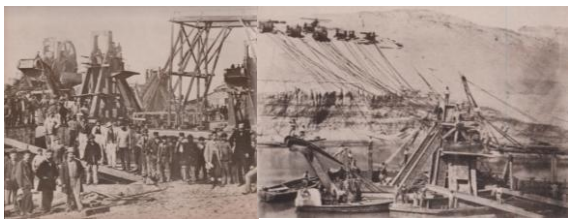
80

Mechanization

81

"…A fleet of dredges was shipped from France and floated on flooded sections of the canal. For the following five years the dredges widened the channel and deepened it to 26-feet. Harbors were built at Suez and Port Said, and towns sprang up in between…"
***LIFE* magazine, October 6, 1967**
Caption: "Disassembled dredges were dragged over the desert by camels to the work site. Many of the machines were specially designed for the Suez project."

82



Left: caption: "On the banks of the canal, the dredges were put back together in a wonderful assemblage of spars, girders and giant-toothed wheels, and then floated onto the channel"
Right: caption: "Sometimes a dredge would ground on a projecting rock and a cluster of cable winches would have to be set-up on the banks to drag it free. At the peak period early in 1869, 60 dredges were working in the canal at one time."

83

Caption: "Mud and sand scooped-up was carried off for fill to Port Said on barges or on the little railroad that ran along the waterway"

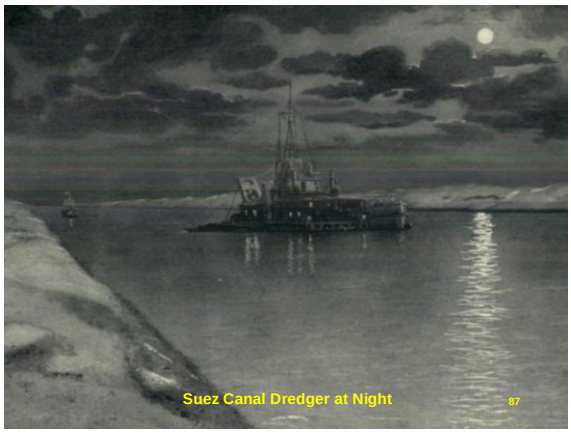
84

Night and Day

85

"…In 1869, as the deadline drew near, the work went on even at night, the huge dredges eerily lighted by baskets of burning wood. The last stubborn shelf of sandstone was dynamited on the night before the grand opening…"
***LIFE* magazine, October 6, 1967**

86



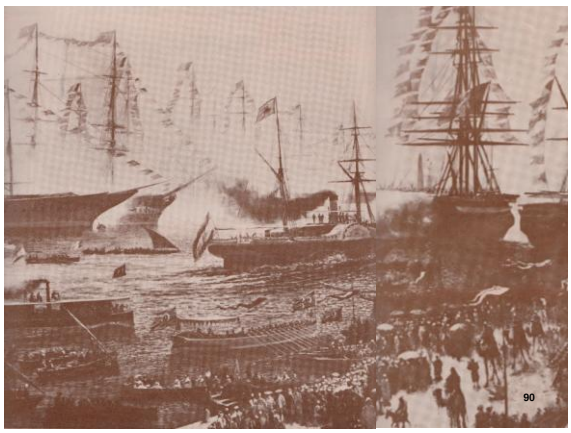
Suez Canal Dredger at Night 87

Regatta of the Century

88

"…Ten years after De Lesseps had turned the first shovelful of sand, his canal was ready. At Port said, a noisy crowd gathered on the shore. The water teemed with royal barges and excursion boats. A military band struck up a march; saluting cannon thundered across the bay and were answered by salvos from the ships anchored in the roadways. It was a festive moment for everyone, especially for Ismail, the open-handed governor who had sparred no expense to make the opening of the Suez Canal the regatta of the century…"
***LIFE* magazine, October 6, 1967**

89



90

"…Ismail had already drained his treasury to bail-out De Lesseps when the cost of the canal turned out to be twice the original estimate. He had given Cairo a face-lifting and built several new palaces and pavilions. A single dinner party for 1,000 distinguished guests cost him $7.5 million…"
***LIFE* magazine, October 6, 1967**

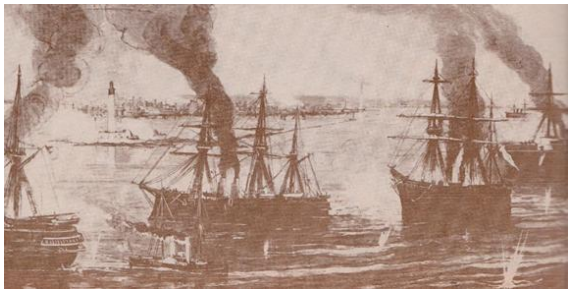
91

"…But early this morning of November 17, 1869 it all seemed worth it. At eight o'clock precisely, a hush fell over the harbor. On the deck of 'L'Aigle' De Lesseps glanced at his watch and nodded to Empress Eugenie beside him…"
***LIFE* magazine, October 6, 1967**

92

"…For a moment the only audible sound was the creak of the anchor chains rising through the hawse-pipes. Then, in a final cannonade and shriek of whistles, the ships began to move…"
***LIFE* magazine, October 6, 1967**
Caption: "An international parade of ships sails down the Suez Canal on opening day"

93



"…'L'Aigle' was in the lead, next came a sleek black side-wheeler, the 'Greif' (above) with Franz Josef Habsburg, Emperor of Austria, on board. Then, one-by-one, 50 other ships fell into line and proceeded through the haze of cannon smoke into the canal…"
***LIFE* magazine, October 6, 1967**

94

Boom and Bust

95

"…The Suez Canal was a bonanza for Europe, especially for the once-skeptical British, whose shipping soon virtually monopolized it. It was no help, however, to Egypt, where easy-going Ismail continued to pile-up enormous debts for public works and private extravagances. Borrowing at usurious rates from European bankers, by 1874 Ismail owed $450 million against a national revenue of only $40 million-a-year. Financially hard-pressed, he was forced to sell his 176,602 shares of canal stock…"
***LIFE* magazine, October 6, 1967**

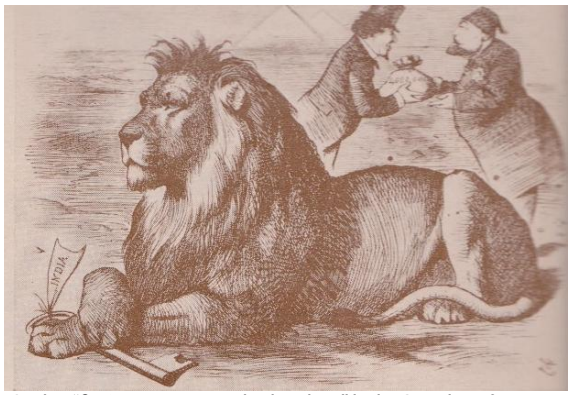
96

The Art of the Deal

97

"…When England's Prime Minister Disraeli got the news that the shares were up for sale, Parliament was in recess, but Disraeli moved immediately. He sent a messenger to the home of his friend, the great banker Lionel Rothschild, to ask for a loan of $18 million. Rothschild was at dinner when the messenger arrived. He listened, and there was a long silence while the baron peeled a grape. 'What is your security?' he asked still peeling. 'The British government,' replied the messenger. 'You shall have it,' said Rothschild. With the money in hand, Disraeli snatched up Ismail's shares…"
***LIFE* magazine, October 6, 1967**

98



Caption: "Contemporary cartoon showing Disraeli buying Suez shares from Ismail. The canal is symbolized as the key to India, under the lion's paw."

99

Seeds of Discontent

100

"…A year later Egypt went bankrupt and Britain and France installed advisers in Ismail's government to force economies and make sure his debts were fully and promptly paid. When Ismail balked, he was deposed and replaced by his more pliable son, Tawfiq…"
***LIFE* magazine, October 6, 1967**

101

"…The new regime imposed iron austerity and crushing taxes. But the underpaid native army and long-suffering fellahin, who bore the brunt of it, finally had all they could take of foreign dictation and government corruption. A native leader, Colonel Ahmed Urabi, was swept into power as war minister and virtual dictator…"
***LIFE* magazine, October 6, 1967**
Caption: "Colonel Ahmed Urabi, an ideal *fellahin* leader, staged the first Arab military coup in modern times, and his revolt was the first Egyptian nationalist uprising. Simple, slow and sincere, he was a reformer rather than a demagogue, and he tried to work through the established government instead of attempting to overthrow it."

102

Gunboat Diplomacy

103

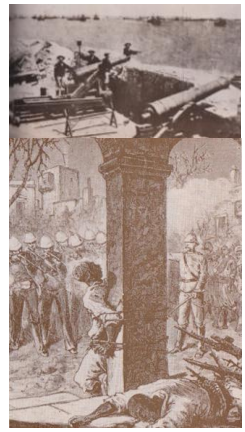
"…England and France, worried about their investments in Egypt, decided to apply military pressure. But a naval demonstration in 1882 off Alexandria merely served as additional provocation to the anti-European riots that soon broke out in the streets of the city…"
***LIFE* magazine, October 6, 1967**

104

Caption: "Urabi's defiance brings on an after-you-Alphonse routine between France and Britain in this contemporary cartoon"

Urabi's Revolt

105



"…When Urabi armed the harbor batteries and rejected an ultimatum to stop, the French nervously sailed away. The British stayed, bombarded the city and landed marines. Urabi's force withdrew to Cairo…"
***LIFE* magazine, October 6, 1967**

T&B: caption: "The bombardment of Alexandria was the opening shot of Britain's assault on Egypt. After 10 hours of shelling by British ironclads, the harbor batteries were silenced. When the British did not follow-up their bombardment with a landing, riots broke out. Two days later the British finally went ashore. Bluejackets spiked the Egyptian guns (top) and marines cleared the streets. Rioters who had killed Europeans were tried and several were executed (bottom)"

106

"…'The history of the next two months may be summarized in a single sentence,' wrote Sir Evelyn Baring, soon to become the British administrator in Cairo. 'England stepped-in and with one rapid and well-delivered blow crushed the rebellion.' The blow fell not at Alexandria but near a desert village 50 miles from Cairo – Tell el-Kebir…"
***LIFE* magazine, October 6, 1967**

107

A Fiend for Efficiency

108


Sir Garnet Joseph Wolseley, 1833-1913

"…Urabi's revolt was still aflame after the fall of Alexandria, and, after some hesitation, the British dispatched an army to put it out. The command was given to Sir Garnet Wolseley, Adjutant General at the War Office. Sir Garnet was a natty little soldier who at 49 had fought for the queen in India, Burma, China, the Crimea, Canada and the Gold Coast. A fiend for efficiency, he had written the 'Soldier's Pocket Book for Field Service' - a must in every knapsack – and was the model for the role of Gilbert and Sullivan's 'Modern Major General'…"
***LIFE* magazine, Oct. 6, 1967**

109

On to Cairo

110

"…With 20,000 men Sir Garnet sailed for the Suez Canal, intending to advance on Cairo from the east. Britain had expected and outcry from the French over this, but the only Frenchman in sight when the convoy reached Port Said was a small, fat, elderly civilian gesticulating on a pier, who was quickly brushed aside. It was Ferdinand de Lesseps in person, making a lone stand against England's violation of 'his' canal…"
***LIFE* magazine, October 6, 1967**

111

The Battle of Tell el-Kebir

112

"…Sir Garnet steamed on. Halfway down the canal he stopped and set out across the desert. On Sept. 13, 1882, after a bold all-night march, the British surprised Urabi's camp at Tell el-Kebir, where many of the soldiers were still asleep. Hundreds were bayoneted in their trenches; thousands were cut down as they scattered in panic across the desert. Urabi himself fled by horse and locomotive to Cairo, pursued by Heavy Dragoons…"
***LIFE* magazine, October 6,1967**
Caption: "The Battle of Tell el-Kebir, show here in correspondent's sketch, was actually fought before dawn. The charge was led by the Highland Light Infantry"

113

A Decisive Victory

114

"…The victory was decisive. Cairo was occupied by British troops; Tawfiq was restored as Khedive; Urabi surrendered and exiled to Ceylon…"
***LIFE* magazine, October 6,1967**

115

116

Part 2

Highway of Nations

117

The Destiny of Nations

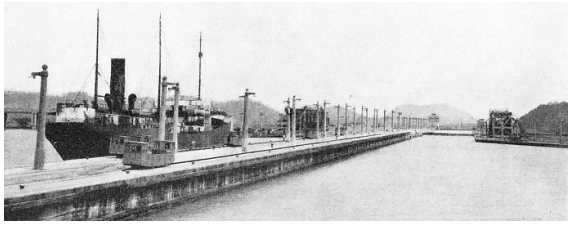
118

A corridor between East and West, a vital link with the destiny of nations, and a short-cut to India, the Suez Canal looms large in the story of the sea
***Shipping Wonders of the World,* ca. 1937**
RE: introduction to an article entitled: "The Suez Canal"

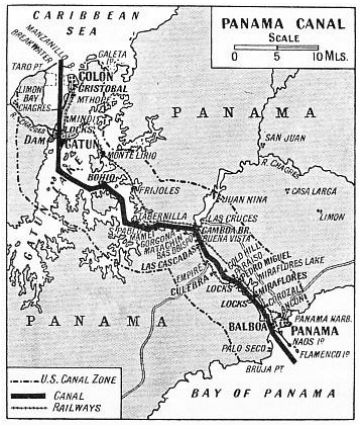
119

Ditch Digging

120

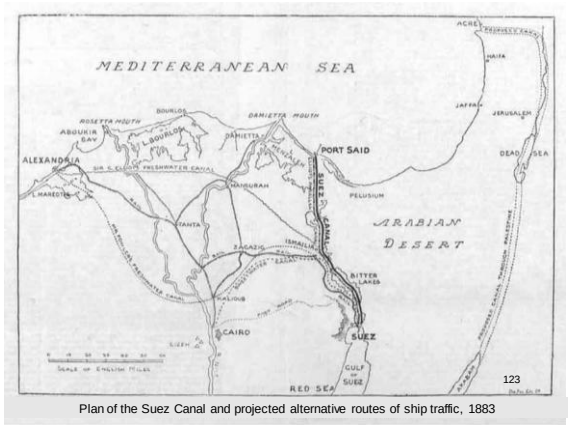


"ABOUT three-quarters of the world's trade passes through the Suez and Panama Canals, the most important ship canals in the world. The Suez Canal is a ditch dug across the neck of sand connecting Africa and Asia; the Panama Canal cuts the Isthmus that links North and South America…"
***Shipping Wonders of the World,* ca. 1937**
Caption: "AT MIRAFLORES. A view of the two sets of locks which lower a southbound vessel 55-feet or so, according to the tide, to the waters of the Pacific. The lock walls here are 82-feet-high, and the leaves of the gates weigh 730 tons. The posts seen along the lock side are lamp standards. Although transits through the Canal are generally made by day, navigation by night is possible." 121



Caption: "A SCALE MAP of the Canal, showing its direction and locality. The territory through which the waterway runs is called the 'Canal Zone' and consists of a strip of land some ten miles wide across the Isthmus. This Zone is administered by the United States Government; but the cities of Panama and Colon, though partly under American administration, belong to the Republic of Panama."

122



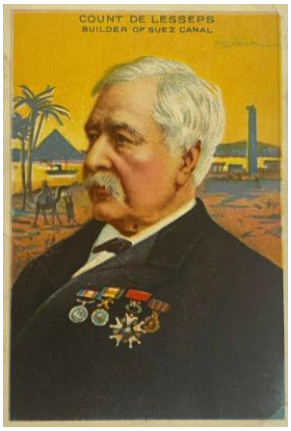
123

Plan of the Suez Canal and projected alternative routes of ship traffic, 1883

Chief Promoter

124

"…One man, Ferdinand de Lesseps, tackled both canals. He triumphed with the Suez, but died in poverty after the malaria-carrying mosquitos of Panama had killed thousands of workers, and it was left to others to try again and succeed…"
***Shipping Wonders of the World,* ca. 1937**
Caption: "Ferdinand Marie, Count de Lesseps (1805-1894) was a French diplomat and, later, developer of the Suez Canal, which in 1869 joined the Mediterranean and Red Seas, substantially reducing sail-ing distances and times between Europe and East Asia. He attempted to repeat this success with an effort to build a Panama Canal at sea-level during the 1880s, but the project was devastated by epidemics of malaria and yellow fever in the area, as well as beset by financial problems, and the planned Lesseps Panama Canal was never completed. A lake-and-lock canal was completed by the U.S. in 1914." 125



Ferdinand de Lesseps

Ferdinand de Lesseps was born at Versailles, France, November 19, 1805. When twenty-four he entered the French diplomatic service. In 1841, when at Port Said, the great idea of cutting the isthmus of Suez first came to him. In 1856 he visited Egypt, got the privilege of digging a canal, and formed a company in 1858. Work was begun in 1859, and the canal was opened ten years later. In 1873 De Lesseps took up the Panama Canal project, work on which was begun in 1879. The project failed and a judicial inquiry resulted in De Lesseps being sentenced to prison, which was not enforced. His diplomatic service included the appointment as ambassador at Madrid in 1848. 126

Ferdinand de Lesseps - Chief Promoter of the Suez Canal

Scientific American
January 1, 1870

127

Ferdinand, the subject of this sketch, was born at Versailles in 1805, and is consequently in his sixty-fourth year, though his appearance is that of a man little past the meridian of life. 129

In 1854 he received a commission from the *Societe d'etudes du Canal de Suez* at Paris to negotiate with Said Pacha for the construction of the canal projected in 1816. Accordingly, toward the close of that year, we again find him on the Isthmus, preparing for his great work. This time he came to conquer. His mission was crowned with success, and the necessary concession made in November of that year. A palace and a retinue of servants were assigned to his use, and he was treated, as a guest of the Viceroy, with the utmost respect. Great opposition followed, especially from England; and it was not till January, 1856, that the second and fuller concession was granted by Said Pacha, and a *Compagnie International* fully organized.

In 1858 M. Lesseps succeeded in raising two-hundred millions of francs in France, and in 1859 he proceeded to Egypt and planted the Egyptian flag in the harbor of the ancient Pelusium, the great seaport of Egypt thirty centuries ago, where Port Said now stands. He laid, at the same time, the foundation of a lighthouse, and proudly proclaimed the work commenced. Fresh difficulties – chiefly of a political nature - interposed, but the indefatigable Lesseps never despaired. In 1859 he had the satisfaction of seeing his company and work placed upon a firm footing, though the final decision of the French Emperor was not given till July, 1864. From that time to the present hour the canal; has steadily progressed toward completion. 131

THE scheme of re-opening the canal of the Pharaohs between the Mediterranean and Red seas, and thus connecting by a short-cut across the Isthmus of Suez the commerce of Europe and Asia, though long entertained by the first Napoleon, may fairly be claimed for M. de Lesseps. His attention was doubtless first drawn to it by reading the memorable report of M. la Pere, who was employed by Bonaparte to make a survey in 1798. The credit of designing and executing the great work belongs alike to him. With the general plan, progress, and purpose of the Canal, the American reader has, during the past few months, been made tolerably familiar.

He is the son of Jean Baptiste Bartheiemi, Paten de Lesseps, who was born at Cette, a French port on the Mediterranean, in 1765. Jean Baptiste was for five years French Vice-Consul at St. Petersburg. In 1785 he accompanied La Perouse on a voyage to Kamtchatka, whence he brought by land the papers containing a description of the expedition. In 1788 he was Consul at Kronstadt and St. Petersburg. From St. Petersburg he was called., in 1812, by the Emperor Napoleon, to Moscow, as intendant. From the latter city, in 1814, he proceeded to Lisbon, and was stationed there as Consul until 1823. He died at Paris, May 6, 1834. 128

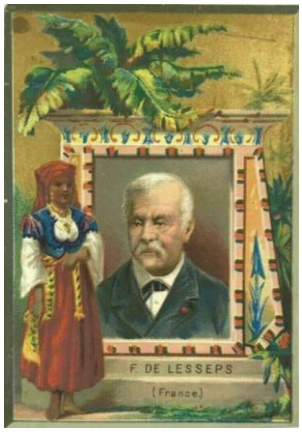
Early in life he evinced peculiar aptitude for the diplomatic career in which he has since distinguished himself - a career as varied and romantic as it is brilliant. In 1825 he was appointed attache to the French Consulate at Lisbon. Two years later found him engaged in the Commercial Department of the Minister of Foreign Affairs. During the latter part of 1828 he was attache to the Consul-General at Tunis; and in 1831 he was dispatched by his Government as Consul to Alexandria. Hard work and rapid promotion for *le jeune diplomat!* But the most eventful period of his long and wonderfully active career lay yet before him.

Seven years subsequent to his appointment at Alexandria, and consequently when he was in his thirty-fifth year, he was sent as Consul to Rotterdam. From Rotterdam he proceeded to Malaga in 1839, to negotiate in behalf of French commerce with the Spanish Government. In the latter part of the same year he was transferred to the Consulate at Barcelona, where during the two subsequent years he was especially active, and signally distinguished himself against the reign of Espartero.

In 1844 we again find him in Alexandria, whither he was sent to take the place of Lavalette. But the time for the development of his great project had not yet come. He did not long remain in the Egyptian capital. Returning to his former position in Barcelona he was witness to some of the scenes of the revolution of February. In 1848 he was appointed French Minister at the court of Madrid. Remaining in the Spanish capital about a year, he returned to Paris immediately after the revolution of '48, and in May of the following year was dispatched as Envoy of the French Republic to the Republican Government of Mazzini at Rome, where he took a leading part in the abortive negotiations which preceded the restoration of the Pope by a French army. 130

The personal appearance of M. De Lesseps is very striking. Though being past middle age, he has a fresh and even youthful appearance. Both face and figure are well preserved; his slightly curling gray hair sets-off in pleasing contrast his bronzed yet clear complexion, his bright eye, and genial smile. He is somewhat over the medium stature, possessed of a compact and well-knit frame, carries his head erect, and moves about with a buoyancy and animation perfectly marvelous in one of his years and experience. His address is that of the well-bred, well-educated French gentleman that he is. His manner is winning, his voice clear and under most excellent control, as all those who have listened to his admirable lectures on the Canal at the late Paris Exposition cannot fail to remember. What is perhaps most remarkable in a man so bred and constituted, is that with great gentleness of speech and suavity of manner he combines a strength of will and fixity of purpose worthy of Napoleon or Caesar himself. Beneath that calm exterior lay a power which needed but the stimulus of a great idea to develop.

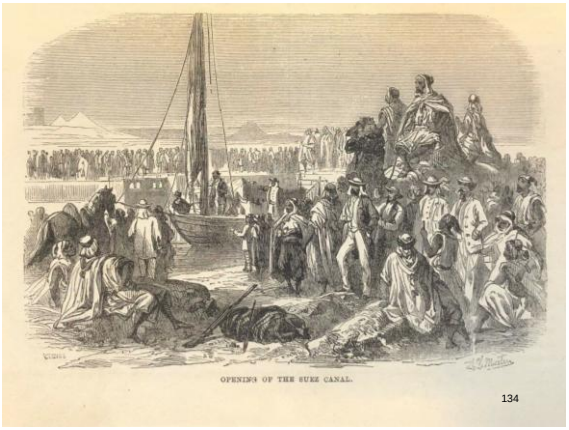
132



Though beset by difficulties, laughed at, and maligned, he has never for a moment swerved from his purpose or relaxed his efforts to accomplish it. Neither the sneers of Stevenson and his associate engineers, the heavy broadside of the "Thunderer," or the squibs of *Punch,* ever made any visible impression on the purpose or action of Lesseps. "My purpose from the commencement was to have confidence," said he.

How bravely he has maintained his principle and redeemed his pledge let the ceremonies which marked the completion and inauguration of his great work tell - when sea sent greeting to sea; and let the keels of richly laden argosies from Cathay and from Ind, which plow the waters of the Canal, declare.

133



134

Wonder of the World

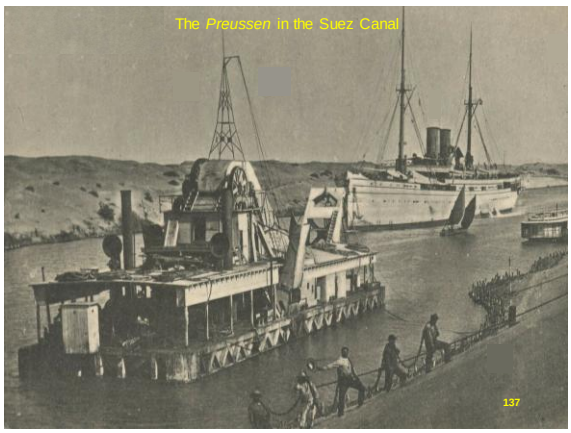
135

"…The Suez Canal, one of the wonders of the world, has a total length of over a hundred land miles, or eighty-seven and-a-half nautical miles, seventy-six and-a-half nautical miles being straight and eleven miles having curves. Some sixty-six and-a-half miles are actual canal, and twenty-one miles pass through large dredged channels in Lake Timsah and the Great and Small Bitter Lakes…"

***Shipping Wonders of the World,* ca. 1937**

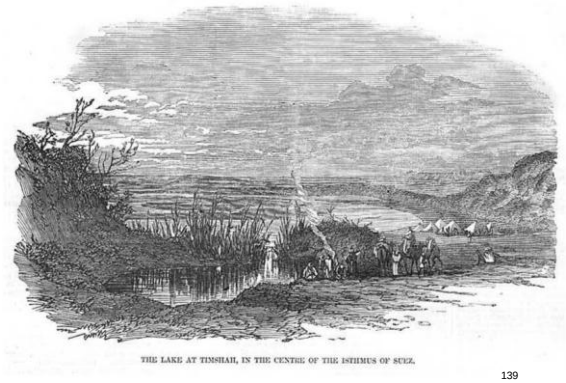
Left: caption: "A PLAN OF THE CANAL which shows all its chief features. With a total length of over eighty nautical miles, about sixty miles are actual canal and over twenty miles pass through dredged channels in Lake Timsah and the Great and Small Bitter Lakes."

136



137

138

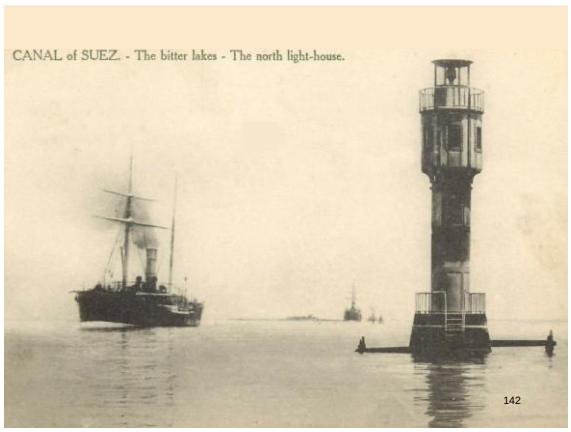


THE LAKE AT TIMSHAH, IN THE CENTRE OF THE ISTHMUS OF SUEZ.

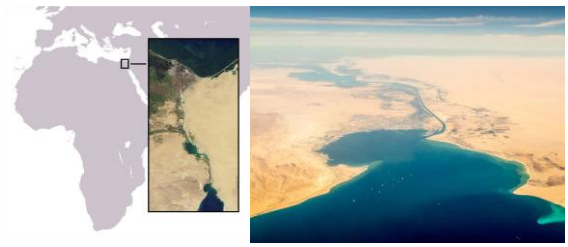
139

Suez Canal Entrance; Lake Timsah 140

The Bitter Lakes. Suez Canal. Wood Engraving, 1870. 141

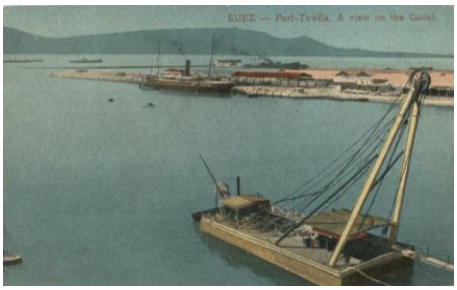


142



"…Since the canal was opened on November 17, 1869, it has become the vital link in the chain of sea transport between Europe and the Far East. It connects the Mediterranean Sea with the Red Sea, Port Said being the Mediterranean terminal and Port Tewfik, near Suez, at the head of the Gulf of Suez, the southern terminal…"
Shipping Wonders of the World, **ca. 1937**
Left: caption: "The location of the Suez Canal, which connects the Mediterranean and the Indian Ocean via the Red Sea"
Right: caption: "The Suez Canal is an artificial waterway that connects the Red Sea to the Mediterranean Sea via the Isthmus of Suez" 143

144



145

146

The Suez Canal
Scientific American
December 18, 1869

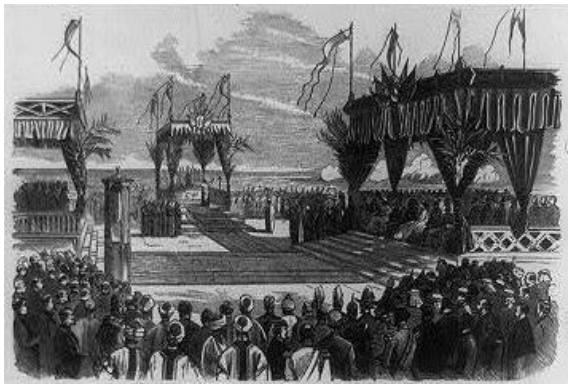
147

THE accomplishment of this greatest engineering work of ancient or modern times, has taught important lessons to both hemispheres. It has shown that capital and skill together are all-powerful in subjugating natural obstacles to commerce. It has taught the Western hemisphere that a similar opening must be cut somewhere in the neck of land which connects North and South America, and the lesson must be heeded. It has given to the world important inventions, which will greatly aid in the performance of any similar work hereafter; and has more than all demonstrated the fact, that climate can be controlled by human agency, so that arid deserts may be literally made to "blossom like the rose."

The whole work has been performed within ten years from its commencement, an instance of rapid work, unparalleled, except in the history of the Pacific Railroad. These works have helped to enforce the truth that the greatest rapidity in the execution of such. enterprises, consistent with thoroughness, is the most economical way to prosecute them.

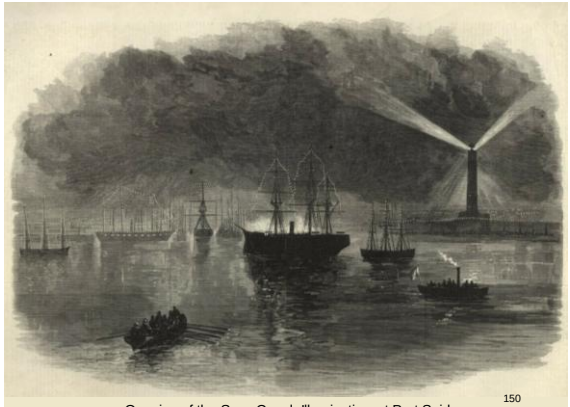
But the Suez Canal has had obstacles to overcome that the Pacific Railroad did not encounter. It struggled with diplomatic troubles till 1864, had its laborers scattered by cholera in 1865, and in 1867 found itself at the bottom of its purse, and at its wit's end to obtain a loan of 100,000,000 francs, necessary to complete the work. The indomitable courage and perseverance of M. Lesseps, his skillful financial management, which at this juncture saved the enterprise, are they not written? The grand celebration which inaugurated the work has passed into history. It must not be long ere the completion of a similar work shall be celebrated on this continent.

148



Egypt - the religious ceremonies preliminary to the inauguration of the Suez Canal, at Port Said

149



Opening of the Suez Canal; Illumination at Port Said

150

Some Account of the Suez Canal, in a Letter to the President

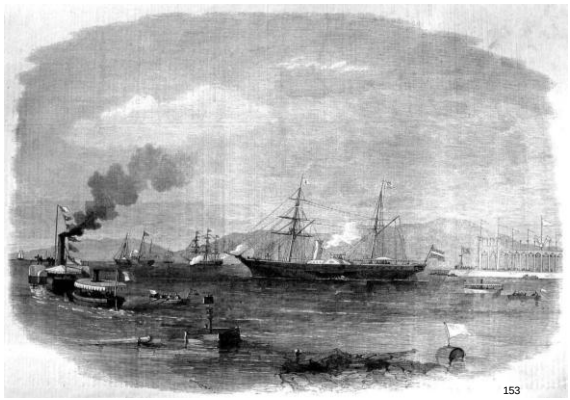
by J.F. Bateman, Esq., F.R.S. Received January 3, 1870
16 Great George Street, Westminster, 27th December, 1869

151

MY dear Sir Edward, - On my return from the opening of the Suez Canal, where, by your kind selection, I had the honour of representing the Royal Society as the guest of the Viceroy, I think it incumbent on me to give a short account of my journey and my impressions of the great and important undertaking which was so magnificently inaugurated.

Nothing could exceed the splendid hospitality of the Viceroy, who had in every possible way provided for the accommodation and the comfort of his guests. The crowd of visitors, however, was so great, and his own personal attendance was so constantly given to the Empress of the French, the Emperor of Austria, and other Royal personages who honoured him with, their company, that it was almost impossible for him to bestow any special attention on other individual guests; but few or none could complain of any want of attention or of any material inconvenience.

152



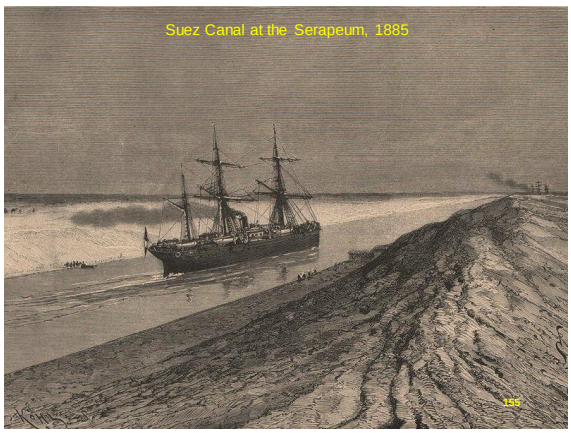
153

The French and Austrian Imperial Yachts entering the Red Sea from the Suez Canal

I was fortunate in being present at every important point and on every important occasion, and in receiving all the civilities which might be considered due to the representative of the Royal Society.

Of the work itself I have no hesitation in pronouncing it a decided success - not all that could be desired, nor all that was promised, and very far from being finished, even on the contracted scale on which it has been executed. A reef of rocks at Serapeum, extending for about 85 metres in length, at a depth of 16- or 17-feet below the surface of the canal, and which was not discovered till just before the period fixed for the opening, at present limits the draft of vessels which can use the navigation.

154



155

There are some objectionable curves and narrow places, and many miles of unprotected slopes, all of which must be improved or remedied before the canal can be placed in a satisfactory condition. Still, in its present state, vessels drawing not more than 16-feet can pass from end-to-end with facility and safety; and when the rocks alluded to are removed, the depth will be increased to 21- or 22-feet.

For years before the commencement of the project which has been, so far, happily concluded, the practicability of forming and maintaining a maritime canal between the Red Sea and the Mediterranean was a much disputed point among modern engineers. It was known that a water communication between the two seas had existed and been maintained for 600 years before, and for about 800 years after, the commencement of the Christian era; subsequent to which time it was allowed to fall into decay, and for a thousand years has so remained.

The first idea, in modern times, of restoring this ancient water communication, or of forming another more suitable to existing circumstances, seems to be due to the Emperor Napoleon I. (then General Bonaparte), who, at the close of the last century, during his occupation of Egypt, directed that a complete survey of the ancient canal should be made under the direction of M. Lepere, a French engineer of reputation. This survey was completed, and a project for a canal was designed in accordance with the apparent facts resulting from M. Lepere's survey. The evacuation of the country by the French put an end to further investigation, and arrested all progress in this direction for many years.

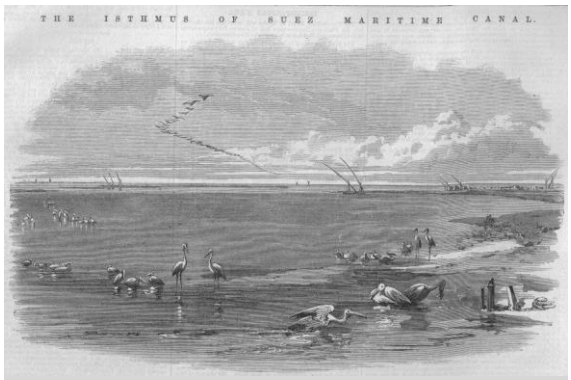
156

The conclusion at which M. Lepere arrived was, that the level of the Red Sea at high water at Suez was 30-1/2-feet higher than low water in the Mediterranean in Pelusium Bay; and his scheme was projected in accordance with the existence of such a difference in the level of the two seas. He also ascertained that the rise and fall of the tide in the Red Sea was 5-1/2- or 6-feet, and in the Mediterranean about 1-foot, leaving still a difference of 25-feet between the respective low waters of the two seas.

Doubts of the accuracy of the statement as to the difference of these levels were entertained by those who carefully considered the subject; but it was not till the year 1847 that these doubts were set at rest. In that year the late Mr. Robert Stephenson, in conjunction with M. Talabot, a French engineer, M. de Negrelli, an Austrian engineer, and Linant Bey, a French engineer in the Egyptian service, directed a series of independent levellings across the Isthmus, which determined beyond all doubt the important fact that "at low water there was no essential difference in the level of the two seas, and that at high water it was not more than 4-feet, the rise of tide being about 1-foot in the Mediterranean and about 6-feet in the Red Sea." Up to that time Mr. Stephenson seems to have been in favour of the proposal to form a canal across the Isthmus, in accordance with the views of Linant Bey, who "proposed to carry a canal from the Red Sea through the Bitter Lakes to Lake Timsah, and thence through the lagoons of Menzaleh to Tineh (Pelusium) on the Mediterranean:" it was "thus expected to create a current through the canal of three or four miles-an-hour;" and "the project appeared very feasible, and was calculated to excite high hopes of success." When, however, it was ascertained that the level of the two seas was practically the same, Mr. Stephenson remarked "it became evident that it would not be practicable to keep open a level cut or canal without any current between the two seas, and the project was abandoned." 157

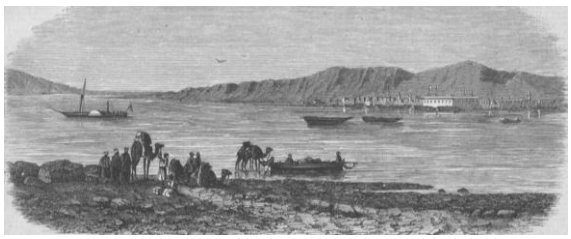
The fact of there being no difference in the level of the two seas led other men to very different conclusions; for shortly after the period here referred to, M. Ferdinand Lesseps conceived the idea which has since been so successfully realized. His project was to cut a great canal on the level of the two seas by the nearest and most practicable route, which lay along the valley or depression containing Lake Menzaleh, Lake Ballah, Lake Timsah, and the Bitter Lakes. The character of this route was well described in 1830 by General (then Captain) Chesney, R.A., who examined and drew-up a report on the country between the Mediterranean and the Red Sea. At that time a difference of 30-feet between the two seas was still assumed, and all proposals for canals were laid-out on that assumption. Allowance must, of course, be made for this error, in so far as it affected any particular project of canal; but it would not affect the accuracy of any general description of the district to be traversed. General Chesney summed up his report by stating, "as to the executive part, there is but one opinion: there are no serious difficulties; not a single mountain intervenes, scarcely what deserves to be called a hillock; and in a country where labour can be had without limit, and at a rate infinitely below that of any other part of the world, the expense would be a moderate one for a single nation, and scarcely worth dividing among the great kingdoms of Europe, who would all be benefited by the measure."

M. Lesseps was well advised therefore in the route he selected, and (assuming the possibility of keeping open the canal) in the character of the project he proposed. 158



Lake Menzaleh 159

From 1849 to 1854 he was occupied in maturing his project for a direct canalization of the Isthmus. In the latter year Mahomet Said Pasha became Viceroy of Egypt, and sent at once for M. Lesseps to consider with him the propriety of carrying out the work he had in view. The result of this interview was, that on the 30th of November in the same year a Commission was signed at Cairo charging M. Lesseps to constitute and direct a Company named "The Universal Suez Canal Company." In the following year, 1855, M. Lesseps, acting for the Viceroy, invited a number of gentlemen eminent as directors of public works, as engineers, and distinguished in other ways, to form an International Commission for the purpose of considering and reporting on the practicability of forming a ship canal between the Mediterranean and the Red Sea. This Commission, which included some of the ablest civil and military engineers of Europe, was honorary, and its members were considered as guests of the Viceroy. 160



The Commission met in Egypt in December 1855 and January 1856, and, accompanied by M. Lesseps, and by Mougel Rey and Linant Bey, engineers, and other gentlemen in the service of the Viceroy, they made a careful examination of the harbours in the two seas and of the intervening Desert, and arrived at the conclusion that a ship canal was practicable between the Gulf of Pelusium in the Mediterranean and the Red Sea near Suez. They differed, however, as to the mode in which such a canal should be constructed. The three English engineering members of the Commission were of opinion that a ship canal raised 25-feet *above* the sea-level, and communicating with the Bay of Pelusium at one end and the Red Sea at the other, by means of locks, and supplied with water from the Nile, was the best mode of construction. 161

Caption: "Suez and Red Sea, South of Isthmus, 1856"

The Pelusian Plain 162

The foreign members, on the contrary, held that a canal 27-feet *below* sea-level, from sea-to-sea, without any lock, and with harbours at each end, was the best system: the harbours to be formed by piers and dredging out to deep water.

The whole of the Members of the Commission, with the exception of Mr. Rendel, met at Paris in June 1856, when the views of the English engineers were, after full discussion, rejected, and the report to the Viceroy recommended the system which has since been carried out. The Commission estimated the work to cost £8,000,000.

Two years from the date of this report were spent in conferences and preliminary steps before M. Lesseps obtained the necessary funds for carrying out the works. About half the capital required was subscribed on the Continent, by far the larger portion being taken in France, and the other half was found by the Viceroy. Further time was necessarily lost in preparation, and it was not till near the close of 1860 that the work was actually commenced.

In this interval two "Reports on the subject of the Deposits of the Delta of the Nile" were made by Admiral (then Captain) T. Spratt, R.N., C.B., F.R.S., extracts from which were printed by order of the House of Commons in 1860. They embraced "An Enquiry into the Soundness of M. Lesseps' Reasonings and Arguments on the practicability of the Suez Canal" and "An Investigation of the effect of the prevailing wave-influence on the Nile's Deposits, and upon the Littoral of its Delta." These documents were dated respectively 30th January and 9th July 1858.

163

The conclusion to which Captain Spratt arrived was adverse to M. Lesseps' project. He was of opinion that it would be next to impossible to keep open any harbour to the eastward of the mouths of the Nile; and he warned "the commercial interest against risking their millions in the undertaking." He contended that the material brought to the sea by the Nile, and which is carried eastwards by the prevailing winds and currents, would accumulate against the piers or jetties proposed to be carried out to deep water at Port Said, so rapidly and to such an extent as to prevent the maintenance of a sufficient harbour. He thought "the sands of the Nile would mount over the piers of Said," and he did not believe that any amount of dredging would overcome the difficulties.

It was against such opinions from high authority that M. Lesseps had to contend; but his confidence in his project and his courage and perseverance never failed him. As time went on, he had other difficulties ahead.

The original concession granted extraordinary privileges to the Company. It included or contemplated the formation of a "sweet-water" canal for the use of the workmen engaged; and the Company were to become proprietors of all the land which could be irrigated by means of this canal. One of the conditions of the concession also was, that the Viceroy should procure forced labour for the execution of the work; and soon after the commencement of operations, and for some time, the number of workmen so engaged amounted to from 25,000 to 30,000.

164

The Isthmus of Suez Maritime Canal; Laborers Removing Earth

165

The work, thus commenced, steadily proceeded until 1862, when the late Viceroy, during his visit to this country at the time of the International Exhibition, requested Mr. Hawkshaw, F.R.S., to visit the canal and report on the condition of the works and the practicability of its being successfully completed and maintained. His Highness' instructions were, that Mr. Hawkshaw should make an examination of the works quite independently of the French Company and their engineers, and report, from his own personal examination and consideration, the result at which he arrived. If his report were favourable, the work would be proceeded with; if unfavourable, it would at once be stopped.

Mr. Hawkshaw proceeded to Egypt upon this important commission in November of the same year; and in February 1863 he wrote a well-considered report which may be said to have in great measure contributed to the rapid and successful completion of the work. Mr. Hawkshaw described the works of the canal which had been already executed, and those which remained at that time unfinished. He examined and discussed the dimensions of the various parts then in progress, recommending various alterations; and having carefully gone into all the details of construction, he proceeded to investigate the question of maintenance, with reference to which it had been urged by opponents:

166

"1st. That the canal will become a stagnant ditch."

"2nd. That the canal will silt up, or that the moving sands of the Desert will fill it up."

"3rd. That, the Bitter Lakes through which the canal is to pass will be filled-up with salt.

"4th. That the navigation of the Red Sea is dangerous and difficult."

"5th. That shipping will not approach Port Said, because of the difficulties that will be met with, and the danger of that port on a lee-shore."

"6th. That it will be difficult, if not impracticable, to keep open the Mediterranean entrance to the canal."

Having analyzed each of these objections, and fully weighed the arguments on which they were based, he came to the following conclusions as to the practicability of construction and of maintenance:

"1st. As regards the engineering construction, there are no works on the canal presenting on their face any unusual difficulty of execution, and there are no contingencies, that I can conceive, likely to arise that would introduce difficulties insurmountable by engineering skill.

"2ndly. As regards the maintenance of the canal, I am of opinion that no obstacles would be met with that would prevent the work, when completed, being maintained with ease and efficiency, and without the necessity of incurring any extraordinary or unusual yearly expenditure."

167

The whole of Mr. Hawkshaw's report is well worthy of perusal; and I must congratulate him on the sound conclusions at which he arrived, and on the foresight by which he was enabled to point out difficulties and contingencies which have since arisen. Could he at that time have seen the full realization of the work, he would scarcely have altered the report he wrote.

Said Pasha died between the period of Mr. Hawkshaw's examination of the country and the date of his report. He was succeeded by his brother Ismail, the present Viceroy or Khedive, who, alarmed at the largeness and uncertainty of the grants to the Canal Company, of the proprietorship of land which could be irrigated by the Sweet-water Canal, and anxious to retire from the obligation of finding forced labour for the construction of the works, refused to ratify or agree to the concessions granted by his brother. The whole question was referred to the arbitration of the present Emperor of the French, who kindly undertook the task, and awarded the sum of £3,800,000 to be paid by the Viceroy to the Canal Company as indemnification for the loss they would sustain by the withdrawal of forced or native labour, for the retrocession of large grants of land, and for the abandonment of other privileges attached to the original Act of Concession. This money was applied to the prosecution of the works.

168

The withdrawal of native labour involved very important changes in the mode of conducting the works, and occasioned at the time considerable delay. Mechanical appliances for the removal of the material, and European skilled labour, had to be substituted; these had to be recruited from different parts of Europe, and great difficulty was experienced in procuring them. The accessory canals had to be widened for the conveyance of larger dredging-machines, and additional dwellings had to be provided for the accommodation of European labourers. All these difficulties were overcome, and the work proceeded.

Left T&B: caption: "Bucket Dredge and earthmover at work on the Suez Canal"

169

Since the date of Mr. Hawkshaw's Report, viz. February 1863, much has been said and written upon the operations of the canal as they were going on, and upon its prospects of success. Sir William Denison, K.C.B., R.E., presented the Institution of Civil Engineers, in April 1867, with a paper on the condition of the works as he found them at the end of 1866, which led to an animated discussion upon the whole subject. The conclusions at which Sir William Denison himself arrived were:

"1st. That (subject, of course, to the condition that the relative levels of the Red Sea and the Mediterranean are as stated by the French authorities) there will be no extraordinary difficulty in carrying an open salt-water channel from the Mediterranean to the Red Sea of the depth proposed, namely 8-metres.

"2nd. That no special difficulty in maintaining this channel need be anticipated.

"3rd. That it will be necessary to modify the section proposed by the French engineers, making the side slopes much more gradual.

170

"4th. That the cost of maintaining the above-mentioned depth of water will be found at first to be largely in excess of the amount estimated. Eventually, it is by no means impossible that means may be found to fix or check the drift of sand, or to shut it out from the canal. But for some years it must be expected that the ordinary action of the atmosphere, which has filled up former excavations made in this dry desert, will have the same effect on the new canal.

"Looking at the work as an engineer, there does not appear to be any difficulty which a skillful application of capital may not overcome."

In the discussion which followed, while on the one hand Sir William Denison's views were well supported, much was said, on the other hand, of the difficulties which would attend the construction, and the impossibility of keeping open the harbours and the canal. The old questions of silting up and stagnation were discussed; and quotations from the correspondence of Mr. R. Stephenson with M. De Negrelli were read, with the object of showing the absurdity of the whole scheme. In one of these quotations Mr. Stephenson thus expresses himself:

"In conclusion, Sir, I will only say that I have - indeed I can have - no hostility to a maritime canal through the Isthmus of Suez. If I could regard such a canal as commercially advantageous, I have already shown that I should be the first to give it the advantage of my time, my money, and my experience. It was because, after elaborate investigation, and in conjunction with such men as M. Talabot, I arrived at a clear conclusion that the project was not one which deserved serious attention, that I refused to give it support."

171

"I should be delighted to see a channel like the Dardanelles or the Bosphorus penetrating the Isthmus that divides the Red Sea from the Mediterranean. But I know that such a channel is impracticable - that nothing can be effected even by the most unlimited expenditure of time and life and money beyond the formation of a stagnant ditch, between two almost tideless seas, unapproachable by large ships under any circumstances, and only capable of being used by small vessels when the prevalent winds permit their exit and their entrance. I believe that the project will prove abortive in itself and ruinous to its constructors; and entertaining that view, I will no longer permit it to be said that, by abstaining from expressing myself fully on the subject, I am tacitly allowing capitalists to throw away their money on what my knowledge assures me to be an unwise and unremunerative speculation."

It was shown also by calculations that the evaporation from the Bitter Lakes alone, without taking into consideration the long length of canal, was such that the channel from the Red Sea to the lakes was much too small to supply the loss, and that the result would be that the water in these Lakes must settle to a level below the low water of a spring tide in the Red Sea. It was urged too that there would be great difficulty in maintaining the entrances to the harbours and the harbours themselves, and that bars would inevitably form at each end of the canal.

It will be seen therefore that, so recently as 1867, opinions were strongly against the success of the canal, those persons who entertained contrary views being in a considerable minority.

172

In the commencement of this year Mr. John Fowler, C.E., wrote an excellent letter to *The Times* on the condition in which he then found the canal, and upon its prospects. The observations which he made, and the conclusions at which he arrived, seem to have been carefully formed and well grounded. He stated that the cost would greatly exceed the original estimate, although the works were carried out of much less than the originally proposed dimensions - that the works were in truth simple in character, and in a soil favourable to execution, but of such vast magnitude, and in a country presenting such peculiar difficulties in climate, and in the absence of fresh water, that special organization and adoption of means of no ordinary kind were required for their realization.

173

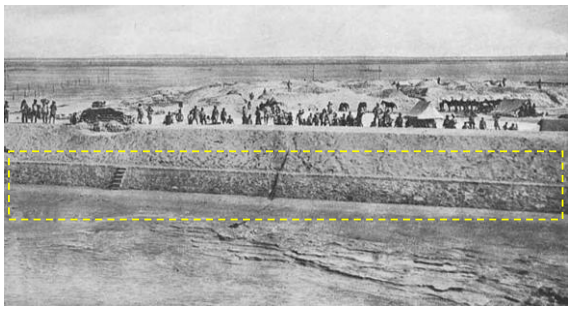
He was of opinion that large quantities of alluvium would find their way into the harbour at Port Said, and that it would be necessary to make the western breakwater solid to prevent the deposit being carried through, as at present – nevertheless that no apprehension need be entertained as to the channel and harbour being silted-up and destroyed, but that considerable expense in dredging would be constantly required. He agreed with Mr. Hawkshaw that the amount of drifting sand would not be such as materially to interfere with maintenance, that various means might be adopted for limiting the amount, but that, after every precaution, it would be necessary to employ one or two powerful dredges to keep the canal clear from the sand blown in.

Caption: "Dredge and ship on the Suez Canal"

174


175


176



He was further of opinion that the protection of the slopes by stone would be necessary. With reference to the evaporation from the Bitter Lakes, and the current from the Red Sea to those Lakes, he believed that it would not be strong enough to affect injuriously the bottom or sides of the channel, after they had been properly protected by stone pitching.

177

Caption: "Stone-pitching along canal bank"


178

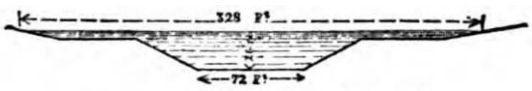
Mr. Fowler then entered into a consideration of the mode in which the traffic should be carried on and the probable use to be made of the canal, and concluded his letter with a well-deserved compliment to the remarkable energy and perseverance of M. Lesseps, to the skill and resources of M. Voisin, the Engineer-in-Chief, and the district engineers acting under him, and to the great powers of organization and high qualities of M. Levalley, the contractor.

The total length of the canal from Port Said to Suez is 99 miles; it varies in width from 196-feet to 327-feet, having, however, in each case a width of 72-feet in the centre, the slopes on each side of this centre-width varying with the character of the material cut through. Near Port Said, and through the shallow lake of Menzaleh, the material is very sandy; and here and elsewhere, under similar circumstances, the slopes must be protected by stone pitching or facing, or they will wash down by the action of passing vessels, and the material thus deposited in the bottom of the canal must be removed by dredging. Further south, the material generally becomes more argillaceous and stony; and here the slopes will be much more easily maintained, though nearly throughout the whole length of the canal some stone protection at the level of the water will be required.

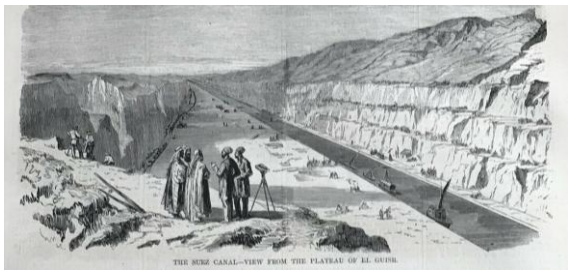
179

THE LOW AND SANDY BANKS OF THE SUEZ CANAL 180

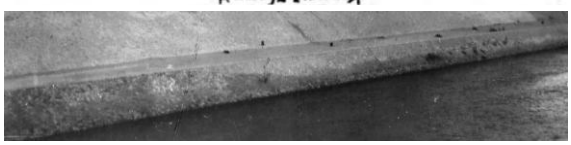
Vessels passing through the Suez Canal have to proceed very slowly in order to create as little wash as possible, the banks being low and sandy and therefore easily damaged. Here a huge floating dock is being taken through the waterway by tugs, all other traffic being suspended during the operation. The Canal is 103 miles long and the least width is just under 197 feet. It was opened in 1869. Construction occupied ten years, at a cost of about £17 million.



Caption: "In the less elevated portions of the land, where the stuff is softer, the slopes are increased, giving a surface width of 325-feet. It will be understood that in the lakes the canal consists of a navigable channel of sufficient depth and breadth to admit the traffic, the surface of the water extending on either side to the edge of the lake. The section above shows a cross-section of the Suez Canal at Lake Menzaleh. The deep channel through the lakes is marked by iron beacons on either side, 250-feet apart. At every five or six miles there is a passing-place, to enable large vessels to moor for the night, or to bring up in order to allow others to pass, all these movements being regulated by telegraph from Port Said, Ismailia or Suez. 181



Before reaching Lake Timsah, which lies about midway between Port Said and Suez, the canal passes through the deep cutting of El Guisr, which at its greatest depth is 85-feet to the bottom of the canal. The lower part of this excavation, at and a little above the level of the water, consists of soft clay, above which is a concreted mass of shells and sand; and this is covered by loose sand liable to be acted on by the wind. The canal here is curved and narrow, and ought to be improved in both respects. It is again restricted in width through the deep cutting at Serapeum; but here, the material being argillaceous and strong, the slope will be easily maintained in shape. From the Bitter Lakes to Suez it is a wide, noble, and well-finished canal. 183

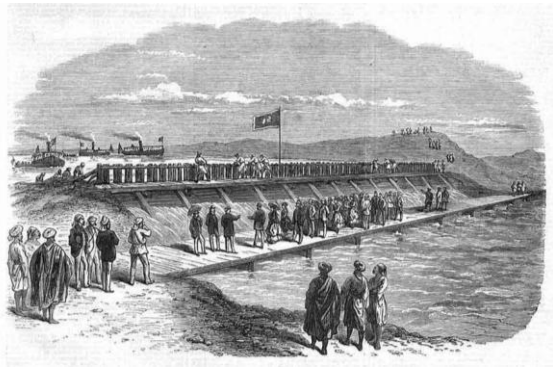


Caption: "The whole length of the navigation is 88 geographical miles. Of this distance 66 miles are actual canal, formed by cuttings, 14 miles are made by dredging through the lakes, and 8 miles required no works, the natural depth being equal to that of the canal. Throughout its whole length the canal was intended to have a navigable depth of 26-feet for a width of 72-feet at the bottom, and to have a width at the top varying according to the character of the cuttings. At those places where the cuttings are deep, the slopes were designed to be 2 to 1, with a surface width at the water-line of about 197-feet, as shown in the section above, which is a cross-section of the Suez Canal at El Guisr." 184

Suez Canal - Dahabeahs in the Trench of El Guisr 185

Out of the whole length, nearly 30 miles are through Lake Timsah and the Bitter Lakes, 5-1/2 miles in the first, and 23-1/2 in the latter. In these lakes a deep channel has been dredged out, which is marked by buoys and stakes. These vast sheets of water in the midst of the Desert, on which so many noble vessels were floating, had been but a few months before mere dry depressions, covered by a stratum of salt. The filling them with water commenced in February from the Mediterranean, and in July from the Red Sea. They were filled by the beginning of October, thus belying one of the many unfavourable prophecies, that the absorption and evaporation would be so great that they would never fill at all, or, if they did, the current inwards in both directions would be so great as to be destructive of the canal. 186

Caption: "The Isthmus of Suez Maritime Canal; Lake Timsah"



The Prince of Wales letting the waters of the Mediterranean into the Bitter Lakes 187

On our voyage from Port Said to near Lake Timsah there was a current setting against us towards the Mediterranean. We anchored about 3/4-mile from the end of this portion of the canal, and at daylight the next morning there was a current in the same direction of nearly 1-1/2 miles-an-hour. Our time of starting from Lake Timsah was purposely delayed till near midday, that we might have the tide from the Red Sea against us, and deep water over the rocks at Serapeum. The current towards Lake Timsah was strong; and on the following morning, between the Bitter Lakes and Suez, it ran at 3-1/2 miles-per-hour, but a strong southerly wind accompanied the tide. We had no opportunity of making observations ourselves, or of obtaining information; but my impression is that at this season of the year there is on the average of the day a regular current from the Red Sea to the Mediterranean.

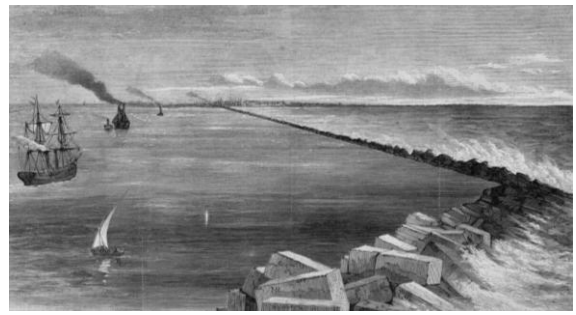
This is an interesting as well as important question; and it is to be hoped that regular observations will be taken at all points along the canal, and at each end, which may show accurately the rise and fall of tide, the velocity and duration of the currents in each direction, and the relative height of the various portions of the canal and the Lakes it traverses.

The range of the tide in the Mediterranean is, as already stated, about 12-inches, while in the Red Sea at Suez it varies from 4- to 6-feet.

On the day of the opening thirty-two vessels reached Lake Timsah without let or hindrance; one Egyptian vessel, the *Garbia* coming after this number, stuck fast for some hours about 12 miles from the Lake, and retarded a number of vessels in its rear; but eventually all came forward, and the mighty fleet assembled on Lake Timsah the following day. 188

At Port Said I counted on the day of the inauguration more than ninety vessels, chiefly of the largest class (many being upwards of 2,000 tons register), and including a fleet of British "iron-clads," which anchored within the western pier. Here, however, a good deal requires to be done. The harbour is formed by two jetties built of concrete blocks, the western one being run out to sea, at right angles to the shore, for a distance of 2,400-metres, and then turned eastwards for 300-metres more. The eastern jetty starts from shore at a distance of 1,400-metres from the western pier, is continued out to sea for a length of about 1,700-metres, gradually approaching to within about 700-metres of the western jetty at its termination.

The western jetty has been erected for protection, and for the purpose of intercepting the sand and alluvial matter which are undoubtedly drifted from the mouth of the Nile eastwards. This work is too light and too open effectually to answer its purpose, and re-quires improvement. Close in shore a considerable amount of the drifting sand, has been arrested, and where the sea recently flowed there is already an accumulation of dry land. On the land thus formed were erected the temple in which the Viceroy received his principal guests at the inauguration, and the temples for the worship of the Mahometan and Christian churches, where all the religions of the world were supposed to be present and to ask a blessing on the great undertaking the opening of which they were assembled to celebrate. 189



In its present condition, the jetty favours the deposit of material within the harbour; and not until the passage of the sand through the interstices of the concrete blocks of which it is built has been checked, will there be any effectual protection against the silting up which is taking place.

Caption: "The Isthmus of Suez Maritime Canal; Breakwater at Port Said and Mediterranean entrance to the canal" 190

Perhaps by degrees an inner bank or shoal may be formed, which would answer the purpose of a breakwater; but this would create a crooked and inconvenient channel, and would be ineffective towards the seaward end of the jetty. The Company will no doubt see the necessity of completing the necessary works here and elsewhere. The harbour at Port Said and portions of the canal will require pretty constant dredging for some time; but in my opinion neither this nor any other work will entail any very serious expense in maintenance.

The cost of the whole undertaking is stated to have been about £16,000,000 sterling; and it may require from £2,000,000 to £4,000,000 more to complete the work satisfactorily on its present scale of dimensions; but interest has to be paid at present on about half only of the capital hitherto raised.

Many persons who are competent to form sound opinions on this point believe that the traffic will be quite sufficient to pay all cost of maintenance and handsome dividends; but I am not sufficiently well informed to hazard any conjecture on the purely financial part of the question. In an engineering point-of-view I consider the canal a great and most important undertaking - great, however, only as respects its magnitude and the country in which it has been executed. There is not a work of art or of difficulty from one end to the other; but there have been about 80,000,000 cubic-yards of material excavated, and at one time nearly 30,000 labourers were employed in the works. 191

The Isthmus of Suez Maritime Canal; Workmen Loading Dromedaries 192

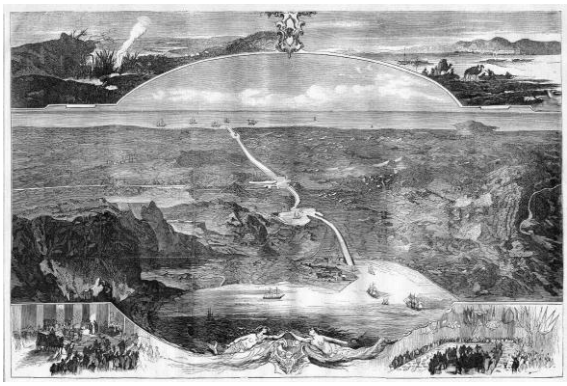
For their sustenance, and before operations could be carried on with any vigour, sweet water had to be brought from the Nile at Cairo, and distributed along the whole length of the canal. This work was in itself one of considerable magnitude. 193
Caption: "View of the Sweet-Water Canal at Tel-El-Kibeer"

Opening of the Sweet-Water Canal at Suez 194

It is a navigable canal from Cairo to Ismailia, and thence to Suez. From Ismailia to Port Said and intervening places, the fresh water is conveyed in pipes. The surplus water has been applied to irrigation, the fertilizing results of which are already visible, and may be expected to perform an important part in the improvement of the country. 195
Caption: "Suez - View of the Maritime and Fresh-Water Canals"

The canal must be regarded as a great work, more from its relation to the national and commercial interests of the world than from its engineering features. In this light it is impossible to overestimate its importance. It will effect a total revolution in the mode of conducting the great traffic between the East and the West, the beneficial effects of which I believe it is difficult to realize. It is in this sense that the undertaking must be regarded as a great one; and its accomplishment is due mainly to the rare courage and indomitable perseverance of M. Ferdinand Lesseps, who well deserves the respect he has created and the praises which have been bestowed. By cutting across the sandy ligaments which have hitherto united Asia and Africa, a channel of water-communication has been opened between the East and the West which will never again be closed so long as mercantile prosperity lasts or civilization exists.

196



Bird's-eye view of the Suez Canal
connecting the Red Sea with the Mediterranean 197

I cannot close this letter without expressing my obligations to Mr. Pender, Chairman of the Eastern Telegraphic Companies, who courteously entertained me, with other friends, on our passage through the canal on board the *Hawk* a steam corvette belonging to the Electric Telegraph Construction Company, which had been placed at his disposal. On board this vessel were assembled a small body of distinguished and intelligent gentlemen, who had more than usual opportunities of obtaining such information as time and circumstances afforded.

I have the honour to remain,
Very truly and faithfully yours,
John Fred. Bateman.
Lieut.-General Sir Edward Sabine, P.R.S., K.C.B.

198

Memorandum as to the Dimensions of the Canal.

The following, it is believed, are the dimensions on which the canal has been constructed. They are principally extracted from Mr. Fowler's letter.

	Miles, in length.	Width at top water, in feet.
1. From Port Saïd, through Lakes Menzaleh and Ballah, to near El Ferdane.	37	327
2. From near El Ferdane, through the great excavation of Seuil de Guisr, to Lake Timsah .	9½	196
3. Through Lake Timsah	5½	327
4. From Lake Timsah, through the excavation of Seuil de Serapeum, to the Bitter Lakes . .	7½	196
5. Through the Bitter Lakes	23¼	327
6. Through the deep portion of Chalouf cutting .	5	196
7. Thence to Suez and the end of the canal . . .	11	327
Total length	99	

199

The canal is intended throughout to be 8-metres, or 26 ft. 4 in. in depth. In every case this depth is to be maintained for a width at the bottom in the centre of 72-feet, with slopes on each side of 2 horizontal to 1 vertical to within a few feet of the surface. In the wider portions of the canal the sides above this level are formed with flat slopes of 5 horizontal to 1 vertical, with a horizontal bench between the two slopes of 58-feet in width. A narrower bench is left where the canal is of the smaller width.

On board the *Hawk* soundings were taken along the whole length of the canal. Between Port Said and Lake Timsah the soundings near the centre of the canal, on both sides of the vessel, showed a depth varying from 21 ft. to 29-1/2 ft., the greater number being from 24 to 29. In Lake Timsah the depth, according to soundings, was from 19 to 23 ft. Between Lake Timsah and the Bitter Lakes there were no soundings less than 21 ft., except over the rocks at Serapeum, where vessels drawing 16 ft. only could pass. In the Bitter Lakes the depth was seldom below 28 ft., often above 30 ft.; and the same may be said of the canal between the Bitter Lakes and the Red Sea at Suez. On each side of the deep part in the centre the depth was generally about 12 or 13 ft.

Where the slopes are unprotected by stone, and the natural soil is sandy, the sides, notwithstanding the flat slope, were a good deal washed when a paddle-wheel steamer (the *Delta* P. & O. 1,600 tons) advanced at seven or eight miles-an-hour; but comparatively little effect was produced when the speed did not exceed five or six miles-an-hour.

Two large vessels will find it difficult to pass each other; bat "lie-by" or passing-places are being constructed to remedy this inconvenience.

J.F.B.

200

The Suez Canal Not Yet a Failure

Scientific American
January 1, 1870

201

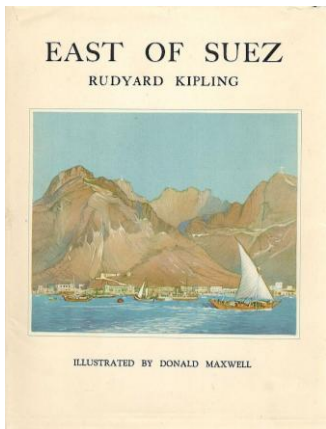
THE daily press is giving currency to a great many facts in regard to the present incomplete condition of the Suez Canal, and some journals are arguing therefrom that it is a failure. As yet, ships of heavy draft are unable to get through it. Some disasters to shipping have occurred in the Red Sea after the canal has been passed, and it is not at all improbable that more troubles will arise before everything goes smoothly.

The Red Sea is comparatively unknown to navigators. It contains hidden rocks which must be charted and buoyed before its navigation can be rendered safe. Surely this ought not to take the world by surprise. As to the canal itself, we are only surprised that it has reached its present state of perfection, and we advise those who now make haste to prophesy ignominious defeat for one of the greatest enterprises of the century, to suspend judgment for a time. New York journalists might certainly call to mind with profit, the annual troubles attending the opening of the canals in this State. Frosts heave and rats undermine, and banks annually give way, yet these things are not regarded as surprising. But upon the opening of a work, to which all the minor canals in the world are like the rods of the magicians to Aaron's rod which swallowed them up, it is expected that everything shall move without difficulty, and that no oversight will have been committed. Truly this would be to attribute a power of provision to M. Lesseps beyond what is human. The world can afford to wait a little till this huge machine gets oiled. Great enterprises move slow at the outset. We have yet unshaken faith in the ultimate success of the Suez Canal.

202

East Meets West

203

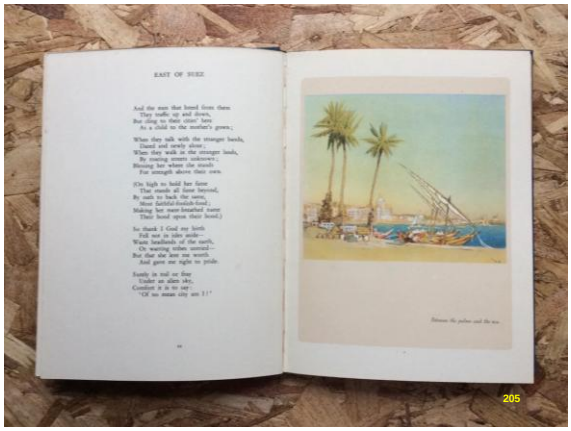


"…So important is the canal to the world that it is taken as the dividing line between East and West, and the phrase 'East of Suez' is apt. The division is apparent to every traveller who makes the transit of the canal…"

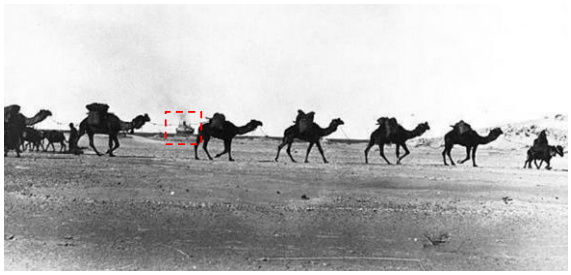
***Shipping Wonders of the World,* ca. 1937**

Caption: "*East of Suez* (1931) contains a selection of Rudyard Kipling's Eastern Verses and is illustrated with twenty-four colored plates in addition to in-text illustrations by Donald Maxwell"

204



205



"…On the one side is the cold efficiency of the Occident, and on the other the colour, squalor, smells, subtlety, and heat of the Orient. Travelling from the West the traveller gazes on the scenes along the banks of the canal with never-ending interest as the novel world of the Orient opens before him…"
Shipping Wonders of the World, ca. 1937
Caption: "Camel caravan in sight of the Suez Canal"

206

207

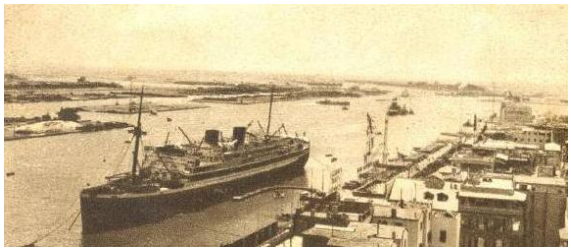
"…Years later, perhaps after his sojourn in the East, or on leave, he comes back this way. By now he is sun-dried. He has looked upon the barren shores of the Red Sea where the earth seems to have had all the life burned out of it by the sun; his eyes rove over the sandy wastes on either side of the canal as the liner jogs along at her maximum permitted speed of seven-and-a-half knots, and he realizes that he is looking on the East for the last time…"
Shipping Wonders of the World, ca. 1937

208

209

"…In the canal itself he is in the grip of the ordered efficiency of the West. Perhaps it is winter-time, and the wind from the north cuts through his suit of tropical 'whites,' and he realizes that this is the last time he will wear them. Somewhere on the west bank is the Nile with the Pyramids. He could have spent a few pounds and left the ship at Suez, 'done' the Pyramids and Cairo, and rejoined her at Port Said; but he has preferred to go through the canal…"
Shipping Wonders of the World, ca. 1937
Caption: "The pyramids of Giza on the southwestern outskirts of Cairo"

210



"…It is a wonderful experience and is as remarkable as the Pyramids, and the returning traveller is too experienced to leave a comfortable ship just for sightseeing. He prefers 'the ditch.' That night at Port Said he lays aside his 'whites.' He knows he is now under the sway of the West and on his way back to an existence governed by the clock…"
Shipping Wonders of the World, ca. 1937
Caption: "Port Said – entrance to the Suez Canal"

211

212

Le Grand Francaise

213

"…Ferdinand de Lesseps was a great Frenchman who thought of many things, but it is doubtful if he ever realized that thousands of men would come to regard his canal as a line of demarcation in their lives…"
Shipping Wonders of the World, ca. 1937
Caption: "Suez Canal – view with De Lesseps statue"

214

"…The present writer was much amused by the remark of a ship's wireless officer who said that the statue to De Lesseps at the entrance to the canal at Port Said gave him the impression that De Lesseps' outstretched hand was indicating the canal as though to say, 'Alone I did it!' …"
Shipping Wonders of the World, ca. 1937
Caption: "Lesseps' statue at the entrance of the Suez Canal, 1955; the outstretched hand indicated that the way was now open to the East"

215

"…De Lesseps was too gentle and chivalrous to make such a claim as that; he made many things, but never a boast. At the base of the statue are the Latin words, Aperire Terrain Gentibus – 'To Open the Earth To All Peoples.' If the sculptor conveyed to the receptive mind of 'Sparks' that De Lesseps did the job himself the sculptor was correct. De Lesseps did the job himself, despite almost every kind of opposition…"
Shipping Wonders of the World, ca. 1937
Caption: "Photograph of Ferdinand de Lesseps, whose genius created the Suez Canal"

216

The foresight and perseverance in the face of adversity of *Ferdinand de Lesseps* created the Suez Canal and his proud statue stood at the entrance to Port Said until it was removed from its ornate plinth when *Gamal Abdel Nasser,* President of Egypt, nationalized the canal in 1956.

Caption: "Lesseps' statue displayed today in front of the Suez Canal International Museum in Ismailia, which opened in 1932 in a building inspired by the Greco-Roman architecture of ancient Egypt"

217

218

"…This short-cut was for the ships of all nations. He saw that and he built it. De Lesseps was a genius and, as are most geniuses, was ahead of his time. Much has been written of the obstinacy of his opponents, but it must be remembered that De Lesseps always looked ahead, whereas his adversaries thought chiefly of the past and the present…"

***Shipping Wonders of the World,* ca. 1937**

RE: humiliated by its defeat in the *Franco-Prussian War* (1870-71), France was determined that it would be a great nation, once again, and would recover its prestige not through war but, as *Victor Hugo* put it: "Astonishing the world by the great deeds that can be won without a war." In spite of political instability, everywhere there was optimism and energy, a spirit of *revanche*. In the spring of 1878, Paris held an exposition which covered sixty-six acres of the city and attracted thirteen-million visitors. Although it cost a fortune, it demonstrated to the world Frances' recovery and new ambition. The embodiment of this spirit was the builder of the Suez Canal; *Ferdinand de Lesseps, alkl*a "Le Grand Francaise" (The Great Frenchman). Untainted by the events of 1870, he represented a new patriotism based not on war, but on achievement for the benefit of all mankind.

219

Part 3

All Things Considered

220

The Suez Canal
Scientific American
July 29, 1868

221

THE financial descent of the Suez Canal to the level of the great Hamburgh State distribution, etc., is a step from the sublime to the ridiculous, which we must regret, but which, taking all the circumstances into consideration, we can scarcely reprehend. A grand undertaking, commenced in the halcyon days of speculation, is found, as many others have been, to be impossible of completion with the amount of capital at first subscribed. In the meantime, such has been the flagrant abuse of the confidence reposed by both he English and French public, in most classes of financial operators, that money is no longer forthcoming, even for what may be considered as eminently safe investments, which, with all its merits, the Suez Canal is not. It is, however, an undertaking of that class, and has already progressed to that stage which gives it a kind of prescriptive right to capital, if capital can, by any fair means, be collected for it; and in the present proposition we recognize a more open and fair mode of procedure than that which failed last year to obtain more than a third of the £4,000,000 now said to be necessary for the completion of the canal. The *modus operandi* then was the very ordinary and exceedingly specious one of placing a nominal value on the self constituted property of the company and proposing a species of mortgage on landed estates, consisting mainly of sandbanks situated either below or above water.

222

In the report which we published recently we find that the directors, who. Like many other mortals, gain wisdom by experience, almost abstain from referring to this class of security for the advance which they ask from the public, and the spirit of their present appeal is one to the candor of which we can take no exception. They say that, from the extraordinary state of European financial affairs, even more than from the peculiar nature of their undertaking, special inducements must e put forward to obtain the capital which is absolutely necessary for the completion of the enterprise. That inducement they provide in the glorious uncertainty of the lottery, and to our mind not a few of the undertakings of modern days would have been much more fairly dealt with id direct and open recourse to gambling, with all its sins, had been made, rather than the money drawn from a too credulous public by representations having very slender foundations in fact. It is curious that just at the moment when the directors themselves have, under the coercion of the times, practically thrown overboard the question of the ultimate remunerativeness of the undertaking, a rather more serious discussion than usual should have arisen on that very subject which is still quite as unfit for discussion with a view to absolute solution as it has ever been.

223

The letters of Mr. Daniel A. Lange in the *Times* though evidently written in good faith, and containing a fair popular idea of the views of the directors on the future of the canal, is almost of necessity without any practical basis for the calculation of the future expenditure of the canal, assuming it to be ready for traffic in 1969; in fact, the only matters of certainty which he puts forward are the facts that the interest and sinking funds for the present "loan" will amount to £360,000 a year, and that a margin of £800,000, when obtained, will pay 10 per cent on the original capital. When he computes the maintenance of the canal he makes a guess which may or may not prove to be correct, and a guess the truth of which no man living can affirm or deny, for the simple reason that the world has as yet no experience as to the cost of maintaining a canal through a sandy desert, nor any adequate experience in the maintenance of colossal ports amid coral reefs and shifting shallow banks.

The probable revenue of the canal, though depending to a certain extent on the realization of the estimates of gross tonnage to and from India, depends far more on one condition of the carrying of that tonnage to which Mr. Lange has not alluded, viz., the proportion of it now carried, or which will hereafter be carried, by steam or in sailing vessels.

224

That almost every merchant steamer trading to the East will pass through the canal when opened there is no reason to doubt, but the Eastern tonnage carried by steamers at present is a mere fraction of the aggregate of over 6,000,000 tons assumed as the total trade; and for sailing vessels, especially or that greater portion of the fleet which comes from the Indian Peninsula, the canal offers scarcely any advantages; in fact, they could not possibly avail themselves of it if a most extensive system of towage both in the Red Sea and the Indian Ocean be not organized for their assistance.

The Red Sea, from the reefs with which it abounds, is perhaps the most dangerous navigation in the world, even for steamers, and sailing vessels have been known to take longer from Aden to Suez than the average voyage of an English clipper from Shanghai to the Thames. Now the tolls for passage through the canal, set down at 8s. per ton, will form no serious obstacle to the transit through it of any class of eastern goods, whether in steam or sailing ships, but steam towage is a very different matter, and will scarcely come to be counted in shillings-a-ton if sailing vessels are to be brought from Suez to points in the Indian Ocean where steady winds can be relied on.

We think, therefore, that the future prosperity of the canal, assuming that it can be maintained at a reasonable cost, depends far more on the increasing employment of steamers for the conveyance of all classes of merchandise than upon any other condition that can now be foreseen.

225

At present our experience of the working of unsubsidized steamers for long voyages is decidedly unfavorable. The case of the Indian trade will, however, be exceptional when the canal is opened, and the question of the shorter steam route competing with the longer sailing voyage will be one of great interest to solve.

The steady progress of the works since the commencement of Messrs. Borel, Lavally & Co.'s contract is a matter on which we cordially congratulate the company. They have promised even less than they seem to be capable of performing, and the great enterprise to which M. Lesseps has devoted a life of energy was never more lucky than in its forced recourse to mechanical excavation, and in the fortunate circumstance that its machinery has been introduced and wielded by such able hands. The engineering world will be indebted to him whatever the commercial value of the canal.

226

The Dawn of the Age of Steam

"…When the canal was opened to traffic the sailing ship was still queen of the ocean. The canal cut such large distances off the route to India and the Far East that a great impetus was given to the improvement of the steamship. Sailing vessels could not benefit by the Suez Canal; the winds of the Mediterranean are variable, and the Red Sea is not suitable for sailing ships. In addition, the world was railway-minded as regards steam, and it was thought that a railway from Suez to Alexandria would solve the problem of the blind alley of the Mediterranean…"

***Shipping Wonders of the World,* ca. 1937**

227

228

Sailing Vessels in the Suez Canal
Scientific American
March 29, 1902

229

NO sailing vessels have crossed the canal since 1874 or 1875, except during the time of the Turko-Russian war of 1877-78. At that time sailing vessels arrived from Calcutta with Indian troops; but for the last ten years no sea-going sailing vessel has crossed the canal. Sometimes trains of coal and materials, treated by the Suez Canal Company as sailing vessels, with the object of collecting the towing duties, have crossed the canal, but no sailing vessel engaged in high-seas navigation has crossed it within the period named.

The absence of sailing vessels in the canal is explained by the difficulties of navigation in the Red Sea. The extraordinary number of sailing vessels lost in the Red Sea (which is full of dangerous reefs and shoals) during the years 1872-73 seems to have effectually discouraged further attempts. The officials of the Suez Canal Company believe that the construction of the canal, which was opened to navigation in 1869, has been an impetus to steam navigation throughout the world.

230

"…This period was the heyday of the sailing ship. Far better vessels than the steamships of that time, they had behind them tradition, experience, and faith in the established order of things. The steamship was still an experiment. Fine ships set out from England, picked-up the north-east trades, left the African coast, worked across the Doldrums by standing over towards South America, swept round the Cape of Good Hope, picked up the 'brave west winds,' and made fast passages to Australia…"
***Shipping Wonders of the World,* ca. 1937**

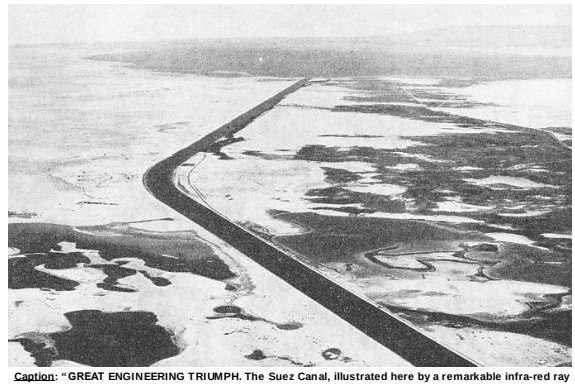
231

"…Although the Suez Canal did not cut many miles off the route to Australia, it was obviously the short-cut to India and the Far East - if marine steam-engines worked. For some period the issue was in the balance. So inefficient were the steam-engines of that day that for a time they could not compete with sail on long voyages. The Suez Canal cut the fairway for the steamship and offered many advantages…"
***Shipping Wonders of the World,* ca. 1937**

232

"…The mileages saved on the routes from London to Bombay and Calcutta were 4,563 and 3,667 respectively. In the early years the success of the Suez Canal was in doubt, but as soon as the advantage of the saving in distance and improvements in steamships took effect, its superiority was recognized and has remained unchallenged. Coaling ports were established at various points; thus ships did not have to load so much fuel as to reduce cargo-carrying, while lack of reliable winds prevented sailing vessels from competing on the new route to the East…"
***Shipping Wonders of the World,* ca. 1937**

233



Caption: "GREAT ENGINEERING TRIUMPH. The Suez Canal, illustrated here by a remarkable infra-red ray photograph taken from the air. The canal was built by Ferdinand de Lesseps, a Frenchman, and opened in 1869. The canal has a total length of over one-hundred land miles. It forms a short-cut to India, and the mileages saved between London and Bombay and Calcutta are 4,563 and 3,667 respectively."

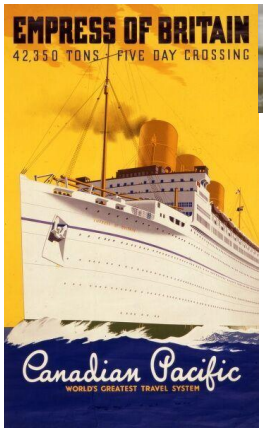
234

Canal Across the Isthmus of Suez
Scientific American
April 19, 1856

235

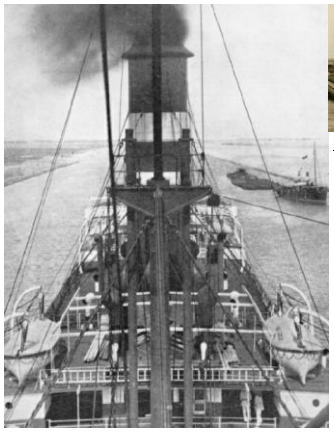
THIS great enterprise, which, for many years, has seemed a visionary project, is likely to be realized. The commission of engineers and scientific men whom the Viceroy of Egypt appointed to examine and determine upon the practicability of it, have made a report, in which they declare that the canal could be built on nearly a direct route from Suez to the Gulf of Pelusium, with a branch to the Nile. The estimated cost is $8,000,000, and the construction will take six years. It is estimated that this canal will effect a saving in distance between the respective places and Bombay, as follows: Constantinople, 12,900; Havre, 8,-928 ; London, 8,550 ; Liverpool, 8,550; New York, 7,317; New Orleans, 8,178 miles. More than one-half the distance is abridged between the principal ports of Europe and Asia, by the proposed canal. This single fact shows its immense utility to all nations, as well as to Egypt and Turkey.

236



"…The waterway now operated by the Suez Canal Company is considerably deeper and wider than the original canal opened in 1869, as it has been improved from time-to-time to accommodate vessels as the size of ships increased. The largest vessel to have used the canal up to the time of writing is the Canadian Pacific liner 'Empress of Britain,' 42,348 tons…"
***Shipping Wonders of the World,* ca. 1937**

237



Above: caption: "Entrance to Suez Canal at Port Tewfik"
Left: caption: "The Suez Canal, an international waterway. The maximum permitted speed of ships in the Suez Canal is seven-and-a-half knots. The waterway is controlled by the Suez Canal Company and has been enlarged from time-to-time; the largest vessel to have used the canal is the *Empress of Britain,* 42,348 tons. Vessels pass through at all hours, and a special searchlight, devised for navigation at night, illuminates both banks some distance ahead of the ship."

238

Navigation by Night

239

"…Once vessels could only pass at a few 'gares,' or crossing stations, but now that the canal is wider ships can pass at almost any point. The rule is that one ship stops while the other proceeds. The maximum speed is seven-and-a-half knots, which is quite a good speed for ships in confined waters…"
***Shipping Wonders of the World,* ca. 1937**

240

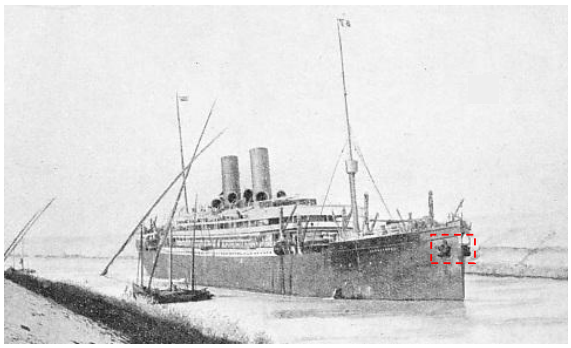
"…Formerly navigation ceased at night, but with increased traffic night navigation became imperative. A special searchlight was devised, known as a Suez Canal light, and arranged in the bows; navigation at night was authorized in 1887, so that ships pass through at all hours. This searchlight consists of two divergent beams of light which illuminate either bank of the canal some distance ahead, with a dark sector in the middle. There are thus three sectors, each of five-degrees. The two beams of light touch the banks of the canal 1,300 yards ahead…"
***Shipping Wonders of the World,* ca. 1937**

241

Lighting Their "Road" by Searchlights Worked by Men in Cages on Their Bows. Vessels Navigating the Suez Canal by Night.

It was stated the other day that the Panama Canal is to be lit by lighthouses whose lights will be put out automatically (save for a small jet) by the warmth of the sun's rays and relit by the colder atmosphere of the night. The lights by which vessels navigate the Suez Canal by night are less astonishing, but are most efficient under the conditions existing. They take the form of searchlights carried on the bows of the ships. Mr. Carol King writes of the method: "When the canal was first opened, in 1869, the vessels had to tire up at night and wait for daylight before proceeding. Later, there was adopted the present system, by which such vessel lights its own road, somewhat as a motor-car lights the highway, by means of a searchlight. This is suspended, with its operators, in a cage over the bows. The beam can be divided into two, with an arc of five-degrees of darkness in-between. This course is adopted when nearing an approaching steamer to avoid "blinding" the navigating staff with the glare. When the ship ties-up, she puts out her searchlights and lights another powerful lamp."
(*The Illustrated London News*, March 9, 1912)

242



<u>Caption</u>: "A PASSENGER LINER in the Suez Canal passing a native dhow. The special searchlight carried through the Canal is shown slung over the liner's bow. When two large ships pass one another in the Canal, one of them has to be 'tied-up' while the other goes slowly by."

243

Through Suez at Night
Scientific American
April 2, 1887

IT is quite a common thing for a big steamer to go through the Suez Canal at night. But what is, perhaps, not generally known is that the steamer itself, and not the Suez Canal Company, has to supply the requisite electric light apparatus for the nocturnal passage. What the company does is to prescribe the amount of illuminating power which the apparatus must possess. For instance, no steamer is allowed to start on a night transit that is not fitted with an "electric projector" which is capable of throwing a light for at least 1,200 meters ahead. And on the upper deck, too, there must be an electric lamp and shade powerful enough to light a circular area some 600 meters in circumference. Big steamers are beginning to carry this apparatus, but there is a company both at Port Said and Port Tewfik which lets out the necessary projectors and lamps on hire.

245

246

Night Navigation on the Suez Canal
Scientific American Supplement
August 18, 1888

247

AN interesting paper has been read by M.P. Lemonnier before the International Society of Electricians, at Paris, in which he gave some particulars regarding the use of electric searchlights on vessels passing through the Suez Canal by night. It appears that since March, 1887, when night traffic was first permitted, some eight hundred vessels have passed through the canal by the aid of the electric light. Of these, slightly over three hundred carried their own lighting plant, the rest of the vessels having obtained the plant from one of the two companies who make it a business to supply the necessary apparatus on hire.

These firms are the Societe Bazin & Cie., whose plant is of English make, and the Societe Worms, Josse & Cie., whose plant is of French make, being manufactured by Messrs. Sautter-Lemonnier & Cie. These firms have depots at either end of the canal, and upon a vessel arriving the plant is hoisted on board, installed by the firms' servants, and superintended by them throughout the passage.

On arriving at the other end of the canal the plant is put on shore, and held in readiness for the next vessel passing in the opposite direction. To avoid delays, it is advantageous that captains should telegraph beforehand either to Suez or Port Said, and to either of the firms mentioned, stating at what hour they will require the electric plant. The latter consists of a steam dynamo weighing about 1 ton 18 cwt., the necessary cable, and a wooden cabin containing the search light, which is hung over the bow of the steamer. The cabin may be suspended from the bowsprit, or, where the vessel is unprovided with a bowsprit, a spar with a pulley at its end must be run out over the bow. Steam must be supplied from either of the main boilers or from a donkey boiler on the vessel, the minimum pressure required being 60 lbs. The cost of hire for a single passage is $50.

248

The Value of Electric Lighting on the Suez Canal
Scientific American
March 1, 1890

249

THE night traffic on the canal has increased very rapidly since electric lighting was started. Thus in 1887 there were in all 371 night transits made, but in 1889 this number had increased to 2,454 out of a total of 3,420, or upward of 71 per cent of the vessels passing through the canal, and four-fifths of the total tonnage, used the electric light to assist them. At the same time the average duration of the passage has been reduced upward of 40 per cent. Putting these facts into another shape, it appears that the effect of the electric light as applied at Suez has been the same as if the canal had been increased from 22-meters, its present width at the bottom, to 32-meters, an operation which would cost at least £4,000,000.

250

Electric Light in the Suez Canal
Scientific American
September 6, 1890

251

The number of vessels passing through the Suez Canal at night by means of electric light is increasing with extraordinary rapidity. The regulations for the use of the electric light came into operation in March 1887, and during the remainder of that year (according to statistics given in the recent British consular report from Port Said) the number using it was 394. In 1888 the number rose to 1,611, and last year reached 2,445. Prior to March, 1887, the privilege of traveling by night with electric light had been restricted to vessels carrying the mails. Since then all ships which conform to the regulations are allowed to proceed by night. The average time of transit has also been considerably shortened. In 1886 it was 36 hours; in 1887, 33 hours and 58 minutes; in 1888, 31 hours and 15 minutes; and in 1889 it had been reduced to 35 hours 50 minutes. The average time for vessels using the electric light in 1889 was 22-1/2 hours. The shortest time taken by a steamer in the transit of the canal in 1889 was 14-3/4 hours, which is ten minutes less than the fastest passage on record previously.

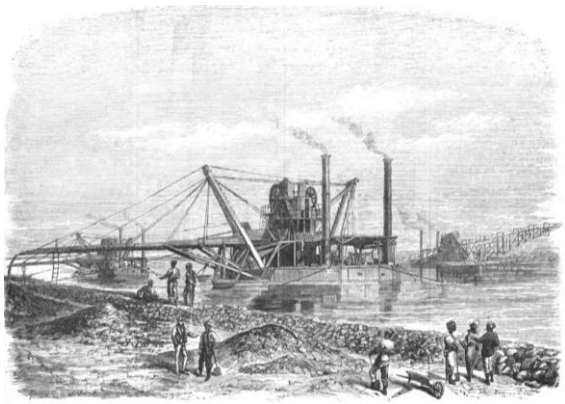
252

A Never-Ending Job

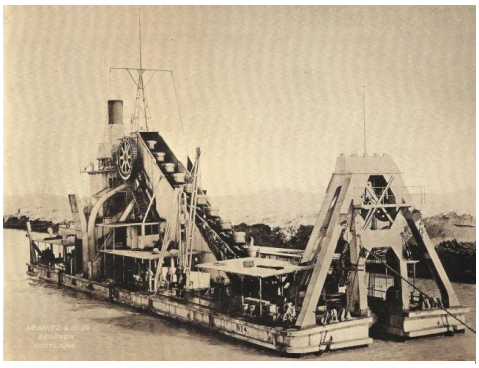
253

"…Far-seeing as De Lesseps was, he could not have imagined a vessel such as this magnificent ship. The company he founded 'for the cutting of the Isthmus of Suez, the exploitation of a way suitable for heavy navigation, the establishment and adaptation of two adequate entrances, one on the Mediterranean, the other on the Red Sea, and the establishment of one or two harbours,' is constantly at work dredging and widening the canal…"
***Shipping Wonders of the World,* ca. 1937**

254



The Isthmus of Suez Maritime Canal; Dredges and Elevators at Work 255



The 18 cubic foot " SUEZ No. 4 " at work in the Suez Canal, constructed by us for the Suez Canal Company. The hull dimensions are 170 ft. × 40 ft. × 11 ft. and the dredging depth 50 ft. This dredge is fitted with the dredging engine on the main framing, thus eliminating the shafting and bevel gearing from the engine room. 256

Caption: "The first modern initiatives to improve the Suez Canal occurred in the 1950s. These improvements were followed by the largest widening and deepening works from 1975 to 1980 when a huge dredging fleet of 12 cutter suction dredgers dug-out 225 million m³ for the 63 kilometers between Lake Timsah and the Great Bitter Lake. The third intervention occurred from 1992 to 1994 when, as part of a plan to handle fully loaded tankers, the canal was widened by 45-meters and the channel deepened to -25 meters. During this phase, some 17 million m³ of bedrock material – 5x harder than normal concrete – were dredged." 257

258

The Suez Canal
Scientific American
October 22, 1870

259

A WRITER in the Boston Traveler gives the following notes on the present condition of the Suez Canal:

The Wabash and Erie Canal, 460 miles in length, occupies a space of 400,672,400 cubic-feet, or more than half as much as the Suez Canal. Take seven of the largest canals in the United States, and any two of them will represent an amount of labor as large as does the Suez Canal. The difficulty with the Suez Canal is found in the fact that it is not, and never will be done. Storms of sand and land slides combine to defeat the object for which this avenue was constructed, and nothing but a perpetual dredging will keep it in a passable condition, making the work of keeping it clear of sand bars a constant repetition of the original work. But all this does not prevent it being a great success.

The system of lights, signals, pilotage and towage is now so complete that the navigation in the canal is as safe and convenient as the entrance into New York harbor, while the constant dredging and excavating is every day improving the channel.

260

How much of a financial success it may be I cannot tell, as the number of men constantly employed exceeds one thousand, and the number of dredging machines over one hundred, which is a separate bill of expense from the tugboats, pilots, etc. But at $2 a ton as toll upon ships, and $2 upon each passenger, there must be taken - now that it is crowded - at least $80,000 a day, besides the receipts for towage, pilots, supplies, wharfage, etc. As far as Egypt is concerned, it has been already of sufficient advantage to cover all expenses.

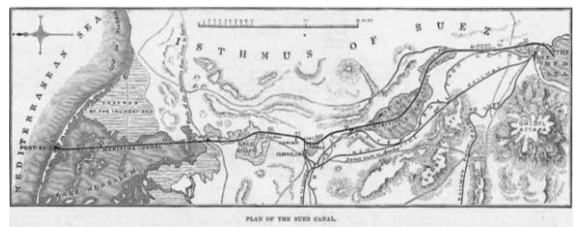
The fresh-water canal, which was built along the line of the larger, to supply transportation and water for beast and man while at work, has already changed the face of the country for miles on either side of it. Before its construction the railroad to Suez was often blocked by sand, which, like the snow in New England, blew-up in great drifts over the track, and sometimes stopped the passage of trains for weeks. But since the presence of fresh water has covered a strip of the desert with vegetation, the track of the railroad has been changed, and, running along this canal, is never troubled with sand drifts; and the amount of labor saved on the railroad would construct the canal in two years.

Without an inhabitant ten years ago, this was a useless, dismal waste; but today, towns and villages, thrifty and enterprising, stand at short intervals.

261

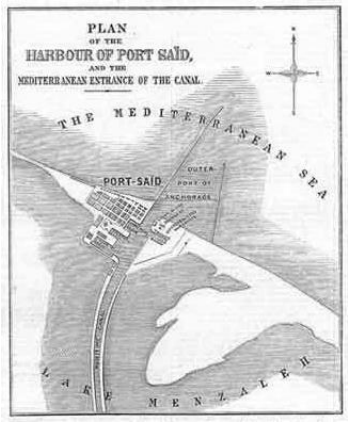
From Port Said to Port Tewfik

263



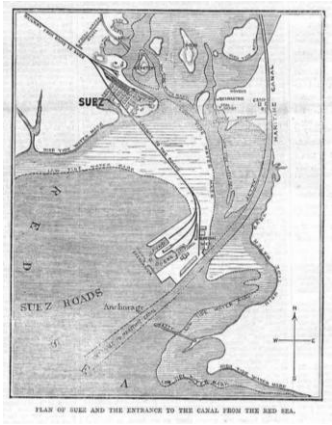
"…There are no locks, bridges, or works to hamper the progress of ships. The length of the canal from the lighthouse at Port Said to the southern end of the quay at Port Tewfik is about 100 miles, of which nearly two miles run between the Port Said basins. The dredged channel in Port Said Roads is four-miles-long, and that at Suez over two miles so that the total length of the waterway maintained by the company is some 106 miles…"
***Shipping Wonders of the World,* ca. 1937**

264

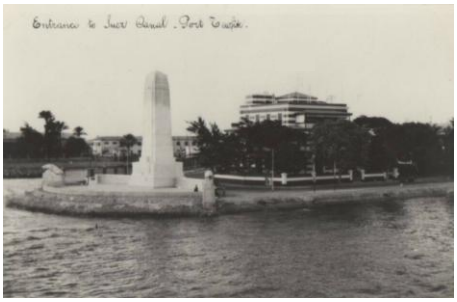


265

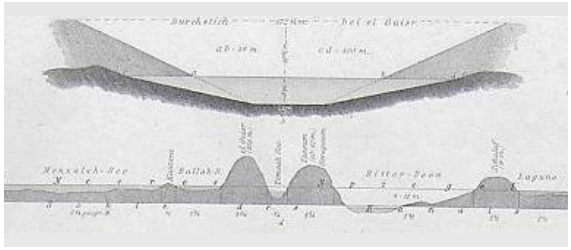
266



267



268

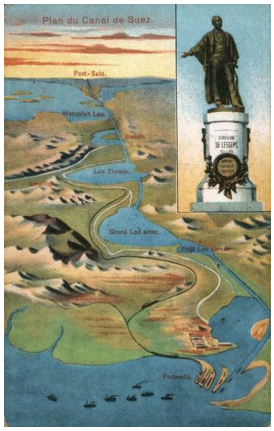


"…The width at the bottom of the channel varies. At a depth of 32.9-feet the minimum width is 196-feet and some lengths are 328-feet-wide. The surface width normally varies from 400- to 500-feet. The maximum permitted draught for vessels is 34-feet at the time of writing…"
***Shipping Wonders of the World,* ca. 1937**
Caption: "Typical Suez Canal cross-section (top) and topographical profile (bottom)"

269

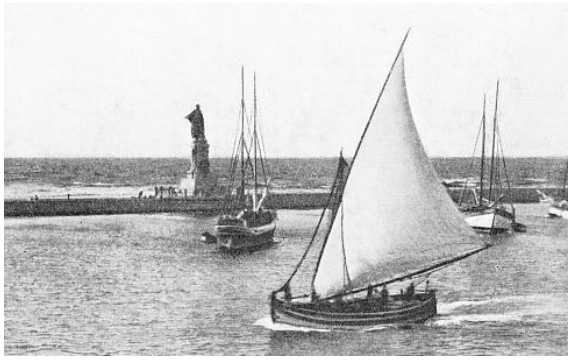
Transiting the Canal

270



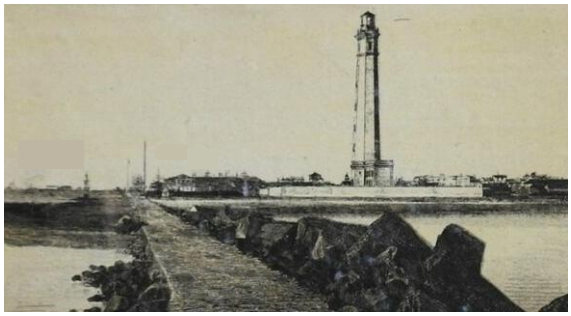
"…Coming from the Mediterranean a vessel has on her starboard side the West Breakwater dividing the channel from Lake Menzaleh; she steams through the dredged channel and draws level with the head of the East Breakwater. A little farther on is the impressive statue of De Lesseps; with right arm outstretched the figure indicates the entrance to the canal, 'Here is my work!'…"
***Shipping Wonders of the World,* ca. 1937**

271



Caption: "THE STATUE OF DE LESSEPS, the creator of the Canal, is at the entrance to the Canal at Port Said. At the base of the statue are Latin words signifying: 'To Open the Earth to All Peoples.' The engineer was most persistent in his ambition to build the Canal and it is said he travelled a total of 70,000 miles trying to get his scheme accepted. He finally succeeded in winning the support of the French and Egyptian Governments."

272

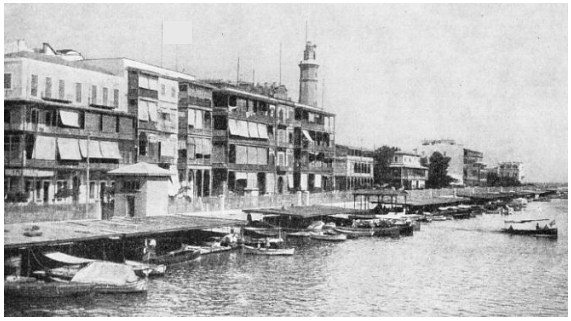


"…Next is the lighthouse from which all distances along the canal are measured, mile-posts being on the east bank and kilometre posts on the west. Liners berth at Port Said, which is on the west side of the entrance…"
***Shipping Wonders of the World,* ca. 1937**
Caption: "Lighthouse of Port Said"

273

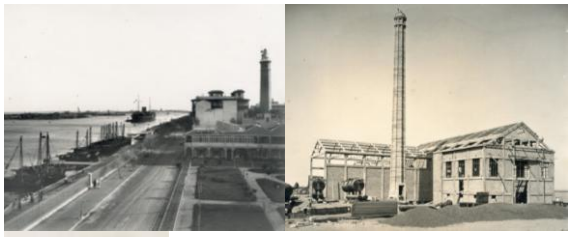
"…This port, one of the most famous, having more than 100,000 inhabitants, was named after Said Pasha, who as Viceroy of Egypt backed De Lesseps with his influence and supported the project financially, but did not live to see the completion of the great work. Said should be pronounced 'Sigh-id'…"
***Shipping Wonders of the World,* ca. 1937**

274



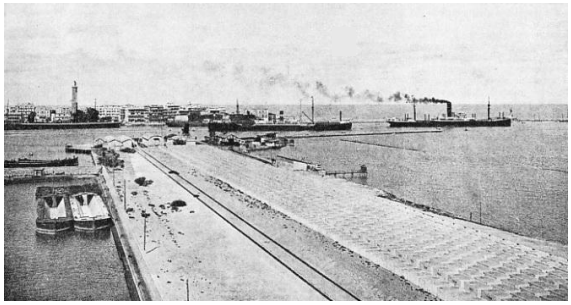
Caption: "PORT SAID is at the northern entrance of the Canal. Liners berth at Port Said, which is on the west side of the entrance. This port, with 100,000 inhabitants, was named after Said Pasha who, as Viceroy of Egypt, backed De Lesseps with his influence and gave financial support to the great project. De Lesseps drove a pick-axe into the earth at Port Said in April, 1859, to signify the beginning of the work."

275



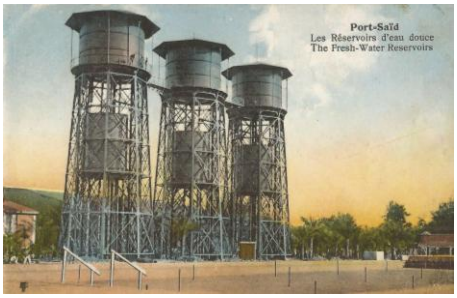
"…Opposite is the new town of Port Fuad, which was inaugurated by King Fuad of Egypt in December, 1926. It is a model city and the Suez Canal Company's engineering and repair shops are situated there…"
***Shipping Wonders of the World,* ca. 1937**
Above L&R: caption: "Port Said workshops"
Left: caption: "Rail-mounted mobile crane, used for ship-building and repair"

276



Caption: "THE ENTRANCE TO THE HARBOUR at Port Said with Port Fuad in the foreground. Transit dues at the time of entry into the Canal are five gold francs per net Suez ton, ships in ballast paying only half this rate. For every passenger over twelve years of age taken through the Canal a charge of ten gold francs is made. In 1934, a representative year, the total number of transits was 5,663, amounting to a net tonnage of over 31,000,000. The Suez Canal Company's engineering and repair shops are situated at Port Fuad."

277

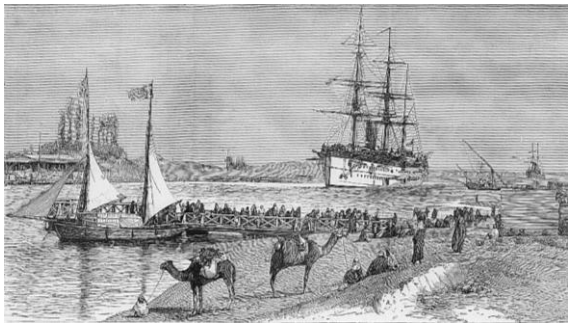


278

"…Many of the workers, however, live in Port Said, which affords the traveller from Europe his first glimpse of the East, and if the liner is stopping for a few hours he hurries ashore…"

Shipping Wonders of the World, ca. 1937

279



"…Meanwhile the captain has been arranging with the authorities the details of the transit of the canal. After leaving the harbour, the ship steams south for about twenty-four nautical miles towards Kantara, through Lake Menzaleh, which is on the west of the canal and is part of the delta of the River Nile…"

Shipping Wonders of the World, ca. 1937

Caption: "Kantara, on the Suez Canal"

280

"…The level of the lake rises in conformity with that of the Nile, and a channel has been cut affording exit for the water to the Mediterranean so that it cannot rise and threaten the safety of the embankment of the canal…"

Shipping Wonders of the World, ca. 1937

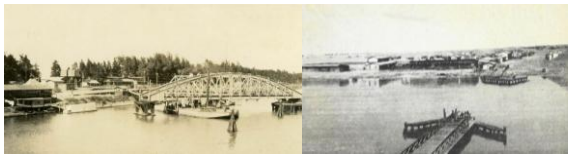
281

"…The low ground to the east was flooded during the war of 1914-18 to protect it from attack. A railway runs along the west bank of the canal from Port Said to Suez; at Kantara, an historic place that has become an important junction, a trunk line goes across the desert from the east bank to Palestine. During the war a swing-bridge carried this important line across the canal, but the bridge has since been removed…"

Shipping Wonders of the World, ca. 1937

Caption: "A Red Crescent ambulance hospital train of the Egyptian State Railway is seen here crossing the Suez Canal swing bridge during WWI"

282



During WWI, Kantara was the site of *Headquarters No. 3 Section*, Canal *Defences and Headquarters Eastern Force* during the latter stages of the *Defence of the Suez Canal Campaign* and the *Sinai Campaign of 1916*. The massive distribution warehouse and hospital center supported and supplied all British and ANZAC operations in the Sinai from 1916 until final demobilization, in 1919. In January 1916, a new railway was constructed from Kantara to Romani, and eastward through the Sinai desert to El Arish and Rafa, on the border with the *Ottoman Empire.*

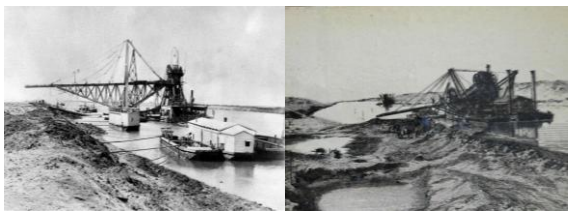
Left: "Kantara swing bridge in open position" 283
Right: caption: "View of Kantara"

"…Kantara was on the caravan route from Palestine to Egypt, and some believe that the Holy Family passed through it during the flight into Egypt from Herod. It was a great city of 500,000 people, but the Persians destroyed it in A.D. 344…"
***Shipping Wonders of the World,* ca. 1937** 284
Caption: "Kantara – camels crossing the Suez Canal"

Above: built next to the site of an ancient city (*Sele*), *El Qantara* (the bridge) is located 99 miles northeast of Cairo and 31 miles south of Port Said, on both sides of the Suez Canal. The two parts of the city are connected by a high-level road bridge, the *Mubarak Peace Bridge*. The bridge makes a connection between Africa, on the canal's western shore and Asia, on the canal's eastern shore. 285

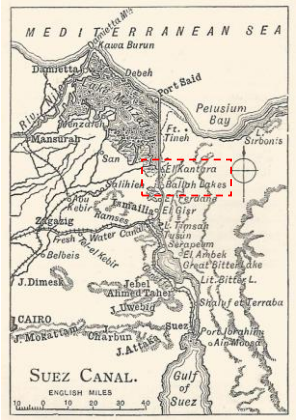
"…Except for one short section, the canal is straight across Lake Menzaleh. The site of the channel being too shallow in places to permit dredgers to be used, local natives dug the earth, passing the clods from hand-to-hand to each bank, the clods being used to build-up the embankments…"
***Shipping Wonders of the World,* ca. 1937**

287



"…When the channel was sufficiently deep, dredgers were floated in to remove the soil more quickly, the soil being cleared from the channel by means of a contrivance similar to a great iron sp-out. It was 230-feet-long, 5-1/2-feet-wide, and 2-feet-deep. The soil was dumped into it, converted into sludge by water, and then pumped clear of the channel…"
***Shipping Wonders of the World,* ca. 1937**
Left: caption: "Dredging work being carried out on the Suez Canal prior to its official opening in 1869" 288
Right: caption: "Dredger operating near the Bitter Lakes"

289



"…From Kantara to Lake Timsah the ground is higher. The sill of the canal in this section is at El Guisr, where the canal banks are 49-feet above the water. As the canal was designed to follow the lowest part of this comparatively high ground several curves had to be made, one being to take advantage of the depression caused by the Balia Lakes…"
***Shipping Wonders of the World,* ca. 1937**

290

"…After the curves through the high ground at El Guisr the canal enters Lake Timsah. The town of Ismailia, on the west side of the lake, a green oasis in the desert, is the halfway port and nerve centre of the canal, where the Works and Traffic Depts. are quartered. At Ismailia there are to be found workshops and tugs. The pilot from Port Said is relieved here by his colleague who is to take the ship to Port Tewfik…"
***Shipping Wonders of the World,* ca. 1937**
Top: caption: "Entrance of the Bitter Lakes"
Middle: caption: "View of the Timsah Lake"
Bottom: caption: "View of Ismailia"

291

"…Leaving Lake Timsah, the vessel passes between high banks, and after proceeding for a number of miles the vessel enters the Great Bitter Lake, which is about ten nautical miles long and from two-and-a-half to six miles wide, and steams through the dredged channel to the Little Bitter Lake, passing through another dredged channel. The sides of the canal are of sticky mud here, but in the next and last section from the end of the lake to Port Tewfik the canal is cut through hard, and in some places rocky, ground. Rocky places where vessels should not secure to the bank are marked by buoys and posts…"

292

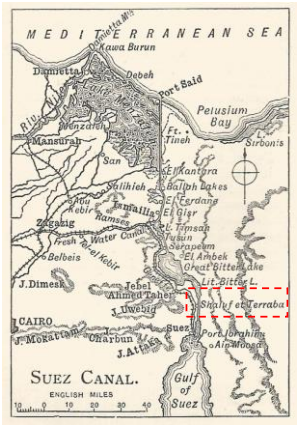
***Shipping Wonders of the World,* ca. 1937**

"…The famous Port of Suez is not on the canal, but lies off the west bank, and is reached by a creek. The southern terminal of the canal is Port Tewfik, and Port Ibrahim. The former is the official terminal of the canal, and Port Ibrahim, which adjoins, is controlled by the Egyptian Government. The district is linked with the Port of Suez…"
***Shipping Wonders of the World,* ca. 1937**

293

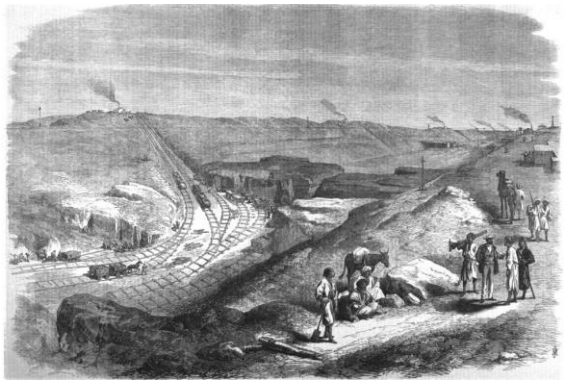
Caption: "The Isthmus of Suez Maritime Canal: Bird's-Eye View of Entrance from the Red Sea, with New Harbour, Docks, and Town of Suez. Source: Illustrated London News 54 (17 April 1869)"

294



"…On this last section there is another sill at Chalouf, between the Little Bitter Lake and Port Tewfik…"
***Shipping Wonders of the World,* ca. 1937**

295



The Isthmus of Suez Maritime Canal; The Cutting Near Chalouf 296

Part 4

A Work-in-Progress

297

Difficulties to be Encountered in Working the Suez Canal
Scientific American
October 23, 1869

298

WE find in *Lippincott's Magazine,* a paper from the pen of Edward B. Grubb, relating "What he saw of the Suez Canal during a trip from Timsah to Port Said last winter." In this article we find set forth some of the difficulties to be surmounted in the navigation of this canal, which though possibly not insuperable, must more or less obstruct trade for some time to come. We make some extracts from this interesting narrative particularly bearing upon this subject:

"Where the canal enters Timsah from the north the cuttings are deep, and the great heaps of sand lie on either side sixty- or seventy-feet-high. The channel through which the water runs is not one-hundred-feet-wide and the depth not over twelve feet. Hydraulic engines of enormous power were at work dredging up and pouring out immense volumes of mud and sand. Hundreds of men, mostly Arabs, with barrow, pick, and shovel, were moving the huge heaps, or waist-deep in the water, turning from our path their uncouth boats; for much traffic is even now done upon the canal, and besides the boat-loads of stores and provisions belonging to the company, we saw many a cargo that reminded us of the Sutler's stores in the 'Army of the Potomac'…

299

…"The Timsah cutting extends for perhaps half-a-mile, and then the desert is scarcely above the level of the water, and in fact in many places it is below it, so that the water covers many hundreds of acres, and the course of the canal is buoyed out sometimes for nearly a mile. As we left the hills of Timsah the wind struck us sharply, and ever and anon a quantity of the light sand of the desert would be caught up by it and sent whirling into the water; and looking closely, we could see where it had drifted little capes and promontories into the canal. Let us repeat what our captain said upon this subject, being asked: 'Yes, monsieur, this drifting in of the sand certainly seems to be one of our greatest difficulties, for the wind blows across the canal all year round – six months one way, six months back. One ounce of sand per-square-yard amounts to five-hundred tons for the whole canal. If it came in at that rate, it would be a long time before the company would pay any dividend. But we do not intend to let it come in; and this is how we prevent it. This sand only extends to the depth of from nine to twelve feet; below this is a stratum of blue mud, mixed with a sort of clay, in which, by the way, we find great quantities of beautiful shells and fossil fish. Well, then, do you see those two huge engines which we are approaching – one an hydraulic dredger in the middle of the canal, the other an iron 'shute' (it looked like the walking beam of an immense steamer), near the edge? Do you see how the vast masses of sand, mud, and water, come up from the dredger, are poured out into the 'shute,' and thence on the ground sixty or eighty feet from the edge of the canal? Do you see how quickly the great heaps rise, and how they extend, almost without break, all along? Well, monsieur, you would find these heaps almost immediately baked hard by the sun, and as they are firm enough to bear the railroad we intend putting upon them the better to expedite the mails from India, so we hope they will be high enough to keep out the sand drifts from the canal.'"

300

"And what are your other great difficulties, mon captaine? 'Well, monsieur, at Chalouf, near Serapeum, we have struck a peculiar hard stone at the depth of twelve feet, and are obliged to blast to clear it out (it is axolite). Then the deposit of the Nile mud near Port Said will always keep us dredging. But what we fear most is the Red Sea. For a long distance from Suez it is extremely shallow; then, lower down, it is very rocky; and while this is nothing to steamers, which can easily keep the narrow channel, yet with the wind blowing six months one way and six months the other, it will not be easy for a heavily-laden clipper to keep off the ground. Yet these things will all be set right, for trade will take the shortest route, and the Suez Canal will be a success, although no nation now believes it except France, and (with a bow) America.'

"A few words now upon the canal in general. Whether or not the idea originated with Pharaoh, Napoleon I acted upon it, and actually had a survey made, when it was reported that there was a difference of thirty feet in the level of the two seas; and for that and other reasons the project was abandoned, and lay dormant until about 1854; upon the 30th of November of which year the contract between the Egyptian government and 'Compagnie Universelle du Canal Maritime de Suez" was signed. Its duration is ninety-nine years from the day of the opening of the canal for traffic. The Egyptian government is to receive fifteen per cent of the net profits, and holds a large proportion of the company's bonds. Egypt conceded to the company all lands which might be irrigated by the fresh-water canal, and in 1868 bought back its own concession for a sum equal to ten millions of dollars."

301

"Kantara is thirty-one miles from Port Said, and the canal is almost perfected thus far; that is to say, although the dredges are still at work, yet for this distance the canal is one-hundred-yards-wide and of an average depth of twenty-six feet; and these are to be the dimensions for its entire length. A curious feature, which is visible along the narrow parts of the canal, is a current flowing in from the north at the rate of one-and-a-half knots-per-hour. Although it is many months since the water attained its level, yet this current still continues. Our captain attributed it to evaporation and absorption. It must be remembered that all cuttings have been from the Mediterranean towards Suez, and that the main body of the men employed, numbering eighty-five hundred, are working at the head of the canal, which is now advanced as far as Serapeum. Here it is necessary to cut through a number of sand hills to the Bitter Lakes, which are a series of depressions in the desert, in the lowest parts of which are marshy ponds. They are twenty-five miles in extent, and it is expected that, when the water is let in, area of one-hundred-and-forty thousand acres will be covered (this has been done). Then comes the Chalouf cutting to Suez, sixteen miles, and the seas meet."

302

"On the 1st of January, 1869, there were at work eighty-five hundred men. These men are obliged by the Egyptian government to work on the canal, but are paid by the company at the rate of two francs-per-day. The engines for dredging are sixty in number. Each cost two-hundred thousand dollars in gold. The expenses amount to one million dollars in gold per month, and the work has already absorbed forty millions of dollars. It is said that the rates of toll are to be ten francs-per-ton. The company is a private one, and has not been publicly recognized or assisted by the French government."

"With regard to the rocks, the calms, and the tortuous channels of the Red Sea, mentioned before as the chief obstacle to the use of the canal by the larger class of merchantmen, plans have already been elaborated in England, with a view to the building of a class of vessels suited to this trade, and carrying each sufficient steam power to assist her through the canal and down the Red Sea. For the dispatch of mails and the transport of troops, this route will be immediately available; and although it will take time to conquer English prejudices and predilections, yet in time the bulk of the India trade must come this way."

303

The Suez Canal

Scientific American Supplement
June 5, 1880

304

A CORRESPONDENT of the *London Times* says:

It is just seven years since I last passed through the Suez Canal, and it is about the same time since I saw Port Said. Many changes were promised seven years ago, and I expected much on my return. But nothing has really been done, and I feel as if it were yesterday that I went through the Egyptian Bosphorus in the good ship 'Nubia.' The vegetation along the banks is just as scanty, the trees that were promised have never been planted, the same wild waste of desert with its marvelous mirage of lake and woodland still meets the eye, the deep-water passage of the ship canal remains only twenty-four yards broad, and the fifteen gares or widened spaces where ships can pass each other have not been increased in number. The broad but useless Bitter Lakes, the wide reaches of Timseh, Bala, and Menzaleh, are still only used as waterways for the passing ships. Indeed, the only improvement I observed after my seven years' absence was that the banks of the canal had been faced with stone for about a quarter of its whole length. Not a single town, not even the smallest hamlet, has sprung up on its banks. Ismailia, which was to be the capital of the Isthmus, is hardly more than a deserted village, the scanty inhabitants of which wander disconsolately through its silent streets. The great fresh water canal which debouches there from Cairo brings no traffic of importance, and the restoration of the ancient land of Goshen, through which it passes with its fertilizing stream, remains a thing of the future. No wonder the passengers pronounce the canal a dull affair as they steam slowly through the vast solitude at the regulation five knots-an-hour.

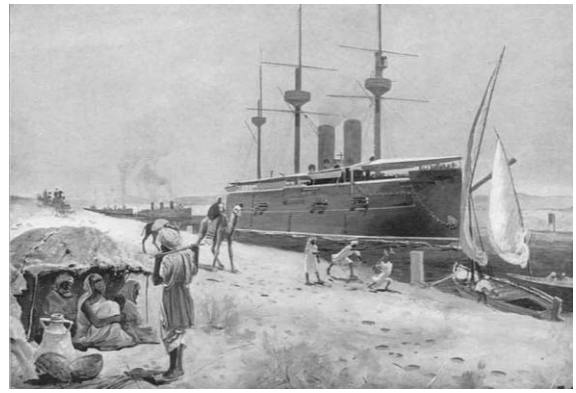
305

Port Said has not advanced any more than the rest of the Isthmus. The railway which was promised from the Delta has never been undertaken; the canal which was to join it with Damietta is forgotten; the vast salt marsh which cuts-off the town from all cultivation still stagnates over four-hundred and fifty-thousand acres, the favorite haunt of pelicans and flamingoes; and Port Said seems doomed to the meager glories of a big coaling station on the highway of nations, but outside all civilization. Seven thousand Arabs thrive on the transfer of coal from wharf to ship, which they do in huge gangs at a rate that makes Port Said the fastest coaling place in the world. All the change I noted in the little red-roofed town lay in the great Dutch hotel built by the late Prince of Orange, and the much increased length of the westward breakwater. This bulwark against the sea has hard work to divert the mud-laden current which sets eastward from the Damietta mouth of the Nile. Constant dredging of the channel by a huge sea-going dredger of one thousand horse-power hardly suffices to keep it clear, and the time must come when a supplementary jetty will have to be constructed some twenty miles up the coast to divert this never-ceasing supply of choking silt. A better plan would be to utilize for the benefit of the country the whole of the riches of the Nile, but I fear the day is far distant when this stock of fertilizing mud will cease to run to waste.

306

It is singular how the only danger that was despised at the creation of the canal is proved to be the one real impediment to its utility. The dreaded current from the Red Sea has turned out no danger at all, and the curves in the channel which were made to resist the effect of this current are now pronounced wholly unnecessary. Indeed, yesterday, when I came through in the 'Poonah,' the longest ship that had ever entered the canal, these curves proved very serious obstacles to a quick passage. The sand storms and wash from the banks, which were other prophesied dangers, are readily controlled by the occasional use of the three small dredgers the company keeps ready for this work of clearance. To the confusion of the prophets, the canal easily maintains its normal depth, and only last week a large Russian ironclad, the 'Minime,' passed through without any check, though she drew twenty-four-and-a-half-feet of water. But stoppages occur rather too frequently, as all ships that pass depend on the good steering of the meanest craft that precede them from station-to-station. If one ship goes on the bank an inevitable jam ensues and the whole commerce of Europe for the time is stopped. Now that the company is, at any rate for the present, commercially successful, they ought to seriously consider the advisability of increasing the number of stopping places, or even of widening the deep water channel, so that ships can pass each other everywhere. This latter task would not be so difficult, as the surface of the canal is nowhere under sixty yards broad.

307



A Russian Man-of-War for the Far East passing through the Suez Canal with an escort of Torpedo Boats

308

I found that quite four-fifths of the traffic of the canal is furnished by British commerce. It is not an exaggeration to say that if the British flag were withdrawn the canal would not last a decade. One English company alone pays on an average £160,000 a year to the concern. Yet the company is French, the officials are French, the pilots are French, the rules and regulations are French, and the whole of the Isthmus is nothing but a little France. However, the management on the whole is good, and the block system to avoid collision is maintained from station-to-station with all the method of a well-managed railway company. But the canal authorities should never forget their strictly international character, and favors as to a speedy passage should not be given even to a French mail line that are not equally shown to the mail steamers of other nations. The question might also be reasonably considered whether the concern is not overweighted with officials and officers. An establishment at Suez, another at Ismailia, a third at Cairo, a fourth at Port Said, a fifth at Marseilles, and a sixth at Paris are hardly consistent with the strict economy of a paying commercial business.

309

One cannot help feeling somewhat sadly how little good this great canal has done to Egypt. All the transit traffic from Europe southward used to pass through the valley of the Nile, while it is now all carried past us through this new arm of the sea. M. De Lesseps spoke unconsciously with a cruel irony when he persuaded Said Pasha to grant the concession to a universal company because "Egypt will then hold the key of the world, and the equilibrium of the Powers will be in her hands" It would have been more true if he had told the Pasha that Egypt would not only lose her proper trade, but also become a bone of contention among the nations. The Caliph Omar was a wiser man when he refused to join the two seas because the work would only benefit the barbarian. It would have been better for Egypt if Said Pasha had clung to the original idea, the idea that contented the Pharaohs, the Ptolemies, Amrou, Napoleon, and Mehemet Ali, and had been satisfied with the union of the Nile to the Red Sea. This, I may add, was the plan supported by the 'Mail,' in the famous preliminary discussions, on the ground that as the silt of the Nile had already produced the Delta, choked Pelusium and the eastern mouth of the Nile, so it would choke the entrance of the proposed canal. Great expense will be necessary to prevent too literal a fulfillment of this prophecy, expense such as a commercial company can hardly be expected to undertake. But the time is, perhaps, not far off when the management of the Suez Canal must change its character, and its neutralization under international control will probably be its next phase of existence.

310

Sylviculture and the Suez Canal

Scientific American
April 6, 1901

311

IN an interesting article on the sylviculture of the Suez Canal, the *Revue des Questions Scientifiques* describes as follows the highly successful efforts of the Suez Canal Company to protect the banks and approaches of that great highway of the world's commerce by a systematic planting of trees and shrubs of various sorts.

The Suez Canal Company is utilizing to great advantage saplings, shrubs, and large trees in order to consolidate its banks, and to preserve the maritime canal from the encroachments of the desert. The operation began in 1897, and was continued from year-to-year with the improvements suggested by experience.

For the purpose of diminishing the effects of erosion at the edge of the banks of the maritime canal, and of the swells caused by the passage of vessels, there has been planted at the water's edge a reed of unusual dimensions, the Arundo gigantean, which spreads its roots rapidly in the water and quickly attains a height from ten to twenty feet. Farther back, on the slopes of the banks, there is employed with success several varieties of tamarisks (T. gallica, T. nilotica, T. articulate), whose branches take root when the sand hills just cover them, and which are intermingled with herbaceous plants like the orach (Atriplex helium) and the alfa (Stipa tenax).

312

In addition to the foregoing precautions it was necessary to protect the canals from the encroachment of the desert sands driven by the wind. To accomplish this there has been establishes, at about 350-feet from the water's edge, hedges formed of arborescent species, and 170-feet-long. The filao, with horsetail leaves (Casuarina equisitifolia), an Australian tree quite well naturalized in Egypt, the acacia of the Nile (A. nilotica), the eucalyptus globulus et robusta; the cypress of Lambert; the caoutchouc and Bengal fig trees (Ficus elastic, F. bengalensis); poplars, mulberry trees and even the sycamore generally thrive well on these plantations. Especially in silicious soils; this, however, is due to artificial irrigation obtained by cutting ditches from the fresh water canals derived from the Nile for the sustenance of the inhabitants.

Vegetation is more rebellious where the soil is found to be argillaccous, compact or too solid. In order to overcome this the lime-bearing waters of the Nile have been brought down, after much labor, and now a number of tamarisks, willows, orachs and other trees thrive well.

On the banks where the swells of passing vessels would endanger the young plantations of reeds, they are sheltered, for the first few years, by hurdles which are taken elsewhere when the plants thus protected have acquired sufficient strength.

313

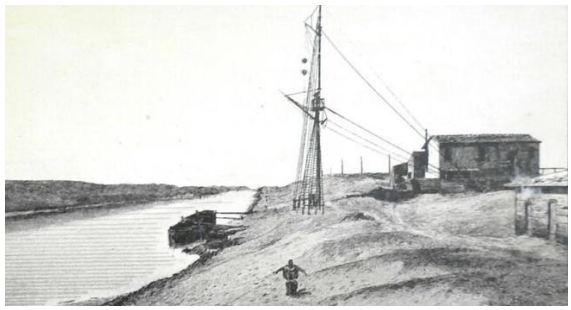
Suez Canal Figures
Scientific American
October 12, 1901

314

The figures for the navigation of the Suez Canal show that out of 3,441 vessels which passed through it in 1900, as many as 3,139 are classed in the night passage, partly by the aid of electric light, or 91.2 per cent, and only 302 vessels, or 8.8 per cent, for the day passage. For the last eight years the comparative results of the day and night navigation are given in the following table, the second column representing the number of vessels which passed the canal partly by the aid of electric light, and the third column shows the number passing by day:

	Night Passage.	Day Passage.	
Year.	Vessels.	Vessels.	Total.
1893.....	3,082	259	3,341
1894.....	3,180	172	3,352
1895.....	3,266	168	3,434
1896.....	3,211	198	3,409
1897.....	2,837	149	2,986
1898.....	3,294	209	3,503
1899.....	3,273	334	3,607
1900.....	3,139	302	3,441

315



"…Except in the Bitter Lakes, at every six miles there is a fully staffed station which keeps in touch with all other stations by telephone and telegraph. Contact between every part of the canal is thus established, and track is kept of all ships throughout transit. Any accident to a ship or to the banks can be known to the authorities within a few seconds…"
***Shipping Wonders of the World,* ca. 1937**
Caption: "View of El-Firdan Station on the Suez Canal"

316

"…Although it has been made in less time, the mean transit time is about thirteen hours and, accordingly, night navigation at some period is essential. Precedence is given to mail-ships…."
***Shipping Wonders of the World,* ca. 1937**

317

Winds and Tides

318

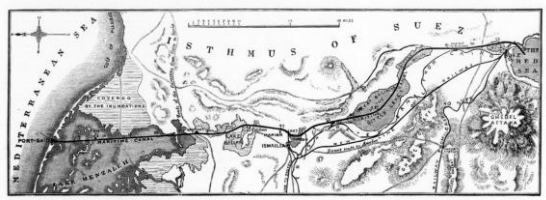
"…There is some current in the canal, according to the season. From November to April the set between Port Said and the Great Bitter Lake is northward, and from June to October southward, the maximum rate being seldom more than one knot. There is no tidal stream in Lake Timsah or the Great Bitter Lake. Between the Little Bitter Lake and Port Tewfik there is a tidal stream. The Mediterranean is, of course, almost tideless, but the Red Sea is tidal, and this accounts for the stream between Port Tewfik and the Little Bitter Lake, the water of which lake is, however, always at the same level. At a point some seven miles from Port Tewfik, the tidal stream attains its greatest rate of one-and-three-quarter knots, although with strong winds blowing from the Red Sea this rate has been estimated at two-and-a-half knots during spring tides…"

***Shipping Wonders of the World,* ca. 1937**

319

The Fresh-Water Canal

320

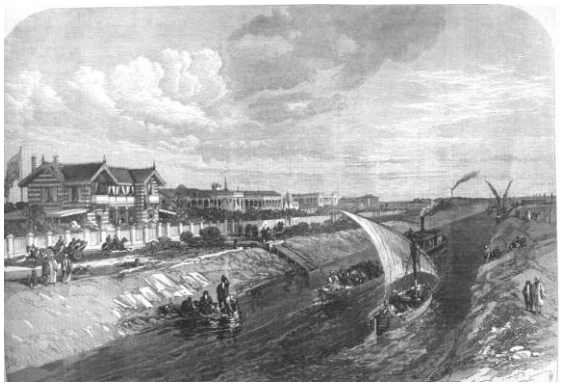


"…The Suez Canal depends upon the Fresh-Water Canal. This brings drinking water from the Nile across the desert, and, although it does not float the ships which pass through the maritime canal, is the life-blood of the whole great enterprise, and was the greatest tool which De Lesseps used to build the canal…"

***Shipping Wonders of the World,* ca. 1937**

Caption: **"Plan of the Maritime Canal, with the small Fresh-Water Canal"**

321



The Isthmus of Suez Maritime Canal; Ismailia and the Fresh-Water Canal 322

A French Enterprise

323

"…The company does not own the canal in perpetuity. The concession expires in 1968, after which the canal passes into the hands of the Egyptian Government, unless other arrangements are made. The company is registered as an Egyptian body with headquarters in Paris, and the canal was constructed by French engineers, with capital that was mainly French and partly Egyptian, by French and Egyptian labour…"

***Shipping Wonders of the World,* ca. 1937**

Caption: **"France/Egypt: Debenture for the Suez Canal, 1985"**

324

"…More than half the revenue is normally derived from British ships, the route being vital to the British Empire. Less than half the shares - 44 per cent - are owned by the British Government…"
***Shipping Wonders of the World,* ca. 1937**

325

The Suez Canal
Scientific American
June 10, 1865

326

THE great canal for connecting the Red Sea with the Mediterranean is so far advanced as to be navigable for small barges through its whole length, with the exception of one point where a large lock is In process of construction; a transshipment is required at this place. The advance of the work to this stage was celebrated on the 7th of April by what was called "an opening of the canal," this being the second "opening," which has been publicly celebrated.

The canal when completed will be about 100-miles-long, and 330-feet-wide at the water line, with its bottom 20-feet below the level of the Mediterranean. The projector of the enterprise is M. F. De Lesseps, a Frenchman, who obtained a grant in 1854 from the Egyptian Government of the right-of-way for 99 years, on condition of paying 15 per cent of the net profits to that Government. He then formed a joint stock company, with a capital of $40,000,000, on condition that 75 per cent of the profit should be divided among the stock holders, 15 per cent should be paid to the Egyptian Government, and 10 per cent should go to the originators of the enterprise. On these terms the stock was taken-up, $18,000,-000 by the Egyptian Government, and the remainder by capitalists in Paris and London. It is stated that contracts have been made for the completion of the several parts of the work by the 1st of July, 1868. The distance from New York to Bombay, in India, is now by the Cape of Good Hope, 18,600 miles; by the way of the Suez Canal it will be 11,283 miles, the new route thus shortening the voyage more than 7,000 miles.

327

328

The Prospects of the Suez Canal
Scientific American
July 22, 1868

329

MERE speculators, and particularly English speculators, have held aloof from the Suez Canal Company, and it has, therefore, been carried on chiefly by French capitalists. This apparent want of enterprise has been caused by the magnitude of the undertaking and the want of definite answers to such questions as, "Will the canal ever pay?" "How much more capital will be required for its completion?" and "Is there no chance of competition?" A feeling of jealousy toward France also contributed to English distrust. One of the directors of the company writes to the *London Times* to supply this deficiency. He expects that when the canal is opened two thirds of the traffic now passing around the Cape will be diverted. Such traffic he estimated at the lowest as 600,000,000 tons annually two-thirds of which would yield at .2 per ton, an income of $8,000,000 per annum. Seeing that more voyages could be made by the same vessel by the shorter distance, the writer anticipates a larger income than this, which it must be observed, is from merchandise merely, leaving passengers out of the question. The cost for maintenance and the interest on loans is estimated at about $4,-000,000, leaving the same sum for division - a very fair dividend of 10 percent. No more capital will be required after the arrangement of the present loan of $20,000,000, the total amount subscribed being $60,000,000. As to whether the canal is safe from future competition by the Euphrates Valley line, no great evil from opposition is apprehended. Lord Clarence Paget inspected the works in 1867, and was of opinion that they would succeed.

330

In France the capitalists are rather slow in coming forward with any more money. The result is that the legislative body has taken the matter up, and passed a bill which allows the managers to get up a lottery in aid of the enterprise. The lottery custom was put down in 1836, but it has been again permitted – "just this once." Berryer, Thiers, and a great number of others, abstained from voting, or stayed away, and some of the minority said some dreadful things about the immorality of lotteries. And yet they have, in their time, built churches, hospitals, etc.; they helped Queen Elizabeth to beat .the Spanish Armada, and they may help M. Lesseps to complete his cosmopolite canal. In this age, however, a reasonable distrust may well be entertained of the financial management of any enterprise that resorts to such questionable means to obtain money.

331

"…The president of the company is always a Frenchman. There are thirty-two directors, twenty-one being French, ten British and one Dutch; they meet on the first Monday in every month to receive the report of the chairman of the committee of management, who is president of the company. This committee, upon which a representative of the British Government has a seat, meets once a week, and directs the policy of the company, subject to the approval of the board…"
***Shipping Wonders of the World,* ca. 1937**

332

"…All the executive work is done in Egypt. The head officer, called the Chief Agent, has his offices in Cairo, and is the diplomatic officer-in-charge of relations with the Egyptian Government and is supreme, being directly responsible to the board in Paris. He supervises traffic, works, health, houses, buildings, legal business and water supplies…"
***Shipping Wonders of the World,* ca. 1937**

333

"…The principal officers of the Traffic Department are recruited from the French Navy. Engineering work, workshops, ferries and tugs are controlled by the Works Department, of which the main secretariat and personnel is French, but the workers are cosmopolitan. No appointment is made without two years' probation…"
***Shipping Wonders of the World,* ca. 1937**

334

"…The canal is of paramount importance to British shipping. Figures vary from year-to-year, those for 1935 being affected by the war in Abyssinia. Taking 1934 as a representative year, 3,071 transits of the canal were made by British ships, representing a net tonnage of 17,238,128. The total figures for all nations were 5,663 transits and 31,750,802 net tons. British figures were, therefore, more than half the totals…"
***Shipping Wonders of the World,* ca. 1937**

335

Caption: "The New Suez Canal Agreement – Conference between M. De Lesseps and the Council of the London Chamber of Commerce (1883)"

336

"…Germany occupied second place with 509 transits and 2,976,451 tons. The Italians were third in the number of transits, 435, but the tonnage, 2,089,003, was below the 2,559,182 of Holland, Dutch ships making 378 transits. French, Norwegian and Japanese ships came in the order named…"
***Shipping Wonders of the World,* ca. 1937**

337

The Suez Canal.

One thousand five hundred and fifty vessels passed through the Suez Canal in 1878. Of these 1,227 were British, 89 French, 71 Dutch, 44 Italian, 38 Austrian, 22 German, 21 Spanish, 8 Egyptian, 8 Japanese, 6 Danish, 5 Swedish and Norwegian, 4 Portuguese, 3 Turkish, 2 Belgian, 1 American, and 1 Zanzibar. The total tonnage was 2,178,316 tons, of which 1,726,946 tons were British.

(*Scientific American*, October 4, 1879)

338

The Suez Canal
Scientific American
February 21, 1874

339

IT has been proposed that the European Powers should buy the Suez Canal, and throw it open for the benefit of the whole world of commerce. The present dues levied by the company, it is stated, are absolutely prohibitive against the greater portion of the imports and exports on both sides of the canal; and a recent increase which has been made, of some 43 per cent on the original charges, on the basis of tonnage, operates to shut-out small vessels and heavy goods. Each country, it is suggested, should contribute a certain quota of the purchase money, to be estimated by a determination of the amount of benefit which each individual commerce would receive by the enfranchisement; and by this means, the entire estimated amount of $70,000,000 (at par, and without interest), it is said, could be collected. Vessels in such a case would be required to pay only such dues as would aggregate sufficient for the simple maintenance of the work, and not be heavily taxed as at present for the accretion of large dividends. It is believed that the commerce of the world would thus be immensely benefited.

340

Rules of the Road

341

"…The company prescribes movements of ships to ensure safety and the speedy passage of mail ships. Vessels carrying ammunition, explosives or other dangerous cargo have to conform to special regulations. Vessels are not allowed to overtake one another under way, and speed has to be eased when passing sidings, sections of the bank where work is being done, or dredgers and barges. The system of measurement is that established by an international commission…"
***Shipping Wonders of the World,* ca. 1937**

342

The Pathfinder

343

"…When railways developed and steamships came into being, the world became interested in speed. The Isthmus of Suez was the obvious short-cut in travel and communication, and the overland route across the isthmus attracted attention…"
***Shipping Wonders of the World,* ca. 1937**

344

"…Rather more than a century ago a certain British officer named Waghorn took some duplicate dispatches from London to Bombay and raced a ship which was carrying the originals to India round the Cape of Good Hope. Waghorn went by way of Alexandria and Suez, and then by sea…"
***Shipping Wonders of the World,* ca. 1937**

345

THE LIFE AND LABOURS OF LIEUTENANT WAGHORN.

[From *Dickens' Household Words.*]

The great benefactors of our species may be divided into two grand classes—the men of thought, and the men of action; the men whose genius was chiefly in the realm of mind, and those whose power lies in tangible things. Let no one set up the idle and invidious comparison as to which of the two is the nobler, since both are equally needful to the world's progress; all great thoughts and theories, dreams and visions (let us never fear the truth, but honour it even in using terms of vulgar and shortsighted opprobrium) of men of genius and knowledge, being the germ and origin of great actions,—and all great actions being the practical working out of the former, without which no good to mankind at large can be accomplished. To set thought and action, therefore, in opposition to each other, it like setting the arms and legs of Hercules to quarrel with his head while performing his labours. Nor can the distinction, thus broadly stated, be drawn at all times with any definite precision, since the man who conceives and developes a new principle, is sometimes able to carry it out himself. This combination of powers in the same individual is very rare, and is obviously one reason why, in most cases, the originator of a new thing is neglected as a visionary, and a madman. But the energy of thought to conceive and design displayed by Lieutenant Waghorn, was *more* than equalled by the energy

346

of character and action required to carry out his stupendous plans. Sometimes with the best assistance—sometimes with none—sometimes in defiance of contest, opprobrium, and opposition—the vigour of mind and body of this man caused him to undertake and to succeed in projects which are among the most prominent of those which especially characterise the genius of the present age.

We have intimated that Mr. Waghorn was a man both of thought and action, but this must be understood with certain marked limitations. Mr. Waghorn's mind was of that peculiar construction, which appears never to think earnestly except with a view to action. Even that quality, which in other men is of the most ideal kind, and commonly exerts itself in matters of little or no substantiality of fact and purpose, with him partook of the physicality of his strong nature as much as the admixture was possible,—so that he may be said to have had a practical imagination. His objects and designs were welded into all the materials of his understanding and knowledge; his ambitions and hopes were fused with the generation of the mighty steam forces that were to drive his ships across the ocean and inland seas; the elasticity of his spirit was identified with the flying speed of Arab horses, and dromedaries carrying the "mail" across the desert; and when he projected a wonderful shortening of time and space, he at the same moment beheld the broad massive arm of England stretched across to govern and make use of her enormous Indian territories, comprising a hundred millions of souls. He never thought of himself; he was too much engaged with the vastness of his designs for his country. We shall see how that country rewarded his efforts.

347

Thomas Waghorn was born at Chatham, in 1800. At twelve years of age he became a midshipman in her Majesty's Navy: and before he had reached seventeen, passed in "navigation" for Lieutenant, being the youngest midshipman that had ever done so—the examination requiring a great amount of both theoretical and practical knowledge, and being always conducted with severity. This made him eligible to the rank of lieutenant, but did not include it. At the close of the year 1817, he was paid off, and went as third mate of a free-trader to Calcutta. He returned home, and in 1819, obtained an appointment in the Bengal Marine (Pilot Service) of India, where he served till 1824. At the request of the Bengal Government, he now volunteered for the Arracan War, and received the command of the Honourable East India Company's cutter *Matchless*, together with a division of gun-boats, and repaired to the scene of action in Arracan, with the south-eastern division of that army and flotilla. He was five times in action, saw much rough work by land and by sea, and escaped with only one wound in the right thigh. He remained two years and-a-half in this service, and after having received the thanks of all the authorities in that province, he returned to Calcutta in 1827, with a constitution already undermined from the baneful fever of Arracan, where so many thousands had died.

Weakened as he had been, Mr. Waghorn nevertheless rallied to the great project he had secretly at heart, namely, "a steam communication between our Eastern possessions and their mother-country, England." Even before his departure from Calcutta on furlough, in 1827, ill in health and only imperfectly recovered from

348

the Arracan fever, still, between its attacks, his energies returned. He communicated his plan to the officials, namely, the Marine board at Calcutta, who forthwith advanced it to the notice of the then Chief Secretary to the Bengal Government, the present Mr. Charles Lushington, M.P., for Westminster; through whom he obtained letters of credence from Lord Combermere, then acting as Vice President in Council, (Earl Amherst, Governor-General, being on a tour in Upper India,) to the Honourable Court of Directors of the East India Company in London, recommending him, in consequence of his meritorious conduct in the Arracan War, "as a fit and proper person to open Steam Navigation with India, *viâ* the Cape of Good Hope."

On his homeward voyage, Mr. Waghorn advocated this great object publicly by every means in his power (the numerous attestations of which lie open before us) at Madras, the Mauritius, the Cape, and St. Helena. Directly he arrived in England, he set about the same thing, and advocated the project at all points, particularly in London, Liverpool, Manchester, Glasgow, Birmingham. But the Post Office, at that time, was opposed to ocean steam-navigation; and so, unfortunately, were the East India Directors,—with the single exception of Mr. Loch. Two whole years were thus passed in fruitless efforts to make great men open their eyes. At length, in October, 1829, Mr. Waghorn was summoned by Lord Ellenborough, the then Chairman of the Court of Directors, to go to India, through Egypt, with despatches for Sir John Malcolm, Governor of Bombay, &c., and, more especially,

to report upon the practicability of the Red Sea Navigation for the Overland Route.

On the 28th of October, having had only four days' previous notice from the India House, Waghorn started on the top of the Eagle stage-coach from the Spread Eagle, Gracechurch street. All his luggage weighed about twenty pounds. The East India Company's steam vessel *Enterprise* was expected to be at Suez, in the Red Sea, from India, on or about the 8th of December. It was much desired that despatches from England should reach her at this place, which Mr. Waghorn undertook they should do. He could not speak French nor Italian, both of which would have been very advantageous; but he had some knowledge of Hindostanee, and a little Arabic.

On this "trip," as Waghorn calls it, so extraordinarily rapid was the first part of his journey, viz., to Trieste, (accomplished in nine days and a half, through five kingdoms) that an enquiry was instituted by the Foreign Office respecting it; for at this time our Post Office letters occupied fourteen days in reaching that place. Yet Waghorn had been obliged to travel upwards of one hundred and thirty miles out of his direct way, in consequence of broken bridges, falling avalanches, and the disabling of a steamer.

Instantly inquiring for the quickest means of getting on to Alexandria, he was informed that an Austrian brig had sailed only the evening before, and having had calms and light airs all night, she was still in sight from the tops of the hills. Away he dashed in a fresh posting carriage, because if he could reach Pesano, through

Instantly inquiring for the quickest means of getting on to Alexandria, he was informed that an Austrian brig had sailed only the evening before, and having had calms and light airs all night, she was still in sight from the tops of the hills. Away he dashed in a fresh posting carriage, because if he could reach Pesano, through Capo D'Istria, twenty miles down the eastern side of the Gulf of Venice, before the Austrian vessel had passed, he might embark from this port as passenger for Alexandria. On reaching Pesano, he could still distinguish the vessel, and he accordingly strove to increase the rapidity of his chase to the utmost. He got within three miles of the vessel. At this juncture a strong northerly wind sprang up, and carrying her forward on her course she was presently lost to sight. Exhausted in body, and "racked," as he says by disappointment after the previous excitement, he returned to Trieste.

Ascertaining that the next opportunity of getting to Alexandria would be by a Spanish ship, which was now taking in her cargo in the quarantine-ground, he instantly hastened there. The captain informed him that he could not possibly sail in less than three days, and required one hundred dollars for the passage. Waghorn directly offered him one hundred and fifty dollars if he would sail in eight and forty hours. Whereupon the captain found that it was just possible to do so; and he kept his word.

"After a tedious passage of sixteen days," says Waghorn, "to whom every hour that did not fly was no doubt tedious," I arrived at Alexandria; but hearing that Mr. Barker, who

held the combined offices of Consul-General in Egypt, and agent to the Honourable East India Company, was at his country-house at Rosetta, I hired donkeys, and was on my way for it after five hours' stay at Alexandria."

One ludicrous characteristic of the Alexandrian donkeys is worth recording. Never in future can we regard the epithet of "an ass," as being properly synonymous with stupidity. The creatures ambled and trotted along very well during the first day; but on the subsequent morning, when they clearly perceived that a long journey was before them, they *fell down* intentionally four or five times, with all the appearance of fatigue and weakness. The drivers informed him that it was a common practice of the donkeys.

Embarking on the Nile, our traveller made it his business to navigate the boat himself, in order to take soundings, and to obtain as much knowledge as would promote both the immediate and future objects of his journey.

Mr. Waghorn rested at Rosetta, to recover from his fatigue, and then set out for Cairo on a *cangé*, a sort of boat of fifteen tons burthen, with two large latteen sails. The *rais*, or captain, agreed to land him at Cairo in three days and four nights, or receive nothing. This he failed to do, in consequence of the boat grounding on the shoal of Shallakan. Waghorn's notions of a reason for fatigue may be curiously gathered from a remark he makes incidentally on this occasion. "The crew," says he, were almost fatigued: we have been continually tacking for five days and nights." Being out of all patience, he left the boat, and again mounting donkeys, proceeded with his servant to Cairo. He left his luggage behind him, merely taking his despatches.

Having obtained camels, and a requisite passport from the Pasha, Mohammed Ali, to guarantee his safe passage across the desert of Suez; Mr. Waghorn left Cairo on the 5th of December for Suez, and at sunset had pitched his tent on the Desert at six miles distance.

At dawn of day he was on his journey, and managed to travel thirty-four miles beneath the burning sun before he halted. The next day he journeyed thirty miles, and in the evening pitched his tent only four miles short of Suez. The next day, he reached the appointed place, and there rested, the *Enterprise* not having yet arrived.

While waiting with the greatest impatience the arrival of this steamer, Mr. Waghorn appears to have endeavoured to calm himself by jotting down a few observations on the Desert he had just crossed. These observations, slight and few as they are, must be "made much of," as they are of all things the rarest with him. He always saw the end before him, and nearly all his observations were confined to the means of attaining it.

"The Desert of Suez, commencing from Cairo, is a gentle ascent, about thirty-five miles on the way; then the same gradual descent till you arrive at the plains of Suez. The soil of the first five miles from Cairo is fine sand; then, coarse sand, ineliuable to gravel. Within twelve miles of Suez; (notice—he is tired already of description, and brings you within twelve miles of the place) "you meet many sand-hills between, till you arrive at the plains before mentioned, which form a perfect level for miles in extent, leads you to the gates of Suez.

"The antelopes I observed in parties of about a dozen each, and the camel-drivers informed me that they creep under the shrubs about eighteen inches high, to catch the drops of dew, which is the only means they have of relieving their thirst. I saw partridges in covies of from six to seven, but nowhere on the wing; they were running about the desert, and I was informed they were not eaten even by the Arabs."

Considering the food they pick up in the desert, perhaps this is no wonder.

Having informed us that camels are to be had very heaply at Suez—say a dollar each camel for fifty miles distance—and that the water is very brackish, he suddenly adds, with characteristic brevity, "To save recapitulation in describing Cossier, it is the same as Suez, viz., camels are to be had in abundance at a trifling expense, and the water is as bad."

He remained at Suez two days, waiting with feverish anxiety the expected arrival of the *Enterprise*. She still did not appear—a strong N.W. wind blowing directly down the sea. Being quite unable to endure the suspense any longer, he determined to embark on the Red Sea in an open boat, intending to sail down its centre, in hopes of meeting her between Suez and Cossier. All the seamen of the locality vigorously remonstrated with Mr. Waghorn against this attempt, and he well knew that the nautical authorities, both of the East India House and the British Government, were of opinion that the Red Sea was not navigable. But he had important Government despatches to deliver—had pledged himself to deliver them on board the *Enterprise*,

and considering that his course of duty, as well as his reputation as a traveller, were at stake, he persisted in his determination. Accordingly, he embarked in an open boat, and without having any personal knowledge of the navigation of this sea, without chart, without compass, or even the encouragement of a single precedent for such an enterprise—his only guide the sun by day, and the north star by night—he sailed down the centre of the Red Sea.

Of this most interesting and unprecedented voyage, the narrative of which every one would have read with much avidity, Mr. Waghorn gives no detailed account. He disappoints you of all the circumstances. All intermediate things are abruptly cut off with these very characteristic words:—"Suffice it to say, I arrived at Juddah, 620 miles, in six and a half days, in that boat!" You get nothing more than the sum total. He kept a sailor's log-journal; but it is only meant for sailors to read, though now and then you obtain a glimpse of the sort of work he went through. Thus:—"*Sunday*, 13th, strong N.W. wind, half a gale, but scudding under storm-sail. Sunset, anchored for the night. Jaffateen islands out of sight to the N. Lost two anchors during the night," &c. The rest is equally nautical and technical. In one of the many scattered papers collected since the death of Mr. Waghorn, we find a very slight passing allusion to toils, peril, and privations, which, however, he calmly says, were "inseparable from such a voyage under such circumstances,"—but not one touch of description from first to last.

355

A more extraordinary instance of great practical experience and knowledge, resolutely and fully carrying out a project which must of necessity have appeared little short of madness to almost everybody else, was never recorded. He was perfectly successful, so far as the navigation was concerned, and in the course he adopted, notwithstanding that his crew of six Arabs mutinied. It appears (for he tells us only the bare fact) they were only subdued on the principle known to philosophers in theory, and to high-couraged men, accustomed to command by experience, viz., that the one man who is braver, stronger, and firmer than any individual of 10 or 20 men, is more than a match for the 10 or 20 men put together. He touched at Crossier on the 14th, not having fallen with the *Enterprise*. There he was told by the Governor that the steamer was expected every hour. Mr. Waghorn was in no state of mind to wait very long: so finding she did not arrive, he again put to sea in his open boat, resolved, if he did not fall in with her, to proceed the entire distance to Juddah, a distance of 400 miles further. Of this further voyage he does not leave any record, even in his log, beyond the simple declaration that he "embarked for Juddah—ran the distance in 3 days, 21 hours, and a quarter—on the 23rd anchored his boat close to one of the E. I. Company's cruisers, the *Benares*."

But, now comes the most trying part of his whole undertaking—the part which a man of his vigorously constituted impulses was least able to bear as the climax of his prolonged and arduous efforts, privations, anxieties, and fatigue. Repairing on board the *Benares*, to learn the news,

356

the captain informed him, that in consequence of being found in a defective state on her arrival at Bombay, "the *Enterprise* was not coming at all." This intelligence seems to have felled him like a blow, and he was immediately seized with a delirious fever. The captain and officers of the *Benares* felt great sympathy and interest in this sad result of so many extraordinary efforts, and detaining him on board, bestowed every attention on his malady.

"Thus baffled," writes Mr. Waghorn, "I was six weeks before I could proceed onward to Bombay by sailing vessels." On arriving at Bombay with his despatches, the thanks of the Government in Council, &c., were voted to him "for having, when disappointed of a steamer, proceeded with these despatches in an open boat, down the Red Sea, &c." There was evidently much more said of a complimentary kind, but Waghorn cuts all short with the &c.

He reached Bombay on the 21st of March, having thus accomplished his journey from London in four months and twenty-one days—an extraordinary rapidity at this date, 1830. Of course, the time he was detained in Cairo, Suez, Cossier, and Juddah (where he lay ill with the fever six weeks), ought to be deducted, because, he would have saved all this time, fever inclusive, if he had not expected the *Enterprise* from India.

He now turned his attention to a series of fresh exhortations to large public meetings which he convened at different places—Calcutta, Madras, the Isle of France, the Cape of Good Hope, St. Helena, &c., on the subject of shortening the route from England to India, and lessening the time. He described the various points of the

357

new route he proposed, and also the new kind of steam-vessel which it was advisable to have built and fitted up for the sole purpose of a rapid transmission of the mail. In an "address to his Majesty's Ministers and the Honourable East India Company," which we find among his papers, there occurs the following passage—simple in expression, noble in its quiet modesty, but pregnant with enormous results to his country, all of which have already, in a great degree, been accomplished.

"Of myself I trust I may be excused when I say that the highest object of my ambition has ever been an extensive usefulness; and my line of life, my turn of mind, my disposition long ago impelled me to give all my leisure, and all my opportunities of observation, to the introduction of steam vessels, and permanently establishing them as the means of communication between India and England, including all the colonies on the route. The vast importance of three months earlier information to his Majesty's Government and to the Honorable Company, whether relative to a war or a peace; to abundant or to short crops; to the sickness or convalescence of a colony or district, and oftentimes even of an individual; the advantages to the merchant, by enabling him to regulate his supplies and orders according to circumstances and demands; the anxieties of the thousands of my countrymen in India for accounts, and further accounts, of their parents, children, and friends at homes; the corresponding anxieties of those relatives and friends in this country; in a word, the speediest possible transit of letters to the tens of thousands who at all times in solicitude await them, was service to my mind of" (of the greatest general importance) "and it shall not be my fault if I do not, and forever, establish it."

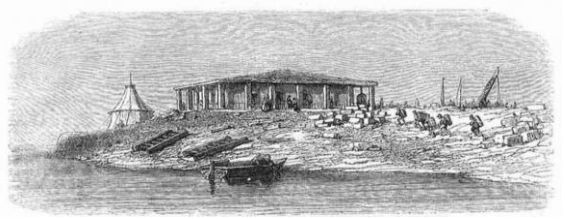
358

"…He died in penury later, but he stimulated the desire for speed, De Lesseps erected a monument to him at Port Tewfik, and the P. and O. line developed this overland route for mails…"

***Shipping Wonders of the World,* ca. 1937**

Above & Left: caption: "Port Tewfik – Monument to Lieutenant Waghorn"

359



"…Later, the British obtained a concession for building a railway from Alexandria to Suez. It should be remembered that when De Lesseps started his propaganda for a ship canal, the P. and O. company were among his most ardent supporters…"

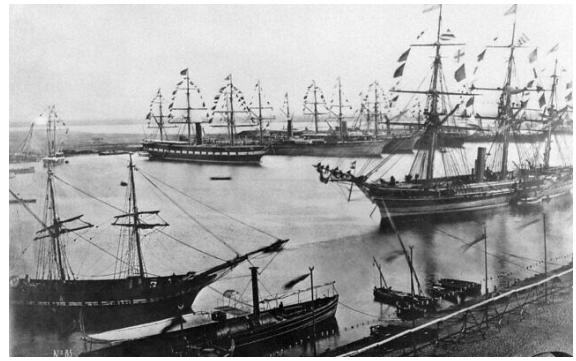
***Shipping Wonders of the World,* ca. 1937**

Caption: "The Suez Canal across the Isthmus of Suez; Kafriel Eis Station on the Alexandria and Cairo Railway"

360

A Day to Remember

361



"…The inauguration festivities were magnificent. A great fleet assembled at Port Said ready to make the first transit on November 17, 1869…"
***Shipping Wonders of the World,* ca. 1937**
Caption: "Ships assembled for the inauguration of the Suez Canal, Nov. 1869"

362

The Canal of Suez and the Future of Egypt
Scientific American
November 27, 1869

363

AS we approach the 17th of November, the day appointed for the final opening of the Canal of Suez, the interest felt in Europe and America in this vast enterprise, increases with every new report of its advance towards completion. A few days more, and the two seas – the Sea of Corals, or Mediterranean, and the Sea of Pearls, or Red Sea – will be joined by a water route of 26-feet in depth and 328-feet in width, except at El Guisr, Serapeum, and Chalouf, where the canal only measures 196-feet.

The greater part of the expense of the works, conducted with as much patience as courage, has been borne by Egypt, while France will carry off the triumph, and England may in time derive the greatest profit.

The influence which this enterprise will have upon Egypt itself, is at the present moment a great and general question among the Egyptian agriculturists as well as European traders. It is certain that the commercial aspect of Egypt will undergo a change within a short time, and the culture of the soil will be carried on in a different way from what has been for centuries.

The large and powerful machines constructed, and many even invented for the works of the canal, will, after its completion, never return to Europe but remain in Egypt, to be used for the drainage of the Nile and the canals employed in irrigation. The "chadouf,' the "sakie" or noria, and other irrigating machines often portrayed in engravings representing Egyptian scenes, will soon give way to steam engines, the price of coal having fallen from $14 to $10 and even less according to the distance of transportation.

364

The great Civil War of America when cotton rose to such a high price, and the speculators were so blinded by their success that they hoped it would rise still higher, caused many failures in Egypt. Even the late Pacha, Mohammed Ali, himself was carried away by the excitement. He believed that the low rate of wages for manual labor and other natural advantages, destined his empire to the cotton and other industries; he did not calculate, however, at that period upon the great worker of modern times – coal. No manual labor, even at the lowest rate, can compete with coal at a low price, such as it bears in England. Many grain mills and factories were built during the year 1864, principally in the Delta of the Nile, which were however abandoned as soon as they were constructed, and are today in a state of ruin.

Ismail Pacha – the "Prince of the Fellahs," as he pleases to call himself – sees clearly the many deficiencies of Egypt. He is aware that in the present state it cannot rival other commercial nations. He knows that its agriculture must undergo a change. He is not ignorant of the fact that the Egyptian wheat is much inferior to that of other countries, on account of a certain acrimony and musky flavor, and that it contains less azotic substance than other cereals. With these defects it brings only two-thirds of the usual market price, and even then it is not greatly in demand.

365

The cause for this degeneration in the quality of the Egyptian cereals is but too plain; the fellahs force the same land to produce the identical crop a hundred time successively. They do not yet understand that it refreshes the soil to change its culture, and as they have always been pressed for money, they have sold the best of their harvest, and sowed the worst.

Most of the Egyptians believe that their soil requires manuring, have taken recourse to the columbine or pigeon dung. But the culture of pigeons has proved to be a greater loss to the country than actual profit. It is estimated that the food of each of these birds amounts to a-quarter-of-a-per-cent-per-day, which multiplied by the estimated number of pigeons in Egypt, makes up a sum of $60,000 value of wheat which they annually devour. The meat of these birds is of but little value, and the revenue of columbine produced by 20,000 pigeons is insignificant. The attempt to restore the land by the use of columbine is consequently a failure.

The Koran forbids the believers to spread the dejectures of men and beasts upon their fields, the former as being impure, the latter as being necessary for kitchen-fuel, for which purpose they have been used since time immemorial, on account of the scarcity of wood in Egypt. For this purpose they are formed into a sort of thin cakes and dried in the sun, which renders them hard and fit for burning.

366

A few cultivators who have studied deeper into the science of agriculture, have discovered that the phosphate of lime is wanting in the soil of Egypt. They need, however, not go far to find the remedy for this defect. The deserts are strewn with the bones of animals. This is an open mine. The bones may be gathered and ground with little trouble, and the dust gained therefrom will restore the wanted phosphate of lime. Experiments with these bones have already been tried with decided success.

Sugar-cane is extensively cultivated throughout Egypt. All the fellah's are allowed to raise, express, boil, and even refine their sugar if they choose; but the high price of machinery and implements has prevented the petty cultivators from producing sugar for the market. Only the Viceroy himself is rich enough to set-up sugar works, and thus sugar manufacturing has almost become a monopoly of the sovereign. The largest of his works is at Ermentin Upper Egypt; but as the price of the ton of coal rises to $20 before it reaches that place, the home-made sugar cannot compete with foreign productions.

367

Out of ten sugar-canes the Egyptians carry nine to the mill and keep the tenth for planting, which they lay into the ground in its full length and every joint produces a bunch of young sprouts. This method is faulty in a double way; it is absurd to bury every year one-tenth of the harvest, when it might be used to so much better advantage; and it is useless to press the upper or white end of the cane, which yields an insipid juice, containing but little sugar. Another great mistake in their planting is that they do not leave a space large enough between each separate plant, the air cannot circulate, the under leaves dry-up, while the cane grows high but has no body.

Irrigation is often practiced at an improper time, a month before the crop is gathered in. This is done especially by those who sell their harvest for the works of the viceroy. They bring in their cane gorges with water; this excess of moisture, which has to be removed requires a greater quantity of heat, which causes consumption of fuel. Yes it seems that it is difficult to hinder the fellahs from exaggerating the weight of their crop to the detriment of its quality. They are like the farmers of Flanders, who sell their beets by the pound, and therefore prefer to have them heavy, rather than rich and good.

368

The rate of wages paid to the fellahs for their labor is on an average about eight cents per day, and it is often paid to them in food, yet they appear satisfied with it. And yet, working hands are wanting in Egypt. For centuries, masters of the country have squandered human life. Those works of art which today are the admiration of travelers, the pyramids, the hypogeums, the temples, and the monuments, have cost the lives of thousands. The insecurity of property, and more than that, the severe laws of bondage have been the cause of many formidable emigrations. When the neighboring tribes will have the assurance of their liberty and that they will not be overtasked, immigration will not be slow and the working population will soon increase.

Ismail Pacha has tried to remedy all these defects ever since his accession to the throne; but what are six years of an improved government in counteracting the evils of centuries of despotism.

Until of late, the Egyptian fellah has been tortured by an insecurity of person and property. The farmer never felt secure against an arbitrary order from Government, which would send him perhaps some hundred miles away from his home to do public work, just at the time when his own fields needed attention; and no one could be sure that the tax levied upon him tomorrow would not take everything he possessed. As of old, the Egyptian of the present day, when he receives a piece of gold, makes it his first care to dig a hole in the ground and bury it as if it was an ill-gotten gain. Egypt may be paved with gold, for this custom dates back to time immemorial

369

The cotton crisis during the Civil War in America had enriched Egypt, yet where are these riches? The apparent prosperity of the fellah has not increased, and hardly any public buildings have been constructed. It is but too probable that all the riches are holden in the ground and will be so, until Ismail Pasha has given full assurance to his subjects, that a new era has begun for Egypt, and that personal liberty will henceforth protect every commercial enterprise.

The Isthmus of Suez, once the curse of the fellahs, may ere long become a blessing to them; for assuredly there is a rich mercantile harvest in store for Egypt since the Eastern portal has been unlocked, and the traffic which, until now, was divided, will concentrate on this hitherto barren neck of land, which in time will become cultivated. Lake Timsah, which was formerly filled with fresh water and in which crocodiles flourished, has been filled with salt water, and sea-fish and oysters can in future be raised in its deep waters, as also in the Bitter Lakes. As to the extensive Lake Menzaleh, another great project has been laid before the members of the Company by a Mr. Ritt, a young Frenchman, who proposed to drain-off this vast lagoon and prepare it for the rice culture. The idea is grand, though it can only be accomplishes at great expense.

With these large sheets of inland water, rain will be a more frequent occurrence in the neighboring deserts, the lack of which has hitherto been the main obstacle to the culture of the surrounding country.

370

The route which the pilgrims and caravans from and to Arabia pursued was to cross the Red Sea at Kosseir, whence they traversed the desert to Keneh to gain the Nile, and thus followed the water route to Cairo and Alexandria. The tedious journey will doubtless be abandoned after the opening of the canal; already thousands of pilgrims going and coming from Mecca have chosen this new road. Keneh and its environs may, nevertheless, become a place of importance through its rich Sulphur mines and granite quarries. The borders of the Red Sea abound with inestimable treasures; but they are guarded against the desires of men by an evil genius – thirst! How can a mine be explored, even if it contains gold and emeralds, in a country where it never rains, and where in consequence, not a drop of fresh water is to be found?

Should this Canal of Suez prove a decided success, then navigation will spread upon waters that have heretofore been undisturbed, and we fully agree with Edmund About, when he says that "Though M. De Lesseps cannot claim the original idea of this work, which is almost as old as the world itself, yet he has invented its success." The glory of the execution will be so much greater as the obstacles appeared at first insuperable. To conquer the indifference, skepticism, avarice, and ill-will which this work has met in its progress, is a greater triumph than was ever won on a field of battle.

371

A Piece of the Action

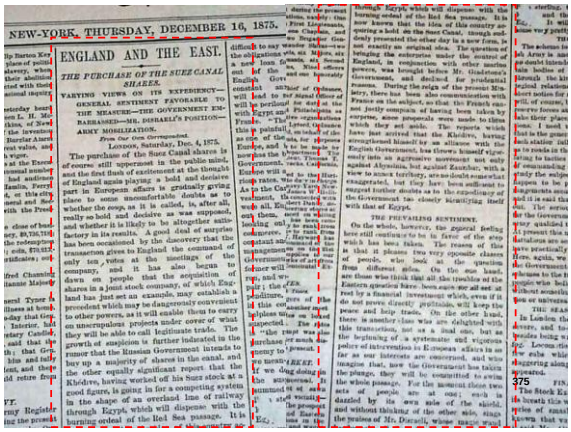
372

"…Although British ships then formed the bulk of the traffic Britain had no shares in the canal…"
***Shipping Wonders of the World,* ca. 1937**

373

"…In November, 1875, Disraeli, the Prime Minister of England, heard that Ismail Pasha, in need of money, was trying to sell his shares in the canal to French interests. Disraeli called a meeting of the Cabinet, obtained their consent, raised £4,000,000 from Baron Rothschild, and in about nine days the Egyptian shares were in British hands. This achievement was the crowning point of Disraeli's career…"
***Shipping Wonders of the World*, ca. 1937**
Caption: "Portrait of Disraeli published in 1873"

374



NEW-YORK, THURSDAY, DECEMBER 16, 1875.

ENGLAND AND THE EAST.

THE PURCHASE OF THE SUEZ CANAL SHARES.

VARYING VIEWS ON ITS EXPEDIENCY—GENERAL SENTIMENT FAVORABLE TO THE MEASURE—THE GOVERNMENT EMBARRASSED—MR. DISRAELI'S POSITION—ARMY MOBILIZATION.

From Our Own Correspondent.

LONDON, Saturday, Dec. 4, 1875.

The purchase of the Suez Canal shares is of course still uppermost in the public mind, and the first flush of excitement at the thought of England again playing a bold and decisive part in European affairs is gradually giving place to some uncomfortable doubts as to whether the coup, as it is called, is, after all, really so bold and decisive as was supposed, and whether it is likely to be altogether satisfactory in its results. A good deal of surprise has been occasioned by the discovery that the transaction given to England the command of only ten votes at the meetings of the company, and it has also begun to dawn on people that the acquisition of shares in a joint stock company, of which England has just set an example, may establish a precedent which may be dangerously convenient to other powers, as it will enable them to carry on unscrupulous projects under cover of what they will be able to call legitimate trade. The growth of suspicion is further indicated in the rumor that the Russian Government intends to buy up a majority of shares in the canal, and the other equally significant report that the Khédive, having worked off his Suez stock at a good figure, is going in for a competing system in the shape of an overland line of railway through Egypt, which will dispense with the burning ordeal of the Red Sea passage. It is

375

Suez Canal is Not Owned by the British Government
Scientific American Supplement
January 25, 1913

376

THERE has been so much loose and uninformed talk about the ownership of the Suez Canal in connection with the discussion of the Panama Canal bill that a statement of that ownership seems timely. It is alleged, for instance, that Great Britain owns it, through her occupation of Egypt, or directs it by ownership of a majority of the shares, or allows her own vessels to use it without paying tolls, while collecting those of other countries.

The Suez Canal is an Egyptian company, authorized by a decree of the Khedive, March 19th, 1866; it is governed from Paris. The British government does not own it, but is merely a private stockholder, and does not own even a majority of the shares. It has, in fact, an equity which might, in conceivable circumstances, be extinguished altogether. On the Board of Directors there are twenty-one French members, one Egyptian member, and ten English members who constitute what is called the "London Committee." The manager and secretary, together with the president, and even the manager of the London office, are all French.

377

The capital of the company, authorized and issued, is 200,000,000 francs, in 400,000 shares, of which 378,231 shares of 500 francs each, fully paid, were in issue on December 15th, 1911, 21,769 having been redeemed. These shares are redeemable at par within 99 years from 1869 by annual drawings on December 15th. They are, in one sense, a mortgage, because they are entitled to 5 per cent interest and dividends up to 71 per cent of the surplus profits. The redeemed shares are replaced by certificates which relinquish the 5 per cent interest.

In 1875 the British government, at the instance of Mr. Disraeli, purchased the holdings of the Khedive of Egypt, who was in urgent need of money at the time, and was practically an independent ruler, in spite of the nominal suzerainty of the Sultan of Turkey. There are 178,202 of these shares, and these may be all redeemed between now and 1968 by annual drawings, although they will retain their right to the dividends but not to the 5 per cent interest. This amount does not constitute a majority of the capitalization, to say nothing of the 400,000 shares of capital stock.

378

Underlying obligations take the form of bonds or shares. Of the latter there are 372,531 of 85 francs each, redeemable up to November, 1922; 99,994 of 5 per cent bonds of 500 francs each, redeemable on or before July 1st, 1918, by annual drawings; 62,944 first series 3's now outstanding, redeemable annually up to 1935; 232,592 second series 3's, redeemable by annual drawings up to August, 1963; while an authorized issue of 150,000,000 francs of the third series of 3's is now in course of issue and is redeemable at par in fifty-three years, the company reserving the right of expediting the redemption. It is understood to have this right in all the issues with the exception of the original shares.

So far as any rebate of the tolls is concerned, neither the British government nor the French government, which incidentally, is not a stockholder although a majority of the shares is owned in France, rebate the tolls, or have the right to do so. No doubt, like other maritime nations, they subsidize for mail purposes, and possibly for use in war, vessels which use the canal. But these subsidies are not paid from Great Britain's dividends on its Suez Canal shares, and are extended to other vessels which do not use the canal at all, - *The Wall Street Journal.*

379

Caption: "Egypt: Compagnie Universelle du Canal Maritime de Suez, 3% Obligation 500 francs, 2nd series, 4.6.1885, No. 181989. Attractive plan vignette showing route of the canal. Blue and yellow, with coupons. Beautiful, large picture of the canal and Egyptian monuments. Between 1879 and 1914 the company issued three series of 3% Bonds for a total of 27 million Francs. The shareholder meeting in 1885 accepted this second series and the bonds were placed between 1887 and 1902. Printed Signature of Prince Auguste Louis Albéric d'Arenberg (1837-1924), President of the Company between 1896 and 1913."

380

The Suez Canal
Scientific American
April 19, 1879

381

Mr. Farman, United States Consul-General at Cairo, Egypt, furnishes the Department of State with an interesting article on the Suez Canal. His facts are derived from authentic sources. A few of them are selected of remarkable interest. The entire cost of the canal was 472,921,799 francs, or $92,273,907. The stock of the company consists of 400,000 shares, at 500 francs each. These shares have sold as low as 100 francs each. At the opening of the canal they had advanced to only 300 francs. They are now quoted at 717 francs, and are probably worth more. The British Government paid about 568 francs. The number of shares bought, in 1875, by Lord Beaconsfield at this price was 176,602. This great purchase, aside from its political and commercial advantages, thus affords a clear profit of 25,000,000 francs at present prices. The balance of the stock is held by a large number of persons, mostly in France. The revenues of the canal have increased from 5,000,000 francs in 1870 to over 30,000,000 francs in 1877. The expenses, including interest, sinking fund, and lands, have been a little over 17,000,000 francs-per-year. While the revenues steadily increase, the expenses are decreasing or stationary. Deducting the amount paid for interest and the sinking fund, the actual expenses are about 5,000,000 francs annually. The cost of cleaning the canal and its accessories is only about 2,000,000 francs-per-annum.

382

The small comparative cost of maintaining the canal arises from the fact that there are no locks or lateral embankments to be broken. Except the ordinary cleaning, there is little to be done. Vessels drawing twenty-five feet of water or less pass through the canal. The saving of distance to the British ships going to India is nearly 5,000 miles. Two-thirds of all vessels passing through the canal carry the English flag.

Monsieur Ferdinand Lesseps, who has been at the head of the enterprise since its beginning in 1854, expresses the opinion that the Panama Canal must be constructed without locks to be successful or remunerative.

383

24/7/365

384

"…Traffic in the canal has been interrupted only on two occasions, once for two days during Arabi Pasha's rebellion in 1882, when British naval forces took over the canal temporarily, and once for less than a day during the Great War."
***Shipping Wonders of the World,* ca. 1937**
RE: the *Suez Canal Company* was founded in 1858 by *Ferdinand de Lesseps*. Initially, the majority of the shareholders were private investors from France, with Egypt also having a significant stake. After ten years of construction and despite bitter opposition by the British government, De Lesseps and his company opened the canal in 1869. It had an immediate and dramatic effect on world trade. The first military intervention in order to safeguard the Suez Canal occurred in the summer of 1882.

385

The Crisis in Egypt
The Illustrated London News
July 8, 1882

386

SINCE the deplorable outbreak of mob fury and license at Alexandria, four weeks ago, by which nearly all the European residents have been driven away from Egypt, a new sub-ject of anxiety has arisen with regard to the safety of the Suez Canal. The British Government, if there should really be need for the sending of a special force to protect that most useful gateway of maritime commerce between Europe and Asia and Australasia, will not wait for the deliberations of the Conference at Constantinople.
Caption: "The crisis in Egypt: refugees embarking at Alexandria"

387

Our military and naval authorities have during the past fortnight been making active preparations at the home establishments, and at Gibraltar and Malta, for an expedition which may possibly be required for that essential object of national policy, without prejudice to the questions already referred to diplomatic consultation. The *Dee* and the *Don,* gunboats, have been quickly fitted out for service, and left Portsmouth on Tuesday afternoon to patrol the length of the Suez Canal; while *H.M.S. Hotspur,* ironclad ram, one of our powerful fighting-ships, will protect its entrance at Port Said.

For the land force, should its services be demanded, Woolwich Arsenal has prepared a complete siege train of heavy and light guns, howitzers, and rockets; while the Ordnance storeship *Stanley,* which left Woolwich yesterday week, carries out a large freight of torpedoes, entrenching tools, and a portable railway, with other military stores. An order has been given for the immediate preparation of 500 submarine mines, and these are now being charged each with 500 lbs. of gun-cotton, and packed in wooden cases ready for transport.

388

H. M. S. HOTSPUR FOR THE PROTECTION OF THE SUEZ CANAL.

389

A thousand of the Royal Marines, including Royal Marine Artillery, who have been draughted from the Chatham, Portsmouth, and Plymouth divisions, sailed in the *Orontes* troopship at the end of last week. The Mediterranean fleet will shortly be augmented by *H.M.S. Orion,* and by the *Inconstant, Tourmaline*, and *Carysfort,* and will soon be joined by the Channel Squadron, under command of his Royal Highness the Duke of Edinburgh. Admiral Sir Beauchamp Seymour has under his command off Alexandria the following ironclads: *Alexandra,* flagship, with a ship's complement of 671 men; *Monarch,* 515 men; *Invincible,* 450 men; *Temeraire,* 534 men; *Superb,* 620 men; *Inflexible,* 349 men; and the smaller craft, *Condor,* 100 men; *Bittern,* 90 men; *Beacon,* 75 men; *Cygnet,* 59 men; with the *Helicon,* 73 men; making a total force of 3,536 officers, seamen, and marines. The Channel Squadron, which will touch at Malta to take on board troops and stores, consists of the *Minotaur,* flagship, 709 men; the *Sultan,* 400 men; the *Achilles,* 705 men; the *Agincourt,* 705; and the *Northumberland,* 706 men, their total complements thus amounting to 3,225 officers and men. This will bring up Sir Beauchamp Seymour's force to 6,761 officers and men, of which about 3,000 could be spared to land should it be found necessary, in addition to the troops brought from Malta by the Channel Squadron.

390

The French Government is equally busied in warlike preparations; by a decree of the Minister of Marine, last Tuesday ten men of war, of which six are iron-clads, have been commissioned for immediate service . . . As to the object of these formidable armaments, it is not easy to understand the reason why France should find so large an increase in her naval force necessary unless it be meant as a counter move to the naval armaments reported from England. It is indeed said that our own government have arranged with M. De Freyeinet the conditions of a landing of English and French troops in conformity with the decisions of the Conference, and that the French military contingent will number only six-thousand men.

The defiant attitude of the Egyptians at Alexandria, under the dictatorship of Arabi Pasha – for the Khedive seems to have lost all authority – grows daily more audacious. The army is being rapidly augmented, by calling-up reserves, and by enlisting thousands of the laboring men thrown out of work since the stoppage of business; new earthworks on the harbor shores, and in the Bay of Aboukir, are being constructed for defence; and on Monday night two large guns were placed in position near the Fort of Pharos, pointing seawards in the direction of the foreign fleet. The British admiral has demanded their removal, as well as the cessation of some very suspicious movements of boats, at the entrance to the harbour, which may have been designed to make preparations for obstructing the channel… 391

The Conference of Diplomatists representing the six great powers: England and France, Germany, Austria, Russia and Italy, continues its sittings at Constantinople, but the Turkish Government still holds aloof, protesting that the restoration of order in Egypt has already been accomplished. It is no longer expected that the Sultan will send a Turkish military force to execute the decisions of the Conference, whatever they may be; and there has been some talk of a mixed force, to be contributed jointly by three or four of the European powers, or by all of them together. But nothing is yet positively determined…The security and freedom of the Suez Canal – the great channel of commercial intercourse between Europe and the Eastern world, India and China, and our colonies of Australia and New Zealand, must be deemed by far the most important object of the British Government in its dealings with the present Egyptian crisis 392

Caption: "Dervish Pasha, Turkish Commissioner in Egypt"

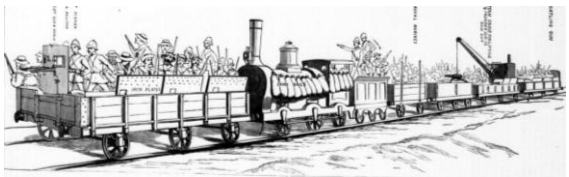
The War in Egypt
The Illustrated London News
August 19, 1882

393

WE publish a number of illustrations, from sketches by our two special artists, Mr. Melton Prior at Alexandria and Mr. Schonberg at Port Said, showing various scenes and incidents of the military campaign which has now commenced against the Egyptian revolutionary army led by Arabi Pasha…

Caption: "The War in Egypt: dragging a forty-pounder into position at Ramleh"

394

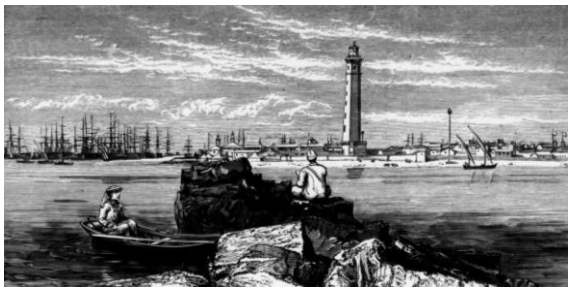


The armoured train on the railway near Alexandria

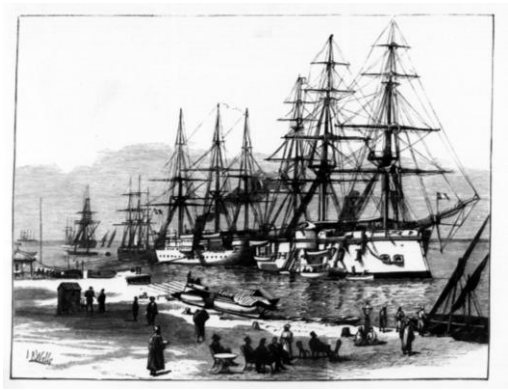
Putting up temporary shops among the ruins in the Grand Square, Alexandria 395

Soldiers bargaining with Egyptians at Alexandria

Sailors riding donkeys at Port Said 396



…Port Said, with the Mediterranean entrance of the Suez Canal, and with the British and other European ships-of-war now lying there, afford the subject of our second special artist's sketches for this week . . . No active military operations of importance have taken place in the past week. There have been several light reconnaissance excursions from the British outposts; and on Tuesday and Wednesday morning, before daybreak, small parties so employed had a little skirmishing with the Bedouins, killing a few of these…
Caption: "Port Said, with the entrance to the Suez Canal from the Mediterranean" 397



Ships-of-war at Port Said 398

The War in Egypt; Naval Brigade skirmishing in front of ironclad train 399

The War in Egypt
The Illustrated London News
September 23, 1882

400

OUR last week's record of the military operations conducted by Sir Garnet Welse-ley, which have now been brought to a completely successful termination, was made up on the Wednesday evening. It contained both the spirited narratives of that day's victory at Tel-el-Kebir, telegraphed in the forenoon by the special correspondents of the London daily papers, and the General's dispatch to the Secretary of State for War. These reports told us of the action fought within half-an-hour of sunrise, when the fortified camp of Arabi Pasha, situated across the Fresh-Water Canal and the railway on the line from Ismailia to Zagazig, and defended by 20,000 Egyptian troops, with forty pieces of artillery, was surprised and stormed by the British Army of 14,000 men, after a night march from Kassassin Lock.

401

The Indian contingent, followed by the Highland Brigade, which had borne the leading part in the action, pushed on westward to Zagazig, an important town and railway junction, while the Cavalry Division, under Major-General Drury Lowe, made swiftly for Belbeis, on the road to Cairo, and reached the capital of Egypt in the afternoon of the next day, which was Thursday week. On his arrival at Cairo, General Drury Lowe, who had only the 4th Dragoon Guards and two regiments of Indian Cavalry then with him, sent a sum-mons to the Egyptian officer commanding the citadel to surrender immediately. There was no opposition to this demand, and forthwith two squadrons of the 4th Dragoon Guards occupied the fortress. A similar summons was dispatched to the officer-in-charge of the fort which commands the city. He also surrendered at once, and the place was occupied by our mounted infantry
Caption: "Highland Brigade bore the brunt of the action" 402

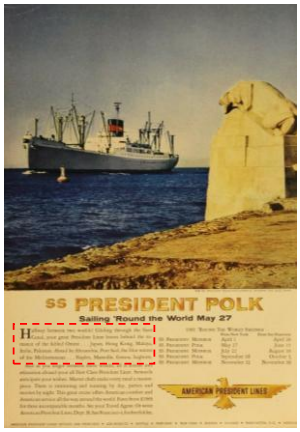
General Drury Lowe next seized the railway station, that being the key to any future movement of the troops. In the evening, the officers commanding the Egyptian army and the heads of the State Departments waited for General Drury Lowe, and made known their readiness to submit to any orders he might issue. He received these overtures courteously, but as there were still 10,000 infantry, besides cavalry and artillery of the Egyptian garrison, he had to demand, as a preliminary to any future negotiations, that all arms should be laid-down and deposited in the barracks while it was still daylight, and the army dismissed. There was no holding back in regard to these terms. Promptly the men laid-down their arms, and were sent off to their homes. Crowds of them were to be seen thronging the banks of the canal, hastening to their homes. They seemed heartily glad of their freedom, and they were very respectful to the victorious Englishmen.

On learning that Arabi Pasha was at Cairo, Major-General Drury Lowe sent a message to inform him that he must either surrender at once of his own free will or as a result of force. The defeated leader gave himself up at once. Having handed his sword to Major-General Drury Lowe, in token of unconditional surrender, he and Toulba Pasha, by whom he was accompanied, were placed under an officer's guard. The other chiefs of the insurgent party, with one or two exceptions, have since been taken prisoners, and will be brought to trial by the authority of the Khedive of Egypt…

403

Between Two Worlds

404



<u>Caption</u>: "Halfway between two worlds! Gliding through the Suez Canal, your great President Liner leaves behind the romance of the fabled Orient . . . Japan, Hong Kong, Malaya, India, Pakistan. Ahead lie Alexandria, Port Said, the blue waters of the Mediterranean . . . Naples, Marseille, Genoa, Leghorn…" (ca. 1960 magazine ad for *American President Lines*)

405

<u>Part 5</u>

Lebensraum

406

Improving the Baseline

407

The Suez Canal in 1882
Scientific American
August 19, 1882

408

I WAS glad to see how much of the banks are now cased with stone. Trees grow with difficulty in the sand and their roots suffer from the salt water. A sandy bank is carried by the wash of the steamers into the deep water channel. But this stone casing resists the wash, and when it is complete the company will be able to increase without danger their regulation speed. We met with no obstacle for two hours. In this great highway of nations we saw no life save the wild marsh birds and the waste of water stretching away to the yellow desert. There are *gares* or passing places every few miles, where the deep waterway is widened from twenty-four to fifty yards, and sometimes more, and a signalman system stops or allows to pass the ships according as the run is free or occupied. We passed the first *gare* successfully, but at the second the ball was hoisted above the flag, which in canal language means "go into the siding." Nothing came by before sunset, when all traffic ceases, and we lay in the quiet moonlight with every intention to proceed at sunrise. But when I came up next morning to see the start I found a fleet of great ships, each with its noisy little tug and yellow flag at the masthead slipping along in single file. It was a grand way of realizing the work of the canal.

409

410

Nineteen vessels went by, averaging, our captain told me, 1,500 tons burden. All save two carried the British flag. Three were crammed with pilgrims, forecastle, main-deck, and quarter-deck, one mass of life. Even the boats were full of them, and from under a canvas awning peeped the pale faces of women. One lot were Russian pilgrims from the Caucasus - savage looking fellows in fur caps and black cloaks; the others were Algerians and Moors in turban and burnous. The rest of the ships were cargo-laden, 22- and 23-feet in the water. All went by safely till the 17th, the *Scotch Greys,* came. She went a yard or two out of her course, and at once was aground. She had passed us, but others had still to come, and there was nothing for it but to wait till the *Scotch Greys* got free. Hawsers were made fast to stern and bow on either bank, and after an hour's shouting and steaming and winching, the big ship swung into place again. The rest came by without disaster, and we got under way ourselves at eleven o'clock.

The canal is not big enough for the present traffic. Shipping to the extent of over 3,000,000 tons passes through every year, and it is steadily on the increase. Ships have to wait their turn, and much valuable time is wasted at either end and in the passage.

411

The accommodation may be increased in two ways. The whole length of the canal may be widened so as to allow of ships passing each other everywhere. Such a work would not be difficult, but it would be very costly, The deep-water passage would have to be more than doubled in width, as the slow speed makes steering difficult, and ships in passing would require plenty of sea room to avoid accidents. The present width of 25 yards would have to be raised to 60, but it would not be necessary to increase the width of the surface of the whole waterway, which is already 100 yards from bank-to-bank.

The second mode of increasing the facilities of passage is more feasible and has much to recommend it. It consists in a considerable increase of the number of *gares* or passing places, and in the lengthening of those already in existence. There are at present thirteen, and they might easily be increased to twenty. The same precaution now practiced would be still enforced in the passing of ships. The block system would be carried out from *gare*-to-*gare*. The buoying of the passage is already excellent, and there would be no increase in the danger of fouling and jamming. The consequences of such accidents in so narrow a waterway as the canal are so serious that I think, on the whole, the increasing of the *gares* is most to be recommended. But one or other improvement is necessary. – *Correspondent London Times.*

412

The Suez Canal

Van Nostrand's ENGINEERING MAGAZINE
January–June 1883 – Vol. XXVIII

413

THE works Committee of the Suez Canal Company has now decided upon the expenditure of about £920,000 on improving the canal and its dock accommodation. The first improvement consists in the construction of a siding or resting and passing place, 500-meters in length and 25-meters in width, along the sheltered slope northward from the Quai Eugenie, and the second is the construction of a new dock at Port Said, on the African bank of the canal and south of the Ismailia dock. It is to be 750-meters-long and 260-meters in width.

The widening of the canal where it crosses the Bitter Lake, between Suez and the 152d kilometer station, already commenced, is to be pushed in to completion, so that the width will be 40 instead of 22-meters. The siding at Kantara is to be increases from 700- to 2,000-meters in length, and increased from 26-meters on both sides, measuring from the center of the canal, to 40-meters on each side. The station at Lake Timsah is to be doubled in area, and thus made to contain as many vessels as the Kantara siding. The curve at the north of El Guise is to be widened from 42-meters to 71-1/2-meters, and other curves are to be similarly treated, to facilitate navigation. At Port Tewfik the siding accommodation is to be greatly enlarged, and the floating dock at the same place deepened.

By these improvements, the execution of which is to extend over several years, the estimated traffic capacity will, it is expected, be doubled, or increased to 10 million tons. When the traffic reaches this the committee propose to take into consideration the idea, not the proposal, they say, of constructing a second canal parallel with that existing, so as to make up and down lines of traffic. If the English scheme for the Alexandria canal is carried, there will soon be a lot of work going on in this part of Egypt.

414

Enlargement of the Suez Canal

Scientific American
February 10, 1883

415

THE Works Committee of the Suez Canal have adopted a programme of improvement works requiring several years to carry out, and estimated to cost 23,000,000 francs.

The improvements involve rectification of the west bank of the channel of the outer port of Port Said; formation of a new basin at Port Said; widening of the canal in the passage of the small Bitter Lakes; widening of the canal between Suez and Kilometer 152; doubling of the Ismailia station; embankment of Kantara station, and of the station of Kilometer 133; rectification of the eastern curve of Timsah station; also of the southern curve of the small lakes; also of the northern curve of El Guisr; also of the curve of Toussoum; widening of the canal off Port Tewfik; deepening of the basin of Port Tewfik; and the annual continuance of the masonry work.

The committee think these works will be adequate for the doubling of the present traffic, or 10,000,000 tons. In anticipation, however, of a still greater increase, they think it will be expedient, at a date which cannot be yet fixed, to take into consideration the idea of the cutting of a second channel, definitively meeting all future exigencies, would involve negotiations for obtaining, besides the compensations foreseen, the land for such a channel, and for the enlargement of the stations and ports.

416

The New Suez Canal

Engineering News and American Contract Journal
June 23, 1883

417

WHILE there is very little doubt now that English capitalists will be most active in hastening the construction of a second Suez Canal or the enlargement of the present one, it is by no means certain that a separate company will be formed. Some of the more conservative English papers do not encourage riling of French susceptibilities at the present time, while the more competent French publicists are not backward in explaining the position of France in the matter – although the *de facto* possession of Egypt by the English tend necessarily to complicate the question.

The most important document in the question of the individual rights is the opinion emitted by the Egyptian State Council as to whether the concession given to De Lesseps constituted a real monopoly. The council affirms that the terms of the concession left no room for any doubt as to the intentions of the Viceroy and of M. De Lesseps. In other words, the work was to be unique, and no rival enterprise was to be permitted, unless there were superior intrinsic interests of the country itself to be considered.

The difficulties in the way of a second canal are greater than are generally supposed, and they have been perfectly well summarized by Lord Granville in his reply to the deputations that recently had an interview with him. He said: "You must be perfectly aware of great complications connected with it – complicated questions of a legal character, questions of an international character, questions of an engineering character, questions of the wishes of the Egyptians themselves."

418

In fact, the engineering difficulties alone in the way of a second canal are very great. The Suez Canal Company has possession of the thalweg, of the Bitter Lake and of Lake Timsah, ad has in fact made them. Another canal would be either through the sandy desert on the east of the canal or through valuable cultivated lands to the west. Wages, too, have greatly increased since 1858, and the total cost would not be under some $160,000,000.

But while such a canal would hardly pay, it would ruin the great French interest in the present canal, and this could hardly be accepted by the French with inactive indignation. At the same time, however, there is a pressing necessity for increased facilities in the canal. It will be sufficient to show the immense and ever-increasing development of the canal traffic to state that the tonnage which was in 1880 4,344,000, was in 1881 5,794,000, and in 1882 had reached 7,122,000, and ten millions is expected within the next few years.

The proportion of English trade, though still 77 per cent, tend to decrease, owing to the transformation of the merchant marine of other countries. The company has laid aside 30 million francs for improvements of the canal, but these evidently will not meet the difficulty.

The construction of a parallel canal with communication with the old canal would furnish vessels with a one-way route, and the passage could be made much more safely and expeditiously than at present. This may perhaps be the final solution of the question, as the English Government will be slow to despoil French interests and run in the teeth of international comity.

419

Shipping through the Suez Canal, 1870-1886

Year.	Number of Vessels.	Gross Tonnage.	Receipts.
1870	486	654,915	£206,373
1871	765	1,142,200	359,748
1872	1082	1,744,481	656,303
1873	1173	2,085,072	915,892
1874	1264	2,423,672	994,375

Year.	No. of Vessels entering.	Gross Tonnage.	Receipts.	Year.	No. of Vessels entering.	Gross Tonnage.	Receipts.
1875	1494	2,940,708	£1,204,387	1881	2727	5,794,401	£2,050,974
1876	1457	3,072,107	1,229,157	1882	3198	7,122,125	2,421,835
1877	1663	3,418,949	1,339,617	1883	3307	8,051,307	2,633,912
1878	1593	3,291,535	1,272,435	1884	3284	8,349,967	2,495 124
1879	1477	3,236,942	1,214,444	1885	3624	8,985,411	2,488,297
1880	2026	4,344,519	1,629,577	1886	3100	8,183,313	2,309,218

420

Proposed New Suez Canal

Van Nostrand's ENGINEERING MAGAZINE
July–December 1883 – Vol. XXIX

421

A PRELIMINARY meeting was held at Cannon Street Hotel, on the 10th May, to consider the possibility of constructing a second Suez Canal, at which there were present representatives from the Peninsular and Oriental Company, the British India Company, the Ducal Line, the Orient Line, the Anchor Line, the Harrison Line, the Clan Line, the Eastern and Eastern Extension Telegraph Company, the Shire Line, and the Glen Line. It is estimated that the tonnage passing through the canal represented by the gentlemen who were present in the room was not less than 3,000,000 tons.

In the course of the proceedings, it was stated by Mr. Stephen Ralli that even if the Suez Canal was not already inadequate to the requirements of the trade, it would soon become so. The trade between the Far East and Europe had been of late years increasing at a very rapid and unexpected rate. There was, moreover, every probability that it would continue increasing. Taking it for granted that the concession given to M. De Lesseps prevented for 99 years from the opening of the present canal, the constitution of another company having for its object the making of a new canal through the Isthmus of Suez, it must be borne in mind that treaties between nations, although in most cases made in perpetuity, were altered as soon as the circumstances which brought them about were altered.

422

Mr. Ralli thought that the proper steps to take must be to try first to come to terms with the present company of the Suez Canal, asking from them what was wanted by the requirements of the rapidly increasing trade between the Far East and Europe. He thought what should be asked could be summed-up in the following points: (1) In consideration that the amount of British shipping passing through the Suez Canal was equal to four-fifths of the whole, and that the trade was principally carried on between India (which is a British dependency) and Europe, they could fairly ask from the French company that its Board should be reconstituted on a different basis, and that, instead of having three English directors against twenty-one French, the number of English directors should be equal to that of the French. (2) That the annual meeting of the company should be held alternately in Paris and in London. (3) That either the present canal should be very much widened, or another canal made. If a large widening of the present canal would cost nearly as much as the construction of a second, the construction of a second would be preferable, as it would allow steamers to come up through one canal and go down through the other.

Resolutions were unanimously carried in favor of another canal, and an executive committee was appointed to take the necessary steps in furtherance of this object.

423

The first two resolutions were as follows:

"That having regard to the great increase of traffic, to the insufficiency of the present canal, even for the present traffic, and to its further certain increase, the time has arrived when arrangements should be completed for making a second canal;" and "That a committee be appointed to examine in detail the best course for such additional canal to take through Egypt, with authority to employ whatever professional assistance may be necessary for that purpose."

A further resolution had reference to the appointment of an executive committee, and to the immediate formation of a guarantee fund to cover preliminary expenses. Among the gentlemen who were selected to act on this committee were Mr. J. Laing (President of the Chamber of Shipping of the United Kingdom), who was appointed chairman, Mr. Thomas Sutherland (Chairman of the Peninsular and Oriental Steam Navigation Company), Mr. John Glover, Mr. Pender, M.P. (Chairman of the Eastern and Eastern Extension Telegraph Companies), and Sir George Elliot, M.P.

It was stated in the discussion, that those who are most competent to judge were of the opinion that steamships in the Indian trade were increasing at such a rate, that the canal traffic was likely to exceed ten million tons before a second canal could be built, and it was contended, having regard to the serious inconveniences which are experienced with the present traffic, that the conduct of the business will become almost impossible when it grows to ten million tons, unless there be a second canal by that time. It was argued that if the present traffic is paying the shareholders of the existing Suez Canal from 15 to 20 per cent, another canal would pay, even if the dues were lowered to five francs-a-ton.

424

A Second Suez Canal

Van Nostrand's ENGINEERING MAGAZINE
July–December 1883 – Vol. XXIX

425

THE question of providing additional means of transit through the Isthmus of Suez bids fair to excite almost more interest, and to arouse even more national feeling than were produced by the original scheme for the construction of the present canal.

For some time past it has been evident that increased canal accommodation must be provided. At the recent meeting of the Association of Steamship Owners engaged in the Eastern trade it was stated that the traffic had increased from 4,500,000 tons in 1880 to 7,000,000 tons in 1882. And at the last half-yearly meeting of the Peninsular and Oriental Steam Navigation Company, the chairman, Mr. T. Sutherland, made serious complaints with regard to the inadequacy of the canal to meet the growing requirements of the Eastern trade. It was stated that the company are now compelled to start their vessels from London twenty-four hours earlier than formerly, in order to ensure their reaching Suez in time for the arrival of the mail from Brindisi. This is entirely owing to the increasing delays in the canal, something like three days being now occupied in traversing a distance of ninety miles.

In short, the necessity for an extension of the present accommodation is every day becoming more pressing. There is every reason to believe that our trade with the East and Australia is still far below the highest point it is destined to reach. With a fuller development of the means of internal communication in India and China, there would seem to be no definite limit to its further growth.

426

For example, it is estimated by competent authorities that India will be able to double her present export of wheat within the next few years. Great reductions are being made in the rates charged on the different railways, and it seems likely that before long Indian wheat growers will be able to enter into a serious competition with growers in America. Already India sends us 20,000,000 cwt of wheat, and if this amount were doubled her export would be equal to two-thirds of the total wheat imports of the United Kingdom. The great increase which is taking place in the amount of shipping engaged in the East shows plainly that trade generally in that part of the world is in a flourishing state, and fully justifies the assumption that no long period will elapse before 10,000,000 tons of shipping per annum will have to be passed through the canal.

The question now calling for decision is not whether additional accommodation is required, but who is to have the privilege of providing it. That M. De Lesseps should assert and exclusive right on the part of the present company to carry out any further works which may be necessary is not surprising. The position of the company, as defined by the concession granted by Said Pasha in 1854, is certainly a strong one; but, in addition to this, the undertaking has proved successful, even beyond the most sanguine expectations of its talented projector, and it is not to be supposed that any scheme for constructing a rival canal will be regarded with indifference by those who are receiving handsome dividends from the present monopoly.

427

Sixteen per cent was the rate of profit for 1882, and M. De Lesseps, we believe, not long since declared his intention of "making fortunes" of the present shareholders. It is evident, however, that the claims made by M. De Lesseps on behalf of the existing company will not be allowed to pass unchallenged. The British shipping trade is beginning to feel, not only the inconvenience arising from the inadequacy of the canal to the requirements of the traffic, but also the weight of the dues from which the "fortunes" of the shareholders are being derived.

Moreover, the payment of interest at the rate of 16 per cent upon an investment that may be regarded as perfectly secure is not without an influence on capital; and as there are no practical difficulties which would impede the construction of further works, it is natural that capitalists should show a desire to take advantage of the opportunity now presented for obtaining a share in the general undertaking.

The problem to be solved by the various authorities concerned is doubtless somewhat intricate, involving as it does, questions of private right, of national feeling and of grave international importance. The position of the present company is tolerably clear. M. De Lesseps relies entirely on the concession made by Said Pasha in 1854 which conferred on the company the exclusive right of making and maintaining a canal through the Isthmus, and extended this privilege for a term of 99 years from that date.

428

The Egyptian Juridical Committee who have recently had the matter under consideration have expressed the opinion that this concession places the company in an unassailable position; but it seems to us that, in one sense, their position is even too good. If Said Pasha had granted a monopoly for a moderate term, the grounds for raising awkward questions with regard to their precise rights would have been somewhat less favorable than they are under the present conditions.

The assumption that Said Pasha, who happened to be the deputed ruler of Egypt in 1854, had the power to settle for a period of 99 years a question of the gravest importance to the whole world, is one by no means easy to uphold by force of argument. If he had merely authorized the construction of a new railway across the Isthmus, and had given a guarantee to the proprietors that for a term of 99 years no canal should be made which would compete with their undertaking, even M. De Lesseps would doubtless have been able to find good reasons for disputing the soundness of the arrangement. Yet such a case would have been precisely similar to the present.

As regards the construction of any further works, the position of the canal company is not, however, so strong as would first appear. In the first place they can do nothing towards enlarging the channels without the consent of the Egyptian Government. The canal could not be widened unless a grant of additional land were made, and whether this would be allowed or not would be for the Egyptian authorities to decide. M. De Lesseps is well aware of this, and he also knows that, as the British Government are at present complete masters of the situation in Egypt, it would be useless for him to seek any further concession without their approval.

429

Moreover, by Article 2 of the concession of 1854, the Egyptian Government reserved the right to appoint the Director of the company, so that practically it has the power to exert a very material influence on the policy to be adopted with regard to the future management of the undertaking.

But, as a matter of fact, this question is not to be decided by any verbal, or semi-legal, quibbles with respect to the exact import of any concession that may have been granted by Said Pasha. The Suez Canal has now become a great international highway, and the point at issue is, whether a particular monopoly is to be allowed to exist to the advantage of the whole civilized world. The pretension of M. De Lesseps that the Canal Company should have the power to dictate terms with regard to the right-of-way through the Isthmus for a period of 99 years, is too extravagant to be maintained.

Even during the recent Egyptian war it was found necessary to interfere with the independence of the company, and what was done then would certainly be done again whenever the necessity of the occasion arose. The so-called private rights, whether of individuals or of companies, cease to exist as soon as they clash with national interests and from the working of this rule the Suez Canal Company will unquestionably not be exempt.

430

As regards the passage through the Isthmus of Suez there are two distinct questions involved. In the first place the requirements of the shipping trade call imperatively for a large extension of the present accommodation, as well as for a reduction in the present heavy dues; and, in the second, in the interests of this country it is essential, as stated in Article 1 of the Draft International Agreement issued by the Foreign Office in January last, that the canal shall "be free for the passage of all ships in any circumstances."

With respect to the first consideration, the construction of a second canal seems to be the only course for providing a satisfactory solution of the present difficulty. M. De Lesseps calculates that by means of certain alterations in the existing canal, accommodation could be secure for a traffic of 10,000,000 tons per annum; but, even if this could be done, the provision would be only temporary. It is tolerably certain that, within the next few years, the Eastern shipping trade will surpass this amount if due facilities for its development are provided; consequently it is useless to look to any enlargement of the present canal for a permanent settlement of the question.

It appears to us that nothing short of an arrangement which would enable the traffic to be maintained continuously in both directions can be deemed satisfactory; and it is evident that only by means of a second canal would this be possible. As long as only a single channel exists there will always be the risk of delays and temporary blocks in the traffic from a variety of causes, and for this reason, if for no other, the construction of a second canal may be regarded as highly necessary.

431

But, in addition to the question of convenience, there is also the subject of the canal dues to be considered. And here it must be borne in mind that, if any appreciable reduction is to be made in the charges which now weigh so heavily on the Eastern shipping trade, it is essential that any additional means of communication which may be provided should be under the control of an independent company. As long as a monopoly exists the Isthmus of Suez will continue to be the mine of wealth it is at the present time, and the shareholders who control the right-of-way will certainly not cease to endeavor to "Make their fortunes" at the expense of the Marine carrying trade.

If the United States, by any ill-judged concession, had granted to the first Atlantic Telegraph Company the sole right of laying submarine cables between their ports and Europe, for example, it is easy to imagine the nature of the inconvenience that would have resulted. And the Suez Canal is an exact parallel. A monopoly in the one case would have long since proved intolerable; and in the other there is nothing which can possibly render it less burdensome.

It is evident that ship-owners in this country are now fully alive to the true position of affairs with respect to the Suez Canal. At the recent meeting of steamship owners interested in the Eastern trade, the representatives of 3,000,000 tons of shipping passing through the canal per annum were present, and a sum of £20,000 was at once subscribed towards the expense of preliminary inquiries, with a view to the commencement of a new undertaking. And we believe there is at present a vast amount of capital ready for investment as soon as the construction of another canal has been decided upon. That this should be the case is natural, for the rate-of-profit is certain to be good, while the risk is practically *nil*.

432

As regards the national interests involved in this particular question, it is clear that the English Government are now masters of the position, an that they will be almost compelled by the force of circumstances to turn their advantage to account. Full credit must be given for the honesty of their declaration that Egypt is to be occupied only temporarily; but the present aspect of affairs seems fully to warrant the assumption that, unless some unforeseen contingency should intervene, our occupation will be prolonged indefinitely. At all events an abandonment of the country is at present quite out of the question, and it would be deplorable if England were not to utilize the opportunity now offered for removing what may at any time become a very serious obstacle to the free use of her great Indian route.

We are well aware of the importance of a friendly understanding between this country and France; but, in the endeavor to preserve this intact, it is highly necessary that certain plain facts should not be lost to sight. M. De Lesseps is justly entitled to the world's esteem for the courage and genius he displayed in bringing his work to a successful issue, in spite of the opposition he had to encounter from this side of the English Channel, and his French supporters may claim full credit for their sagacity in assisting to carry his scheme into effect. We have to admit that England's former policy in this matter was erroneous; but our gratitude to the founders of the canal must not be carried to excess. 433

We must now deal with the facts as they stand. And these facts are simple. The Suez Canal has become a maritime highway as important as the straits of Gibraltar. In consequence of the growth of British commerce, which supplies four-fifths of the total traffic, it has become inadequate to the demands for accommodation. It is the key to England's most important possession; but it is in the hands of an independent company.

It is now admitted on all hands that new works must be undertaken, and the question is whether England is to allow this company to hold the right-of-way through the Isthmus as its own private monopoly, or whether she will insist that when the new channel is cut it shall be placed either under her own direction, or be made subject to an international arrangement which would ensure just and equitable treatment for all.

With all due respect to M. De Lesseps, it seems to us that his claim to tax the Eastern carrying trade for the purpose of "Making the fortunes" of certain shareholders, is not more defensible than was the practice of petty German chiefs who, in the Middle Ages, levied blackmail on the vessels down the Rhine in front of their castles.

There is in this country no desire to deprive the company of its just rights. It is entitled to generous treatment in return for the great services it has rendered to the world, and this we have no doubt it will receive. Bit that it shall be allowed to have entire control over the right-of-way through the Isthmus until the year 1953, simply for the purpose of enriching two or three generations of private shareholders, is a pretension altogether too extravagant to be maintained, and one, moreover, which England could not allow without ignoring her most vital interests in the East, nor without completely reversing the policy she has already spent several millions sterling in maintaining.-*The Nautical Magazine* 434

Report of the International Commission On the Suez Canal

Van Nostrand's ENGINEERING MAGAZINE
Translated from the *Annales des Ponts et Chaussees,*
for *Abstracts of the Institution of Civil Engineers*
by *A. Flamant*
July–December 1886 – Vol. XXXV

435

THE commission was appointed in 1884, to determine what new measures, in respect of works and navigation, should be undertaken to enable the ship-canal to meet fully the exigencies of a traffic exceeding 10,000,000 tons per annum. Its Report was presented in February, 1885, of which document the author furnishes a summary.

The commission considered three methods of increasing the carrying capacity of the canal, namely: (1) widening the existing canal; (2) construction of a second canal; (3) doubling the capacity of the canal by a combination of the first two methods.

When the canal was first designed, in 1856, it was supposed that two vessels, being towed, could easily pass where the bottom width was 144-feet, or double the normal width adopted. At the present day, however, when vessels of 50-feet in width propel themselves through the canal, a bottom width of 230-feet has been proposed for the 81 miles from Port Said to the southern end of the Bitter Lakes, where the tidal currents do not exceed 1 knot-an-hour, and 262-feet for the rest of the distance to Suez, where the currents often exceed two knots, in order that the vessels may pass each other freely.

The cost of this widening was estimated at £8,240,000, supposing the depth of the canal remained as at present, 26-1/4-feet below low-water of ordinary spring tides, but would be increased by £975,200 if the depth was augmented to 29-1/2-feet, unless the proposed width could be reduced 18-feet. 436

The construction of a second canal, within the limits of the company's lands, having, like the existing canal, a bottom width of 7-feet, widened out to 131-feet through the small Bitter Lakes, was estimated at from £8,200,000 to £8,920,000, with an additional cost of £698,800 if made 29-1/2-feet-deep. The third plan took into consideration the different velocities of the tidal currents north and south of the Bitter Lakes. Assuming that the greater velocity might lead to collisions between vessels passing on a single enlarged canal, it would be advisable to restrict the enlargement to the northern portion, and to form a second canal between the Bitter Lakes and Suez.

The Commission decided unanimously in favor of the enlargement of the existing canal from the Mediterranean to the Red Sea, for the following reasons. An enlarged section would enable vessels to increase their speed from 5-1/3 to 8 knots-an-hour, and thus to traverse the canal in about twelve hours, which could never be accomplished with two separate canals; and, moreover, there would be only two banks to maintain, instead of four. This increase of speed will greatly facilitate the steering, which, together with the greater width of canal, will enable vessels to avoid stranding on the banks, an important gain which would not be obtained with two canals.

437

The danger of collisions between passing vessels on a single canal will be obviated by the great increase in width proposed for the canal, and by reducing the speed of the vessels in the act of passing. Moreover, the plan of enlargement will include the easing of the curves on the canal, and will thus remove the impediments which these sharp and narrow bends present to vessels 360-feet in length, which is quite an ordinary length now, though rare twenty years ago.

Lastly, this system will possess the inestimable advantage of enabling each successive portion of enlargement to be at once utilized as an addition to the passing places for vessels.

The Commission exhibited some difference of opinion on the question whether, in order to keep within the lower estimate, the depth should be increased at the expense of the width; but it was eventually agreed that the depth should be increased to twenty-eight feet, with a corresponding decrease in the proposed width of the northern portion to 213-feet, and of the southern portion to 246-feet, measured at a depth of 26-1/4-feet. The present limit of draught is 24-1/2-feet; but it was considered necessary to provide for a probable increase to a maximum of 27-feet, which a depth of 28-feet would just accomplish, leaving the deepening to 29-1/2-feet for a future time, when the increased number of vessels of large draught may demand it.

438

Whilst adopting the above width for the straight portions of the canal, as sanctioned by the experience of navigation on the Clyde, the Tyne, the South Pass of the Mississippi, and the Sulina mouth of the Danube, with similar widths and more rapid currents, the Commission laid-down the widths suitable at curves in proportion to their radii. In the northern portion of the canal the widths, 26-1/4-feet below low water, were fixed at 246-feet for curves exceeding 8,200-feet in radius, and 262-feet for sharper curves; whilst for the southern portion, the widths at the curves, which all exceed 8,200-feet in radius, were designed to be 262-feet.

As the long slopes of the canal banks, where unprotected by vegetation, are seriously damaged by the wash of passing vessels, the formation of a narrow berm on each slope, below the action of the waves, about 6-1/2-feet below the water surface, has been recommended, and also the protection of the slopes from that depth up to 3-1/4-feet above the water by pitching.

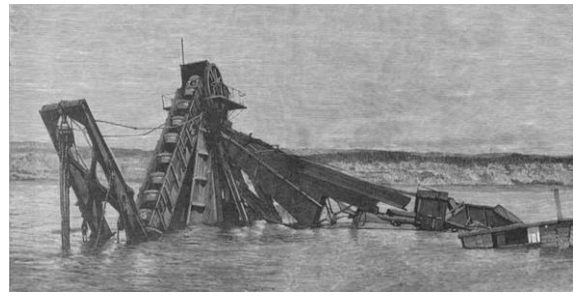
Owing to the increased speed admissible on the enlarged canal, the normal period of transit will not exceed twelve-and-a-half hours, allowing ample margin for stoppages; so that the journey might be accomplished in a single day, if an early start was effected, so as not to be overtaken by nightfall; whereas at present the average time occupied in passing through the canal is forty hours. 439

The Commission considers that the works should be executed in three different stages, namely: (1) An adequate increase in width, to provide for the passing of vessels at any point of the canal, by stopping one vessels and drawing it to the side, together with an increase in depth to 28-feet, at an estimated cost of £2,449,750; (2) the completion of the enlargement to the full width prescribed, at a cost £5,190,900; (3) the deepening of the canal throughout to a depth of 29-1/2-feet, at a cost of £618,050, making a total estimated cost of £8,258,700 for the whole of the works. Adding, however, £180,100 for sale of plant, the final estimate is £8,118,600. 440

"Trains" of Vessels on the Suez Canal

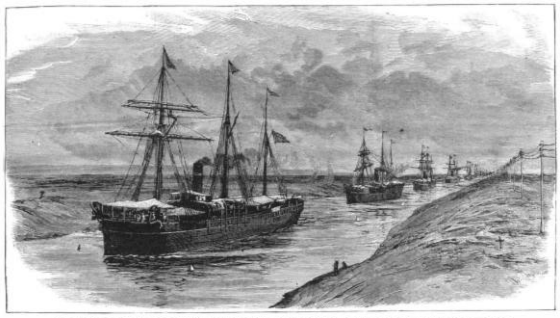
Scientific American
August 22, 1885

441



EARLY in June last, the navigation of the Suez Canal was practically stopped by the sinking of a great dredge. An endeavor was made to open a temporary channel around the obstruction, and a few vessels thus got through, but it was not until the 22d of the month that business was fully resumed, after the wreck had been blown-up and the deb-ris removed from the bed of the canal. 442

Caption: "Sunken Dredger Blocking the Suez Canal, 1885"



THE BLOCK IN THE SUEZ CANAL.—PROCESSION OF STEAMERS AFTER THE RENEWAL OF TRAFFIC.

The illustration herewith, for which we are indebted to the *London Graphic,* gives a good idea of the procession of vessels which then began to stream through the canal. 443

Four days before the reopening of the canal, there were one-hundred steamers anchored at Port Said, and a corresponding number at Suez. In order that vessels from each terminus may pass each other, the floor channel of the canal being but seventy-two feet wide, with a depth of twenty-five feet, there are several turnouts, in which steamers may anchor at one side of the channel for those proceeding in another direction to pass by, much as trains of cars on a single track railroad are switched off on sidings. These turnouts have been repeatedly enlarged to meet the increasing demands of commerce, as the numbers of vessels traveling together in the same direction have steadily added to the length of the trains, as it were; as a safe distance must be preserved between the vessels of each train, these trains are sometimes as much as two-miles long, and the maximum speed allowed is 5.3 knots-an-hour.

To avoid this waiting on sidings, and provide for the further increase of the canal business, two different projects have been under discussion for a considerable time back; one was the building of another and separate canal by the side of the first, and the other the simple widening of the present canal. The last plan was finally adopted by the "International Commission" of June, 1884, and, at a meeting of the Suez Canal Company, in Paris, on June 4 last, the directors were authorized to borrow $20,000,000 to carry forward the proposed improvement. 444

The Development of the Suez Canal

Scientific American Supplement
September 22, 1906

445

BECAUSE of the rapid progress in the increase of the dimensions and tonnage of modern steamships, extensive widening operations and developments in the docking and wharfing facilities of the Suez Canal are being effected.

The navigable dimensions of the waterway are now nearly double what they were twenty years ago, the superficies of the vertical profile having been increased from 320 to 580 square-meters. In the ordinary channel and to 740 square-meters in the numerous crossing places or gares. From 1898 to 1904, owing to the increasing dimensions of vessels, twenty larger gares were carried out at intervals of three miles, each having an effective length of 2,640-feet, with approaches at either end of 984-feet. At each gare the width at the bottom of the canal is 150-feet and at the water level over 300-feet, the depth of the gare itself being 93-feet. Taken as a whole, the width on the water level of the canal in the northern half varies from 300- to 360-feet, and in the southern half from 240- to 300-feet. In 1902 the maximum draft was increased from 25-feet 6-inches to 27-feet on January 1 of this year.

446

The tariff when the canal was opened was two-dollars per ton for laden vessels, but this rate has now been reduced to $1.55 per ton, the tariff for passengers remaining at the original figure of two dollars. The mean net tonnage has increased from 1,000 tons in 1871 to 3,191 tons in 1905. Out of a total number of 4,116 vessels passing through the canal in the year 1905, 2,484 were British, representing a total tonnage of 8,556,940 tons net, a decrease of 195 vessels and 476,989 tons respectively upon the previous year, and representing a British percentage in vessels of 60.4 per cent and in tonnage 63.6 per cent.

These figures, however, apply only to the general total, the British percentages in regard to merchant vessels only having risen during the past five years from 67 to 74 per cent in number and from 71 to 77 per cent in net tonnage. The speed of transit remains the same – 18 hours – but the general effective rate for mail steamers is 15 hours.

447

The Suez Canal and its Intended Improvements

Engineering News and American Contract Journal
Translated for *Engineering News* from the
Transactions of the Austrian Society of Engineers and Architects
No. 24, 1885
by *George J. Specht, C.E.*
September 26, 1885

448

THE Suez Canal is not a creation of the present century, but dates back to the day of Sesostris, B.C., 1600, when it then ran along the Nile to Memphis, and from there to the Red Sea. That ancient canal seems to have been abandoned, and Nero, who intended to build a canal, B.C., 549, was prevented from so doing by the prediction of his priests. Darius, again, in B.C. 500, proposed the same task, but his mathematicians told him that the waters of the Red Sea would overflow Egypt if the canal was built. In the second century before Christ, a canal was actually commenced by Ptolomaeus Philadelphus, but the work was neglected in time, and the Turks finally blockaded it against foreign vessels. The philosopher Leibnitz proposed to Louis XIV, of France, to rebuild the canal, and Napoleon I also considered the same scheme.

Thus affairs stood until the advent of M. De Lesseps, who, in connection with Linaut-Bey and Mongel-Bey, persuaded Mahommed Said Pasha, Viceroy of Egypt, to finally undertake the construction of the canal. Ferdinand de Lesseps had been the French Consul-General in Egypt, from 1831 to 1838, and was intimately acquainted with Mahommed Said, Linaut and Mongel. In 1854, the Viceroy invited De Lesseps to revisit Egypt, and the details of the enterprise were then discussed and agreed upon, and work on the canal inaugurated on Nov. 30, 1854.

449

The agreement stipulated: “That M. De Lesseps shall organize under his direction a company called Companie Universelle du Canal Maritime de Suez, for the purpose of constructing and operating a large navigable canal. The concession is granted to De Lesseps for a period of ninety-nine years, from the date of opening of the canal for traffic. The work shall be done at the expense of the company; the necessary land, not be- longing to private individuals, is given to De Lesseps, free-of-charge. The Egyptian Government shall receive 15 per cent, the company 75, and the organizers 10 per cent. of the proceeds. The canal shall be open to ships of all nations.”

450

451

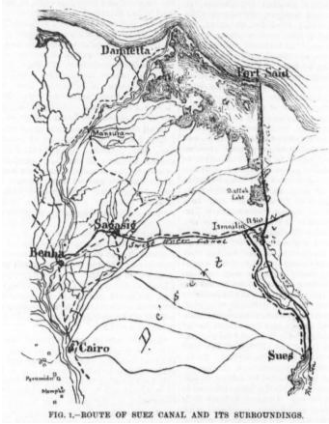


FIG. 1.—ROUTE OF SUEZ CANAL AND ITS SURROUNDINGS.

Exact surveys were made, showing the fallacy of the assumption, that the level of the Red Sea was higher (by 32.4-feet,) than the waters of the Mediterranean. Linaut and Mongel proposed a line running directly from Pelusio to Suez, and Messrs. Talabot and Barrault suggested a line connecting Alexandria, Cairo and Suez. The International Commission to which these two propositions were submitted, decided in favor of the direct line.

452

To prevent the accumulation of sand at the western mouth of the canal, Palescapa recommended the construction of two jetties, built of rip-rap, and 7,500- and 11,000-feet-long respectively. The line proposed by Talabot and Barrault was 149 miles longer than the direct line, and required expensive work to cross the Nile, with an open aqueduct as proposed by Talabot, 1-1/4-miles-long, and with the water surface 85-feet or more above low water in the Nile, and 118-feet above sea-level; ten locks would have been necessary, and 105,000 cubic-feet of water would have had to be raised per day. Barrault suggested the crossing of the Nile at its own level, with only six locks in the canal.

453

The commission submitted its report to the Viceroy on January 1, 1856. They said: “The direct canal from Suez to the Gulf of Pelusio offers the only good connection between the Red Sea and the Mediterranean. No great difficulties will be met with in its construction. Its success is certain, and it will be of immense benefit to the commerce of the world. The cost of the construction of the canal will not exceed $40,000,000.”

At this stage of the proceeding, England pretended that the canal would be of no advantage to her, and she commenced to oppose the enterprise by all possible means France considered the matter as a simple question of commerce, and De Lesseps started a subscription to raise the required capital. The $40,-000,000 was divided into 400,000 shares, and the various nations subscribed as follows: France ranking 1; Turkey and Egypt, 2; Austria, 3; Russia, 4; England, 5; United States, 6; Spain, 7; Netherlands, 8, etc., up to Sweden, which occupied a sixteenth rank. The company was organized on December 15, 1858, by electing boards of general, legal and constructive management.

454

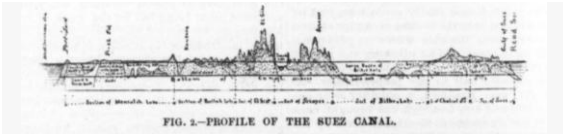


FIG. 2.—PROFILE OF THE SUEZ CANAL.

The geological features of the isthmus are as follows, (*from Etude geologique de Pisthme de Suez,* by M. Tinot); Commencing at the Mediterranean Sea, the first 24 miles are of recent formation; a narrow sand-spit, separating the Mensaleh lake from the sea, consists of sand, loam, clay and shells. The next 13 miles (Ballah Lake division) is another sand bank geologically older than the first and separates the Mensaleh and Ballah Lakes; sedimentary deposits from the Nile occur along the edge of Lake Ballah. A bank of gypsum is found in the last 3 miles of this division, which is intermixed with layers of clayey and sandy gypsum. The next 5 miles (El Gisr division) are sand, clay, gypsum and hardpan, with little homogeniety in the ground and it is covered by fine quicksand for nearly its entire length; this is the highest ground traversed by the canal. The following 18 miles (Serapo division) have, at the entrance of the Lake Timsah, deposits of quicksand and coarse sand, containing many organic fossils of the period when this part of the isthmus was still fertile. The remainder of this division is sand firmly packed and impervious to water.

455

The next 21 miles (Bitter Lake division) is the most interesting on the Suez Canal. The basin is 9.3-miles-long and is 26-feet below mean sea-level; it has dried out by degrees and the bottom (area, 14,000 acres) is covered with a layer of pure sea-salt, 2- to 10-feet thick, and in some places, 8- to 10-feet. Along the edge of this saline deposit is a layer of muddy sand mixed with numerous crystals of salt, and under this is compact clay.

The next 9 miles (Chalouf el Terraba division) forms the divide between the Bitter Lake and the Red Sea. It consists of gypsum, heavy clay, sand and sand stone. The last division (Suez) is 10-miles-long: at the second mile is a bank of lime stone, and at the 5th mile a layer of hard sand stone. The last part of the isthmus belongs to the more recent geological formation.

456

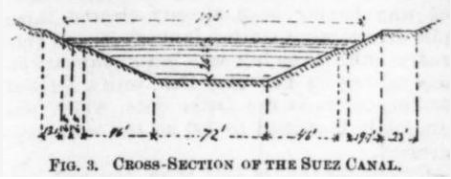


FIG. 3. CROSS-SECTION OF THE SUEZ CANAL.

In order to ascertain the proper width for the canal, a study of existing canals was made by the Commission. Most of the French canals are about 49-feet-wide at the water level, 33-feet-wide on the bottom, and about 5.4-feet-deep. The English canals average 36- to 20-feet-wide on top, 24-feet at the bottom and 5-feet-deep. The canals in the United States (then 250 miles in aggregate length) have a top width of 40-feet, bottom width of 28-feet and a depth of 4-feet. The canals in Spain, Germany and Russia have about the same dimensions.

All of these canals, however, were built to carry vessels of only 70 to 140 tons, while the Suez Canal was to take ships of 1,000 or more tons. The only similar canal was the Caledonian Canal in Scotland, which was 133-feet-wide and 20-feet-deep. The Commission proposed a width of 328 ft. and a depth of 21.25 ft. this width permitting vessels to pass. This was not accepted, and it was decided to make the canal from Port Said to the Bitter Lake 190-feet-wide at low water, and 26.2-feet-deep, and the remainder of the canal 262-feet-wide and 26.2-feet-deep.

457

On May 15, 1860 the commission met again and considered the labor question. Between Ghemile and Quin-Feregh a town had already sprung up, which was called Port Said in honor of the Viceroy. It has at present about 5,000 inhabitants. Another important town is Ismailia and a number of smaller towns grew up along the line of the canal, as El Gisr, Kantara, Ferdane, Toussoum, etc.

Caption: "The Suez Canal Works: Toosoomville, near Timsah, on the road to Suez"

458

A department of morals and health was established in each settlement; Ismailia was the central telegraph station and at the same place the superintending department had its headquarters. The general offices were at Cairo and the headquarters in Alexandria. A large fleet of sailing vessels transported the material required for construction. From April to December 1863, 295 vessels cast anchor at Port Said. For land transportation, 1,500 camels were used, principally to carry water which was obtained either from the Nile or by distilling seawater; this water was stored in cisterns along the line.

During the year 1864, 36,000 laborers were employed, of which 1,500 were Europeans, 14,500 natives and 20,000 Fellahs furnished by the Egyptian Government, according to the agreement of July, 1859. This last was such a draft on the Egyptian population that the standing army had to be reduced from 39,000 to 10,000 to prevent interruption of farming. One Fellah worked 30 days when he was replaced by another one.

459

Later on, the Viceroy declined to furnish any laborers at all, and the Emperor Napoleon, having been, appointed arbitrator between the Viceroy and the company, decided that Egypt had to pay the company $7,600,000.

Caption: "Napoleon III bronze medal commemorating the construction of the Suez Canal, 1864"

460

On account of the great demand for water, work on the Sweet-water canal from Sagasig to Suez was pushed with energy. This canal follows the old line of Nero mentioned before; it is 41-feet-wide on top, 24.4-feet-wide on the bottom and 4-feet-deep. The 1,308,000 cubic-yards of excavation in the Suez end of this canal were moved by 7,000 *Fellahs* in nine months. From Ismailia to Suez, 56 miles, the canal is 49-feet top-width, and 4.9-feet-deep; the excavation amounted to 4,380,000 cubic-yards, and the canal was finished on December 29, 1863. The benefit from this Sweet-water canal is great, the surrounding country is no longer a desert and $250,000 per annum is saved in water transport.

461

The work on the Suez Canal proper was commenced in 1859; the west mole at Port Said was the first work, this progressed slowly, as the rock had to be hauled from a quarry at Mex, near Alexandria. Since 1863, artificial stone has been used for this mole; 78,500 cubic-yards of rock and 327,000 yards of artificial stone were required. After the completion of this mole, excavation was commenced in the Lake Mensaleh region; this was done in cuts from 66- to 82-feet-wide and was finished by 24 dredges in three years. The capacity of a single dredge varied from 20,000 to 40,000 cubic-yards per month.

The ground in the section Kus-el-eh was not very firm and the natural slope was from 4 to 6 to 1. The work in the Ballah Lake section was done by hand-labor to the full width of 190-feet and depth of 5-feet; the remainder was done by dredging. The excavation through the ridge of El-Gisr was done largely by hand-labor; 18,000 men moved 5,250,000 cubic-yards in 10 months (1862) in this section. When the Egyptian Government refused to furnish new laborers, the work was done by excavators, each of which had an average capacity of 525 cubic-yards per day, or, under very favorable conditions, 785 yards; each machine was 18 horse-power. The Serapo section was dug 6.5-feet-deep and 190-feet wide by hand, the amounts excavated being 2,600,000 cubic-yards.

462

The sections Chalouf-el-Terraba and Suez were partly excavated by the flowing water; a ditch 72.5-feet-wide was excavated from the Red Sea to the Bitter Lakes with a grade of 0.035-feet per 1,000-feet, the surface velocity of the stream was calculated at 0.83-feet and the bottom velocity at 0.66 feet-per-second. The ground in this section cannot resist a velocity exceeding 0.48 feet-per-second. About 12,600,000 cubic-yards was washed by this process into the Bitter Lake, and 2,500 acres was thus raised about 4-feet.

The work was carried on with energy, and on August 25, 1865, a vessel, loaded with 300 tons of coal passed from the Red Sea to the Mediterranean, using part way the sweet water canal. At this time England renewed its efforts to prevent the completion of the canal, and, had it not been for the intervention of Napoleon III, she would probably have succeeded.

On November 17, 1869, the canal was opened to commerce. The currents proved st-ronger than expected; the velocity in the Port Said division to Bitter Lake was 1.64 feet-per-second, and from Bitter Lake to Suez, even 3.3-feet and more, according to the tide in the Red Sea. At many places the cross-section of the canal was deformed by wash-outs. The shores are frequently damaged by vessels running into them, and also by waves caused by heavy traffic; continuous dredging is necessary to keep the canal open; this is a great annoyance to passing ships. The turn-outs, one at every six miles, are not sufficient to prevent the passing of vessels in the canal proper.

463

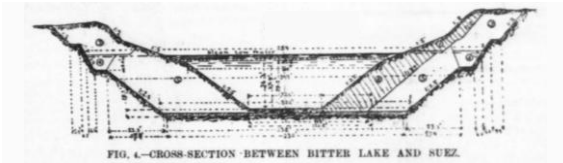


FIG. 4.—CROSS-SECTION BETWEEN BITTER LAKE AND SUEZ.

All of these circumstances made an enlargement of the canal, or the construction of a parallel canal, more and more necessary. The International Commission has finally de-cided to enlarge the entire canal, The committee met in Paris on November 25, 1884, and the general board of directors, in January, 1885, accepted the proposition of the ex-ecutive committee. The principal points in this proposition are as follows: The depth of the canal shall be increased to a total depth of 29.5-feet below low water level. At pre-sent this work shall be confined to securing a depth 27.8-feet, the remaining work shall be done within the following 2 years (economy was the purpose in this clause, as the cost of increasing the depth 3.28-feet is not less than $4,800,000). The width of the enlarged canal measured 26.2-feet below low water, shall be: Division Port Said to Bitter Lake, in straight parts, 213-feet. in curves of less than five minutes, at least 246-feet, and in curves of sharper radius at least 262-feet for half the length of the curve. The Division Bitter Lake to Suez, in straight parts, 246-feet; in curves of less than five minutes, 262-feet. The curve in the Timsah Lake shall be straightened by enlargement on the concave shore, to prevent sand deposits.

464

The protection of the slopes in the canal through the Lakes Mensaleh and Ballah, and between the Small Bitter Lake and Suez, being absolutely necessary, it was decided to commence protecting works at once. A pavement is to be made wherever the ground permits its use, laid at as steep a slope as possible and extending 7-feet below low wat-er. This pavement is to be laid in trenches excavated before the actual enlargement is done.

The work contemplated is to be done in three periods. First, enlargement of the bottom of the canal to about 121-feet by connecting the turnouts with each other; at the same time the canal shall be deepened 1.64-feet. The estimated cost of this work is $12,248,-709, of which sum $439,765 is for protection of the shores. Second period, enlargement of the canal to final dimensions; estimated cost, $25,954,528, of which sum $1,717,125 is for paving the shores. Third period, deepening the canal to 29.5-feet; estimated cost $3,090,166.

The total estimated cost is therefore $41,293,403, which will be reduced to about $40,600,000 by the money realized by the sale of rights. The total amount of earthwork is estimated at 91,000,000 cubic-yards.

The toll to be paid by passing vessels is regulated according to the registered tonnage (1 ton equal to 100 cubic-feet of that space in the ship from which an income can be de-rived); the rate for each registered ton and each passenger is 1.90. This is less than the additional insurance would be if the vessel went around the Cape of Good Hope. The maximum toll is fixed at $2.00. It was stipulated that the toll shall be decreased as soon as the dividend on the shares of the first issue would amount to more than $18, but with a proviso that the dividends could be increased to $25; if the dividend is so large, then the surplus shall be applied to a reduction of toll.

465

The financial statement of the company for 1883 was:

Total earnings	$13,704,668.75
Total expenses, including 5 % interest and a reserve fund	6,531,960.69
Profits	$7,172,708.26

The mode of navigating vessels through the canal is as follows: The position of the vessels passing through is telegraphed from all turnout stations to the head office; it is marked on a small model. Orders for the proceeding or stop-ping of each vessel are then given. The vessels are towed into the turn-outs; some of these last are formed by a one- sided enlargement of the canal, others by a systematical excavation on both sides. Those built after the first plan have caused collisions of vessels oftener than the latter, because both vessels are steered into the same turn-out.

The long time occupied in passing the canal is a serious objection. The maxi-mum speed allowed is 5 knots-per-hour; this and the time lost in the turn-outs makes the trip a long one. A greater speed, which would be better for steering the vessels is prohibited on account of the dangerous wave-action on the sh-ores. Notwithstanding this precaution, these slopes are damaged continually, although a considerable length of the slopes has been protected by rip-rap.

466

The area of the cross-section of the canal is 3,956 square-feet; this is too small for vessels with a displacement of 645 square-feet, and is the reason for running many vessels ashore (from 1870 to 1883, 11 per cent. of all vessels went into the shore). These stranded vessels are pulled-off by three powerful steam tugs, at the expense of the canal company, this work usually consumes 5 hours. The average time of an undisturbed passage, in 1884, was 38-1/2 hours, while the total average since opening the canal is 41 hours 22 minutes; 27 per cent of this time was consumed in waiting for the passage of other vessels.

467

The Widening of the Suez Canal

by the English Correspondent of the *Scientific American*

Scientific American

July 25, 1908

468

OWING to the steady increase of the dimensions and displacement of steamships plying between Europe and the East via the Suez Canal, the task of maintaining an adequate passage through the canal is one of great magnitude and difficulty. Operations have to be carried on incessantly in order to accommodate the waterway to the increasing size of the vessels that avail themselves of this route. When opened in 1869 the canal was from 150- to 300-feet-wide at the water level by 72-feet-wide at the bottom and 26-feet-deep. In a short time these dimensions were found to be totally insufficient, and at last the question of enlarging the canal throughout its entire length of 100 miles became urgent. The problem was investigated, and a comprehensive scheme drawn up by the Suez Canal Company for enlarging the canal to double its original size; the work to be carried out in sections, and upon such a basis that the service of the waterway would not be interfered with. An appropriation of $5,000,000 was made for this purpose in 1901. This scheme has been pushed forward during the past three or four years with great activity, and it is anticipated will be completed within the next four or five years.

Up to December 31, 1906, the total cost of construction had amounted to $122,496,-840, while the revenue has steadily increased from $6,234,938 in 1876 to $22,397,824 in 1906, the net dividend in that period having risen from $5.21 to $28.20 per share. During 1906, 3,975 vessels passed through the canal, representing an aggregate tonnage of 13,445,504 tons. While this shows a decrease of 141 vessels as compared with the previous year, the tonnage increase is 311,399 tons.

469

Owing to the waterway passing through the Arabian desert, the greatest danger confronting the authorities is the silting up of the canal by sand, the movements of which are tremendous. A comprehensive idea of the work entailed in this direction alone may be gathered from the following figures, which represent the amount of material excavated from the canal itself during the past three years:

1904	1,353,497 cubic yards.
1905	1,760,864 cubic yards.
1906	1,918,595 cubic yards.

In addition to this, the extent of the dredging necessary at Port Said aggregated during the same period 1,933,348, 1,842,772 and 1,464,935 cubic-yards respectively.

In 1904 a minimum depth of 28-feet was maintained for the whole distance between Suez and Port Said, sufficient to admit vessels having a maximum draft of 26-feet. In this same year twelve new gares or crossings, where vessels proceeding in opposite directions are able to pass one another, were completed, while plans were prepared for the construction of twenty-one similar gares, each 2,460-feet in length, near the various lakes. Arrangements were also completed for deepening the canal to 34-1/2-feet, a task which will be accomplished within the next five years.

470

In order to enable this work to be carried out with all expedition, the authorities acquired an extensive dredging and excavating plant, including a powerful bucket dredger with attendant lighter and five carrying barges of 520 cubic-yards capacity, together with two water-tank lighters, one 60 ton floating shear-legs, and a 12 ton floating crane. For the convenience of vessels, a 3,000 ton floating dock was obtained for use at Port Said, thereby obviating the necessity of any ships, more particularly the dredging appliances of the company, proceeding to Suez for dry docking.

The actual amount of excavation carried out in 1904, when the canal was widened by 50 feet to ensure a maximum width at the bottom of 147-feet, aggregated 1,689,275 cubic-yards of earthwork and 1,863,646 cubic-yards of dredging. The ballast above the water level is removed by manual labor, terraces being cut into the banks, along which temporary railroad tracks are laid. From the water level to the prescribed depth dredgers of various types are employed, some cutting their way into the bank and dumping the excavated material by means of overhead transporters upon the bank, and others discharging it into lighters. The ballast for the major part consists of sand, the rock encountered being approximately four per cent of the total amount. In the dredging of the navigable channel itself the type of dredger with floating conduit is most favored, the excavated material being discharged through the pipe, usually where the bank is somewhat low-lying, thereby building up an artificial embankment, which is subsequently planted with suitable vegetation.

471

One of the greatest menaces against which the authorities have to contend is the stranding and foundering of vessels, whereby the passage through the canal is blocked. In 1905 such accidents averaged 1.7 per cent of vessels passing through, whereas in 1885 the average was 4.3 per cent. This improvement is attributable directly to the widening of the waterway, together with the improved facilities now in vogue for enabling vessels to proceed.

In 1905, however, the resources of the authorities were severely taxed by the foundering of the *Chatham* by collision with another vessel. The ship sank in the center of the channel, tying-up all navigation for several days. Within a period of four days the authorities had to handle no less than 109 vessels which had been delayed, 53 passing from the north, and 56 from the south, directly the channel was reopened, and this was successfully accomplished without the slightest hitch. The wreck itself was removed by being blown-up, and the debris salvaged…

472

The Suez Canal Explosion

Scientific American
November 18, 1905

473

Details have come to hand of the methods adopted when the steamship *Chatham,* which recently sank in the Suez Canal with a load of dynamite on board, was removed by blowing-up the vessel. Some curiosity has been expressed as to the way in which the detonation of this large amount of high explosive was made at once certain and safe, and we are indebted to an Egyptian paper published on the day after the removal of the wreck, for an accurate description of the greatest explosion of dynamite on record.

The steamship *Chatham,* when it took fire and was scuttled in the Suez Canal, had on board about 100 tons of dynamite, as well as a supply of detonators. The blowing-up of the ship was accomplished by means of large mines, each containing 300 pounds of explosive and fitted with the proper electric fuses. One of the mines was placed by divers in the hold in which the cases of dynamite had been loaded, and the other mine was lowered into the hold containing the detonators. Cables were led from the mines to the shore, where they were connected to two of the telephone wires on the banks of the canal. The firing station was located three miles from the sunken wreck, and after the circuits had been tested by sending a small current through electric resistance fuses, the mines were fired.

474

An enormous column of water and debris immediately arose, and ascended continuously for five seconds, the estimated height of the column being over 1,500-feet. The report of the explosion reached the firing point in sixteen second after the firing key had been depressed, and it was noted that the report was not particularly loud. The earth tremor, however, was felt almost instantaneously, in fact, while the firing key was still depressed.

Although half-a-minute after the explosion the greater part of the debris had fallen, the air continued for over two minutes to be obscured with what looked like a mist. Although telephone wires were torn from the posts opposite the explosion, the blast was not sufficient to throw down the posts themselves. The water of the canal overflowed the surrounding country for a thousand yards in every direction, and fragments of the ship were distributed over a circle 1,200 yards in diameter. The enormous downward thrust of the explosion was shown when soundings came to be taken over the spot where the ship had lain. Here was found a huge hole, 73-feet in depth.

This is the greatest explosion of dynamite ever recorded, the nearest approach to it being the blowing-up of Hell Gate in 1876, when 50 tons of high explosive was detonated, and the accidental explosion some years ago of 30 tons of dynamite at the port of Lisbon.

475

"…With a muffled rumble from the depths of Hell Gate, nine acres of the river surface was lifted into the air, a tremendous mass of rock and foam 150 feet high. A sickening jar was felt on land, and seconds later waves lapped the shores. The greatest single explosion ever produced by man was over."

RE: excerpt from an article authored by *Claude Rust* entitled: "Hell Gate's Infamous Past – Part/s 1 and 2, which appeared in the September-October and November-December 1971 issue/s of *Military Engineer* magazine (respectively). On October 10, 1885, *Miss Mary Newton,* daughter of General Newton, as she did at *Hallet's Point*, pressed the key that simultaneously set-off the charge that destroyed *Flood Rock*. The event was viewed by 50K spectators and one-hundred cameras.

476

Caption: "At 11:13:50.2 AM, on October 10, 1885, with all charges in place, the cavern at Flood Rock flooded with water - 12 year old Miss Mary Newton pressed the key that set the charge and snapped the shutter of the camera that took this picture"

477

With the elimination of *Flood Rock,* vessels were able to navigate *Hell Gate* easily. Shipping trade increased to some $4 million worth of cargo-per-day, justifying the millions of dollars spent for the blasting operations. New life was infused into the *Port of New York,* which was once again able to assert itself as the leading port in the nation.

478

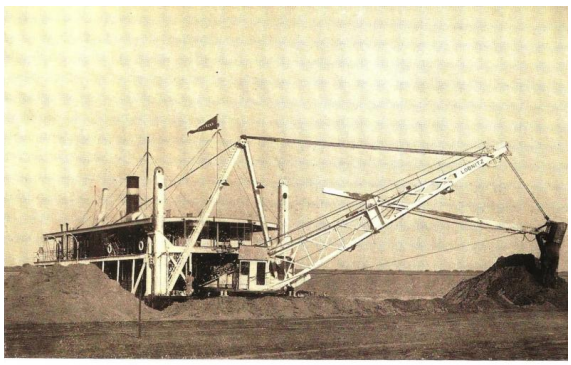
Caption: "Hell Gate from Astoria"

…The work of widening the bottom of the Suez section of the canal by 50-feet was maintained during 1905, involving the. removal of 1,570,476 cubic-yards of earthwork and 914,316 cubic-yards of dredging. In addition to increasing the width of the canal, the various curves are being rectified and eased.

During 1906 the extent of dredging aggregated 3,255,271 cubic-yards, of which total 1,339,071 cubic-yards were excavated by the Suez Canal Company, and 1,916,200 cubic-yards by private enterprise. The extent of earthwork excavated amounted to 1,829,564 cubic-yards.

From January 1, 1908, the maximum draft permissible for vessels passing through the canal will be increased to 28-feet, as the task of carrying the depth of water to 34-1/2-feet throughout the entire length of the waterway will then be completed. In order to maintain this depth, the authorities have ordered a third dredger of the Lobnitz type, capable of dredging to 36-feet, and which will be one of the most powerful machines of this description in the world.

479



The 2½ cubic yard Lobnitz Dipper Dredge " KHARTITA," one of two recently constructed for the Egyptian Government. This dredge has an 85 ft. outreach, and is seen commencing its trials on the River Nile.

480

The new works comprise among other developments the construction of a new dock to the west of the railroad station at Port Said. The object of this is to encourage the building of warehouses, so that vessels may berth beside the piers, thus obviating the necessity of discharging into lighters and barges as at present. Should this first dock prove successful, a second and third will be laid out upon similar lines, and to which access will be possible from a navigable channel communicating with the canal proper. The opening of the Egyptian government railroad, by which Port Said is linked with Cairo, has resulted in a heavy traffic, vessels stopping at Fort Said to unload their cargoes intended for Egypt. Consequently, on the African bank of the canal arrangements are to be provided for the unloading of colliers and other vessels and to assist in the erection of depots along the line of the railroad, the demand for which is at the moment very pressing. The gare of Port Tewfik is to be deepened, and other improvements effected. To carry out this work will necessitate the excavation of about 4,810,000 cubic-yards of earth and will occupy several years. In order to facilitate the enterprise, the Egyptian government will cede 358 acres of land at Port Said to the canal authorities for the construction of proposed docks.

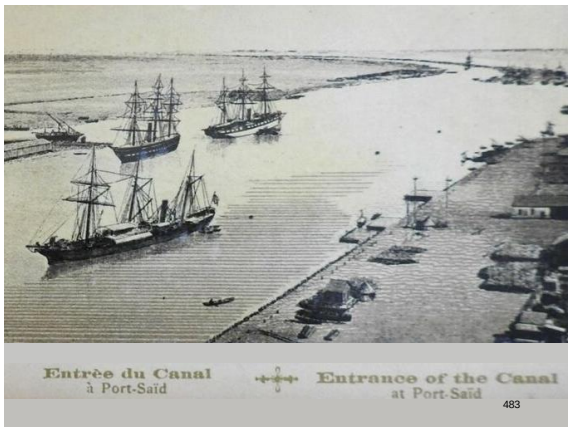
481

At Port Said a number of basins and docks are in course of construction upon the Asian bank for colliers and oil boats. When these are completed, the space at present occupied by this class, of traffic will be available for vessels carrying general merchandise destined for the interior of Egypt. The construction of new docks intended for general maritime traffic upon the Asian bank, together with the restoration of the eastern breakwater and its extension for 1,640-feet toward the northward, will be completed by 1912.

In connection with the general improvement scheme, a large tract of land has been reclaimed from Lake Menzaleh. A deep and wide channel has been dredged across the shallow waters of this lake, and a ferry service established by the Menzaleh Canal and navigation companies between Port Said and Matarieh, the eastern point of the fertile country of Mansourah. Ultimately this channel is to be connected to the main waterway by means of a lock; the present fresh-water canal extending alongside the main canal being siphoned under the channel.

Caption: "The entrance to the canal at Port Said; on the left are the construction works for new basins for colliers and petroleum boats"

482



483

Since 1896, $7,200,000 has been expended upon the widening and improvement of the canal. In that year the minimum superficies of the vertical profile was 504 square-yards, while today it is more than 611 square-yards, and with a depth from one sea to the other to admit vessels drawing 28-feet of water. More than twenty stations have been provided at various points between the termini, nearly all the curves have been eased and gares provided at intervals of about three miles.

484

Excavating for the New Docks at Port Said

A Pontoon Rockbreaker at Work

Manual Labor and Primitive Transportation Are Largely Used in the Work

Above the Water Level the Earth is Carried Away in Cars on Temporary Railroads

Below the Water Level the Dredger Works and Often Uses the Material for Raising Low-lying Bank

This View Gives a Good Idea of the Flat Land - Sand Deserts and Shallow Lakes - Through Which the Canal Passes. It Shows the Works for a New Quay in Course of Construction at Cherif Basin.

485

FEVER ON THE SUEZ CANAL.

During the same period vast improvements have been effected concerning the welfare of the numerous employees engaged in the maintenance of this enterprise. The ravages of the mosquitoes and fever which, formerly prevailed along the Isthmus have been subjugated.

Left: 1909 newspaper article concerning an outbreak of malarial fever in the Suez Canal Zone caused by *Anophele* mosquitoes

486

FEVER ON THE SUEZ CANAL.

Under the title of "The Prevention of Fever on the Suez Canal," Mr. E. H. Ross has published at Cairo an important account of the details of the campaign against mosquitoes which was conducted under his direction at Port Said, and subsequently at Ismailia, and which has afforded invaluable experience of the methods most calculated to be successful in other localities. Commencing with the European quarter at Port Said, the whole of the district to be treated was divided into seven portions, each of which was visited once a week by the mosquito brigade, which entered every house and renewed the supply of oil by which the larvæ lurking in cesspools and other receptacles were destroyed. The success attained was so marked as to induce the inhabitants of the native quarters to ask for the extension of the resulting benefits to themselves, and to waive the objection to the admission of officials into their houses which they would in the first instance have entertained; so that ultimately the whole of Port Said could be effectively dealt with. The inhabitants had been accustomed to suffer frequently from

487

"fever" of a somewhat obscure type, which was sometimes called "dengue," and sometimes "influenza," and was usually treated successfully by quinine, but which had not been recognized as mosquito-borne until the results of the campaign against these pests revealed the truth. Every one was accustomed to take quinine on the occurrence of any symptoms of fever, and hence the blood of the patients contained no parasites, and it was said that there was no malaria in the town. The discovery of some specimens of Anopheles modified these views, and led to a search for parasites in the blood of native children, to whom quinine is never given, and in whom they were found to be abundant. True, dengue was also prevalent, and came in epidemics, communicated by a gnat called *Culex fatigans*, which was common in the town, so that a single imported case might become the source of many others. There was also a common form of what was called "simple continued fever," the cause of which is still unknown, but which affected whole households or workshops, and which, after continuing for four days, was followed by severe prostration often lasting for a considerable time.

488

During the summer of 1907, after mosquito reduction had been in progress for a year, it was noticed that the fevers were disappearing. An epidemic of dengue occurred in other parts of Egypt, but Port Said escaped. Some of the doctors complained that their practices were diminishing. The life of the town became more active, visitors increased in number, there was more going on, and people were not as ill as they used to be; but it was with children that the change was most apparent. These, before the campaign was started, were always ailing during the hot weather, and the infantile mortality was enormous. Now they are well and strong, with some colour in their cheeks, able to play upon the beach, and the schools are better attended. The deaths during 1908 were 150 below the annual average for the last five years; while the population increases steadily and the town is growing in size.

489

In Ismailia, under the strong government of the Suez Canal Company, a still more decisive result has been obtained, for both mosquitoes and malaria have been abolished; but this condition of things is only maintained by constant vigilance; and Mr. Ross explains at some length that, even in the most favourable surroundings, the campaign must from the nature of things be a continuous one. But his narrative shows clearly the lines on which it must be conducted, and calls for the careful study of every administration which is called upon to contend with any form of fly-borne fever. There are still many dependencies of the Empire in which the lessons to be learned from the experience of Ismailia and Port Said might be so applied as to banish an immense amount of discomfort and disease and to pave the way for a great increase of prosperity.

490

A modern sanitary system was evolved for Ismailia by the Egyptian government in cooperation with the company, the results of which have been completely successful. At this point a huge hospital has been erected, together with dispensaries, where the afflicted of the surrounding country receive free medical assistance and advice. A comprehensive idea of the natives' estimation of this interest in their well-being is afforded from the fact that the dispensaries of Ismailia and Port Tewfik have tended 120,000 cases and held over 500,000 consultations.

491

Coincident with the remarkable progress in the traffic receipts and high dividends that prevail, the dues have been reduced. When first opened, the tariff for all laden vessels was $2 per ton; reduced to $1.90 in the eighties, and then further reduced to the existing levy of $1.50 per ton. The tariff for passenger vessels has always remained the same, however - $2 per ton. The reserve funds of the company today stand at $5,000,000; while a special fund, to which a certain sum is devoted every year for the acquisition of new machinery to maintain and improve the canal, is provided, which stands at $6,000,-000.

Caption: "Brass plaque (12"x12") placed in cargo hold of a U.S. merchant vessel to identify non-commercial ship's gear exempt from Suez Canal passage fees"

492

The Widening of the Suez Canal.

To the Editor of the SCIENTIFIC AMERICAN:

We note in your issue of the 25th of July your article on the widening of the Suez Canal. Under one of the illustrations you state manual labor and primitive transportation are much used in the work, and this point we desire to discuss with you.

If you will notice the photograph, you will see that the transport is done by means of portable track and dump cars which have been supplied by our company for the work on the Suez Canal. This method of portable track is the most modern for excavating and transportation. This fact has been recognized in the different parts of the world and is used everywhere on the globe where excavation work is done. Only in the United States this method is not entirely known by all contractors, and a great number of them are using wheelbarrows and scrapers instead.

We can assure you, and we are prepared to prove, that in the United States to a large extent much more primitive methods for excavating and transportation are used than at the Suez Canal.

ARTHUR KOPPEL COMPANY.

Pittsburg, Pa., August 1, 1908.

(*Scientific American,* August 15, 1908) 493

The Rock Removing Machinery of the Suez Canal

Scientific American
February 1, 1913

494

THE Suez Canal traverses a diversified country. Near Port Said it passes through argillaceous sand and a few large beds of more or less compact clay. The bed of Lake Timsah consists of a hard conglomerate of sand and limestone: between Lake Timsah and the Bitter Lakes occur loose sand, mixed with clay, gravel and gypsum, and overlain by a layer of salt and other deposits left by ancient evaporation; finally, compact clay, marl, and sandy conglomerates alternate until the Red Sea is reached. No rock has yet been found, except in the southern part of the canal between kilometer 85 and Suez. Here the outcrop of the rock is almost horizontal. It occupies an area of 300,000 square-meters (3,229,200 square-feet) in the bed of the canal. The rocks include limestone of greater or less hardness, calcareous and silicious conglomerates generally containing shells, red calcareous tufa, gypsum and alabaster. In general, the rock is of medium hardness, except in certain deposits of compact limestone and sandstone.

In the construction of the Suez Canal, the rocky portions were removed before the water was admitted. In 1884, when the company undertook the work of widening and deepening the canal, it became necessary to devise means of removing rock under water. The hardest rocks were shattered by submarine mines, and the softer ones were removed by apparatus composed of a battery of 10 steel rams, weighing 3.5 tons each, which were raised and let fall on the rock in the manner of pile drivers. These same were placed on a floating bucket dredge which removed the rock as it was broken. 495

Experience soon showed that the efficiency would be increased by separating the rock breakers from the dredge and placing them on special floats. Although this arrangement produced an appreciable improvement, it still gave only a mediocre result because of the insufficiency in the weight of the breakers From fourteen to sixteen blows per square-meter were required to break up rock of medium hardness to a depth of 1/2-meter (20-inches).

In 1897, when it was decided to increase the depth of the canal to 9.5-meters (31-feet), the engineers of the company studied the question more thoroughly. They found that for the removal of rock under water, the method described above is more economical than drilling and blasting. Furthermore, the employment of explosives presents certain obstacles to the navigation of the canal. After each blast, for example, it is necessary to send down divers in order to make sure that the channel is not blocked by the shattered rock. The blasting method cannot be carried out on so regular a plan as the other, and it also involves the removal of an excessive quantity of rock in order to obtain the desired profile with certainty.

A few years ago, therefore, the engineers definitely adopted a rock-breaking apparatus provided with two spindle shaped rams of cast steel, 13.5-meters- (44.3-feet) long and weighing 13 tons each. These rams terminate below in replaceable points of very hard steel. The two rams are placed a yard apart and are raised by powerful steam winches which operate almost instantaneously through very flexible steel cables permanently attached to the tops of the rams. By means of this arrangement it is possible to hoist the rams very rapidly and to regulate without difficulty the height of fall, which ordinarily ranges from 5- to 10-feet. The two winches may be coupled in order to exert an exceptional effort upon a single ram which has become fixed in the rock. 496

Fig.1 – Fourteen ton rock-breaking ram

Fig.2 – Placing in position the head of a rock-breaking ram

Fig.3 – Rock-breaking float at work on the Suez Canal

The apparatus is mounted on a float 30.5-meters (100-feet) long, 10.57-meters- (34-1/2-feet) wide, and 2,44-meters- (8-feet) deep, made entirely of Siemens-Martin steel. The falling rams are guided by a frame of special construction which also carries the pulleys over which the cables run. The float is moved forward, backward and in any direction rapidly by means of a steam winch.

This apparatus was put into service in 1902, and since a few improvements in detail have been made. It has operated perfectly and broken all kinds of rocks without difficulty. In 1908 a second apparatus was installed, having two rams weighing 14 or 15 tons each and 15-meters- (49-feet) long, which operate to a depth of 12- or 13-meters (about 41-feet). As a rule, 132 blows are delivered in each working hour. The mean thickness of the layer of rock shattered is 0.8-meter (31-1/2-inches). In these conditions the number of blows required to break a cubic-meter of rock varies from one to forty, according to the character of the rock. The average is about seven blows per cubic-meter.

The output thus varies from 132 to 3.3 cubic-meters (172.6 to 4.3 cubic-yards) per hour with a mean value of 19 cubic-meters (24.8 cubic-yards) per hour. 497

Deepening the Suez Canal: A Record of Progress

Scientific American Supplement
February 28, 1914

498

WHEN the Suez Canal was originally made, for a great part of its 100 weary miles nothing but a mere furrow cut through sandy desert, it had a depth of 8-meters, or 26 English feet. At various periods it has been deepened until it reached its present depth of 39-feet. Operations are now in progress with a view to making it uniformly 39-feet-deep, a process which, with other great works of improvement also going on, will involve a very large expenditure.

In one respect the Suez Canal has a fortuitous advantage over other great artificial waterways, such as, for instance, the Panama Canal and the Manchester Ship Canal – it is not affected by tides to an appreciable degree, and has therefore no need of locks. There is not a single lock between the almost tideless Mediterranean and the Red Sea, and the waterway remains constantly at an almost uniform depth. The 39-feet will represent the minimum depth at low tide at Suez.

499

Question of Draught

500

The principal reason given for this new departure is the obvious one – the necessity of providing for the transit of larger vessels. The first vessels to pass through from sea-to-sea after the opening of the flood gates in 1865 was an 80-tonner. The largest vessel that has been through in its period of latest development is the Hamburg-Amerika liner *Cleveland,* measuring 588-feet-long and 65-feet broad, with a molded depth of 46-feet, and of 17,340 registered tonnage.

The “molded” depth of a vessel is not, of course, its draught depth, but something very much greater. No vessel is at this moment permitted to pass through the canal which draws more than 29-feet of water – a measurement which allows a clear margin of 3-feet between the keel and the bed of the waterway. With an added 7-feet the range of traffic will be very considerably expanded, though the canal company are by no means persuaded that the needs of the not very distant future will be met even by this improvement.

A vessel measuring 46-feet-wide may safely pass another of the same dimensions even in the narrowest part of the canal (146-feet), provided the strict rule is conformed with, that no vessel shall pass another while both are under headway. In the early days vessels could pass only at a few cross places, or *gares,* with a collective length of less than a mile, but passing is now possible anywhere, under the conditions mentioned, owing to the widening improvements that have been made from time-to-time.

Partly owing to this cause, but also in large measure owing to the use of searchlights, which render transit, except in the case of sailing craft, possible by night as well as by day, the passage of the canal from end-to-end has been reduced from an average of 36 hours to half that time within the last 25 years. The maximum speed permitted to vessels of any type is 5-1/3 nautical miles-per-hour.

501

Sand Storms

502

While the sand storms to which the Suez Canal is exposed are among the causes which make constant dredging necessary, they are not a factor of much weight in promoting the new deepening project. As a matter of fact, the deposit lodged in the most exposed parts of the waterway by these eruptions is infinitesimal. The greatest mischief is done at Port Said, in the early months of the year, when cross-currents drive before them great billows of sand, and a part of the extensive improvements now in hand is the extending of the breakwater at the port by some 2,700 yards, at a cost of about $3,000,-000, to counteract this evil.

The mention of some of the extreme precautions required under the rules of navigation of the canal in order to ensure safety, tempts allusion to others as not remote from the subject of deepening and widening. Before any vessel is allowed to enter the canal the captain must see to it that the yards are braced forward, the ladders and jib-booms run in, and the boats swung in. The tie-up hawsers must be ready for rapid handling; the bow anchor must be ready to let go; the searchlights must be in good working order. When the journey has commenced there must be a watch both by day and night; there must be no overtaking of one ship by another; no vessel must anchor in the canal except in case of absolute necessity; no ashes, cinders or articles of any kind must be thrown overboard; if any article falls overboard the vessel must stop to pick it up, but report the matter to the company’s officials at the nearest station; and when a collision appears probable there must be no hesitation in running aground if necessary.

So the list might be indefinitely extended of rules enforced to secure the perfect transit of the famous channel, which at its inception and afterward caused so much international confusion and jealousy, and has since been of immeasurable benefit to the maritime interests of every land.

503

No Preference

504

Since, under the wise foresight of Lord Beaconsfield, the British Government acquired the Khedive's shares, as well as other interests, in the undertaking, and since British and French capitalists joined in friendly earnestness to make the best of the project, the commercial progress of the canal has had no check. It has been worked for the benefit of all nations. The ships of every country may make use of it on level terms. There is no preferential treatment. The ship of no country can demand as a right immediate passage through the waterway, but all must take their turn.

In the year 1870 there was general satisfaction at the announcement that 500 vessels had traversed the canal during the twelve months. The number in 1912 was 5,373, representing a net tonnage of 20,275,120. Of the total tonnage British ships claimed 63.4 per cent, German 14.9, Dutch 6.1, Austro-Hungarian 4, and French 3.9. The position may be put in another form, thus;

	Vessels.	Tonnage.
British	3,335	12,847,621
German	698	3,025,415
Dutch	343	1,240,264
Austro-Hungarian	248	813,908
French	221	798,822

505

The *Convention of Constantinople* – a multilateral trade treaty, was drafted on March 2, 1888 and signed on October 29, 1888 by the UK, Germany, Austria-Hungary, Spain, France, Italy, the Netherlands, the Russian Empire and the Ottoman Empire. It went into effect on April 8, 1904. The Khedive of Egypt, through whose territory the Suez Canal ran and to whom all shares in the *Suez Canal Company* were due to revert to when the company's 99-year lease to manage the canal expired in 1968, was not invited to participate in the negotiations and did not sign the treaty.

506

CONVENTION RESPECTING THE FREE NAVIGATION OF THE SUEZ MARITIME CANAL.

Signed at Constantinople, October 29, 1888.

In the Name of Almighty God, her Majesty the Queen of the United Kingdom of Great Britain and Ireland, Empress of India; His Majesty the Emperor of Germany, King of Prussia; His Majesty the Emperor of Austria, King of Bohemia, etc., and Apostolic King of Hungary; His Majesty the King of Spain, and in his name the Queen Regent of the Kingdom; the President of the French Republic; His Majesty the King of Italy; His Majesty the King of the Netherlands, Grand Duke of Luxemburg, etc.; His Majesty the Emperor of All the Russias; and His Majesty the Emperor of the Ottomans; wishing to establish, by a Conventional Act, a definite system destined to guarantee at all times, and for all the powers, the free use of the Suez Maritime Canal, and thus to complete the system under which the navigation of this canal has been placed by the Firman of His Imperial Majesty the Sultan, dated the 22nd February, 1866 (2 Zilkâdé, 1282), and sanctioning the concessions of His Highness the Khedive, have named as their Plenipotentiaries, that is to say: —

(Here follow the names.)

Who, having communicated to each other their respective full powers, found in good and due form, have agreed upon the following articles:

ARTICLE 1. The Suez Maritime Canal shall always be free and open, in time of war as in time of peace, to every vessel of commerce or of war, without distinction of flag.

Consequently, the high contracting parties agree not in any way to interfere with the free use of the canal, in time of war as in time of peace.

The canal shall never be subjected to the exercise of the right of blockade.

Above & Left: the signatories of the Convention represented all the great European powers of the era and the treaty was interpreted as a guaranteed right-of-passage for all ships through the Suez Canal, in both war and peace. During the 74 years of the UK's military presence in Egypt (1882-1956), the British government was de facto in control of the canal and defended it.

507

Although France takes the fifth place for 1912, it is officially stated that when the figures for 1913 are completed she will be found to have advanced to the fourth position in that year.

The relative position of these countries in 1912 and 1911, as represented in percentage of the total tonnage, is as follows:

	1911. Per Cent.	1912. Per Cent.
British	64.0	63.4
German	15.3	14.9
Dutch	5.3	6.1
Austro-Hungarian	3.4	4.0
French	4.5	3.9

508

Increase of Tonnage

509

A better idea of the general progress made in the usefulness of the canal is obtained, however, from the grand totals of traffic, apart from their relation to different countries. And for this purpose we may go back as far as 1887, and give the number of vessels passing through the canal, and their tonnage, in the year and every fifth succeeding year:

	Vessels.	Tonnage, Net.
1887	3,137	5,903,024
1892	3,559	7,712,029
1897	2,986	7,899,374
1902	3,708	11,248,413
1907	4,267	14,728,434
1912	5,373	20,275,120

It would scarcely be worth mentioning that there is a slight difference between the British registered tonnage and the tonnage adopted by the Suez Canal authorities, as prescribed by the International Commission on Tonnage in 1883, but for the fact that the Suez scale is to be adopted on the Panama Canal.

510

Reduced Tariffs

Since the canal was opened the dues have undergone many changes, and at ties have proved a very troublesome subject, insomuch that at one stage British ship owners strongly protested at the rates levied, and talked of making a new canal. The original authorized tonnage dues were fixed at 10f. (8s) a ton with a surtax of 4f. In 1885 there was a reduction of 9-1/2f. to be still further reduced as the dividends increased. In 1906 the figure was 7-3/4 per cent, and at the present time it is 6f. 25c. per ton with reduction for ships in ballast.

The dues amounted:

In 1870 to	£200,000
In 1883 to	2,400,000
In 1911 to	5,245,425
In 1912 to	5,320,000

Deducting expenses from these receipts, there remained last year a gross balance of £368,788.

511 512

Panama Canal Not a Rival

Such steady advancement in financial matters finds a natural sequel in the important developments, necessitating large expenditures, which are now taking place. Nor is there fear in official quarters of a check being given to continued advancement by such analogous enterprises as the Panama Canal, just completed and thrown open to traffic. The converse is, in fact, the case. At the last annual meeting of the Suez Canal shareholders in Paris, M. Jounart, the president of the council, ventured his opinion that the Panama Canal would be a complement to the Suez Canal rather than a rival. He prophesied that the opening up of regions in eastern Asia by the American company would create a traffic, some of which would naturally find its way through the Suez Canal. Be that so or not, the Suez Canal would still remain the shortest route from Europe to the Far East. – *London Daily Telegraph*

513 514

Part 6

In the Beginning

The Suez Canal
NATURE
November 16, 1940

515 516

NATURE seventy-one years ago (1, 81; 1869) recorded the opening of the Suez Canal “in presence of emperors, kings, princes, and potentates; of eminent engineers, famous warriors, and distinguished savants invited from the East and from the West”. The question of the canal has, however, dated back to a much earlier period. Tradition has it that Alexander first discussed its feasibility, but decided against it on account of the difficulty of the mouth of the canal becoming silted up. After other projects, the first Napoleon revived the idea, and from that time the question of a ship canal became a standing topic. With progress in the sciences, especially those of immediate bearing such as geology and engineering, the possibility became more and more convincing, and culminated in the opening on November 17, 1869, the result of one of the greatest of modern engineering feats. It may be well to think of the difficulties faced by science at the time, which in the “pre-scientific age rendered man’s contests against the works of the winds and sea perfectly hopeless” but with the aid of science were now conquered.

517

The Suez Canal
NATURE
November 18, 1869

518

IF all went well, and we hope it did, yesterday witnessed a grand gathering on the sandy shores of a dreary bay in the Midland Sea - that sea around which so much of history has been enacted, and in whose annals the gathering in question will not be the least noteworthy incident. The Suez Canal - that problem of many centuries - is to be opened in presence of emperors, kings, princes, and potentates; of eminent engineers, famous warriors, and distinguished savants invited from the East and from the West; and while the ceremonial lasts the very dreariest of the dreary wastes that here and there border the blue waters of the Mediterranean will be animated by a brilliant throng and the sound of music; and speeches will be made and healths will be drunk, and all present will join in wishing success to the memorable enterprise, which, for a time, is to furnish to Arab storytellers and Frankish newsmongers a topic to talk about.

Dreary as the region is, it has a history. There marched with invading armies the kings whose names are recorded in Scripture; there Artaxerxes was stayed ill his victorious advance by the siege of Pelusium; there are yet to be seen relics of cities and towns named in the “Itinerary” of Antoninus; there Titus marched to the siege of Jerusalem; there Baldwin and his Crusaders took the city of Pharamia: the actors in these and other exploits never dreaming that the sands of the desert, drifted by the winds and by the stream of the Nile, would so bury and alter the surface of the land, that after generations should be puzzled to identify its historical localities.

519

The question of a canal dates from a very early period. In high floods the waters of the Nile spread to within two or three miles of the Red Sea, which would suggest the idea of a permanent communication between the river and the great Arabian Gulf. This communication was actually established, as is said, under Ptolemy Philadelphus; but of course it fell into neglect, and was buried under the drifting sands, until one of the caliphs had it cleared out, after which there was a navigable canal between the Nile and the Red Sea for more than a hundred years. Then it was again lost, and so completely that its ever having existed became matter of doubt and dispute.

But the main project was a ship canal across the Isthmus. There is some tradition that Alexander consulted with his engineer officers as to its feasibility, and that they reported against it on account of the difficulty in preventing the mouth of the canal from silting up. In a later age Sultan Selim, who had been baffled in his scheme for a canal to connect the Don and Volga, resolved on cutting one from Pelusium to Suez; and he took an important step towards accomplishing his purpose, for he conquered the country all across, and made his name a terror to the Arabs. But he did not live to cut the canal. The first Napoleon revived the project, and ordered a survey, during which the long-buried remains of the canal above-mentioned were discovered, and the question as to its having existed was settled. From that time the question of a ship-canal became a standing topic, enlisting divers opinions, among which were some to the effect that the project was simply impossible, because, as the level of the Red Sea was so much higher than that of the Mediterranean, the swift current in one direction would prevent navigation.

520

During this time of debate, Captain Spratt of the Royal Navy was sent, with the ship *Medina,* to make a survey along the shores of Egypt and of the Isthmus, of which an account was published by the Admiralty in 1859, entitled, “An Investigation of the Effect of the prevailing Wave Influence on the Nile’s Deposits;” and this was followed by “A Dissertation on the True Position of Pelusium and Farama.” Beginning at the western extremity of the Egyptian coast, Captain Spratt found that the Nile there exerted no influence, but that, owing to the prevalent north-westerly and westerly winds, the deposits brought down by the Nile were drifted to the eastward in prodigious quantity, even to the shores of Syria. This was no hasty conclusion: by a careful series of soundings and dredgings, Captain Spratt determined the identity oi the sand along the sea bottom, within a given distance of the shore, with that of the deserts through which the Nile flows. Farther out to sea the sand was coralline, and of an entirely different character, while the Nile drift is made up of quartzose sand, with fine mud and particles of mica. The verifications in this particular were too numerous and too exact to leave room for doubt. “By this means,” writes Captain Spratt, “I was enabled to trace the extent of the Nile’s influence both directly off the coast and along it, as well as to ascertain the large quantity of sand - pure silicious sand - it must annually bring to the sea; and to an amount which far exceeded my expectations and experience in respect to other rivers, particularly that of the Danube, which, in comparison, brings a very much less proportion of sand to mud. The Danube sand, also, is of the finest quality. The Nile sand, on the contrary, is much coarser generally, and forms sandbanks off the coast that are composed of quartzose sand nearly as large as mustard seed.”

521

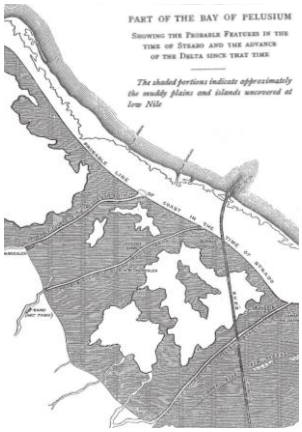
The quantity of solid matter brought down by the Nile when in flood is prodigious, and precisely at this season - that is, for three or four months - the north-west winds blow strongest. Indeed, if the wind did not blow with the violence of a monsoon it would be impossible for sailing-vessels to navigate the river during the time of its rise. The suspended matter is consequently driven to the eastward along the coast, and there accumulating forms dunes or sandhills, which shift their position with every gale, “burying at times the huts of the coastguard men.” The hollows between the dunes are cultivated by the Arabs, but the plots must be protected by screens of reeds, against which the sand accumulates by repetition, until in some instances the hill is a hundred feet in height. Captain Spratt here remarks: “The best efforts of a population of several thousand Arabs, who inhabit the villages along this strip of land, fail in permanently fixing these dunes. For as the sea continually re-accumulates the sand upon the beach, onward it moves, in spite of those efforts, and the rate of progress may be imagined when I state that a mosque near Brulos has in about twelve months been nearly buried in one of the dunes” advancing from the westward. “And as the coarse sand of which these hills are composed is not distinguishable in differing from the sands of the desert near the Pyramids, or that on the route to Suez, they must undoubtedly be all the gifts of the Nile.”

522

Besides coarse sand the Nile carries down fragments of brick, pottery, and other heavy substances, which are also drifted along the coast by the combined action of wind and current. When the wind blows its strongest the coastguard men say they cannot walk against it. To test these facts, Captain Spratt one day landed eleven bags of ashes and clinkers, five of the bags containing pure clinkers, the largest of which weighed from four to five pounds. The whole were laid in a heap just above the water's edge, and left to the care of wind and sea. Twelve days later, when the party returned, not a vestige of the heap, which had weighed nearly two tons, was to be seen. The shore was examined towards the quarter from which the wind blew, but without result; while in the other direction, that of the prevailing wave movement, clinkers weighing about two ounces were found dispersed to a distance of fully 1,500 yards, one of 3-1/2 pounds was picked up at 240 yards, and others from 4 to 8 ounces at from 600 to 700 yards. The greater portion had, however, been buried by the movement of the sand. "Thus this evidence," writes Captain Spratt, "of the movement of the beach in only twelve days, in the month of May, during which there was but one strong westerly breeze and several fresh easterly breezes, is a positive evidence of the great easterly movement of the shore and littoral shallows along this coast, but which, during a succession of winter gales, and during the prevailing north-west breezes at the period of high Nile, must cause a continuous progression of an immense quantity of the sands and matter carried out by the turbid river." 523

We quote another passage bearing on this point. The captain was walking along the coast for the purpose of observation, from the beacon marking the site of Port Said, to the head of the bay of Tineh, when he found a great quantity of broken pottery, broken jars, ancient and modern, and broken bricks scattered on the shore, at the highest and lowest surf margin, "On discovering them in such quantity," he continues, "I was naturally anxious to trace out their origin, thinking they must have come from some adjacent ruin. But I found eventually that they had come wholly from the mouths of the Nile, and that they were the positive debris from the towns situated on the banks of the river, and brought out by the strength of the current at high Nile, but then dispersed along the coast to the eastward by its littoral currents and prevailing ground swell."

It would be easy to multiply facts, if further evidence were wanted, that the Nile is no exception in the great transforming powers of Nature, washing down the dry land into the sea, and forming there beneath and on the margin of the waves new continents and islands. The Mississippi, the Ganges, the Yangtse-Kiang, and other rivers of the great continents, carry down millions of tons of solid matter every year. The North Sea is gradually being silted-up by the rivers of Belgium, Holland, and the British islands. At the mouth of the Ebro, on the northern side of the Mediterranean, the deposits brought down by the river are in course of reclamation by an eminent English engineer. Hence we need not feel surprise that the Nile - one of the greatest of rivers - has during long ages wrought great changes on the southern shores of the same sea. 524



In the face of facts such as are above adduced, a government or a nation might well be justified in believing the project of a harbour and canal on the Bay of Pelusium to be, if not impossible of execution, at least unprofitable. Places which were on the shore when Strabo wrote are now from four to six miles inland, as is shown on the accompanying map, reduced from that published with Captain Spratt's report; and this modifying action is still going on.

525

Since the Suez canal was first projected engineering science has advanced; and though the sands will accumulate at Port Said as from of old, the piers and breakwaters will be periodically lengthened, made to stretch further and further into the sea, while powerful steam-dredges will scrape away the sand from the mouth of the harbour. Whether heavy gales will effect any more serious choking of the approaches, or drift tons of blowing sand into the canal itself remains to be seen. But while the world is greeting, and worthily greeting, the great work as a triumph of engineering skill, it may be well, at the same time, to bestow a little thought on the facts and conclusions here brought under notice, which in the pre-scientific age rendered man's contests against the works of the winds and sea perfectly hopeless.

526

The Suez Canal
NATURE
Letter to the Editor
November 4, 1869

THE all-engrossing topic of the day is the Suez Canal, about which some diversities of opinion still exist. As for many years back I have had my attention particularly drawn to some of the chief matters in dispute, having been engaged on the largest irrigation works in India, I venture to trouble you with the following remarks.

Engineering science and indomitable energy have, in the case of the Suez Canal, overcome difficulties which at one time were considered insurmountable; but even up to the present moment doubts still exist, and some fear that the whole scheme may yet prove a failure, owing to the debris of the Nile travelling eastward transported by the currents of air and water. That we can overcome the former is, in my opinion, beyond all doubt; for it is found that whenever an irrigation channels is run out from the Jumna Canal into the great desert of Northern India, rich vegetation takes the place of arid sand. And so in Egypt will irrigation force back the desert; so the only question is, Can irrigation be carried out on an extensive scale? And of this also I have no doubt, for the enormous volume of water which now flows into the sea and is lost, is quite sufficient to reclaim the whole of the desert.

527 528

It may be asked, Can the water be made to flow over the desert? And of this I hold that there can also be no doubt. The very name of the Timsa Lake proves, I think, that the Nile, or at least a branch of it, flowed eastward, for the word *Timsa* signifies crocodile, showing that the water must at one time have been brackish or fresh, for these creatures could not have existed in this lake had it been salt as at present. If, therefore, a portion of the Nile water at one time flowed eastward there can be no great engineering difficulty to make it do so again; and I am almost inclined to think that it would have been better to have made the canal a fresh-water one, for it is only by vegetation, the produce of irrigation, that the desert can be kept under control.

Other advantages may be cited, such as cleaning the bottom of ships by bringing them into fresh-water, and the prevention of any of the disturbed and very muddy waters along the Mediterranean coast getting admission into the canal; for by keeping the water in the canal at a higher level than of the sea at both ends there could only be an outflow. So all the water wasted would be expended on lockage.

529

It may be objected that the fresh-water canal would get silted up by the muddy waters of the Nile; bout could not this Timsa Lake be used as a silt-trap? I do not mean to say, that the present canal will be a failure because it has not been made a fresh-water one; but what I do think is, that possibly in the end a fresh-water canal would have been best and perhaps cheapest, as the dredging of the canal might have been reduced,* as the water could have been kept at a higher level in the canal.

The great difficulty, however, to contend against, appears to me to be to keep a deep-water channel at the Mediterranean end of the Canal; and what drew my attention to this more than a dozen years ago, was the fact that the harbour of Alexandria does not get silted up.

Caption: “View of Lake Timsah from the sandpiles”

• I observe that, in a discussion at the Civil Engineers Institution, the total excavation of the Suez Canal is stated to be 70,000,000 cubic-metres. The excavation of the Ganges Canal was 2,-547,000,000 cubic-feet, or a little over 70,000,000 metres; but this latter does not include some 3,000 miles of distribution channels.

530

Some have supposed that the subsidence of the delta accounts for this, and that the small advance of the land on the sea in this direction is owing to a constant sinking of the land. In my opinion a very different cause can be assigned: Nature here is working by a very different agency, namely, the current in the Mediterranean which flows eastward all along the African coast, and transports the debris of the Nile, depositing it all along the western portion of the Mediterranean.

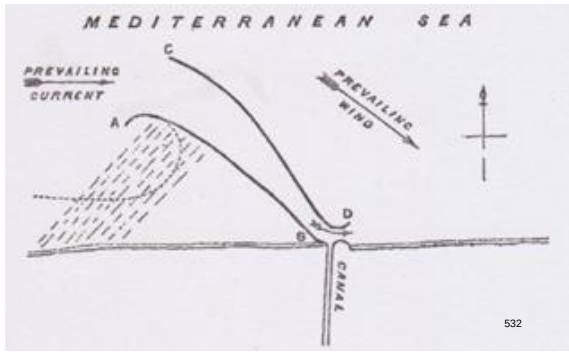
The fact of the Timsa Lake being at one time fresh or brackish, goes to support this view; so the only question is, Will the cost of continuous dredging be so excessive that the Canal will become a financial failure? On this point I cannot venture to give an opinion, as I have no data, but I think this difficulty may be met by forcing this easterly current to aid in keeping the mouth of the Canal clear of silt deposits.

What aids this current to transport the earthly matter is the beat of the sea always stirring the mud and sand up on the coast, and enabling the water to hold a large proportion of matter in suspension, and even to transport heavy matter.

* At Felixstowe, last March, during a gale of wind, I watched a mass of brickwork, some eighteen inches square and about six inches thick, moved along the coast by the action of the waves, which were in an oblique direction to the coast, and no doubt the same takes place along the mouths of the Nile. By a sample I took of this agitated water, I found it contained 0.7375 per cent of its weight of small pebbles, sand, and mud. This sample was taken at a height of nearly ten feet above the sea, and was got by catching the spray of the sea as it was falling.

531

The proportion of earthly matter a short distance out-to-sea is comparatively little, so the great object appears to me to prevent the agitated water travelling as it does at present, and this can be done by arranging the breakwaters somewhat as shown in this diagram.



532

The breakwater AB is intended to prevent the very muddy water travelling along the coast, and the point A should extend well out into deep water. The breakwater CD is to direct the comparatively pure water where the sea is deep to pass across the mouth of the canal; and by the funnel-mouthed shape thus given, the velocity D will be increased, and thus keep deep water at the head of the canal.

Some may say that the expense will be enormous, and that it will have to be year-after-year extended, But, in reply to this, I say that deltas do not extend out into the sea at so rapid a rate as some suppose; and that the formation of a delta takes several thousands of years to accomplish, so that in this very delta, the advance is hardly perceptible; and that a sinking of the land has been brought forward, to account for the very slow progress made; while, in fact, Nature has at present a power at work which is quite sufficient to explain the reason why so little advance is made on the sea during he historic period (see my paper on the Delta of the Irrawaddy, read before the Royal Society of Edinburgh in 1857).

In conclusion, I have no doubt this Suez Canal will have many ready to abuse it and say it is a total failure, as has been said of the Ganges Canal; but like the latter work, which last year saved some three million human beings from starvation, so will this canal, I have little doubt, outlive the abuse, and become one of the greatest blessings to the civilized world.

T. Login, C.E., late of the Ganges Canal

London, Oct. 29, 1869

533

Recent Subsidence of the Northern Suez Canal

NATURE

July 24, 1997

534

Abstract

In contrast to a recent interpretation of delta coast stability, we now show that the northeastern Nile delta in Egypt has been actively sinking relative to the sea during the recent Holocene epoch. The northern Nile delta is only about 1m above sea-level, making the northern Suez Canal and coastal cities of Port Said and Port Fuad (combined population nearly 500,000) highly vulnerable. Subsidence and world sea-level rises contribute to coastal erosion, incursion of salt in the groundwater underlying the delta plain, and silting problems in the canal entrances. These processes must be considered when implementing protection measures for this area.

535

Main

The entire Holocene sedimentary sequence has been recovered from Smithsonian core S-21 (total length, 49m; elevation < 1m), drilled in Port Fuad beside the northern canal bypass Fig. 1). The early Holocene sediments comprise basal shell-rich sands identified as transgressive deposits from shallow marine to littoral origin. These are overlaid by a thick (47m), typical Holocene deltaic offlap sequence (Fig. 1). Marine muds and delta-front sandy muds evolve upwards to sandy littoral and muddy lagoonal sediments.

536

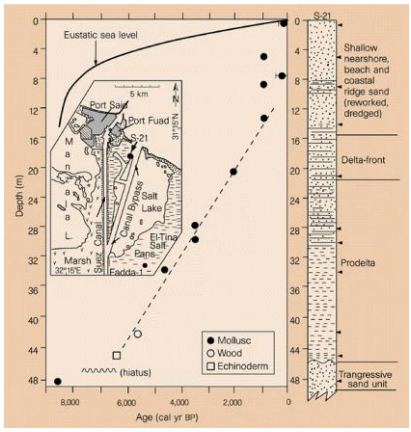


Figure 1: Calibrated radiocarbon dates (for ΔR=0; that is, the worldwide value for the marine radiocarbon reservoir age, R, is assumed) from Nile delta core S-21, in relation to depth. Error bars (1σ) fall within the symbols except where shown. The dashed line shows the age-depth trend for 14-45m depth, and the solid line is the eustatic sea-level curve. Inset shows the core location in the northeastern Nile delta.

537

Our study differs from earlier analyses in that we dated sediments using accelerator mass spectrometric (AMS) 14C analysis of individual shells, urchin fragments and wood, calibrating the dates to obtain calendar ages. We also took into account the water depth at the time of sediment deposition, estimated from an analysis of the fauna present (ostracod, foraminifera, mollusc). This is an important factor limiting the precision of subsidence-rate determination.

We obtained 11 AMS dates from core S-21 ranging from 6,480 ±40 yr BP (radiocarbon dates are all calibrated calendric ages unless otherwise noted) at a depth of 45 m in the lower part of the Holocene mud section, to modern dates near the core top. There was a remarkably consistent pattern of sediment accumulation between 6,500 and 950 yr BP (at a depth of 14m; Fig. 1). The upper 14m of core section comprises a mixture of sandy shallow near-shore, strandline and coastal-ridge deposits - this inconsistency in the relationship between age and depth in the upper 14m of sand is probably due to reworking during dredging of the Suez Canal bypass in the 1970s and 1980s.

538

Near the base of core S-21 (at a depth of 47m), there is a marked unconformity (or break) between the top of the transgressive sands and the immediately overlying marine prodelta muds. Sands at a depth of 48m (1m below the sand-mud contact) are dated to 8,540 150 calendar yr BP by conventional 14C analysis of bulk-sample carbonate. This date is comparable to that of a sample near the top of transgressive sands in core Fadda-1 to the south (9,020 ±330 calendar yr BP; uncalibrated age 8,480 280 yr BP, at a depth of 42m). Dates in both cores indicate a hiatus of up to 1,000 years.

Littoral shell-rich sands present at 48 m (~8,500 yr BP) and 14.6m (~950 yr BP) were deposited at a water depth of 0-10 m, whereas the fauna in the muds at 45m (6,480 yr BP) represents water depths of >10m (ref. 6). At 8,500 yr BP, sands were deposited at a depth of 0-10m below a sea-level which, taking a rise in eustatic sea-level into account, was ~14m below the present level; that is, 14-24m below the sea level at the time. At 6,500 yr BP, these sands were 3m below the sediment surface, which was being deposited at a depth >10m at a time when sea-level was ~6.5m below present. Thus the 8,500-year-old sands would have sunk by that time to a depth of at least 19.5m below present sea level.

539

Similar reasoning places these sands at a depth of 34.5 to 44.5m below present sea level at 950 yr BP (0.5m lower eustatic sea-level +34m overlying sediments+0-10m water depth). At present, the sands lie at 48m below sea-level.

From this analysis we calculate a mean subsidence rate of 3.98mm per year from 8,540 years ago to the present. Thick Holocene sediments in cores P.S.16-1979 (in Port Said) and Fadda-1 at 46.5m and 42m, respectively, indicate similar subsidence rates. In addition to long-term subsidence, the absolute sea-level is rising at roughly 1.0-1.5mm per year, so current relative sea-level rise in this area is at least 5mm per year. Independent analysis of the 1923-1946 tide-gauge record at Port Said shows a relative sea-level rise of 4.8mm per year.

540

The accumulation rate of muds during most of the Holocene (5.4mm y-1) is quite constant (dashed line, Fig. 1). After the deposition of littoral sands at 8,500 yr BP, inundation due to rapid sea-level rise allowed the accumulation of muds at a rate exceeding subsidence. Starting at 950 yr BP, more rapid accumulation of sands (~15 mm yr-1) brought the sediment level up to sea-level, and allowed deposition to keep pace with subsidence.

The main cause of subsidence in this delta region is ongoing faulting, as well as downwarping, of the underlying 3000m of Late Miocene to Quaternary sequences. The whole northern Nile delta plain has been lowered north of a flexure roughly 30 km inland from the coast. Vertical displacement of our dated Holocene sediments provides the most accurate means to measure long-term subsidence, rates of relative sea-level rise and recent sediment accumulation in this region.

541

The Suez Canal
NATURE
Letter to the Editor
December 9, 1869

542

I NOTICE in your number of 4th inst. an article relating to the Suez Canal (by Mr. Login, C.E., late of the Ganges Canal), and shall be glad if you will allow me to make a few observations with reference to it.

In making his suggestions, Mr. Login appears to have overlooked the fact that there is already a sweet-water canal connecting the Nile with the centre of the isthmus, and passing through the Wadi Toumilat, which it has watered and fertilised; and, further, that it is proposed, when the actual work of excavation in the maritime canal is completed, to commence irrigating operations on a large scale by means of this canal.

As to diverting the Nile, or one of its mouths, and thereby forming the great maritime canal, that is quite another affair. In the first place, if I remember rightly, the water in the present sweet-water canal, where it meets the great canal, is some twelve feet above the level of the latter - in other words, above the level of the sea. Does Mr. Login think, then, that to carry the water at this level for 50 or 60 miles across and above the shallow lakes of Menzaleh and Ballah and the plain of Suez would have required *less* excavation than the actual scheme? In the second place, as Mr. Login says, there would be locks at either end of the canal, which would be not only costly, but most inconvenient for ships in their passage. In the third place I doubt very much whether the whole stream of the eastern branch of the Nile would suffice to keep the canal and the great Bitter Lakes full. Some time ago, indeed, it was disputed whether the Mediterranean and the Red Sea together, pouring into the Bitter Lakes, would raise them to the level of the sea, owing to the influences of absorption and evaporation. The facts, however, proved to the contrary.

543

Still, Mr. Login is much more ambitious. With a single stream (that is to say, taking the eastern branch of the Nile at Damietta), less in volume than the present maritime canal, he proposes not only filling the Bitter Lakes to the level of the sea, but raising them to a level of at least twelve feet beyond it (thereby nearly doubling their present volume). Lastly, if the canal and Bitter Lakes could be filled sufficiently by the Nile spring the dry season, it would be overflowing during the floods, and if it could be filled only in the season of the floods, in the dry season it would be nearly empty.

As to the question of breakwaters at the Mediterranean end, Mr. Login rightly says that the annual deposit along the coast is hardly perceptible. I cannot see, therefore, what improvement the breakwaters he suggests would be upon the present ones, seeing that the easterly current nom passes the extremity of the west pier with a speed of two or three miles-an-hour. He therefore not only proposes sending a current of at least five miles-an-hour for a considerable distance up the canal (as his plan infallibly must) - rendering it in strong prevailing winds almost impossible to get out from between his breakwaters - but also sacrificing a splendid harbour of 550 acres in extent.

I quite agree with Mr. Login in thinking that the Suez Canal will not only outlive all abuse, but become one of the greatest blessings to the civilised world.

Birkenhead, Nov. 11 Edw. Rae

544

The Suez Canal
NATURE
Letter to the Editor
January 13, 1870

545

SINCE I last addressed you I have had an opportunity of inspecting the Suez Canal under the most favourable circumstances. After a careful personal examination, and having heard the various opinions of others differing in every conceivable respect, I think that, considering all things, M. De Lesseps and his staff have much cause to feel proud of the success they have attained. To return to my previous letter, I may say, without fear of any objections which may hereafter be raised, that not only do I think the suggestions I then made are sound and practical, but that to carry them out would be most economical to the shareholders of the Canal, while to the Egyptian Government it would add probably 25 per cent, to the land revenue, by reclaiming a vast extent of desert that only requires water to make it most productive.

From inquiries also into the land settlement question of Egypt, I believe that this project of raising the canal-levels by fresh water could be carried out without any complaint being raised by the cultivators, who do the earth work, and would be repaid by title-deed to the land to be reclaimed; for, after all, the work would not be great, simply widening the present sweet-water canal some 30 metres. By a set of locks just before entering Lake Ballah from the south, and a similar set of locks before entering the Bitter Lakes from the north, the surface level of the water in Lake Timsah should be held up 2-1/2-metres. This much of the expensive deepening and widening of the canal would be saved, which is all the more important as it is in this division of the canal that rock has been found.

546

It may be said that the Nile could not supply sufficient water, but with a weir or "anicut" across the Nile at Cairo, where stone is plentiful, not only could a supply of water be obtained, but I believe the whole system of irrigation in Egypt would be greatly improved.

So much for the interests of the shareholders and the people pf Egypt, but what would the ship captains say at being detained by having to pass two sets of locks?

In reply to this objection I say, that as the passage from the Timsah Lake takes seven or eight hours of daylight either way, half-an-hour's detention is of no consequence, for all sea-going ships must remain a night in Lake Timsah; so that as the ship would thus be some eighteen hours in *fresh* water, the marine animals and weeds would most probably all drop off the ship's bottom, and so the hour's loss of time by lockage would be more than compensated by the days saved on the voyage.

I have not time at present to speak of the deposits at Port Said, or the currents at the Suez end of the Canal, but will address you on these interesting questions on some future occasion after I arrive in India.

In conclusion, I must add, that the Canal authorities have one and all been most civil and obliging, showing and explaining everything.

T. Login, C.E.
Late of the Ganges Canal

P. & O. Co.'s Ship *Nubia,*
Suez, November 29, 1869

547

The Suez Canal
Scientific American Supplement
July 29, 1882

548

THE special hall of the Museum of the Marine - the Lesseps Hall - devoted to the history of the ship canal, contains some remarkable models of the powerful machines that we have described in a former article, such as dredges with long chutes, sand elevators, dry-earth excavators, etc.; all of which give a very accurate idea of the operations on the colossal work. Those of our readers who live in Paris will be enabled, then, to make completer descriptions than we have endeavored to render as clear and as short as possible, by going and making a short stay before the pygmy dredges, reduced with wonderful accuracy, which are seen at anchor on the sandy bottom of the trench, pouring the desert sand into a long chute that terminates at a hillock already raised out the bank. Under the elevators are seen the barges with their boxes filled with the excavated material; the dry-earth excavator is stretching its chain and buckets over the talus of the cutting, and the microscopic steam engine that actuates all this assemblage seems just ready to operate. To have made the illusion complete it would only have been necessary to average this mechanical toy in such a way that a simple stress exerted on the mechanism would cause a revolution of the chains and buckets and a rolling of the cars over their inclined plane.

549

Let us give life to each of these apparatus for a few moments, and we shall then faithfully re-establish the mode of work adopted for each of the great sections of the Isthmus Canal. If we cause the dredges and elevators to work, we shall have before our eyes the digging of the low parts of the desert, the marshes of Menzaleb, the approaches to Lake Timsah and Bitter Lake, and the plain of Suez. Let us set the excavator in operation, and we shall reproduce the installation of the great El Guisr cutting (Fig. 1), executed by Mr. Couvreux. On the slope that had been already worked by the preliminary labors of the Egyptian fellahs, are stationed the excavator and the motor that actuates the chain and the buckets. The material removed is poured uninterruptedly into trains of cars which carry it to the dumping station. The entire apparatus - motor and excavator - runs on rails, and may be shipped to other appropriate roadways when the progress of the work requires it. The operation of the excavator, like that of the dredges that are to come after it to finish the submarine excavation, is certainly very easy to understand; and, in regard thereto, we have no need to enter into any mechanical details, as every reader will imagine without effort the progress made each day until the 4,500,000 cubic-meters of the cutting were removed.

550

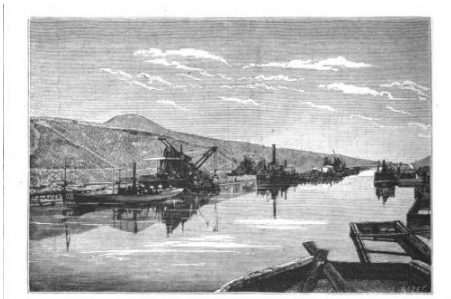


FIG. 1.—THE SUEZ CANAL.—THE COUVREUX EXCAVATOR IN THE GREAT EL GUISR CUTTING.

551

Besides the specimens of the machines the Museum of Marine possesses also a plan in relief of the entire Isthmus, prepared under the intelligent direction of Vice-Admiral Paris, the curator of the institution. An examination of this plan, which measures 10-meters in length, by 2.4 in width, and which is constructed on a scale of 0.06 of a meter to the kilometer, is nearly indispensable to those who wish to acquire a clear conception of the superficies of the Isthmus. While speaking of colossal work, of millions of cubic-meters of clay or sand to be removed, it has all the time seemed to us that the reader might be led to form an erroneous idea of the work, and imagine it to be an imposing one, with high mountains to be cut through, and accompanied by natural obstacles that were almost insurmountable. But, as we have already said, the Suez Canal was far from presenting any such features of extraordinary difficulty. The Isthmus is a tongue that may be considered as being on a level with the sea. The "hills" of the El Guisr, Serpeum, and Chalouf are scarcely discernible on the relief plan in the Museum, although the scale of heights bas been exaggerated therein.

So, the glory of having finished the canal, and of having created a new route between through this bond of union of Africa and Asia, resides principally, not in the mechanical operation of removing the sand, however intelligently this was done, but in the general installation of the entire work, in the character of grandeur that M. De Lesseps infused into his enterprise, with sufficient confidence in its duration and prosperity to allow him to predict at Port Said the future of a new Venice. The founding of this new town of Port Said, and the finishing of the fresh water canal, which sets Ismailia free, vivifies the entire Isthmus, and afterward directs its waters toward the Red Sea and the Mediterranean, are two of the most interesting chapters in the history of the ship canal.

552

When we see the present Port Said, with its admirable basins, its two gigantic jetties between which the steamers sail before entering the canal, we certainly find it difficult to imagine the beginning of this important town, when only twenty years ago, at that period of the work that has been called the “heroic,” the encampments of the first workers, consisting of huts elevated on piles that were lashed by the waves of the Mediterranean, bore quite a resemblance to the lacustrine villages of prehistoric ages. In 1859 that corner of the desert waste which, ten years later, was to offer a splendid hospitality to the representatives of the entire world, contained twelve Europeans and one hundred fellahs. In 1860, the first shelters were erected; and in 1861 a few shovels and wheelbarrows were received. Fresh water - in the majority of cases brackish - came from Damietta in reservoirs; later, it was brought through Lake Menzaleh, cost sixteen francs per cubic-meter, and was almost fought over on its arrival.

553

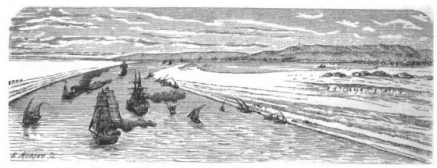
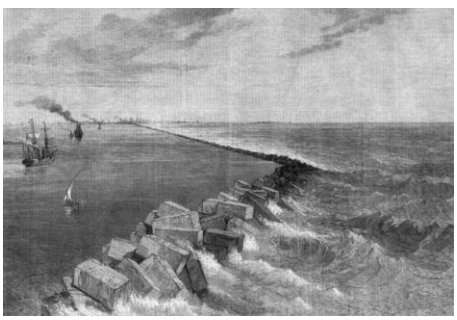


Fig. 2.—THE SUEZ CANAL IN THE PLAINS OF SUEZ.

Over the whole length of the arc of the circle that separates the Mediterranean from the marshes formerly watered by the now obliterated branches of the Nile, the choice of Port Said had not been left to chance. At first the thought had occurred to select the Bay of Peluse as the mouth of the future canal; but, in order to find in front of Peluse the depth of 8-meters, which was necessary both for the anchorage of ships and for the bottom of the channel, it was found that it would be necessary to go out sea a distance of 7,500-meters from the shore. At Port Said it was only necessary to prolong the jetty 2,300-meters to accommodate the maritime service. This latter place was then selected, and, after some preliminary work, the two superb jetties that we now see stretched out like two immense arms, gradually began to show their luminous blocks of stone above the waves. Let us remark just here that Suez, unlike the Mediterranean port, has no jetties, the waters of the Gulf being sufficiently calm. At Suez the canal debouches between the quays of the town (Fig. 2).

555



Breakwater at Port Said and Mediterranean entrance to the Canal

557

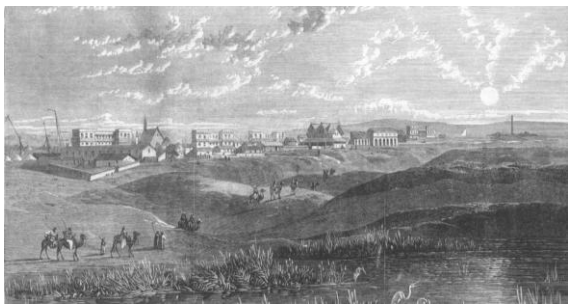
Finally, the first dredge, which was not at all comparable with the machines of the real period of the work, was dragged with great trouble, piece-by-piece, through the mud of Lake Menzaleh. Beginning with this epoch Port Said rose as if by magic.

554

Caption: “Port Said”

The construction of the Port Said jetties was one of the most curious works in the execution of the canal. They were formed by piling up blocks of stone 10 cubic-meters in size, and each weighing 20,000 kilogrammes. These blocks when brought to the place at which they were to be submerged, were rolled over inclined planes into the sea, or else lifted by cranes which afterward allowed them to drop. The talus of the jetty was thus formed with the inclination that the blocks of themselves assumed. It was not necessary to bring natural stone to Port Said, for the sand there, mixed with the lime from Ardeche, in the proportion of 325 kilogrammes of lime per cubic-meter. furnished an artificial substitute. These two admirable pieces of work were constructed by Messrs. Dussaud Brothers, the Marseilles contractors, who had previously executed the works in the ports of Cherbourg, Marseilles, and Algiers.

556



Between Port Said and Suez, at an equal distance from the two seas, rises, on the banks of Lake Timsah, the third capital of the kingdom, conquered from the desert by M. De Lesseps - Ismailia, a town that gives life to the entire Isthmus through its fresh water canal, deriving its supply from the Nile at Cairo, that the existence of the maritime canal is assured the width of this canal is 17-meters, and it is capable of distributing daily from Cairo to Ismailia 30,000 cubic-meters of water.

558

Caption: “Ismailia, 1866”

At 4 kilometers from Ismalia, at Netiche, it forks to supply Suez and Port Said – the former by a prolongation of the canal itself, and the latter by a double cast-iron conduit, 80-kilometers in length, laid along the bank of the ship canal. This magnificent installation, during the progress of the work, supplied the 25,000 laborers who were scattered throughout the whole extent of the operations; to do which, in the beginning, it became necessary to collect a regular army of camels, two-thousand in number, which traveled for water to a distance of 25-kilometers from Ismailia, and returned each carrying two sixty liter barrels of it. Before the establishment of this fresh-water canal the water trains that supplied Suez occasioned an annual expense of 1,200,000 francs. Today, Suez, as well as Port Said, is fully stocked, and, throughout the whole extent of the fresh-water canal, the ancient valley of Gessen of the Hebrews is restored to fertility.

The importance of the fresh-water canal could not, in our opinion, be better presented than by the striking comparison instituted by M. De Lesseps in the discourse that he delivered on the day on which the waters of the Nile first reached the banks of Lake Timsah: "It is seven years ago, in December, 1854," said he, "that I had to make the first exploration of the desert of the Isthmus. I required fifteen days for preparations; forty camels, twenty of which were for water; tents, provisions of every kind; men as escorts and servants; and the whole of this for four persons. Before reaching the place where we were to unite, we had consumed fifteen days and spent ten million francs. In January 1862, three days ago, I left Cairo in a boat, and, after a trip of forty hours, landed a few steps from here, having spent only twenty francs."

559

This intelligent appreciation of the *role* of the fresh-water canal by the creator of the Suez Passage, may be extended so as to apply to the maritime canal itself. It is yet but a few years ago that exchanges between the Asiatic continent and the different countries of the globe were effected through the long route by the way of the Cape of Good Hope, or through that of Cape Horn, thus doubling the extreme end of Africa or of South America. From Bombay to Marseilles or Bordeaux, for example, the route by way of the Cape of Good Hope was not less than 5,650 leagues. To Havre it was reckoned 5,800 leagues, to London, Trieste, or Amsterdam, 5,950 leagues; and to New York, 6,200.

Since the opening of the ship canal these distances have been greatly reduced. From Bombay to Marseilles, instead of 5,650 leagues it is now only 2,375, from Bombay to London 3,100 instead of 5,950; ad from Bombay to New York 3,700 instead of 6,200. The route of the Indies is today a direct one, and the Old World no longer forms but one and the same commercial continent, whose vital center is on this desert waste of Suez.

560

During the year 1881, 2,727 ships, gauging 5,794,400 tons, passed through the canal. From year-to-year the progression becomes more striking, for in 1880 there passed only 2,026 ships, with 4,344,400 tons, and, in 1879, 1,477 ships with 3,237,000 tons. To repeat what we said in the beginning, this new river "flows with gold," and it could not be otherwise with a work which, by shortening distances, gave a new impulse to the commercial life of nations in reducing the elements of traffic to the strictest economy.

From Bombay or Shanghai to Marseilles and London, freight today is not over three pounds sterling per ton, while from Melbourne to the same ports the charge is four pounds. Can navigation by sail around the Capes be sustained in competition with the rapid route by the canal, even if the same conditions be imposed?

The route through the Isthmus will hereafter have no rival; and this canal, which, according to the lugubrious predictions during its early days, was so soon to be filled-up by the desert sands, M. De Lesseps is thinking about widening. The indefatigable maker has recently been at Alexandria again to inaugurate this new phase in the history of the ship canal.

561

Outside of the works that may be called prehistoric, which were executed on the Isthmus by the ancients – by the Pharaoh Nechos, by the Ptolemies, and by the Caliphs – the history of the piercing of the Isthmus of Suez, before the adoption of the definite project of M. De Lesseps, is long and instructive. During the course of his Egyptian expedition, Bonaparte recognized the ancient Egyptian canal, and formed a project of opening it anew from Cairo to Suez. He commissioned the engineer Lepere to take the levels of the Isthmus, but, as we have before stated, the latter found a difference of level of nearly 10 meters between the two seas. Moreover, as the conqueror was going to have other cares than establishment of an entirely peaceful route, the project was given up by him.

In 1840 M. Linant, of Bellefonds; in 1846, Enfantin; in 1847, M. Talabot; and then M. Barrault proposed different projects. During the course of the studies of the Talabot project the leveling M. Bourdalone made known for the first time that the level of the two seas was the same, thus confirming the assertions of Laplace and Fourier.

562

It would be unjust not to name also, along with M. De Lesseps, two men who, in absolutely different ways, have merited the gratitude of the public – Mohamed Said and Waghorn. The first name is the Khedive who accorded to M. De Lesseps the concession of the canal, without which the work could not have been undertaken. During the course of the work this Egyptian sovereign had many a time to fight English influence, which was hostile to the canal, and the judgment of which at that epoch was reflected in the words of Palmerston.

Waghorn is the English captain who, during the seven years from 1829 to 1837, fought against opinion with an unexampled tenacity. In order to show that, even overland, amid numerous natural obstacle, the Isthmus route was still preferable, as to rapidity, to that of the Cape, Waghorn carried, on Arabian boats and the backs of camels, duplicates of letters that had been forwarded by the Cape of Good Hope route. It was as a consequence of material proofs accumulated thus by Waghorn, that the Peninsular Company organized its first line of steamers on the Red Sea, and that a line of diligences was established from Suez to Cairo, the Isthmus route being created in principle.

The name of the Khedive has ben bestowed on the Mediterranean port of the Isthmus, and, with a consideration replete with delicate modesty, M. De Lesseps has desired that a bust of Waghorn, the pioneer of the Isthmus, be set-up on the quay at Suez.

563

This tribute of gratitude and admiration having been paid to the two men whose studies or power had aided in the accomplishment of his work, and the last piece of fire works of the inauguration fetes having been extinguished, any one else than M. De Lesseps would have rested on his well-earned laurels, But the daring traveler was already revolving in his mind the project of piercing the American Isthmus.

Ten years later, we shall find the creator of the first maritime canal traveling over the swampy plains of Panama, as he did formerly over the desert of Suez; crossing the defiles of the Isthmus; ordering soundings; marking the first track of the new transoceanic route; convoking at Paris a congress of engineers and savants; indefatigable; full of hope in the final success of his work; burying himself with measures, conferences, and voyages; surmounting difficulties of all sorts – diplomatic, technical, and financial; and thus obeying the proud device that he has adopted – *Aperire terrain gentibus. – La Nature.*

564

The Suez Canal

Scientific American Supplement
August 26, 1882

565

IF we refer to a profile of the isthmus, along the track of the Suez Canal, and to a concise classification of the soils that compose it (sands, clays, or muds, but no rock, even of secondary hardness), we shall readily obtain an idea of the methods of excavation that had to be adopted in order to bring about a successful termination of that colossal work. The digging of the maritime canal from Port Said to Suez, over its extent of ninety-six miles, was, in fact, only along *dredging* operation in the sandy plains of the desert. The practical realization, however, much surpasses the simple conception that we give.

What a gigantic work, in fact, must that have been which employed at one time eighty large dredges, twenty of them supporting chutes whose length exceeded, by one-half, the height of the Vendome Column, and which together discharged on the banks of the canal in a single month sufficient material to cover, as high as the tops of the trees, the whole roadway of the Champs Elysees between the Obelisk and the Arch of Triumph! This amount of two-million cubic-meters that was removed by the Suez dredges, has given rise to estimates no less curious than the foregoing.

This mountain of dredged matter, spread out from the Madeleine to the Bastille, would fill the Boulevard up to the first stories of the houses. Poured into the Place Vendome, it would be necessary to raise, one on top of the other, five circumferences of houses like those now standing there, in order to contain it. As for the total cubage of 73,000,000-meters of the entire canal there might be constructed with it a gigantic pyramid like that of the Pharaohs, but one having sides one kilometer in length at the base, and being 250-meters in height..

566

In addition to the accessory engines that we shall briefly enumerate further on, the extensive materiel for ditching this canal included, in the first place, dredging machines which, although proportioned to the grandeur of the work to be accomplished, resembled those ordinary dredges that we may see almost any day at work in our rivers and harbors. The interest that attaches to a description of the apparatus used on the isthmus resides, as we shall see, in the mode of emptying on the shore, either by means of long chutes or by elevators, or by cars annexed to the dry excavator, the dredgings that had been brought up by the buckets. When the dredgings were not thrown upon the shore to form the banks of the canal, or when the work was taking place in the proximity of the sea or of the interior lakes, they were emptied into false-bottomed punts that were towed out into the sea or lake and dumped therein.

The dredge with long chute, that we show herewith in Fig. 1, consists essentially of an ordinary dredging machine whose chute has been elongated until it forms a semi-elliptical conduit 70-meters in length, 1.5-meters in breadth and 0.6-meters in depth, and which is supported by an iron framework that is itself supported by a barge. The entire affair is stiffened by iron cross braces, which connect the dredging machine with the barge. A sweeping chain, in a jet of water kept in operation by a pump, hastens the descent of the sand in the chute, which has an inclination of 0.04 to 0.05 meter-per-meter. The mud descends naturally. The chute may be raised or lowered according to any desired angle by means of two small hydraulic presses.

567

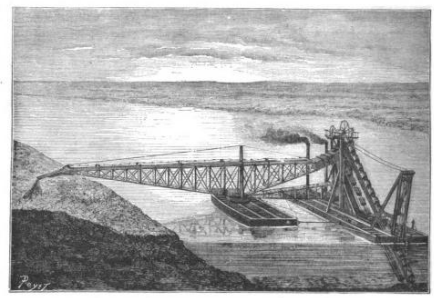


FIG. 1.—DREDGING MACHINE WITH LONG CHUTE.

568

The barge supporting the framework is provided with a turn-table, around which the chute may be revolved in any direction. The entire system is kept in place by four anchors. The operation of the dredge is essentially automatic, for the engineman who takes charge of the engine has only to turn the cock that allows of the introduction of steam into the cylinder, when the chain that carries the buckets begins its regular descent and ascent, and each of the latter brings up and empties into the chute 400 liters of sand that it has dug-up from the desert.

Between the excavation of the material and its deposit upon the bank there is no intermediate operation of transportation by punts, such as we shall describe for the dredging where elevators are employed.

However ingenious its operation, the dredging machine with its long chute did not permit of exceeding a certain limit in the height of the material emptied on the bank, and which was proportionate to the height of the chute itself at the summit of the excavating machine, and to the inclination indispensable to the sliding down of the sand that was helped along by the sweeping chain, or simply by workmen provided with hand-rakes.

As the point of attachment of the chute could not be raised more than fourteen or fifteen meters above the level of the water, the height of the deposited dredgings could scarcely exceed five to six meters. It became necessary, therefore, to set-up alongside of the dredging machine another arrangement that should permit of depositing a much greater height of sand. The apparatus adopted for this purpose was an elevator, which was constructed under the direction of Messrs. Borel & Lavalley, and which is shown in Fig. 2.

569

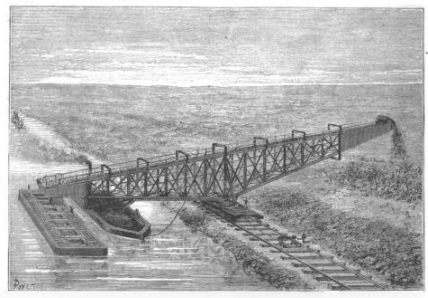


FIG. 2.—ELEVATOR FOR LANDING AND DUMPING DREDGINGS.

570

In the first place, the reader will notice that the apparatus is a simple elevator, a sort of railway carried on an incline plane and supplied with material by dredging machines operating at various distances. The elevator consists of an irregularly triangular framework, whose base carries two tracks, over which run small box cars filled with dredgings from the canal. The shorter end of the frame points toward the canal, and the longer end toward the shore. The entire apparatus is arranged so as to be moved on a track along the bank.

The operation is very simple: A punt filled with boxes containing the dredgings is floated under the lower end of the elevator, When by a simple maneuver the box is raised up and drawn along the inclined plane to the opposite end, where its contents are dumped on to the bank. The box is then slid quickly down again and replaced in the punt, and the remaining ones are then emptied one after another in the same way. The punt then returns to the dredging machine, and another one comes to take its place beneath the inclined plane. When a maximum height of fourteen meters has been reacted in the embankment the elevator is moved along its track to a new position.

The two apparatus that we have just described served to dig the maritime portion of the canal into which the water had already been introduced; and thus was accomplished the long and laborious crossing of Lakes Menzaleh, Serapeum, Timsah, and the Bitter Lakes. 571

In certain parts of the Isthmus, where the necessary amount of water to float the dredges could not be introduced at the beginning of the work, it became necessary to have recourse to a third apparatus, the “dry excavator” which was devised by one of the section contractors, Mr. Couvreux. This apparatus is a dredge whose chain and buckets are maneuvered by a steam engine located on the side of the ditch to be dug. The entire apparatus is moved along on a railway, and the buckets emptied into cars that are drawn by a locomotive. The bucket frame is given the desired amount of inclination by means of the tackle that supports it. In measure as the ditch is enlarged the track is moved.

Along with these three principal apparatus that we have just described the gigantic Suez work necessitated the use of a colossal *materiel,* comprising ordinary dredges, elevators; excavators; punts for carrying the dredgings out to sea; flat-boats and their boxes; steam cranes; iron boats for carrying coal; cars; locomotives, etc., etc., requiring a power of; 10,000 horses, and consuming 10,-000 francs; worth of coal per month. Twenty-two thousand laborers added their quota of intelligent power to this *materiel,* whose cost was figured at 40,000,000 francs. 572

To the mechanical history of the Suez Canal it is impossible not to add what has properly been culled the “heroic story” of the work, when, during the first period of operations, the power of machinery had not yet arrived to lend man its aid.

The first attempt to cross Lake Menzaleh recalls the work of antiquity. Before the dredges could be introduced into these long marshes, where the layer of mud was covered with scarcely more than 20- to 40-centimeters of water, 400,-000 cubic-meters of the semi-liquid mud were extracted from a trench of four- to five-meters in width by fellahs, who scooped it up with their hands, pressed it against their breast to squeeze out the moisture and form it into solid lumps. Often even the mud was thrown onto the back of a fellah, who held it with his crossed arms and carried it to the bank as a hod-carrier would with his hod.

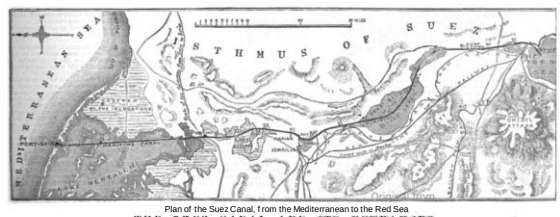
The European laborer was rare, if not totally absent from these works, which remind us of the drudgery of primitive ages. Through machines and fellahs the entire work was finished in ten years. On the 25th of August, 1859, Mr. Lesseps struck the first blow of the pick on the desert beach where now stands Port Said, and which marked the mouth of the future canal, and on the 15th of August, 1869, Ali Pacha broke down the last rampart that composed an artificial barrier to the complete union of the two seas at Suez. Three months afterward, on the 17th of November, the fleets of all nations were traversing, in a triumphal march a thousand times grander than those of antiquity, the new route to the East.—*La Nature.* 573

The Suez Canal

Scientific American Supplement
September 1, 1883

574

CONSIDERABLE excitement has recently been occasioned, both among politicians and among British ship owners and others interested in Eastern maritime traffic, with regard to the terms of a proposed agreement between her Majesty's Government and the Suez Canal Company, represented by M. Ferdinand de Lesseps, the president, for the construction of a second waterway alongside of the existing canal, to be aided by an advance of eight millions sterling from the British Government. There is no difference of opinion concerning the utility of this work, by which the up and down traffic would be enabled to proceed along parallel lines of canal without obstructing each other; but many influential persons consider that, in return for the pecuniary assistance given by Great Britain, the company ought to be required to make a speedier and larger reduction of its tolls, four-fifths of which are levied upon shipping; that England ought to have a greater part in the direction and management of the company; and that the company's exclusive privileges, under the concession it obtained from the Egyptian Government, ought not to be extended to a further period of time. These questions will soon come before Parliament, whose assent is needful to ratify the proposed agreement. In the mean time we present a few illustrations of the actual situation and works of the existing Suez Canal, with a brief account of its construction. 575



Plan of the Suez Canal, from the Mediterranean to the Red Sea

THE SUEZ CANAL AND ITS ENTRANCES.

The plan shows the whole course of the Maritime Canal, from Port Said on the Mediterranean coast to Suez at the upper end of the Red Sea, with the small Fresh-Water Canal from Ismailia to Suez, and with the adjacent country. The upper side of this plan is to the east.

The entire length of the Maritime Canal is not quite a hundred miles. The first piece of it, from Port Said to Kantura, runs through the shallow Lake Menzaleh, the bed of which has been excavated to the required depth along a line of twenty-nine miles, forming a navigable channel protected by dikes on each side. All this tract of country is low and flat, being the eastward portion of the delta formed by the ancient mouths of the Nile, frequently overflowed, and half composed of mud, half of lagoons varying in extent at different seasons. 576

Leaving this region of Lake Menzaleh, at Kantara, a station on the desert route from Egypt to Syria, the course of the canal for two miles is through low sand hills. It then enters La Ballah, traverses it for a distance of eight miles, and next enters a deep cutting from El Ferdane to Lake Timsah. Near El Guisr, four miles south of El Ferdane, the deepest cutting had to be executed, from 60 ft. to 70 ft. deep. On the shore of Lake Timsah, half-way from Port Said to Suez, is the new port and little town of Ismailia, which is the headquarters of the Suez Canal Company in Egypt, and the residence of its local managers.

It is here that the Fresh Water Canal, from the Nile below Cairo, approaches the Maritime Canal, and dispenses part of its water, through pipes laid along the northern section, to supply the inhabitants of Port Said as well as the stations and shipping on the Maritime Canal.

The remainder of the course of the Fresh-Water Canal, as shown in our plan, winds round the western shore of the Bitter (or Salt) Lakes, and through the Chalouf cutting to reach the town of Suez.

The Maritime Canal, however, cuts directly through the rising ground of Toussoum and the Serapeum; thence passes twenty-four miles through the Bitter Lakes, which are of sufficient depth, having been filled by letting in the water of the Mediterranean; finally penetrates the last piece of high rocky ground by the cutting of Chalouf, and twelve miles further on arrives at the Red Sea, a mile below the town of Suez.

577

FERDINAND DE LESSEPS.

The projector, the creator, and hitherto the supreme director of the Suez Maritime Canal is the Vicomte Ferdinand de Lesseps, one of the most extraordinary men of the age, ad whose portrait is most worthy to appear in our journal.

578

He was born at Versailles, in 1805, and was employed in the French Consular Service in Egypt, in the time of Mohammed Ali, from 1836 to 1840. He was afterward Consul at Barcelona, next French Minister at Madrid, and in 1849 Special Envoy to Rome, when the French military intervention took place for the restoration of the Papal Government.

In 1854, when Said Pasha became Viceroy of Egypt, M. De Lesseps, who knew him intimately, was invited to pay a visit to Cairo. There, living as an honored guest in the Viceroy's palace, he conceived the project of the Suez Canal. It was an old idea of Napoleon I, and M. De Lesseps had often turned it over during his former sojourn in Egypt, but without ever having had leisure to study the question in its practical bearings.

579

PERCEMENT

DE

L'ISTHME DE SUEZ

EXPOSÉ ET DOCUMENTS OFFICIELS

PAR

M. FERDINAND DE LESSEPS

MINISTRE PLÉNIPOTENTIAIRE.

PARIS.

HENRI PLON, ÉDITEUR

1855

In a pleasure trip which he made with Mohammed Said from Alexandria to Cairo across the Libyan desert, he broached the subject to his host, and the Khedive, perceiving at a glance all the profit which might accrue to Egypt, requested to draw-up a memoir. M. De Lesseps set to work, and eighteen months later published his admirably elaborate and yet concise book, "Percement de l'Isthme de Suez." In this, all the advantages that would attend the opening of the canal were exposed luminously, and the material difficulties of the enterprise were so carefully entered into and disposed of, that Mohammed Said, seeing the thing to be decidedly feasible, empowered M. De Lesseps to begin the work.

580

INDICATION DES PORTS D'EUROPE ET D'AMÉRIQUE.		Distance JUSQU'A BOMBAY PAR LE CANAL DE SUEZ.	PAR L'ATLANTIQUE.	DIFFÉRENCE
Constantinople	Lieues.	1,800	6,100	4,300
Malte	—	2,062	5,800	3,778
Trieste	—	2,340	5,960	3,620
Marseille	—	2,374	5,650	3,276
Cadix	—	2,224	5,200	2,976
Lisbonne	—	2,500	5,350	2,850
Bordeaux	—	2,800	5,650	2,850
Le Havre	—	2,824	5,800	2,976
Londres	—	3,100	5,950	2,850
Liverpool	—	3,050	5 900	2,850
Amsterdam	—	3,100	5,950	2,850
Saint-Pétersbourg	—	3,700	6,550	2,850
New-York	—	3,761	6,200	2,439
Nouvelle-Orléans	—	3,724	6,450	2,726

581

AVANT-PROJET DU PERCEMENT DE L'ISTHME. 89

Repères du nivellement de 1853, comparés aux mêmes Repères du nivellement de 1847.

	ORDONNÉES au niveau de la basse-mer de la Méditerranée à Tineh. 1853	1847	[illegible] avec le nivellement de 1847.
Basse mer de la Méditerranée à Tineh	0,0000	0,0000	0,0000
Repères des ingénieurs allemands à Tineh	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]		
[illegible]	[illegible]	»	»
[illegible]	[illegible]	[illegible]	[illegible]

582

The political obstacles which now beset the eager Frenchman were very formidable. Lord Palmerston and Sir Stratford Canning (Lord Stratford de Redcliffe), at Constantinople, did all they could to oppose it. No assistance or encouragement was afforded by any influential party or class in England; merchants, ship owners, capitalists, engineers, as well as politicians, set themselves against it.

But M. De Lesseps persevered, and the French nation, under the Emperor Napoleon III, entered readily into the scheme, which also found favor in Italy and Austria, and in other Mediterranean States. The "Compagnie Universelle du Canal Maritime de Suez" was thus formed, with an original share capital of eight millions sterling; but it raised four millions additional by debentures, and received nearly four millions from the Viceroy of Egypt as indemnity for his nonfulfillment of some of the conditions of the contract.

The canal, with its ports at each end, was to belong to the company for ninety-nine years, from 1869, after which it would revert the Government. Of the traffic earnings, th Egyptian Government was to receive annually fifteen per cent. The Fresh-Water Canal was, at first, made the property of the Suez Canal Company, but was afterward relinquished to the Government for a pecuniary compensation. The total cost of the works was seventeen millions sterling.

583

Transverse Section of Suez Canal.

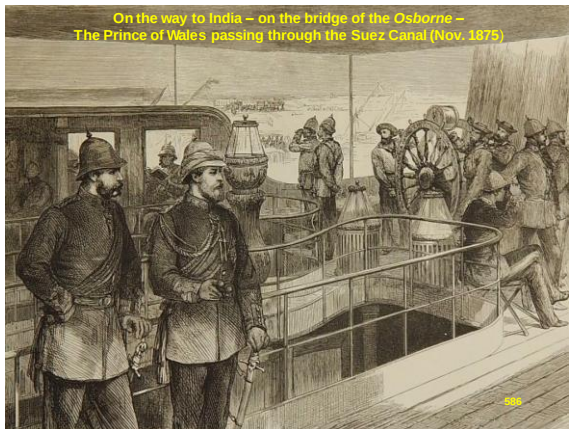
The work of construction was designed and superintended by French engineers, with two or three Italian assistants. The engineer-in-chief was M. Voiain or Voisin Bey. The line was divided into four sections, of which M. Laroche, M. Gioia, M. Berthoult, and M. Larousse were respectively the resident engineers. The contractors for the canal works were Messrs. Borel, Lavalley & Co.; the contractors for the Port Said harbor works, Messrs. Dussaud. The whole was completed in 1869, when the Empress of the French, the Emperor of Austria, and princely representatives of all the great nations of Europe were present, on November 17 of that year, at the splendid opening ceremony.

Some particulars of construction may be here added. The canal has a uniform depth of 26 ft. 4 in., and its bottom has a uniform width of 72 ft. 5 in., which does not allow two large ships to pass each other, except at certain places, where a wider basin is formed. The full width at the surface of the water is 329 ft. 2 in., as shown in our engraving of the section; but, where the canal was cut through rocky ground at El Guisr and the Serpeum, and at Chalouf, the upper width is reduced to 200 ft. 11 in.

584

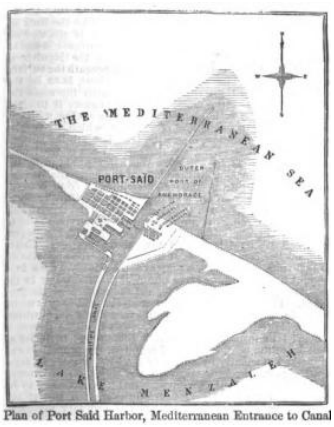
The work of excavation was at first done by hand, by thousands of Egyptian laborers; but latterly, by the aid of floating dredges and other mechanical contrivances. It was more quickly and economically performed. The vast natural basin of the dried-up Bitter Lakes, twenty-four miles long, was converted into an inland sea, in March, 1869, by admitting the waters of the Mediterranean. Their Royal Highnesses the Prince and Princess of Wales visited the canal during this operation, and the Prince was there on a later occasion.

585



On the way to India – on the bridge of the *Osborne* –
The Prince of Wales passing through the Suez Canal (Nov. 1875)

586



Plan of Port Said Harbor, Mediterranean Entrance to Canal

Port Said and Suez, the two harbors that form, respectively, the northern or Mediterranean entrance and the southern or Red Sea entrance to the Maritime Canal, are represented in two of the plans we have engraved.

Port Said is quite a new creation, being constructed since 1859 expressly for the canal. The town is built upon an island or sandbank dividing Lake Menzaleh from the Mediterranean Sea. The harbor is entirely artificial, formed by two breakwaters, one a mile long, the other a mile-and-a-half, which were made by casting into the sea about 25,000 blocks of concrete, each weighing above twenty tons. They enclose a space of 570 acres, the outer harbor, which has a depth of 26 ft. or more, kept clear by constant dredging; three sheltered basins inside constitute the inner harbor.

587

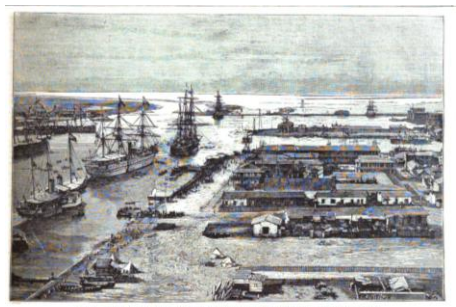


Fig. 2.—PRESENT ASPECT OF THE SUEZ CANAL AT PORT SAID.

588

THE SUEZ CANAL.—VIEW NEAR PORT SAID ON THE MEDITERRANEAN.

589

Plan of Suez Harbor, Red Sea Entrance to Canal.

The Port of Suez had for many years, before the Suez Canal, been used by the Peninsular and Oriental Company's steamships to India, and by the French Messageries steamers. It was already connected with Alexandria by railway, as shown in the map. The works here required for the Suez Canal traffic consisted of a breakwater, 850-yards-long, to protect the entrance to the canal; also the deepening of the channel from the anchorage in Suez Roads; and embankments or sea walls to enclose space for docks and basins, including a dry dock, 160 ft. long and 85 ft. wide, constructed by the French Messageries Company

590

591

Such, described in mere outline, are the great works executed within the past thirty years by French enterprise and capital, which have chiefly availed for the service of the British mercantile marine, nearly four-fifths of the aggregate tonnage yearly passing through the canal belonging to England. In 1875, when the late Khedive, Ismail Pasha, was obliged to raise money by selling his portion of the company's stock, the British Government wisely purchased his shares at the price of nearly four millions sterling. These shares, however, do not yet entitle their holders to receive dividends, or to vote among the other shareholders in the company, but they will do so after the year 1894.

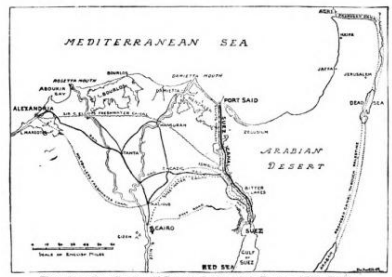
We now come to the recent history of the negotiations which have resulted in the provisional agreement explained in the House of Commons by the Chancellor of the Exchequer, which is dated July 10, 1883. Sir Charles Rivers Wilson and Sir John Stokes, the two English official Directors on the Board, in the months of April, May, and June last, had repeated consultation with M. De Lesseps on the improvement of the canal communication between the Mediterranean and Red Seas, and the conditions under which the canal must be hereafter worked. The views suggested in Lord Granville's instructions and those of the President and Vice President of the Canal Company approximated so closely that they were invited to London to confer with the Chancellor of the Exchequer and the President of the Board of Trade.

592

The points to which attention was directed were: 1. The improvement of the canal accommodation across the Isthmus, so as to meet the increasing requirements of commercial traffic. 2. A substantial reduction of the dues and tolls. 3. An increased share in the government of the company. Improved communications may be obtained by one of three methods: (1) By the simple widening and deepening of the present canal. (2) By the construction of a second canal on ground forming part of the company's concession, which would lead to the new channel not being on the most advantageous line; and (3) the construction of this second parallel canal on ground outside the boundary of the company's territory, but which would allow of the channel being traced to the best direction for the navigation and for economy of construction.

Either of the two first alternatives was open to M. De Lesseps to adopt, without any fresh concession from the Egyptian Government, and therefore without the necessity of having recourse to any agreement with her Majesty's Government for their good offices. From the moment that such intervention was rendered possible by an understanding on other points, the third alternative appeared to be the only one deserving of consideration. It is sufficient to mention the obvious advantage resulting from a system which secures to vessels two distinct and efficient routes, one for the outward, and the other for the homeward traffic.

593



Plan of the Suez Canal, and Projected Alternative Routes of Ship Traffic.

594

The number of steam vessels that passed through the canal, out and home, in the year ending with last April was 3,154, having an aggregate tonnage of 4,889,923 tons. Of these vessels, 2,469 were British, with 3,781,905 tons; 197 were French, with 382,855 tons; 111 were Dutch, with 199,473 tons; 115 German, with 144,732 tons; 65 Italian, with 119,370 tons; 81 Austrian, with 112,115 tons; 42 Spanish, with 75,340 tons; and 74 of all other nations, with 74,133 tons, including Russian, Belgian, Turkish, and Chinese, in which last mixed class there is falling off since the preceding year.

The British shipping in the year ending April, 1882, was in number 2,484, in tonnage, 3,512,857. In the year ending April, 1881, there were 1,714 British ships, with 2,390,974 tons burden; when the total canal traffic of the year was 2,158 vessels and 3,023,772 tonnage. The vast proportion of British shipping to the whole is thus steadily maintained.

The receipts of the canal for the year 1882 amounted to about £2,000,000, or four-fifth, was paid by British ships. The year's working expenses were £730,-000. After certain deductions for he sinking fund and interest on consolidated coupons, there was a net profit of £1,260,000. This profit of the year was distributed as follows: To the Egyptian Government, 15 per cent, or £188,000; to the founders, 10 per cent, or £126,800; to the directors, 2 per cent, or £25,320; and £25,320 to the invalid fund for employees; leaving to the share-

595

holders of the company 71 per cent of the net profit, amounting to £930,000.

This gives a dividend of 56 francs 22 centimes per ordinary share (of 500 francs), 31 francs 67 centimes to the founders' shares, and 82 francs 73 centimes to the preference shares. There are 400,000 shares in the company, of which 176,602 shares are held by the British Government; and these are not entitled to any dividends until the year 1894, the late Khedive, from whom they were purchased, having alienated his dividends for twenty-five years in advance from 1869.

596

Part 7

A Work of Civilization

597

The Suez Canal –
Its Engineering, Commercial and Political Aspects

by *Lieut.-Gen. F.H. Rundall, C.S.1., R.E.,*
Late Inspector-General to the Government of India.
From the "Journal of the Society of Arts."
Van Nostrand's ENGINEERING MAGAZINE
January 1884

598

THE Suez Canal has of late occupied, and is still occupying largely, the attention of all Europe - and, perhaps it may not be too much to say, of the whole civilized world. At the same time notwithstanding so much has been written and talked of about it, beyond the fact of its being the great thoroughfare to India for the ships of all the Western nations, but little comparatively regarding it is known to the public generally.

The mercantile world, and those more particularly interested in the Canal, can of course obtain from the Parliamentary Blue-books a mass of important information and statistics not otherwise available, more especially as regards the official negotiations which have passed between the various Governments in reference to the commercial and political aspects of the undertaking. But Blue-books are not attractive reading, even to those who have leisure, while business men seldom have time sufficient to devote to their study. The Society of Arts, therefore, being desirous of procuring a succinct, and at the same time correct and comprehensive, account of the Suez Canal in all its aspects, an endeavor is made, in the following remarks, to meet that desire, by collating, from official and other publications, the most important of the particulars available, and, at the same time, to consider the various bearings of a question which is now attracting such universal attention, and which is generally felt to be of primary importance to England at the present time.

599

The Suez Canal has to be viewed in three aspects:

1. As an engineering work.
2. As a commercial undertaking.
3. As a political problem.

Before commencing to discuss these three points in detail, I propose to give a short history of the scheme, from the period of its first incubation, to its present stage of development.

The first idea, in modern times, of connecting the Mediterranean with the Red sea seems to have originated with Napoleon I, but before he could give any practical shape to that idea, the Emperor had to evacuate Egypt.

Nothing further was attempted till the year 1842, when Captain James Vetch, of the Royal Engineers, published a pamphlet, in which he indicated the direction a canal should take across the Isthmus, and its vast importance to this country; but the Government of the day were opposed to the construction of any canal, and Captain Vetch's suggestions fell to the ground.

Subsequently, in the year 1846, a Commission of engineers assembled to discuss certain proposals, which, however - beyond exposing the error as to a difference of level of thirty feet between the Mediterranean and Red Sea - came to nothing, and so the subject dropped until 1854, when it was revived by Monsieur De Lesseps putting forward his project for a direct canal between the two seas.

600

His proposals met with considerable opposition in England, strangely enough from commercial authorities, who foresaw the total revolution that would be made in the carrying trade, but who were apparently unable to appreciate or believe in the enormous advantage that would accrue to them from such a revolution. But there was likewise a formidable political opposition, based on certain objections which the Government of the day foresaw would, unless duly safeguarded, be likely to give rise to considerable difficulties in the future. That those objections were not destitute of foundation, every statesman of the present day will readily admit; and the difficulties which are now attendant on current negotiations only too plainly indicate that a scheme which at first apparently concerned only a small body of speculators, has turned out to be a political problem, perplexing more or less the whole continent of Europe; but the difficult task of solving which has, by a general consensus of opinion, devolved, and rightly so, upon England.

This phenomenon is not without its prototype. Our Eastern Empire, as is well known, had its first beginnings in the ventures of a few enterprising merchants, whose marvelous prosperity, in spite of themselves, raised the East India Company to the highest importance as a political factor, stimulated its acquisitive energy until its operations got beyond control, and the Merchant-princes of the East found themselves overturned in the great convulsion which, in 1857, shook the Empire to its foundations, and so nearly involved the whole of the gigantic fabric in ruins. 601

It is, to say the least, a curious coincidence that, ere India had recovered from the throes of that convulsion, an enterprise like the Suez Canal, originated by private speculators, and the interests and prosperity of which are so closely dependent on those of India, should be started into existence, and, after nearly foundering, should, in a brief time, enter on such a career of prosperity, become a link between gigantic interests, and in its turn rise to be an important factor in the political world; and what is stranger still, instead of proving, as was anticipated, a spear for piercing its armor, it has been converted into the first line of defence for England - a veritable covered way for safe-guarding its Eastern possessions! Is the parallel to be pursued any further? Doubtless the projector would exclaim, *"Dit omen avertant!"*

But to return to the history. In 1859, Monsieur De Lesseps' scheme was actually begun, and after successfully combating many difficulties, both physical and political, the Canal, though incomplete, was finally opened from sea-to-sea ten years afterwards, in the year 1869, with great pomp and ceremony, in the presence of a brilliant Imperial assemblage. From 1869, to the present time, the Canal has been in constant use, with- out a day's intermission. Its career has not been altogether unchequered; but it has emerged from its difficulties, and has now reached a pitch of prosperity exceeding the most sanguine expectations of its projector. 602

To pass on to the consideration of the Canal as an engineering work. It is unnecessary, as well as out of place here, to enter into minute details of construction, and therefore only its most general features will be brought under review. There is little room to doubt but that the engineers who were entrusted with the surveys, selected, on the whole, the most favorable line for the Canal, as regards economy of first construction. The entrance from the Mediterranean is between two long piers, or moles, run out from the coast, with the idea partly of creating a species of harbor, in which vessels approaching the Canal might lie in quiet water. The western mole, however, was also intended to serve as a protection against the entrance becoming silted by the Nile deposit, which is transported during the floods of that river in enormous quantities along the coast for many miles.

It may be open to comment whether, instead of placing the entrance from the Mediterranean at Port Said, it might not have been better made more to the eastward, and further removed from the influence of the silt-laden waters of the Nile. It is said that the difficulties connected with the silt deposit at that entrance have been overcome, but that assertion must be received with caution; for it is quite certain that the coast line between the Damietta mouth and near the Canal has advanced considerably, while the 5-fathom line had receded, as noticed in Sir John Stoke's Report in 1874, 1,200 yards in three years. 603

The diagram on the wall is on too small a scale to show the present position of that line, and the rate at which the intervening space is being filled up, or how far the statements of Monsieur Lemasson, the French engineer, are borne out, as to the effect that a deposit of 74 million cubic-meters per annum was likely to produce. The western mole has, it is believed, now reached a length of nearly 3,000 yards, and to where the 5-fathom line used to lie. Of course, as deeper water is reached, the process of silting up will become slower, but that it cannot be wholly arrested by mere extensions of the western pier, though accompanied by dredging, is incontrovertible. Hence it may be admitted that the further the entrance could have been removed to the eastward, the less inconvenience would have been experienced from the translation of the Nile deposits.

With the exception of some unnecessary curves, especially that near the town of Ismailia, the general alignment of the Canal is satisfactory; but since the traffic began to increase, the mistake of making those curves has become apparent. It must be admitted, however, that the mistake has been aggravated rather by the continually increasing length given to vessels which have been (and are still being) built for the navigation of the Canal.

The total length of the line from Port. Said to Suez measures 88 geographical, or 100 land miles, of which 39 miles only are in cuttings through land, the other 61 miles running through a succession of lakes. 604

The northern half of the Canal, as far as Lake Timsah, had to be excavated by manual labor, until sufficient depth could be obtained to admit of dredging operations; but the portion south of Lake Timsah was excavated entirely by dredgers, as water was obtained on a high level from the Fresh-water Canal, which had, meanwhile, been constructed; and thus by filling-up the line of the Suez Canal to that level, sufficient depth was obtained for floating the dredgers. At El Guisr, Serapeum, and the Chalouf plateau - in all, about eighteen miles of cutting - rock (more or less hard) was encountered, rendering excavation both difficult and costly, as blasting operations had to be resorted to. Though along the rest of the line the material to be excavated consisted principally of sand, with an occasional admixture of clay, yet the task of not only excavating soil to a depth of 26-feet below water, but of conveying it away, involved some difficulty, which was finally overcome by some very ingenious adjuncts and appliances to the ordinary dredgers. The excavated material could not, as in the case of river or harbor dredging, be simply lifted into hopper barges, and be towed out and discharged into the sea; it had to be deposited on banks on either side, the height and breadth of which were, of course, continually increasing.

605

According to Lieut. Colonel (now Sir A.) Clarke's report, written in February, 1870, it was originally intended to construct the Canal with a surface width of 325-feet, and a bottom width of 144-feet; but the latter, at the present time, does not average more than 70-feet. The side slopes, which vary according to the soil passed through, are being now faced with stone, by which means a considerable length of the Canal is protected from the erosion which used to take place from the wash of the steamers.

A minimum depth of 26-feet is maintained throughout the Canal. The bottom width being only half that originally intended is, of course, insufficient to allow of vessels passing one another, and obliges a low speed to be maintained.

Sir John Stokes observes, in a report dated April 20, 1876, that, in his opinion, the narrow width is not altogether a disadvantage, inasmuch as by necessitating the Canal being worked on the block system the risk of collision is greatly reduced, and the passage of vessels is, in the long run, performed in a shorter space of time than if vessels were allowed to navigate independently.

Unquestionably, the risk of collision is especially to be avoided where large vessels are concerned, for the momentum of masses 2,000 to 4,000 tons in weight, moving even at a low velocity, is exceedingly great, and when brought into collision must be attended by disastrous results.

606

But the narrowness of the section operates disadvantageously in retarding the speed of vessels below the economical unit. When the difference between the sectional area of the Canal and that of the vessel's midship section is so small, the piling of the water caused by the vessel's displacement is greatly increased ; the friction on the sides of the vessel, as well as on those of the Canal, so retards the flow of the water that the void created by the vessel's onward movement cannot be filled sufficiently fast, and hence the steering power is destroyed, and the ship either takes the ground astern or runs bow on to the bank.

By experiment on the Indian Canals, it was found that when the relative sectional area of the vessel and canal were in the proportion of from 1 to 12 or 14, with a depth of 3- to 4-feet under the steamer's keel, there was no perceptible piling, and a speed of from 8 to 10 miles-an-hour could be maintained, but wherever that relative proportion fell short, piling began to take place, and the speed was proportionately diminished. If, therefore, the Suez Canal were finished more nearly to its original dimensions, or say, to 320 on the water line, and 200 at the base, with slopes of 2 to 1, it would, if 30-feet-deep, contain a sectional area of 7,800 square-feet, and yield a proportion of 13 to 1 to all vessels whose midship section did not exceed 600 square-feet, and which would probably include all ships registering 2,000 tons. 607

The block system, if found absolutely necessary, might still be maintained, but it would give the opportunity for such vessels to accomplish the passage of the Canal in twelve hours of daylight. The narrowness of the bottom width of the Canal not admitting of large vessels passing one another, side-cuttings, called "Gares" or stations, have been made at intervals of five miles, wherein large vessels can lie moored during the night, or whenever the necessity may arise. As observed before, the method of working the Canal is that known on railways as the block system, no vessel being allowed to proceed from one station to another until the line is signaled clear, for which purpose a perfect telegraphic communication is kept up through its entire length.

The arrangements for carrying this out are described in Sir J. Stoke's report, as follows: "Each of the superintendents of the transit at Ismailia, Suez, and Port Said has a model of the canal in his office, with miniature vessels, which enable him to fix the position of each ship as it passes through. As soon as a vessel enters the canal, either at Suez or Port Said, its counterpart is launched on the models with name affixed. As it passes each siding, which is also a telegraph station, its position is made known to the superintendents, who fix its place on the model, and the chief transmits orders for the guidance of the pilot on board. Then, whenever a vessel approaches a siding, it finds a signal directing its movements, whether it is to remain or move; if to remain, the orders are strict that it is to make fast to the bank in the siding, and to leave the navigable channel quite free." 608

If these orders are acted up to, it is impossible for two vessels to meet in the section between two sidings, and so collision is rendered impossible. The canal is also furnished with every accessory in the shape of lighthouses, beacons, buoys, telegraphs, &c., for facilitating the navigation as far as possible.

It would have been impossible to carry (on the work of the Maritime Canal without a supply of fresh water, which was wanting along the whole line. The company was therefore empowered by the Egyptian Government to construct a canal for irrigation and navigation from the River Nile, at a point below Cairo to Timsah, and thence to furnish a supply for the towns of Port Said and Suez. This canal has since been enlarged and completed with locks, and is the work which proved of such invaluable aid in the late military operations in Egypt. The extensive tract of land granted to the company, and for which irrigation had to be supplied, was subsequently taken back by the Government, and the company empowered only to use the water for domestic purposes.

So far, then, as an engineering work, it would leave little to be desired, had vessels of the type in vogue before its construction continued to be used. But as the science of shipbuilding progressed, it has been found possible and necessary, in order to keep up with the requirements of trade, to construct vessels of much larger dimensions, and on different lines; and, consequently, ships have outgrown the existing dimensions of the canal, and demand increased accommodation. 609

It has been seen that the original intention was to construct the canal of double the present dimensions, but the financial necessities of the company prevented them from carrying out that intention. Though forced upon them the course adopted was quite the right one; for the canal, on the smaller scale, has thoroughly served its purpose for thirteen years; and now that it is placed in a highly satisfactory and flourishing financial condition, the time has arrived when additional capital may prudently be laid out, to increase the accommodation which a rapidly-increasing trade demands.

The best means of providing additional accommodation is still a matter under consideration, notwithstanding certain measures have been publicly announced in some of the daily papers as having been definitely settled. Probably the company, finding that it will be to their own interest not to postpone any longer meeting the demands made upon them, have decided on carrying out meanwhile certain obvious improvements; but the larger and more permanent provision, that must sooner or later be made, has yet to be settled. The possible alternatives that present themselves will be explained hereafter.

Meanwhile, there only remains to be noticed, under this head, the items of cost of original construction, repairs and supervision. The total capital expenditure up to 1869, the year in which it was opened, amounted to £18,000,000. The sum spent annually on repairs and improvements carried out from revenue, does not vary very much, amounting, in 1880, inclusive of supervision, to £218,900; and, in 1881, to £212,490, thus averaging less than 1-1/4 per cent on the first cost - a very moderate and satisfactory outlay. 610

Passing on now to consider the canal in its second aspect, as a commercial undertaking, there is much of a very interesting character to be explained. The first fact is one which, outside official circles, will probably be entirely new to 99 persons out of 100, and that is that La Compagnie Universelle du Canal Maritime de Suez (The Universal Suez Maritime Canal Company) is not a French but an Egyptian company, having its principal office at Alexandria, amenable to the laws and customs of not the French, but of the Turkish Empire, and, therefore, subject to the jurisdiction of its local tribunals. The importance of this fact will be sufficiently evident, when the disputes which subsequently arose between the directors of the company and the Egyptian and Turkish Government come to be noticed. It is not too much to add that, but for this precaution at the time of the formation of the company, it would not only have been impossible for the nations of Europe to make use of the canal, but that the subsequent attempted exactions of the company might have led to very serious misunderstandings, if not to actual embroilments, amongst some of the European Powers.

Before proceeding, however, to explain the more especial commercial features of the canal, it is necessary to draw attention to the nature and terms of the various "concessions" granted by the Egyptian Government, and subsequently ratified in a firman by the Sultan as suzerain. 611

Eight concessions were granted by the Viceroy of Egypt between the years 1854 and 1869, the details of which have been published in the Parliamentary Paper, "Egypt, No. 6 (1876)." In the first of these, dated November 30th, 1854, the Viceroy confers on Monsieur De Lesseps "exclusive power to form and direct a universal company for piercing the Isthmus of Suez, and the working of a canal between the two seas within, and subject to certain specified restrictions and conditions," the most important of which, as regards the constitution of the company, were:

1. That the director of the company was to be always named by the Egyptian Government, chosen, as far as possible, from amongst the shareholders most interested in the undertaking.
2. That the duration of the concession was to be for 99 years from the date of the opening of the canal throughout.
3. That the Government reserved to itself the power to erect any fortifications it pleased in the neighborhood.
4. That the Egyptian Government were to receive, yearly, 15 per cent. of the net profits shown in the balance-sheet of the company, without prejudice to any dividends belonging to the shares which the Government reserves a right to take on its own account, and without any guarantee on its part.
5. That the rest of the profits were to be divided as follows: 75 per cent. for the benefit of the company; 10 per cent. for the benefit of the original promoters.
6. That, on the expiration of the concession, the Government to succeed to the company, enjoy all its rights, and enter into full possession of the canal.
7. That no alterations could be made in the statutes of the company without receiving the previous approbation of the Viceroy. 612

The second concession, dated 5th January, 1856, is an amplification of the first one, explaining, in more detail, the nature of the charges and concessions, the most important of which are:

1. The limitation of the power of the company to carry out a canal east of the Nile, from the Gulf of Pelusium, and authorizing the construction of a fresh-water canal from Cairo to Lake Timsah.

2. The solemn declaration of the Viceroy, subject to ratification by the Sultan, of the Maritime Canal and its ports being always open as neutral passages for all merchant ships on payment of dues, without preference to any vessel, company, or person.

3. The dues on vessels navigating the canal not to exceed 10 francs per ton of capacity and per head of passengers.

This concession was made over to Monsieur De Lesseps, previous to ratification by the Sultan, to enable him to constitute the financial company. Amongst the statutes of the company approved by this concession was one appointing its seat at Alexandria, and its administrative domicile at Paris.

613

The statutes direct that the annual proceeds were to be applied in the following order:

1. To expenses of maintenance, working and administrative, and generally all charges of the society.

2. To interest and sinking fund of such loans as might be contracted.

3. Five per cent on capital of society to be applied to provide for shares redeemed and not redeemed, and an annual interest of 25 francs-per-share; the interest attributable to shares redeemed being carried to the sinking fund.

4. Four hundredths per cent. on the capital to be applied to the sinking fund.

5. To the amount required for creating and keeping up a reserve fund for unforeseen expenses. The excess over the above proceeds to constitute the net profits, which were to be distributed as already stated.

Concession No. 3, dated 6th of August, 1860, is a financial agreement containing the first settlement of accounts with the Egyptian Government respecting its subscription; and, in March, 1863, concession No. 4 contained another financial agreement for settling the balance payable on shares subscribed for by the Egyptian Government.

614

At this period intervenes an important act by the Porte, which perceiving in the concession of the fresh-water canal, and of vast tracts of land, a menace to its independence, and in the stipulations for the providing of workmen, a violation of the laws under which the Ottoman Empire is governed, declared by a diplomatic note, dated 6th April, 1863, addressed to its representatives in Paris and London, its opposition to the continuance of the works. The same notification was made to the Viceroy, who communicated it to Monsieur de Lesseps, expressing his intention to treat on and settle these questions with the company, and accrediting Nubar Pasha to come to an understanding on the proposals to be submitted. The Council of Administration rejected the proposals, and then the Khedive begged the intervention of the Emperor of the French, who, after receipt of the report of the Commission which he appointed to examine into the questions involved, gave his decision; awarding to the company a sum of 84 millions of francs, or £3,360,000, the payment of which was to be spread over a period of fifteen years, ending with 1st of November, 1879.

1. Consequent on this award, a sixth convention was drawn up, dated 30th January, 1866, in which the following important articles occur.

2. Egyptian Government to keep all strategical points.

3. Power for the Government to occupy sites for post-offices, customs, barracks, and other services.

4 and 5. The Government to take possession of the fresh-water canal, on the terms specified.

615

A further agreement was drawn-up in the following February, and received the sanction of the Sultan in a firman, dated 19th March, 1866, which stated the conditions to which such a sanction was subjected. One important article being to the effect:

"That the Maritime Canal and its appurtenances remain subjected to the Egyptian police, which shall exercise its functions freely, as at every other point of the territory, so as to secure good order, the public peace, and the execution of the laws and regulations of the country."

In Article 16 occur the words: "The Universal Company of the Maritime Canal of Suez, being Egyptian, it is governed by the laws and usages of the country;" and the articles which follow declare its complete subjection to the Egyptian Government. Two agreements, dated 23d April and 26th January, 1869, complete the negotiations prior to the opening of the canal, and in them is the arrangement by which the Viceroy assigns fifty coupons from each of the 176,662 shares belonging to the Egyptian Government, for the space of twenty-five years, in settlement of the 30,000,000 francs, the value awarded for the resumption of the fresh-water canal from the company.

The recapitulation of the concessions though somewhat tedious, is essential to the right understanding of certain events which occurred shortly after the opening of the canal, as also of the obligations that regulated the amount of dividends which the company paid to the shareholders, as well as of the status of the company generally.

616

Turning now to the cost of the canal, already stated to be £18,000,000, it appears that of this, the amount of capital originally subscribed was only £8,000,000, in 400,000 shares of £20 each. That amount was subsequently augmented by the loan of 1867 for £4,000,000, being debentures ("obligations") redeemable in fifty years, bearing 5 per cent. interest, and having a first charge on the profits. After these, the loans of 1871 were contracted by the issue of thirty years bonds, bearing 6.7 per cent. interest, which, in their turn, were succeeded by £1,360.000, representing consolidated arrears of interest on ordinary shares, in the shape of seven coupons of 5 per cent. yearly. Lastly, came the advance on detached coupons of the Egyptian Government shares amounting to £1,200,000, styled "delegations," and entitled, for twenty-five years, to 5 per cent., and a dividend (if any) on those shares. The balance of the cost of the canal was made up from the indemnities which had been paid by the Khedive under the late Emperor's award. In 1870, the year after the opening of the canal, the prospects of the company being doubtful, a suggestion was made by the Khedive that it should be transferred to some English company.

The negotiations which followed this suggestion belong rather to the political than the commercial aspect of the canal, and will be better adverted to hereafter.

617

The doubtful prospects of the company, however, led to a very objectionable proceeding on the part of the Board of Administration, viz., in determining arbitrarily the interpretation of the term, "ton of capacity," on which the authorized due of ten francs was leviable. That due had been for the past three years, levied on the net register tonnage, as shown in the ship's papers, and calculated on the Moorsom system, which, after reckoning the gross tonnage of the ship, deducted the space occupied by the engines, fuel, &c. The term, "ton of capacity," not having, however, been actually defined at the outset, the company took upon themselves to interpret that term as signifying the "real capacity" of the ship, which, by a commission of their own appointment, they declared to be greatly in excess of the net register tonnage, the result being that the dues were levied on the gross tonnage, and consequently the tolls payable by every ship traversing the canal were raised 30 per cent. The burden of such an interpretation at once made itself felt in the case of steamers, in which the machinery occupies one-third of the tonnage, and was therefore equivalent to levying 50 per cent. more from steamers than had been levied in the three previous years. Remonstrances were immediately put forward by the principal maritime companies in England, and the Messageries Nationales actually brought an action against the Canal Company in France. A decree was first given in their favor, but it was afterwards reversed on appeal.

618

The protest, however, by the British Government led to the assembly of an International Commission at Constantinople, and to the adoption of a style of measurement according to what are known as the Constantinople Rules. It was not, however, without great discussion, in which the tact and firmness of the English delegates, Sir John Stokes and Sir P. Francis, were eminently conspicuous, that the proceeding of the Canal Company were set aside, and the Moorsom system of measurement declared to be correct, and adopted accordingly.

Finding themselves entirely in the minority, the French delegates eventually joined in signing the report of the Commission, which set forth the rule to be followed in the measurement of vessels, and the deductions to be made in order to arrive at the net tonnage. As a set-off, however, against the diminished revenue which it was supposed would follow the first introduction of the new rules, the Commission recommended permission being given to the company to levy temporarily a graduated surtax of 3 francs per ton on vessels provided with the prescribed certificate of net tonnage measurement, on condition that the deduction did not exceed 50 per cent.

Vessels not measured according to the Moorsom system were to have their tonnage reduced by calculation to the scale of the Danube, and to pay a surtax of 4 francs-per-ton, as also vessels measured according to Section A, Clause 23, of the British Merchant Shipping Act of 1854.

619

The surtax of 3 francs to be reduced in the following proportions: to 2-1/2 francs per ton, as soon as the net tonnage passing through the canal reached 2,100,000; to 2 francs when it reached 2,200,000; and so on, 4 francs for each annual increase of 100,000 tons up to 2,600,000 tons, at which figure the surtax was to cease altogether, and the original due of 10 francs-per-ton only to be levied. Vessels of war, transports, and vessels in ballast to be exempt from the surtax

The Porte was pleased to approve of the report of the Commission, and desired the Khedive to inform the company of the same, and direct it to be put in force in three months time.

Monsieur De Lesseps first protested, and then refused to accept the new rules; but, as in the event of his persisting in his refusal the canal was to be seized by the Egyptian Government, he submitted, but under a protest, which was not withdrawn till some years afterwards.

Towards the close of the following year a rumor got abroad that a project was on foot to purchase the shares of the Canal Company belonging to the Egyptian Government. This led to the correspondence which is given in detail in Parliamentary Paper, Egypt, No. 1 (1876), and which ended eventually in the purchase of those shares, 176,602 in number, for a sum of £4,000,-000.

620

In 1876, after the purchase had been concluded, and in consequence of a new convention, the company withdrew all opposition, accepted all that had been laid-down by the Constantinople Commission, and agreed to the decrease of the surtax at fixed dates, and to its total abolition in 1884, and consented to expend one million francs per annum for thirty years in improving the canal. That convention, which is known as the Stokes-Lesseps Convention, has consequently been in force up to the present time.

It is time, now, to turn to that part of the subject which possesses the greatest interest for the English public, and that is the traffic passing through the canal, and the revenue derived therefrom; for it indicates not only the relative importance of the canal to the several nationalities which make use of it, but it in contestably proves that were it not for he trade carried by British vessels, the Canal Company must, long ere this, have entirely collapsed, and were it now to be withdrawn through any other channel, the Suez Canal could not possibly be maintained.

Seven years ago an interesting paper was read before the Society, by Mr. Charles Magniac, on the “Commercial Aspects of the Canal,” in which, on the whole, he took rather a depressing view of the prospects of British trade at the time, saying: “That the returns up to that time showed that the great expectations entertained of a large increase of trade due to the canal, had not been borne out;” “that the imports into India were feebly stationary” “that the falling off from France was immense, but greatly due to the effects of war;” “that the item most deserving of attention was that of the Mediterranean ports.”

621

Similarly, in regard to the exports, the United Kingdom told the same story of stagnation, and it was only the Mediterranean ports that showed a buoyant and increasing trade, and that principally in the staple articles of Indian produce. But he summed up his description with the words, “Whatever we may say or do, however much industries or individuals may suffer at first, one thing we do know, that India has been brought within three weeks journey of England. We gained our supremacy there when a letter and its reply were frequently 12 months on the road. The same thing can now be done in 12 minutes. Is it to be supposed that this energetic nation will not find its advantages in such facilities as these? I am sure it will, and that even many here will live to see it.” Mr. Magniac has doubtless ere this already satisfied himself of the verification of his prediction; but as possibly many are present who have not had the same opportunity, I propose briefly to call attention to the figures in the several tabular statements of the trade of India with England and the world generally, obtained from published official records of the Indian Government.

First, in regard to the imports of the United Kingdom; these show a steady increase from 1874, when they stood somewhat over 293 millions, to over 32 millions in 1879-80, with the exception of the previous year, when, in consequence of the depression caused by the famine, they fell just below 29 millions. In 1880-81 they rose to £41,300,000, or an increase of over 33 per cent. In the foreign trade, France increased from £362,400 to £705,600, and Italy from £334,000 to £576,000.

622

From the rest of Europe the import trade is insignificant. The export trade to the United Kingdom does not show a similar increase in value, owing to the great fall in prices, but an examination of the quantities exhibits a satisfactory progress, while the exports to the principal European countries is more marked as regards increase in value. France having risen from £3,134,000 to £6,500,000; Mediterranean ports - Italy, £1,400,000 to £2,-781,000; Austria, 1,428,000 to £2,226,000.

In five of the most important staples, cotton, rice, seeds, tea and wheat, the progress in exports has been as follows:

	1876-77.		1880-81.	
	Quantity	Value	Quantity	Value.
	Cwt.	£.	Cwt.	£.
Cotton, raw.	4,557,914	11,746,184	4,541,539	13,241,734
Rice	19,548,731	5,742,540	26,769,344	8,971,661
Seeds	9,582,865	5,319,124	10,229,109	6,345,309
Tea	27,784,134	2,907,425	46,413,510	3,054,340
Wheat	5,583,936	1,956,333	7,444,375	3,277,942

Of the quantity, 4,541,539 cwts. of cotton 3,818,557 cwts. were taken by Europe; that is, 2,019,612 cwts. by England, 633,891 cwts. by Italy, 605,954 cwts. by, France, and 559,-100 cwts. by Austria.

Of the total quantity, 26,769,344 cwts. of rice, about half, or 13,582,300 cwts., were conveyed to Europe; of which, England and Malta took all but 300,000 cwts.

Of 10,229,109 cwts. of seeds, 9,705,200 were brought to Europe, nearly 5,600,000 cwts. coming to England, and 3,256,180 cwts. going to France.

623

Of the 46-1/2 million pounds of tea, only one million went to the Australian market, all the rest being brought to England. In 1879-80, the price of tea was ruinously low, and a collapse in that industry was imminent; but happily, the Australian market was partially opened, and gave just sufficient stimulus to prices to avert disaster.

In 1875, only 1-3/4 million cwts of wheat were shipped from India. In 1880-81, there were 7-1/2 million cwts., of which England took 4,800,000 cwts., 1-1/2 million went to France, and 790,000 cwts. to the rest of Europe.

The proportion of the whole trade which came to and left India by the Suez Canal during the last five years, has been as follows:

	Whole Trade.	*Via* Suez Canal.	Per Cent.
1876-77	113,920,539	60,243,259	52.88
1877-78	126,252,968	68,380,719	54.16
1878-79	109,777,084	53,398 875	48.64
1879-80	122,068,908	63,033,231	51.64
1880-81	138,108,657	81,175,876	58.78

624

625

The imports from the United Kingdom into India constitute 82.08 per cent. of the whole, and 42.33 per cent. of the produce shipped from India. The import trade is thus practically monopolized by: Great Britain, the reason being that the only articles which the people of India largely consume are English products, in which other nations have not at present the capacity of competing with her for the supply of foreign markets.

On the other hand, the reason of her taking a smaller proportion of the exports arises from some of the most valuable Indian produce being shipped to other countries – notably, opium to China and the Straits; indigo, hides, and seeds to France, Italy, and the United States.

From these figures, it will be readily gathered that the commercial interests of England have not suffered from the canal, but, on the contrary have been largely augmented, and that while India has benefited by the opening of additional markets in Europe, England has also gained largely, and still maintains, a virtual monopoly of the Indian market for the disposal of her own merchandise, the value of which, in 1880-81, amounted to over 414 millions sterling.

Passing on to the general trade through the canal, a reference to the tabular statements will show that, first, as regards the total tonnage, the number of vessels which passed the canal in 1870 was 486, and the tonnage 435,911 tons. In 1879, the vessels numbered 1,477, and measured 3,236,942; that is, while the vessels had increased threefold, the gross tonnage increased more than sevenfold.

626

In 1870, the vessels averaged 900 tons each; whereas, in 1879, the average size reached 2,180 tons. In 1877, however, the greatest number of vessels, viz., 1,663, passed through the canal, but they only measured 3,418,950 tons, giving for the average of each vessel 2,056 tons. During the same period, the receipts of the company increased from £256,000 to £1,214,520. Great as that increase was, it is nothing compared to the increase within the last three years. In 1880, the vessels numbered 2,026, with a gross tonnage of 4,344,519 tons; and in 1881, the number rose to 2,727 vessels, measuring 5,414,050 tons.

Now, as to the nationalities of the vessels indicated in Table II. In the decade, ending 1879, out of 12,454 vessels, no fewer than 9,154, or three-quarters, were British; conveying 17,555,500 tons out of the total quantity, 23,105,535 tons.

In like manner, out of the 2,026 vessels in 1880, 1,592 were British, measuring 3,446,-431 tons, out of a total of 4,344,520 tons; and, in 1881, the British numbered 2,251 out of a total of 2,727 vessels, and the tonnage, 4,792,118, out of 5,794,400, thus increasing the proportion of vessels and tonnage from two-thirds to four-fifths. The trade of 1881, then, of vessels other than British, amounted to only 1,002,282 tons, and would, at 10 francs-per-ton, have yielded a revenue of only £400,915.

In 1880, the total expenditure on the canal was about £218,900; interest and sinking funds of loan, £531,560; total, £750,460. So that, but for the British trade, instead of 134 per cent interest accruing to the original shareholders, there would not have been sufficient to pay even a moiety of the interest of the loans!

627

Similarity, with regard to the revenue realized. In 1879, it amounted to £1,-214,520; 1880; £1,672,836; 1881, £2,187,047. The actual returns obtained from the canal will be seen from the following figures:

In 1880, the expenditure on repairs was	£218,898
Amount set aside for interest and sinking funds	531,559
To provide for the interest at 5 per cent. on share capital and sinking fund	403,215
Total	£1,153,972
Which deducted from the total receipts	£1,672,836
Leaves a balance of	£519,164

to be allotted to reserve funds, and other purposes, as enjoined in the statutes above quoted, after deducting the 15 per cent. appropriated to the Egyptian Government. Of this sum, £350,176 was divided among the original shareholders, raising their profits to 5 + 4.3 = 9.3 per cent.

628

In 1881, the cost of working the canal was somewhat less than in 1880, viz., £212,490, while the interest and other charges remained about the same, but the total receipts were £2,187,047; so that the sum to be divided reached £700,856, and the original shareholders pocketed 5 + 8.76 = 13.76 per cent. By arrangement, a certain number of shares are drawn to be paid-off each year; those shareholders, therefore, who have got back their capital, cease to receive the annual 5 per cent. interest but are entitled to the dividend of 8.76 per cent on it, and will continue to receive the enhanced dividend, whatever it may amount to, till the charter of the company expires in 1968. The dividend for 1882 is expected to reach 16 per cent.

Little comment is required on these figures, and there can be little doubt as to what nationality the future management of the canal should be entrusted, when four-fifths of the revenue is contributed by British trade. One cannot be surprised that there should arise a cry from British ship-owners, that the time has arrived when the tax of ten francs-per-ton should be lowered. Abstractedly, it is a heavy burden, but relatively, it is less so, when it is remembered what economy in the expenses of transport has been effected by the saving in distance, and, therefore, in time, as well as in diminished risks and insurances. It is true that freights have fallen somewhat in proportion, and it may be said that, one year with another, the profits of the carriers are by no means so great as formerly; and it may be fairly urged, therefore, that the whole community is interested by the cost of transport, being kept at the lowest figure possible. A tax which represents so considerable a fraction of the whole freight, 16 per cent, I am informed, ought to be reduced, especially when it is no longer needed for the security of the capitalists from loss.

629

In approaching the consideration of the Suez Canal as a political problem, the difficulties which surround a satisfactory solution of it must at once be acknowledged. It has been seen, how, though originating in a commercial speculation, the scheme contained, from the very first, elements of a political character, which the British Government of the day could not possibly ignore; and how, as its operations progressed, sharply accentuated differences of international policy have been manifested, requiring the best efforts of diplomacy to arrange. Though, happily for England, no rupture in friendly relations has occurred, yet recent events have only too plainly shown "how great a matter a little fire kindleth," and how small a circumstance might vitally affect the interests of England, as regards her Eastern possessions, by the closure of this great thoroughfare to India. The immense importance to this country of those clauses in the concessions in which the Government declares the company to be Egyptian, subjects it to all the laws and usages of the Turkish Empire, and reserves to itself entire control in all particulars, military and civil, have been unmistakably manifest. Still more so, in the action of the Porte in insisting on the restoration of large tracts of land along the canal's course, which had been at first made over, without due consideration, to the company; for had that land still remained in their hands, it is extremely doubtful whether national susceptibilities might not have interfered with the able and successful strategic movement of our troops from Alexandria to Ismailia.

630

Again, the overwhelming preponderance of British trade over that of all other nationalities, added to the fact that its magnitude alone enables the Canal Company to exist, and the canal itself to be maintained, renders it imperative that that trade should not be imperiled, or its safety left dependent entirely on such strategic movements, the success of which a small error in judgment or a trifling miscalculation of time might wholly frustrate. It was pointed out, in a recent able article in the *Nineteenth Century,* that of all the naval powers England was furthest off from the Suez Canal, and in the event of hostilities, her enemies might be first on the scene, and occupy it some days before her fleet could possibly arrive; but on the other hand, to be forewarned is to be forearmed and England possesses harbors nearer the canal than Portsmouth, and cruising ground nearer than the British Channel. If advantage be duly taken of these, and England is true to herself, the rest may be left safely to the judgment of Lord Alcester (late Sir Beauchamp Seymour), and such men as he has the good fortune to command.

But though such eventualities cannot be altogether ignored, yet there are, perhaps, other means left for procuring a more desirable solution of the desired end.

631

As far as can be judged from the sentiments expressed in the various organs of public opinion throughout Europe, there seems, with one exception, to be a tolerably unanimous desire that the management of the Suez Canal should be vested in British hands; just as there was at the time when Monsieur de Lesseps was anxious for the maritime powers jointly to purchase his scheme. The correspondence on that subject is published in Parliamentary paper Egypt, No. 2 (1876), and goes to show how nearly the canal was changing hands.

As the practicability of that transaction was once seriously discussed, there is really nothing quixotic in a similar suggestion at the present time. To acquire the remaining shares, even at their enhanced value, would not be a financial operation beyond the power of England, which has, within the last few years, paid a much larger sum in wars than would probably be required to satisfy the demands of even the public-spirited and patriotic shareholders of the Suez Canal. England could well afford to take over the whole of the obligations and liabilities connected with it, as, with the prospect of an increase of traffic such as is now opening up, the surplus of the receipts over and above the necessary current expenses would quickly furnish the means of discharging those obligations and liabilities, while the mercantile community and public generally would not grudge a continuance of even the present high due of 8s. per ton, so long as there was the certain prospect before it of its diminution to the small figure requisite to defray the necessary expenses of the up-keep of the canal. For obvious reasons, details of calculations and figures cannot be entered into at the present time.

632

If, however, international exigencies or individual susceptibilities should bar the way to such an amicable solution, and one profitable alike to all concerned, there remains a suggestion, which has elsewhere been made, of enabling the ruler of Egypt to become the proprietor of a grand public work, which should never have been allowed to become the property of any private body of shareholders, but ought decidedly to have been undertaken solely and simply by the State. It is true that it is easy to be wise after the event, but it would 'equally be folly not to avail oneself of the wisdom when gained; and if, as was wittily remarked by the writer of the article in the *Nineteenth Century,* already adverted to, we are not only in the position of the *beati,* but the *beatissimi possidentes,* it will be odd if, with nine points of the law in our favor, we are not able to justify our proceedings.

But even should this position be rendered untenable by a *force majeure,* there is yet a third resource, and that is, the construction of an alternative line of canal. This will, of course, be opposed on the ground that the several concessions conferred exclusive power on Monsieur de Lesseps for the construction of a canal across the Isthmus of Suez, east of the Damietta mouth. The exclusive power actually conferred, however, was that of forming a company for the purpose. If it excludes any other private individual from forming a company, it most assuredly did not exclude the Egyptian Government itself from making another canal anywhere it pleased within its dominions; and, therefore, the Egyptian Government is at perfect liberty to take whatever action it pleases in such a matter.

633

But is it possible to make another maritime canal? Decidedly so; either east or west of the Damietta mouth. On the east, as far as can be judged from the line of coast surveys, a favorable approach and entrance could be formed in or about longitude 32.55, where the 5-fathom line runs nearest the coast, and from whence a pier, carried at an acute angle to the coast line on to the adjacent shoal, would form a protection against the littoral currents, while the Bay of Pelusium would afford an enormous area for receiving so much of the Nile deposit as would be arrested by the pier. As, however, the pier would run not perpendicularly, but at an acute angle to the coast, its interceptive action would be much smaller than that caused by the Western pier at Port Said. The line of the canal could be taken through Lake Sirbon, and then through more or less cutting to the Bitter Lakes; from whence a course could be found more or less parallel to the present canal.

The difficulty with regard to the supply of fresh water, which immediately suggests itself, could be overcome by pipes led from the Ismailia canal, under the maritime canal, into a reservoir, and pumped up from thence to every part of the new line. The probable cost of such a canal it is impossible to conjecture, in the absence of detailed surveys, but the difference between it and the existing line, if any, would be confined to the northern half. The economy which would be effected in the excavations by the experience already gained, would probably fully compensate for the increased depth of cutting, which might be unavoidable. A line to the westward could be found skirting the coast through the lagoon, and crossing the tidal rivers near their mouths as is now being done between Calcutta and Orissa.

634

A scheme for a fresh-water canal from Alexandria to Suez, via Cairo, attributed to the late Khedive, has lately been put forward, and advocated on the merits of its combining irrigating capabilities with those of navigation; but independent of its practicability, or otherwise either technically or financially, it is simply out of the question that England could have its present trade of 4 million tons, much less its future trade of possibly five times that amount, on a canal which would be exposed to such contingencies as are likely to occur to any fresh-water canal, whose navigability depends upon a series of locks, a class of works continually liable to derangement and injury.

An inter-oceanic canal ought, if possible, to be unencumbered throughout its entire length. Accidents, such as the wreck of a vessel, or the creation of shoals, may occur, of course, at any time; but a few days would, at the most, suffice to clear a passage through them; whereas, the subsidence of a lock could not be remedied under many months; and if the existing maritime canal be in unfriendly hands, as it assuredly will be were a rival line constructed, then what will become of England's trade?

There is no more zealous advocate of canals combining the two properties of irrigation and navigation than the writer of this paper; but works suitable for the requirements of inland navigation come under a wholly different category to those adapted for the oceanic traffic. The late enlightened and shrewd ruler of Egypt would not have failed to appreciate the difference had it been clearly explained to him, and would have quickly seen that the interests of Egypt would not be advanced by such a work; while one of the chief ends desired, viz., to supply irrigation to the Delta direct and by gravitation, can be attained at one-fifth of even the estimated outlay of a ship canal, and all the requirements of internal navigation be simultaneously secured.

635

In properly devised schemes of delta works, such as those in India, several alternative navigable lines are led to the chief port, so that, in the event of one being blocked, others are still available; but deliberately to leave the traffic of distant countries dependent on a single line of canal, the masonry works of which a few charges of gunpowder in time of war, or an unforeseen accident in time of peace, might destroy, would, to say the least, be the gravest of mistakes - tantamount to an act of commercial, if not national, suicide.

In the event, however, of a satisfactory arrangement being come to as regards the existing canal, there remains the question how it can be best adapted to meet the requirements of the traffic, which has already outgrown its capabilities. Opinions seem to be divided as to the alternative of enlarging the present course, and that of constructing a parallel line. At first sight, it would seem as if there could be no doubt as to the former being the most economical, both in regard to first outlay and subsequent working expenses.

If there is not much of the excavated material.in the banks to be removed, there can be no question as to the economy of widening the present canal over excavating a new one, while the cost of supervision for working the traffic would remain the same; whereas, if there is a double line, there must bean increased establishment, though not |necessarily a doubling of its numbers.

636

On the other hand, there would doubtless be an advantage in having a double line, both in minimizing the chance of accidents, and in expediting the transit through the canal, by almost entirely obviating the necessity for stopping in sidings; though, as a low speed would still have to be maintained, ships would not be able to accomplish the voyage in twelve hours, and would therefore be obliged to spend, at least, one night in the canal, as at present. An additional advantage of a double canal would be, that in case of either becoming temporarily blocked, the whole traffic would not be suspended; a point of very great importance when the number of vessels increases so rapidly, as it seems likely to do.

It is concluded the expense of separate entrances at either end are not contemplated, but the present arrangements would be common to both lines. These, of course, could only exist, if the control is in the hands of England, or otherwise arranged for beyond the possibilities of risk in the time of war.

On the whole, however, after weighing the matter from all points of view, my own recommendation would be to enlarge the existing canal to a width of 200-feet at bottom, the dimensions of the great canal from the River Sutlej, recently opened in North India, with such slopes to the sides as the nature of the soil admits of at different points of its course, and substantially revetted with stone where necessary. The speed of vessels might then be increased to a maximum of eight miles-per-hour, but limited to four miles when passing one another in opposite directions.

637

As few steam vessels have a lower speed than eight miles, there would be no necessity, except in a few instances, of their overtaking each other; especially if an interval between the starting of each vessel at daylight is made compulsory. A restriction of traffic during the night may still be necessary, unless very perfect arrangements can be made for avoiding collisions; but it would be safest to confine the voyage to daylight hours, and to make it feasible to pass through the canal between dawn and dusk.

There is yet one other phase in the political aspect for consideration, and that is, what are the principal dangers to which, in time of war, the Suez Canal would be exposed? They are:

1. A blockade at either end.
2. The removal of buoys, beacons, and necessary adjuncts to the navigation.
3. Blocking-up the canal with obstacles of any kind.
4. The destruction or scuttling of vessels.
5. Last, but not least, cutting-off the supply of fresh water from the Ismailia Canal.

The remedy for the first lies, of course, in the hands of the nation that commands the seas; and, if it is only careful to keep that command, it can equally anticipate and prevent any of the other dangers besetting the course of the canal itself. Cutting-off the fresh-water supply could only occur in the event of another such eruption in Egypt as has lately been extinguished; and it would, no doubt, be done again, and done more effectually than it was on the last occasion.

638

It rests entirely with England whether such an eruption shall be again possible; and whether, with the forewarnings she has received, and the experience which India has afforded her of a somewhat similar, though far graver, character, she shall not accept the position now thrust upon her, and herself keep the key of the Water Avenue that leads to her Eastern Empire.

It would be presumption on the part of the writer of this paper to offer further detailed suggestions on a matter which is entrusted to one of the ablest of diplomatists at England's command; but he cannot conclude without expressing his hope that the rumors of possible arrangements, as recently put forth in the daily journals, may prove to be inaccurate, and that it will soon become patent to the world that Egypt's extremity having made England's opportunity, the Suez Canal will no longer be allowed to remain an apple of international discord, and that it will prove to be the particular link in a chain of providential circumstances leading to the land of the Pharaohs once more recovering prosperity, with the help of England's guidance, and maintaining it under the aegis of England's power.

639

The Engineering Works of the Suez Canal
Scientific American Supplement
February 16, 1901

640

442 THE SUEZ CANAL.

April 16, 1867.
THOMAS HAWKSLEY, Vice-President,
in the Chair.

No. 1,172.—"The Suez Canal."[1] By Colonel Sir WILLIAM THOMAS DENISON, K.C.B., R.E., Assoc. Inst. C.E.

THE varying reports of the character of this work made the Author desirous of inspecting it on his way home from India. In order to do this, as thoroughly as time would permit, letters of introduction to the French Engineers were obtained from the authorities of the Company, and to Her Britannic Majesty's Consul-General from the Secretary of State. Consequently, on arriving at Suez, it was found that every facility would be afforded for inspecting the works of the Canal, and that means would be provided, by the different authorities, for securing conveyance to Port Said, and from thence to Cairo, after the inspection of the works had been completed.

Although furnished with copies of the correspondence between the late Mr. R. Stephenson and M. de Lesseps, as well as of Mr. Hawkshaw's Report, it was thought that it would be wiser to inspect the Canal, and to ascertain the views of the French Engineers employed upon it, and then to form, as an Engineer, an independent opinion, so far as such a mere hasty inspection would allow, before attempting to deal with questions which have assumed a mixed character—partly political, partly economical, and partly professional. Accordingly, while the aspect of the work was fresh in the Author's memory, such remarks as occurred to him were committed to writing, and the following notes comprise the substance of the opinions formed while inspecting the works. Allusion will afterwards be made to the report and correspondence before mentioned.

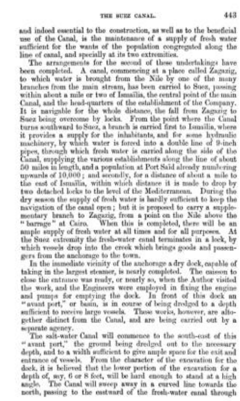
The scheme of the Suez Canal may be said to comprise two distinct undertakings. The first, and principal, is the construction and maintenance of a broad and deep salt-water channel on one level between Port Said on the Mediterranean, and Suez on the Red Sea. (Plate 13.)[2] The second, preliminary in point of time,

[1] The discussion upon this Paper occupied portions of two evenings, but an abstract of the whole is given consecutively.
[2] The plan and sections of the Suez Canal (Plates 13 and 14) have been compiled from "Compagnie Universelle du Canal Maritime de Suez. Carte générale de l'Isthme, etc., 1866," and the plans of Port Said and of the Port of Suez from "Percement de l'Isthme de Suez. Actes constitutifs de la Compagnie Universelle du Canal Maritime de Suez avec cartes et plans. Documents publiés par M. F. de Lesseps." [illegible]

IT is a surprising fact that in spite of the unique position among ship canals that cut across the Isthmus of Suez, there is no satisfactory official or semi-official account in English of its engineering features, says *The Engineering Record*. Nearly 33 years ago Sir William Denison read a paper on the subject before the *Institution of Civil Engineers,* and from that time until March, 1900, English professional literature has been nearly barren of contributions on the subject.

Caption: "Minutes of the Proceedings of the Institution of Civil Engineers, Volume 26 Issue 1867, 1867, pp. 442-448, Session 1866-1867, Author: Sir W.T. Denison"

641



THE SUEZ CANAL. 443

and indeed essential to the construction, as well as to the beneficial use of the Canal, is the maintenance of a supply of fresh water sufficient for the wants of the population congregated along the line of canal, and specially at its two extremities.

The arrangements for the second of these undertakings have been completed. A canal, commencing at a place called Zagazig, to which water is brought from the Nile by one of the many branches from the main stream, has been carried to Suez, passing within about a mile or two of Ismaïlia, the central point of the main Canal, and the head-quarters of the establishment of the Company. It is navigable for the whole distance, the fall from Zagazig to Suez being overcome by locks. From the point where the Canal turns southward to Suez, a branch is carried first to Ismaïlia, where it provides a supply for the inhabitants, and for some hydraulic machinery, by which water is forced into a double line of 9-inch pipes, through which fresh water is carried along the side of the Canal, supplying the various establishments along the line of about 50 miles in length, and a population at Port Saïd already numbering upwards of 10,000; and secondly, for a distance of about a mile to the east of Ismaïlia, within which distance it is made to drop by two detached locks to the level of the Mediterranean. During the dry season the supply of fresh water is hardly sufficient to keep the navigation of the canal open; but it is proposed to carry a supplementary branch to Zagazig, from a point on the Nile above the "barrage" at Cairo. When this is completed, there will be an ample supply of fresh water at all times and for all purposes. At the Suez extremity the fresh-water canal terminates in a lock, by which vessels drop into the creek which brings goods and passengers from the anchorage to the town.

In the immediate vicinity of the anchorage a dry dock, capable of taking in the largest steamer, is nearly completed. The caisson to close the entrance was ready, or nearly so, when the Author visited the work, and the Engineers were employed in fixing the engine and pumps for emptying the dock. In front of this dock an "avant port," or basin, is in course of being dredged to a depth sufficient to receive large vessels. These works, however, are altogether distinct from the Canal, and are being carried out by a separate agency.

The salt-water Canal will commence to the south-east of this "avant port," the ground being dredged out to the necessary depth, and to a width sufficient to give ample space for the exit and entrance of vessels. From the character of the excavation for the dock, it is believed that the lower portion of the excavation for a depth of, say, 6 or 8 feet, will be hard enough to stand at a high angle. The Canal will sweep away in a curved line towards the north, passing to the eastward of the fresh-water canal through

642

the lowest portion of the land, which is, in point of fact, very little above the level of the Red Sea.

Nothing, however, has as yet been done towards the commencement of the salt-water Canal, at the Suez end of the line, for the first 10 or 12 miles. At this distance from the sea, the line crosses a sort of spur from some hills to the westward, at a place called Chalouf, and there about three hundred men were at work upon a cutting, consisting partly of a bed of hard conglomerate, 8 or 10 feet in thickness, below which were strata of sand and clay. The surface of the soil at this cutting was said to be about 12 feet above the salt-water level, so that the total depth of excavation will be 38 or 40 feet. The slope of the side was 2 to 1, and there was a "bench" about 12 feet in width, 3 feet above the surface of the water; while another bench, 12 feet below the water, and 9 feet wide, formed a sort of base for the stone work with which it was proposed to face the upper part of the slopes. The stone was procured in part from the excavation itself, and in part from quarries on the west shore of the Red Sea a few miles south of Suez. The work here was carried on with a good deal of method. Inclined planes were cut in each bank, up which the wagons filled with spoil were hauled by steam engines, and then drawn to spoil banks at convenient distances. Pumps discharged the drainage water into a portion of an old salt-water canal, said to have been excavated by one of the Pharaohs, and the work was being pressed forward at a fair rate. Three hundred men, however, could not make much impression upon a work of such magnitude; the section of which is equivalent to about 350 cubic yards per lineal foot, the whole, it must be remembered, having to be lifted to the top of the bank.

Soon after leaving this cutting the Canal has to pass through the Bitter Lakes, the surface of the water, or soil, in which is nearly on a level with the Red Sea. Here the cutting will not exceed the ordinary section of the Canal; nothing, however, has been done to the work as yet.

The fresh-water canal passes at too great a distance from these lakes, and indeed from the rest of the line as far as Ismailia, to allow of the Author personally examining the line, or ascertaining what work was done, or doing. He was told that some dredging machines were at work, water sufficient to float them being admitted from the fresh-water canal.

The distance between Suez and Ismailia is about 50 miles, and it took twenty hours to get to the latter place, the average speed being 2½ miles per hour, but exclusive of stoppages about 3 miles per hour.

A little east of Ismailia the branch from the fresh-water canal came to an end, and the boat dropped, as before stated, by two

643

single detached locks to the level of the Mediterranean, into a salt-water canal about the same size as the other. For some distance this was only a branch, but at about 2 miles from Ismailia the branch enters the line of the main Canal, which turns sharp to the left or northwards, and passes through a heavy sandbank from 40 feet to 60 feet above the level of the surface water in the Canal. The line did not seem to be well laid out here; it wound about, apparently to avoid cutting, but the result of this would be to render the passage of long vessels difficult. It was said that this portion of the work would be rectified.

The works here were in active progress; the Contractor was cutting down the face of the excavation, loading the spoil into wagons, trains of which were constantly in motion, being drawn by locomotives obliquely up the slope of the hill, and thence to spoil banks at some distance on the west side of the Canal. Some dredging machines were also at work deepening the channel; the soil raised being discharged into wagons and hauled up the bank. The amount of work to be done here was very great, as the sandbank or ridge extended about 5 miles.

To the north of the sandbank the Canal entered the beds of some lakes—the soil of which cannot be more than a few inches above the Mediterranean. Here, in places, the soil had evidently a disposition to slide into the Canal; as the trifling load of an embankment, sufficiently high to cover the fresh-water pipes, had forced the bank out, in spite of some piles and sheeting, which had been driven and fixed to support it. This sort of work extended the greater part of the remainder of the distance to Port Said, about 10 miles from which the Canal entered Lake Menzaleh, a shallow sheet of salt water, through which the line was marked, by slight embankments, distant apart the full width of the Canal. At several points between the deep-sand cutting and the shore of Lake Menzaleh, the Canal was opened to its full width. Dredging machines were at work both widening and deepening it, and some amount of activity was shown.

The dredging machines appeared to be well put together. They were worked by powerful engines, and a variety of expedients had been devised, for the purpose of adapting them to the work they had to perform, in lifting the spoil from a great depth, and discharging it at a point above the engine. Still, however, the impression conveyed, after watching carefully the working of these machines, was that the work must be expensive, and that any estimate of cost, deduced from the work done in shallow water, would be most fallacious, if applied, without very large allowances, to determine the cost of excavating the lower portions of the Canal, say the last 10 feet from the bottom.

The main work in progress at Port Said (Plate 14) was the jetty,

644

or breakwater, which is to protect the port against the action of the north-westerly, or prevailing winds. This jetty is formed of blocks of concrete, rectangular in form, and weighing 20 tons. Experience has shown, that a block of this size (10 cubic metres) and of this weight, is sufficiently massive to withstand the action of the heaviest sea. The concrete is composed of sea sand, dredged from the harbour, and of good hydraulic lime procured from Marseilles, the proportion of lime to sand being about 350 lbs. of the former to a cubic metre of the latter, or about one to thirteen. Sea water is used to mix the ingredients, which are well worked and amalgamated in mills, ten of which are driven by one steam-engine. The mixture is poured into cases, or frames, of wood, where it is allowed to remain four days; the cases are then removed, and the blocks are subjected to the influence of an Egyptian sun for two months, by which time they are said enough to withstand the action of the sea. Each mill can turn out three blocks per day.

The Contractor has engaged to furnish the blocks, and to deposit them at appointed spots, for 600 francs for each block. This sum is to cover the interest of capital upon the whole cost of the plant, the cost of dredging the sand, importing the hydraulic lime, mixing the material, and interest upon all this outlay for two months. The cost of conveying the blocks to the breakwater, and of depositing them, is paid for at the rate of about 1½ francs per cubic foot.

The mass will of course stand at a much steeper slope than it would were the blocks of smaller dimensions, and there will be a large space between the blocks, which will eventually be filled with sand drifted in by the sea. Still, however, it will not be safe to calculate the average section at less that 1,500 cubic feet, or the cost at less than 2,000 francs, per lineal foot.

At present a length of about 300 yards of the western arm is above water; and although the action of the sea on it is heavy, the material appears to stand well. Sand is accumulating rapidly along the western face; and it may be expected that a portion of the sand, which now chokes up the space marked out for the harbour, will be removed by the action of the easterly drift. A very large amount, however, will have to be dredged out. The cost of excavation by dredging machines is dependent upon a variety of contingencies. The French Engineer admitted that the cost of dredging was heavier than that of excavating by manual labour. The latter, however, cannot be got; while dredging machines and steam power are procurable to any extent which can be paid for.

It is true that, in theory, the whole expense of providing and maintaining the "plant" is thrown upon the Contractor; but it may be surmised that advances must be made by the Company, for there were at Port Said forty large dredging machines, either under con-

645

struction or repair, while sixty were said to be at work at different parts of the Canal. The cost of these cannot have been less than a quarter of a million sterling, and the establishments at Port Said, which had the appearance of a large dockyard, were maintained in great measure at the expense of, or at all events, principally for the use of, the Contractors. The cost of these must be very heavy, and fall upon the Company either immediately or eventually.

The result of this inspection of the works of the Canal is an opinion, that it will not be possible to maintain the section adopted by the French Engineers; that the slope of the bank, or sides, is far too steep to maintain itself against the action of the water, even when faced with stone, unless indeed the work can be done with better materials, and at a much heavier cost, than estimated; and that the estimate for maintenance, that is, principally, for removing drift sand and deposit, will be largely exceeded.

The effects produced upon the banks by the small vessel in which the Author was towed along the Canal, at a maximum rate of 3 miles per hour, were very marked. Not only were the banks cut away, but the debris assumed a slope differing, of course, according to the character of the soil, but in every case approximating nearer to that of an ordinary beach, than to that of the section proposed. As, therefore, most of the excavations will have to be taken out by dredging, in which case it will not be possible to protect the irregular slope left by the machine with any hard material except at an enormous expense, the Author cannot but think, that it will be found necessary to augment, largely, the surface width, and to give to the sides a slope of nearer 6 to 1 than 2 to 1. By thus widening the surface of the Canal, the action of the water raised by the passage of vessels will not be so injurious to the banks, as the wave would not be so high,—the section of the vessel bearing a much less ratio to that of the Canal than according to the present section. There are other advantages which would result from the increased width of the Canal to which it is unnecessary to allude.

The correspondence between M. de Lesseps and the late Mr. R. Stephenson, in which the late Mr. Rendel, Mr. M'Clean, and Mr. Manby appear to have taken part, was principally as to the relative merits of a canal according to the proposed construction, and of one at a higher level, drawing the water required for lockage and waste from the Nile, and dropping by locks into the sea at each end. The whole gist of the arguments lies in the statement made by the English Engineers, that an open canal upon a level between the two seas was "an impossibility." To this view the Author cannot yield assent.

The second document referred to is the Report of Mr. Hawkshaw, dated February, 1863. While adopting generally the statements

646

and opinions therein expressed, especially those dealing with the engineering objections to the present scheme, the Author is inclined to think that the difficulties to be encountered, and the cost of maintaining the work, have been under-estimated.

The opinion the Author has arrived at, based upon what he saw and heard during his visit to the Canal, and upon a fair consideration of the correspondence and report before alluded to, may be stated as follows:—

1st. That (subject, of course, to the condition that the relative levels of the Red Sea and the Mediterranean are as stated by the French authorities) there will be no extraordinary difficulty in carrying an open salt-water channel from the Mediterranean to the Red Sea of the depth proposed, namely 8 metres.

2nd. That no special difficulty in maintaining this channel need be anticipated.

3rd. That it will be necessary to modify the section proposed by the French Engineers, making the side slopes much more gradual.

4th. That the cost of maintaining the above-mentioned depth of water will be found at first to be largely in excess of the amount estimated. Eventually, it is by no means impossible that means may be found to fix, or check the drift of sand, or to shut it out from the Canal. But for some years it must be expected, that the ordinary action of the atmosphere, which has filled up former excavations made in this dry desert, will have the same effect in the new Canal.

Looking at the work as an Engineer, there does not appear to be any difficulty which a skilful application of capital may not overcome.

[Sir W. Denison.

647

13 March, 1900.
SIR DOUGLAS FOX, President,
in the Chair.

(*Paper No. 3106.*)

"A Short History of the Engineering Works of the Suez Canal."

By Sir CHARLES HARTLEY, K.C.M.G., M. Inst. C.E.

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] 24 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. 462.

[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 6 feet 6 inches. The prevailing winds are from north and north-west.

648

On that date a short history of the engineering works on the canal, written by Sir Charles Hartley, was presented by his colleague on the International Consultative Commission of the Suez Canal Company, Sir John Wolfe Barry. The author has been connected with the enterprise almost from its inception, and speaks as an authority on the subject. The paper has been printed by the Institution, and the following article is merely a summary of some of its most interesting portions.

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 Said Pasha for a water-way 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 (26¼ 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 Said 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 Said, whereas at the proposed easterly entrance, near the old Pelusiac 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

649

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 ½ 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, Mongel 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.

650

The distances between Port Said and these lakes are as follows:—

	Nautical Miles.
Port Said to North end of Lake Ballah	26
" " South " "	30
" " North end of Lake Timsah	41
" " South " "	44
" " North end of the Bitter Lakes	52
" " South " "	73

The total distance from Port Said to Suez, Port Thewfik, is 88 nautical miles (100 English miles) or 160 kilometres.

The only serious obstacles to be overcome in the line of the canal were at El-Guisr, the summit of the work, situated between the Ballah Lakes and Lake Timsah, where the hills crossing the canal vary from 30 feet to 60 feet above the sea-level over a length of 6 miles, and at the deep cutting of Serapeum between Lake Timsah and the Great Bitter Lake. From Port Said to Kantara, a distance of 24 miles, the canal passes through Lake Menzaleh, a shallow lagoon which covers an area of nearly 1,000 square miles.

The character of the soil, which is mainly composed of pure sand and sandy-clay lying above and below a nearly continuous stratum of hard clay-slutting, for the most part, on the water-line between Lake Menzaleh and Lake Timsah—intersected here and there by bands of hard and soft rock (conglomerate and limestone) between Serapeum and Suez—was favourable to rapid execution; and the construction at Port Said and Suez of commodious basins for shipping, and of the long sea jetties, composed of "pierres-perdues" and artificial blocks of concrete, thrown down at random to a height of 4 feet above the water-line, presented no serious engineering difficulties. In short, the canal works in general were of a very simple nature; but, being of vast magnitude, involving, as originally proposed, the removal of 60 million cubic metres of dry earthwork and 56 million cubic metres of earthwork under water, and being situated in a country entirely destitute of fresh water, a specially well-conceived organization was imperatively required to bring the colossal work to a successful issue.

Commencement of the Works.—On the 25th April, 1859, Mr. de Lesseps, President of the newly-formed company, turned the first spadeful of sand at Port Said. Early in March, 1861, the Author, who was kindly furnished by Mr. de Lesseps with letters of introduction to the principal employees of the company, visited all the works between Ismailia and Port

651

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 those 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 deplorable 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 1861.—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 Conrin; 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 sheets, 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 EDIT. C.E. VOL. CXLI.]

652

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 financier," No. 22, as follows:—

	£	
General expenses of the constitution of the company, cost of negotiation, commission, stamps, and expenses up to date		361,380
Cost of management for 11 years		367,300
Interest during construction, including sinking fund		2,316,220
Service of health, telegraph, domain, and transit, 1859-1869		123,330
Cost of construction, including sinking fund to pay for materials		11,454,220
Total		£14,622,450

[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 reinversion of land grants; and for abandonment of other privileges attached to the original concession.

653

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 1879 a modification was made in the terms of reduction by which 1 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 ½ 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 a 5 per cent. till 1875, and that the Khedive had at that time mortgaged till 1894 the interest on the shares he

654

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] ...resent market value of £150 per share the actual value of the ... the British Government is £26,300,000.

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 1875-1897.
	Cubic Metres.	Cubic Metres.	Cubic Metres.	Cubic Metres.
Dredging at Port Said.				
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	306,605	1,263,836	1,560,441	80,229
Seaward of the jetties	1,332,716	3,060,602	4,393,318	224,040
Dredging between Port Said and Suez.				
Port Said section	3,330,621	6,577,597	9,908,218	439,310
Ismailia section	1,178,239	3,051,072	4,229,311	203,405
Suez section	1,283,088	2,717,888	4,000,976	181,192
Total	9,584,332	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 versâ*, 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 Coode and the Author.
Germany	Mr. Prachock.
Austria-Hungary	Mr. Crillanovich.
Italy	Mr. Gioia.
Holland	Mr. Dirks (President).

"Reporter," Mr. Voisin Bey. Secretary, Mr. Vicuna.

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 (26¼ 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 3½ 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 2½ 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 1½ times the beam of a vessel, and the remainder of from ½ to 1½ times the beam.

[1] Between Suez and the Bitter Lakes the current ranges from ½ 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 5½ 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 800 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 14 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 3 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 sub-merged 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 water-way 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 1,000 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 84 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. Goudet'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 1,000 metres (3,300 feet) and less radius, a width at the apex of at 80 metres (262 feet).

B. Along the portion of the canal between the Great Bitter Lake 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 inconstestably 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. DETERMINING 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. Lemesurier, the adoption of a depth of 9 metres instead of 8 metres would involve an extra outlay of £1,300,000, 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 2½ 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 7½ metres (24 feet 6 inches) with ½ 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. Lemesurier) 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 realizing 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	21,984,000 cubic metres	2,440,000
Second " " "	45,360,000 "	3,190,200
Third " " "	8,262,000 "	660,360
Totals	49,622,000	9,300,000
Deduct sale of plant		182,000
Total		£9,118,000

The excavation and dredging of 49,622,000 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 International des Travaux"), whose duty it should be to meet annually

[1] The Author strongly advocated the adoption of a depth of 9·20 metres (31 feet) from end to end of the canal, so as to allow steamers drawing from 8·20 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. Quellennec, 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 Alexzieff, 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 2¼ 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 1885 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") ½ 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 ½ 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 ½ 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 summarise 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 4½ 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 3½ 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	924,430	..
1874–78	7,471	10,362,330	..	1,390	5,410,265	..
1879–83	12,735	20,306,201	96	1,600	9,071,886	67
1884–88	16,385	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	15,124,395	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 219,534 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.

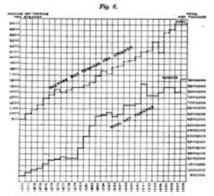


DIAGRAM SHOWING THE GROWTH OF TRAFFIC AND THE INCREASED TONNAGE CAPACITY OF STEAMERS FROM 1870 TO 1898.

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	336	969,398	11
French	221	571,517	6
Dutch	193	381,866	4
Austrian	85	213,020	2½
Japanese	46	183,325	2½
Russian	48	133,191	2
Spanish	49	149,306	2
Italian	74	137,294	1½
Eleven other nationalities	136	181,743	2½
	3,503	9,238,603	100¼

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, Renaud and Lieussou, 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. LAVALLEY DE FOURCY, inspecteur-général des ponts et chaussées (Président).
Le Vice-Amiral JURIEN 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).
LABOUREE, 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 CHETTY, 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. FRANZIUS, 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. VIZURRA (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, MOUSETTE, Vice-Présidents.
V. DELAMALLE, MOTET BEY, E.-J. STANDEN, BARON J. DE LESSEPS, Administrateurs, Membres du Comité de Direction.
ANSLYR, LE BARON A. DE CATERS, A. DE CLERCQ, J. GUICHARD, J. HENRETTE, C.-J. MONK, A. PROBOUX, le Colonel Sir JOHN STOKES, Sir C. RIVERS WILSON, DE MONTDIDIER, Administrateurs: (Directors).
MARIUS FONTANE, Secrétaire-général de la Compagnie.
LEMASSON, Ingénieur, chef du service de l'entretien en Égypte.
GHINDA.
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. OPPERMANN.
Mr. PERROUX.

Great Britain—
Sir JOHN WOLFE BARRY.
Sir CHARLES A. HARTLEY.

Germany—
Mr. FRANZIUS.

Austria-Hungary—
Captain CRILLANOVICH.

Spain—
Mr. SAAVEDRA.

Italy—
Mr. GIOIA.

Holland—
Mr. CONRAD.

Russia—
Captain SHEIN.

Secretary, Mr. VIZURRA.

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 5⅓ 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 proceedings and accidents of whatsoever kind, resulting from the management and manœuvring of his ship by day or by night.

Private 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 master roll and its subsidiaries. (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 12.
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 authorised 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 black in the centre, and by night a white light.

ART. 7.

All ships ready to enter the Canal must have their yards lowered forward, their life-boats 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 hedge with a stout hawser boat 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 cast 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 lessie 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 as 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 mast 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 seconds' 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, be 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 materials 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 the steam-whistle in the ports of the Canal, except as an alarm signal in case of serious danger;

7. Bartel 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 3 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 9 francs 32 centimes 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 conveyed by the Company's tugs no other distance 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 600 tons and under, 1,200 francs; for sailing vessels measuring above 600 tons, 1,200 francs for the first 600 tons and 2 francs 50 centimes for every surplus ton.

For steamers measuring above 600 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 600 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 9 francs 32 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[2] 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 entitled 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[3] by the Canal Company.

Ships towed or accompanied by tugs belonging to their owners will pay 9 francs 32 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.

[THE INST. C.E. VOL. CXLI.]

194 HARTLEY ON THE SUEZ CANAL. [Minutes of

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 mail 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, 1866.

(Signed) PRINCE AUGUSTE D'ARENBERG,
President.

685

In November, 1854, Ferdinand de Lesseps obtained a concession 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. The final report of the Commission was accepted by the Khedive in June, 1856. It adopted a direct route through the Isthmus from Suez to the Mediterranean.

It was 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 26-1/4-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; ad 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 our jetties directly seaward at Port Said to protect the entrance.

686

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 26-1/4-feet was found at a distance of less than 2 miles from Port Said, whereas at the proposed easterly entrance, near the old Pelusaic mouth of the Nile, the 26-1/4-foot contour was full 5 miles from shore.

At Suez the construction of a single jetty was deemed sufficient, and no difference of opinion existed as to the disposition of the necessary inner harbor 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.

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 requires, 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.

687

The distances between Port Sais and these lakes are as follows:

	Nautical Miles.
Port Said to north end of Lake Ballah	26
Port Said to south end of Lake Ballah	30
Port Said to north end of Lake Timsah	41
Port Said to south end of Lake Timsah	44
Port Said to north end of the Bitter Lakes	53
Port Said to south end of the Bitter Lakes	73

The total distance from Port Said to Suez, Port Thewfik, is 88 nautical miles (100 English miles) or 160 kilometers.

The only serious obstacles to be overcome were at the summit of the work, where the hills crossing the canal vary from 30- to 60-feet above the sea-level over a length of 6 miles, and at the deep cutting between Lake Timsah and the Great Bitter Lake. From Port Said to Kantara, a distance of 24 miles, the canal passes through a shallow lagoon which covers an area of nearly 1,000 square-miles.

The character of the soil, which is mainly composed of pure sand and sandy-clay lying above and below a nearly continuous stratum of hard clay, intersected here and there by hands of hard and soft rock, was favorable to rapid execution; and the construction at Port Said and Suez of commodious basins for shipping, and of the long sea jetties, composed of "pierre-sperdues" and artificial blocks of concrete, thrown down at random to a height of 4-feet above the waterline, presented no serious engineering difficulties.

688

In short, the canal works in general were of a very simple nature; but, being of vast magnitude, involving, as originally proposed, the removal of 60,000,000 cubic-meters of dry earthwork and 56,000,000 cubic-meters of earthwork under water, and being situated in a country entirely destitute of fresh water, a specially well-conceived organization was imperatively required to bring the colossal work to a successful issue.

On April 25, 1859, De Lesseps turned the first spadeful of sand at Port Said. In March, 1861, not a fiftieth of the earthwork of the canal proper had been removed; a condition of affairs due to financial difficulties, a great paucity of laborers, the difficulty of providing them with fresh water, the faulty construction and inefficiency of the steam-dredges then employed, and the impossibility of keeping open the newly-dredged entrance channel at Port Said before it was protected by jetties.

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 M. 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; while 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 camelback.

689

The financial difficulties were overcome (1) by decreasing the width of the bottom of the canal to 72-feet, 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 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 until March, 1869, that it was allowed to flow into the nearly dry salt-encrusted basins of the Bitter lakes. On November 17, 1869, the Suez Canal was inaugurated with great pomp and thrown open to navigation. On December 31, 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 decadaire, No. 22, as follows:

General expenses of the constitution of the company, cost of negotiation, commission, stamps and expenses 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

690

According to the official statistics, made-up to December 31, 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-meters (exclusive of 1,800,000 cubic-meters 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-meters. When it is considered that the cost of dredging averages upward of 1 shilling per cubic-meter, the heavy annual charge incurred for maintenance becomes at once apparent.

Owing to the increased delay in the passage of steamers through the canal after 1876, and to the startling augmentation of traffic after 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 concessions for the canal were obtained, it was universally admitted in 1883 that a radical plan of improvement was imperatively demanded.

This opinion caused the Directors to announce in 1884 that a second International Consultative Commission, consisting of eight Frenchmen, eight Englishmen and six members of other nationalities had been appointed to study 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 of a traffic exceeding 10,000,000 tons-a-year.

691

The Consultative Commission met in Paris, and held there sittings in the latter part of June, 1884, when, after discussing two alternative schemes presented by the engineer-in-chief of the canal, M. 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.

Inasmuch as M. Lemasson's project for the 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. M. 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 the opinion that there should be a space equal to two clear beams between them, and an interval of 40-feet between their outer sides and the line of buoys. This meant a channel – taking 48-feet as a maximum beam – about 230-feet broad at the bottom, which he considered would be sufficient for the long straight reach south of Port Said; while for the Suez end and for the curves he proposed to increase the breadth to 262-feet. The total cost, including plant was estimated at £8,118,000 if the depth were kept at 26-1/4-feet, or £9,750,000 if increased to 29-1/2-feet.

692

The cost of a parallel canal having a depth of 29-1/2-feet 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, an 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.

The result of the visit of the Sub-Committee to the canal and its interesting experiments on the restriction of the speed of vessels in the canal by the reduced waterway was the passage of the following resolutions by the full Commission on February 11, 1885:

"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 depth, the Commission is of the opinion that the project for the works and estimate of cost should comprise a final deepening of the canal to a depth of 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 program for the successive execution of the work should be fixed with the object of first obtaining a depth of 27-feet 10-inches; the complementary deepening of 1-foot 7-inches being the last phase of the execution of the projected improvement.

693

"2. As to the widths of the canal and the easing of the curves, the Commission is of the opinion that the canal should have the following widths at the depth of 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 213-feet. In curves of more than 8,200-feet radius, a width of 246-feet, measured at the apex of the curve adjusted gently to the normal width of the canal; and lastly, in curves of 8,200-feet and less radius, a width at the apex of at least 262-feet.

"B. Along the portion of the canal between the Great Bitter Lakes and Suez: In straight reaches, a width of 246-feet. In the curves, a width of 262-feet at the apex. As to the curve in the Timsah lake, to increase its radius to 4,100-feet, and to begin its correction without loss of time.

"3. As to the harbor 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 mile post to a radius of 9,843-feet.

Concerning the typical sections of the canal, the Commission is of the 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 the 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.

694

"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 favorable ground, reaching down to 6-feet 6-inches below the level of low water of ordinary spring tides, resting on a benching of a width just sufficient to ensure a solid base for the work, and rising to a height of about 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."

These recommendations were signed by all the members of the Consultative Commission, and were accepted soon afterward by the president and directors of the Suez Canal Company.

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, while 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.

695

Moreover, by eventually 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.

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 M. Lemasson, the adoption of a depth of 29-1/2-feet instead of 26-1/4-feet 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 endeavored, 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 2-1/2-feet under the keel; while, on the contrary, certain other members of the Commission contended that there was no necessity to provide vessels with a greater draught than 24-feet 6-inches, with 1-1/2-feet under the keel.

696

The first phase of the enlargement was completed in December, 1898, from a width of 72-feet to 121-feet 4-inches, and from a depth of 26-feet 3-inches to 27-feet 10-inches, or 12 years from the commencement of the work; a much longer time than was originally specified, owing to financial 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 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-meters) removed during the first stage of the work has only been 2-1/2 per cent in excess of the quantity originally estimated.

697

The advantage to trade by increasing the limit of the draught of steamers on April 15, 1890, from 24-feet 6-inches to 25-feet 7-inches is proved by the fact that, while in 1891 the percentage of vessels passing through the canal drawing from 24-feet 6-inches to 25-feet 7-inches was only 3.2 per cent compared with the total number, the proportion in 1897 amounted to 13.1 per cent.

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 fro 60- to 70-feet, have passed through the canal for the first time, whereas in 1885 the maximum length and beam of trading vessels frequenting the canal did not exceed 460-feet and 48-feet respectively.

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, 49-feet-wide and 2,460-feet in length, in order to facilitate the passage through the canal of steamers of the greatest beam. They are now completed to their full width and give great satisfaction to the navigation.

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 highly desirable, in the interest of commerce, that a sufficient depth should be provided, as soon as practicable, for vessels of a draught of 27-feet 10-inches instead of limiting it to 25-feet 7-inches, as at present.

698

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-metes-deep and 200-meters-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 dredge, 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 29-feet 6-inches at Port Said, 663,140 cubic-meters were dredged between, and to seaward of, the jetties in 1898, and, in addition, 181,370 cubic-meters of deposit were removed from the inner basins, exclusive of a cube of 565,800 cubic-meters dredged from the canal itself between Port Said and Suez.

In the dredging operations at Port Said, the engineers happily hit upon the idea that it would be advisable to attack the deposits passing through the interstices of the west jetty, which was almost entirely composed of large concrete blocks thrown down at random, by dredging the newly-deposited sand under shelter of the jetty instead of beyond its head in the open sea. In order still further to check the growth of the sand bank seaward, the plan had also been adopted during a period of several years of removing and replacing from time-to-time portions of the superstructure of the jetty, near its root end, to allow the sand driven westward through the gaps during gales the enter the canal, where it could be easily dredged away.

699

This rough method of breaking-up and restoring the superstructure of the jetty over a length of about 300 yards had lately been superseded by the construction of a roadway from the shore, supported at its outer end by sixteen arches of masonry, each of 20-feet span, through which the sand now traveled freely in stormy weather.

On January 1, 1899, there was an available depth of 29-feet 6-inches over an aggregate length of 56 miles, and by continuing to dredge down to 31-feet, as at present practiced, 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 31-feet in 1902 includes the provision of a receptacle for deposit 1-1/2-feet deep over the entire bottom width of the canal from end-to-end.

At the Suez entrance, at the present time, a vessel drawing 25-feet 7-inches (the maximum draught allowed) has a depth of 3-feet 3-inches under her keel at ordinary low water of spring tides, and a minimum of 16-inches under her keel at an extraordinary low tide.

700

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 December 31, 1878, to December 31, 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	...

701

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 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 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 as long the banks of the canal in order that the navigable channel might be clearly indicated.

It was soon recognized, 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 vessels 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.

702

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 practiced leaves nothing to e 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 enlarges 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 projector, passing each other in contrary directions without danger, owing to the dazzling effects of the traveling lights on the vision of the pilots.

703

The first vessel that effected the through passage by night was the P&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 and 45 minutes in 1888 to 26 hours and 44 minutes in 1889. In 1898, 94 per cent of the total shipping made part of their passage by the aid of electric light, the average duration of transit being 17 hours and 22 minutes, and the minimum duration only 16 hours and 36 minutes, whereas the average time taken by steamers navigating by day was 28 hours and 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.

704

Part 8

There is a River

705

The Suez Canal
Van Nostrand's ENGINEERING MAGAZINE
1869 – Vol. I

706

From a letter to the London "Times," by Captain Macgregor, of canoe "Rob Roy" fame, we extract the following interesting facts and impressions: The Suez Canal Company have been fourteen years at work upon their gigantic labor, and they announce positively that the canal will be opened within a year from the present time (November, 1868). The canal is to be 100-miles-long, and 328-feet-wide (at the water's edge). The depth throughout will be 26-feet in the middle. The direction is nearly north and south, with a few turnings, but no locks or bridges. There will be a slight tidal current along it, but no one can say at what intervals. Already about 50 miles of the cut is filled with salt water, and is traversed daily by numerous small vessels and some steam-launches and mail boats.

The sensation of wonder at the prodigious scale of the operations in progress increases day-by-day as one moves along what seems to be a wide river, with villages on the banks and smoky funnels and white sails on the surface. Of this 50 miles many parts are not wide enough yet for large vessels, and only a small portion is excavated to the full depth. The remainder of the canal is more or less dug-out. While some parts are quite dry, others are put underwater to moisten the sand; others have great blastings of rocks, and one long section of 20 miles has to wait until the sea is admitted into the great dry basin of the future lake.

707

The dredging machines are 40 in number, and each of them cost £40,000(?). They deliver the sand to barges to be carried out-to-sea, or pile it upon the banks, in some places to a height of 50-feet. The expenses at present amount to £200,000 every month, and the work has already absorbed £28,000,000 sterling.

Port Said, the town at the north entrance of the canal, is built of wood, with wide, straight streets, and accommodates 6,000 people of every nation, but with the Greek and Levantine element largely preponderating. The two long piers that form the harbor are made of blocks of sand, cemented with lime (concrete); each block weighs 10 tons, and there are 25,000 of them.

Ismailia is a pretty town half-way along the canal, which here enters the Lake Timsah. Here the Arabs and their camels and the jackals of the desert are alongside the steamboats, the whirring lathes and sounding forge-hammers of the company's workshops. A fresh-water canal comes hither all the way from Cairo, and then branches out north and south along the whole extent of the salt-water canal. The sweet-water canal is already a blessing to Egypt. It is from 30- to 40 -feet-wide, and boats with all sorts of cargoes are towed or sail through it.

708

During one day a violent gale swept across the canal. To look at the desert was to see a vast yellow picture of men and camels dimly floating in a sea of sand without any horizon. The quantity of sand, whisked from the plain and cast into the canal-water by a wind like this will be a serious matter to deal with. One ounce of sand per square-yard amounts to 500 tons on the whole canal, and the wind sometimes blows in this way for a month together.

At Chalouf I found 14,000 men at work. They labor very hard, indeed, running up the hill with baskets of sand on their heads. About 1,000 donkeys walk in long lines with neat mat baskets on their backs. In curious and close contrast to those simple carriers the mighty power of steam toils and puffs as it hurls up huge bulks of heavy clay, and it is, perhaps, only in Egypt one could see human and animal power exerted in such competition with steam power.

The laborers are sent from all parts of Egypt. They must come, but they are highly paid – from 2 francs to 3 francs-a-day. Prices, both of labor and of food, have risen very much since the canal has been begun, but the supply of fish has rapidly increased. The salt water canal teems with fish.

At this, the Red Sea end, the works of the canal seem very far behind. The entrance port has all the obstacles of a shallow mouth, soft and shifting sand for bottom, and a crooked irregular tide eddying about in a most puzzling way.

709

When the passage from the Mediterranean to the Red Sea is open to the world it is intended to tow vessels through by tug boats working along a chain which lies at the bottom of the water. Steamers are not to be allowed to use their own paddles or engines for fear of damaging the soft sloping banks of the canal by the “wash” thus created. The difficulty of towing a vessels of 2,000 tons in this manner when the wind presses her to one side is an objection to which I have heard no feasible answer.

710

The Suez Canal
Present State – Particulars – Usefulness – English Opinion
Van Nostrand's ENGINEERING MAGAZINE
1869 – Vol. I

711

In a communication to Paris, M. De Lesseps states that a small schooner, *La Levrette*, has recently passed through the Suez Canal, and that six vessels belonging to the Egyptian fleet are about to pass from one sea to the other. It now may be safely said that this canal is opened for vessels of small tonnage; and in six months' time ships of from 2,000 to 8,000 tons burden will be able to make use of it.

The Suez Canal is about 90–miles-long, and will be 328-feet-wide at the water line, 74-feet at the bottom and 26-feet-deep. The slopes under water are very flat - five-to-one. The excavation will have required the removal of 96,-000,000 yards of earth. The work presents no engineering difficulty except magnitude. The cost is estimated at 60,000,000 to 75,000,000 dollars gold.

As to the usefulness of the canal, the Dutch Commission report that it will help sailing vessels bound beyond the Indian Ocean very little - ten or fifteen days in 100; but that it will save steamers fifteen to seventeen days in a voyage of 60 to 70 days. The rate-of-toll is not decided, and it is stated that steamers will not be allowed to use their own propellers, but will be towed by some means that will not wash the banks. The English papers are “calculating” that it will hardly pay.

712

An American scientific writer, sojourning in London, ten years ago, prepared an elaborate article favorable to the Suez Canal. The article was thrown-out by the proprietor of the journal to which it was contributed. But, said the writer: “the project must succeed - there are no insurmountable difficulties.” To which the proprietor replied to this effect, and his reply sums-up the British opinion of the period: “The Suez Canal is not recognized as a proper subject for professional discussion in England. Englishmen have determined that it should not succeed.” But British opinion is subject to change on this as on other subjects, and the *Practical Mechanic's Journal* now makes this handsome acknowledgement:

The Suez Canal - after years of labor and perseverance against every obstacle and discouragement, enough alone to immortalize the names of Lesseps and those who have, like his able contractors Lavalle and Borell, stood staunchly by him through every difficulty -at last begins to prove itself to the world–at-large, and even to the most incredulous eye, as about at an early period to be accomplished. In fact, in some sense, it is so already. The Sweet Water Canal has already conferred great agricultural benefits upon the country through which it passes, and must prove hereafter a source of uncountable riches to Egypt, and of great revenue to the canal company. The English engineer who showed himself, as regards this Suez Canal question, the only competent one - for Mr. John Hawkshaw, in his able report, boldly stated that it was not only practicable but easy to construct, and that the dogmata of Robert Stephenson as to the impossibility of keeping it open were purely chimerical - has stated, that he would undertake to irrigate the whole land of Egypt, i.e., all its tillable land, from that canal…

713

…A condition produced by the relations of the salt water or great ship canal and the arid climate of Egypt, which Stephenson never thought of, has since been carefully taken into account, and it is now certain that whenever the sea shall be let into and fill the Bitter Lakes, the evaporation from the water surface alone will be such as to cause a considerable current through the canal, which, according to Stephenson, would be “no more than a stagnant ditch;” indeed, the question has been raised whether the scour due to this cause and to alternate action of the tides, though these are small at either end, may not prove more than desirable. The effect, however, of this evaporation will unquestionably be to totally and rapidly change the whole climate of Egypt, so that, irrespective of any irrigation, it will probably become sufficiently moist to gradually put an end to the Egyptian Sahara, through the unseen working of the forces of nature. Should this even in a minor degree be realised, and there can be little doubt upon the subject, it will be probably the most wonderful result in the modifying of cosmical forces as found in nature ever achieved by human means…

714

…England has all along occupied a most unenviable and unfortunate position as regards this grand project, of which France may be so justly proud, and the completion of which we hope the Emperor may live to see, and to know that it will be one of the events by which history will mark his reign. But we will not go back upon the unpleasant track of misjudged policy, mainly due to Lord Palmerston's political prejudices as to Eastern affairs, sustained by R. Stephenson's engineering misjudgment, in which the facts and deductions were fitted for the political foregone conclusion, rather than to nature and reality. The recent tardy sort of half retraction of ancient opposition and prejudice on the part of the "Times," and some other English leaders of opinion, is but a pitiful display of grudgingly admitted error and half-given praise, the old story, "it will never pay," however, is still raised, but no attempt is made upon any solid and sensible basis of figures, in Great Britain at least, to prove that that is so.

715

Isthmus of Suez Canal

A LETTER addressed to the Editor of the *Austrian Gazette*
by *Robert Stephenson, M.P.*
In reply to the statements of *M. De Negrelli*, Engineer
July 1858

716

THE *Austrian Gazette* of the 18th of June, 1858, published the following letter from M. de Negrelli to the Editor :—

"SIR,—In the discussion in the English Parliament on the 1st of June, Mr. R. Stephenson asserted, in regard to the possibility of the Suez Canal, that, in 1847, a commission, composed of a Frenchman, an Austrian, and himself, had confirmed the impracticability of this project."

[M. de Negrelli here cites the first part of Mr. Stephenson's speech.]

"Last year I had intended to rectify the assertions publicly made by my honourable friend, on the subject of the opinions of the Austrian engineer; but M. Paleocapa anticipated me. His refutation of the assertions of Mr. Stephenson was so complete, that I contented myself, as did the other members of the International Commission, by affixing my signature to his reply. I waited for an answer based on technical arguments from my honourable friend in England.

"To the astonishment of all those who look upon the canal with that interest which so great, so important, and so useful an enterprise must excite, this answer was never made by the honourable member in the House of Commons. Mr. Stephenson only repeated his former assertions in the discussion of 1st June. It is requisite, therefore, to the interest of truth to expose the real facts of the case; and in so doing I feel it necessary to refresh Mr. Stephenson's memory. I will take the liberty of calling to his mind that between us—(an Austrian, Negrelli; a Frenchman, Talabot; and an Englishman, Stephenson)—there never has been, either in 1847 nor afterwards, any change of opinion on the question of the Suez Canal. The only time I have ever spoken to Mr. Stephenson on this subject was on 30th November, 1846, at Paris, when we concluded a treaty according to which I was to undertake the exploration of the

717

Bay of Pelusium and of the shore of Tineh. My friend Talabot took the levelling of the isthmus, and Mr. Stephenson the exploration of the Gulf of Suez. This treaty contained other stipulations, all adopted by Mr. Stephenson. At that time he appears to have had faith in the utility and profit of the canal, and not to have considered as absurd the project of piercing the isthmus. That the canal has not a fall of thirty feet has nothing to do with the question. For my part, I consider that a horizontal canal is more advantageous to navigation than one with a fall, and I have found that in all canals having a fall it is necessary to establish locks to moderate it. I consider that it is a favourable incident that there is no difference of level between the two seas, a circumstance which essentially facilitates the construction of a free canal.

"M. Talabot and myself, in 1847, despatched detachments of engineers into Egypt, and addressed the results of their levellings to the commission at Paris. Mr. Stephenson sent nobody into Egypt, but merely submitted, without any explanatory observations, some printed geographical charts of the Red Sea.

"We were convinced that no faith could be placed on the results of the surveys made by the Austrian and French engineers till the engineers-in-chief, Negrelli, Talabot, and Stephenson, had established them by their own experience.

"In the month of January, 1848, we arranged to proceed together to Egypt during the month of March, and to deliberate, after exploring the land, on the possibility and the details of the project. All the preparations for the voyage were completed, when the events of February took place; the voyage was put off, and since that time no deliberation has taken place between the three engineers. It is true that they met again at Paris in the month of August, 1855; but no word passed between them on the project of the canal.

"During this time, M. Bourdaloue, chief of the brigade of French engineers, published his levellings; and, as they agreed with those of the Austrian brigade, any interested person might prepare a plan on the execution of the project.

"It is true that Mr. Stephenson went into Egypt without consulting his colleagues, not on the subject of the canal, but with the intention of entering into a negotiation with the Government on the subject of executing a railway from Alexandria to Suez.

718

On this occasion Mr. Stephenson may have traversed the Desert between Cairo and Suez; but, if so, he can only have seen that part of the isthmus which is near to Suez. However, our honourable friend pretends to have traversed on foot the whole isthmus between the two seas. But in Egypt, where the preparations for a journey in the Desert always attract attention, no one has ever heard of this journey of Mr. Stephenson; and his last assertion in the English Parliament, in which he stated that it would be necessary to dig eighty English miles, confirms the general opinion in Egypt, that Mr. Stephenson has never seen nor traversed the isthmus, properly so called, as in that case he would have observed the basins of the Bitter Lakes and Lake Timsah, which will not have to be excavated, and which lessen by a considerable number of miles the number stated by Mr. Stephenson, as well as facilitate the execution of the canal in a considerable manner.

"The engineers of the Viceroy of Egypt took part in the surveys of the French brigade, and they were in possession of the results. They repeated the levelling in 1853, and arrived at the same conclusions. At the end of these works they drew out a preliminary plan for piercing the isthmus after the concession had been granted to M. de Lesseps in 1854.

"M. Talabot published a plan, in which, abandoning the idea of a direct union of the two seas, he proposed to cut a canal from Suez to Lake Timsah, and from thence through Ouadie-Toumilat, crossing the Nile, to Alexandria.

"For my part, I considered the results of the surveys favourable to the direct union of the two seas; the fact of their being on the same level renders the construction of locks unnecessary. However, I reserved my opinion till my ideas should be confirmed by exploring the land and by the soundings to be made. At the end of the exploration of the land, made in the month of December, 1855, by the International Commission, I was convinced of the facility of the execution of the canal, and of the possibility of the construction of the entrances and ports at the two extremities of the canal and Lake Timsah.

"Immediately on the termination of the researches in the Desert and in the two gulfs being strengthened in my opinion by these studies, I pronounced myself in favour of the direct union of the two seas by a free canal.

719

"I do not share the opinion of my honourable friend in England, that the canal without a current must become a ditch where the water will be perpetually stagnant.

"The great basins in the interior of the isthmus will form a considerable surface of water, and will maintain, as all interior lakes, a constant motion. The difference between the tides in the two seas will communicate to the canal the agitation which they possess themselves. The canal can only be considered as the continuation of the two seas whose waters meet in the basins. If my honourable friend will look from the windows of the building in which he has developed such singular hydraulic knowledge, he will see that the reflux of the Thames, as far as Windsor, is caused by the rising of the tide and the agitation communicated to the river. Notwithstanding that Windsor is many leagues from the sea, the influence of the tide on the interior waters is regularly felt. In the same manner the Mediterranean and the Red Sea will agitate the Suez Canal. The waters will rise and fall; in one word, they will take part in all the movements of the sea. The canal, I repeat, is merely an elongation of the two seas to their point of union in the Bitter Lakes, and it will always be fed by them. This agitation manifests itself in all canals which communicate with the sea. The lake Menzaleh, fed by the Mediterranean, stretches a great distance into the country without becoming stagnant.

"My honourable friend may thus understand that he will not find in '*The Austrian*' any support to his opinion, and that the latter does not renounce his conviction, formed after serious study, that the piercing of the Isthmus of Suez, with the view of establishing a Maritime Canal to unite the two seas, would be easy of execution in a technical point of view.

"NEGRELLI, *Engineer*."

720

To the Editor of the Austrian Gazette.

SIR,

THE *Austrian Gazette* of the 18th of June published a letter under the signature of the Chevalier de Negrelli, Engineer, on the subject of a speech delivered by me on the 1st of June last, in my place in the Commons' House of Parliament, in the course of a debate on the Suez Canal.

For a long time I have considered it most dignified and becoming, to pass without notice the various statements, anonymous or otherwise, which have been published on this subject. But the letter of M. de Negrelli, with whom I was associated in the first investigation of the practicability of piercing the Isthmus, and who, questioning my statements in Parliament, has now, for the first time, declared himself at issue with me both as to my facts and conclusions, renders it imperative that I should declare,

in a formal manner, what are the facts of this case, and by what circumstances my opinions are supported.

In the year 1846, I was solicited by my friend, M. Talabot, one of the most eminent Engineers of France, to investigate with him the practicability of piercing the Isthmus of Suez for a Ship Canal. The project had been suggested to M. Talabot by Linant Bey, a French Engineer, who had been for many years resident in Egypt. The statements submitted by Linant Bey were so remarkable, that they engaged my co-operation in the interests of science, and, M. de Negrelli having been secured by M. Talabot as a coadjutor, we entered into a formal agreement to share the labours and the cost of a preliminary investigation.

The construction of a Canal through the Isthmus of Suez involved two classes of engineering works:—1st, the construction and proper maintenance of the Canal itself; 2dly, the formation and maintenance of Sea Ports and deep entrances to the Canal, both in the Red Sea and in the Mediterranean. It has been generally believed, that the ancient Canal, of which vestiges may still be seen near Suez, was filled neither by the waters of the Red Sea, nor of the Mediterranean, but by the waters of the Nile, obtained at Cairo. And history had declared that Alexander the Great, in founding the Port of Alexandria on the west side of the Delta of the Nile, had been

influenced by consideration of the fact, that along the coast of the Levant there is an almost invariable current from west to east, carrying the *débris*, poured from the mouths of the Nile, into the Bay of Pelusium, and thereby rendering the maintenance of a deep harbour in that Bay as difficult as at the mouths of the Danube or the Rhone. But, on the other hand, Linant Bey submitted to us that the French engineers under Mons. Lepère, who had accompanied the Expedition to Egypt in 1799, had satisfactorily established, that there was a difference between the levels of the Red Sea and the Mediterranean of no less than 9·90 metres. Under such circumstances it was apparent, that nothing would be easier than to open a channel, and to establish a sufficient current from the Red Sea to the Mediterranean, with a velocity which it was assumed would keep the Canal open by its scour, and maintain a clear channel, not only in the Canal itself, but in the Harbour in the Mediterranean.

Undoubtedly, it was under the impression of the existence of this difference of level, that M. Talabot and myself entered on the inquiry; and as M. de Negrelli would not have been engaged in it, save at M. Talabot's instance, it is tolerably evident that the same primary consideration must have influenced him. That such was the case is additionally apparent from the fact, that our first joint act was to

take measures to confirm the difference of level reported on M. Lepère's authority. Under the direction of M. Talabot, a corps of scientific engineers was sent to Egypt to take the levels, upon which they were occupied from about September, 1846, until January, 1847, when M. Bourdaloue, the chief of the expedition, reported to M. Talabot, that it had been ascertained beyond the possibility of doubt, uncertainty, or question, that M. Lepère had been mistaken,—that no difference of level whatever existed between the two seas, and that, consequently, a canal capable of being scoured by the waters either of the Red Sea, or the Mediterranean, was impracticable, especially as both those seas may be said to be nearly tideless.

Upon the accounts and levels submitted to him, M. Talabot made a Report which, whether considered in an historical, scientific, or engineering point of view, is at once the most comprehensive and logical document that has ever appeared upon the subject. After reporting on the non-existence of a difference between the levels of the seas, and on the effects of the current along the shores of the coast, he concluded that the maintenance of a channel, and of an entrance in the Bay of Pelusium to the east of the Delta, was "*une difficulté insurmontable*;" and from this he went on to show that, even supposing an entrance could be

established to a Canal in the Bay, the prevalence of north winds, during nine months of the year on that part of the coast, would prevent ships from attempting, with safety, either to make it, or to leave it, unless a harbour of refuge were established, to save them from the consequences of being blown on a lee-shore. And after alluding to the difficulty of executing such works, he says, "I am persuaded that to construct in the Bay of Tineh a safe roadstead, and a conveniently situated channel, as much would have to be expended as for making the whole of a Canal by the way of Alexandria, and that only to obtain a pass of uncertain success, or, rather, one that is certainly impracticable." And M. Talabot concluded that the result was, "to exclude every project which shall end in the Bay of Tineh" (Pelusium).

Concurring most entirely in these conclusions, and regarding the project as wholly at an end, in consequence of the premises on which it was based having been found to be entirely erroneous, I paid from my own personal means the share of the expenses attending the inquiry, for which I had undertaken to be responsible (one-third of about £4,500), and all correspondence on the subject ceased. Several years afterwards, in August, 1855, during the Exposition, I had the pleasure of meeting both M. Talabot and M. de Negrelli in Paris, but so utterly was the Suez Canal project closed and abandoned, that, as M. de Negrelli

tells you in his letter, "no word passed between us on the subject."

You will here permit me to mention a personal matter, which M. de Negrelli has elevated into importance. In the autumn of 1850, fatigued by the labours of an arduous year, I sought health and recreation in a yacht voyage to the Mediterranean. Arrived at Alexandria, I determined to make a personal investigation of the district in which four years previously I had been so deeply interested. Proceeding from Cairo by the usual route to Suez, accompanied for some distance by Captain Lindquist, then the agent of the Peninsular and Oriental Steam Company, I turned thence northwards into the Desert, visited the site of the Bitter Lakes (now dry and desolate), encamped for two days at Lake Timsah, and from thence proceeded over the high ground towards Lake Ballah, travelling on foot, as indeed it is difficult to traverse otherwise a large portion of the deserts. From that ridge of comparatively elevated ground I was enabled to overlook the district towards Lake Menzaleh, which, during the period of high Nile, becomes a shallow lagoon, stretching along the coast and far into the desert. Then returning westward, I entered the Ouadee Toumilat at Sababiar, and following the course of the ancient canal, I travelled in the direction of Bulbies and of the ruins of the ancient Bubastis, visiting the higher grounds to the north, and thence, re-

turning to Cairo. Altogether I spent fifteen or sixteen days in the district, and all that I saw and ascertained on this expedition confirmed my convictions as to the Suez Canal project, and the finality of M. Talabot's report. On my return to England, I gave, on the 20th of May, 1851, an account of this expedition, in the course of a discussion on a paper read at the Institution of Civil Engineers, stating emphatically the opinion at which I had arrived, "that it was evident, that it would not be practicable to keep open a level cut, or canal without any current, between the two seas, and that the project was abandoned."

A report of my speech on that occasion will be found in the published "Minutes of the Proceedings of the Institution of Civil Engineers," (vol. x. pp. 10—13,) a book which M. de Negrelli may find in the public libraries of Vienna. The circumstances of my expedition, though made without any ostentation, are well known both in England and in Egypt. I am astonished, therefore, at what I must call the audacious assurance with which M. de Negrelli insinuates in his letter; first, that I have never been in the locality at all; then, that if I have, I "can only have seen that part of the Isthmus which is near to Suez." "Our honourable friend," he writes, "PRETENDS to have traversed, on foot, the whole Isthmus between the two seas. But, in Egypt, where the preparations

for a journey in the Desert always attract attention, no one has ever heard of this journey of Mr. Stephenson." I must be permitted to tell M. de Negrelli, that the sense of honour which prevails in England forbids our presuming to doubt the word of a gentleman, without having at least some foundation for suspicion; and that when, without foundation, he insinuates, that I could be base enough, before the Institution, of which I have been President, and, seven years after, before the Commons of England, of which I am a Member, to make statements, as deliberately false, as ridiculously objectless, he is attributing to me a course of conduct utterly unknown to his "honourable friend."

It curiously enough happens, that my journey over this district in 1850, was not my only expedition to it. In the year 1851, my yacht was burned at Cowes, having on board all the specimens I had collected at the Bitter Lakes, Lake Timsah, and the elevated ridge to the north. In the winter of 1854, being at Cairo, I felt a desire to replace these specimens, and I started for the district under the escort of a Cavass of his Highness the Pacha of Egypt, and accompanied as far as the Bitter Lakes by Mr. Ayrton, an English gentleman resident at Cairo. On this occasion I pursued the same route with little variation; renewing my acquaintance with the physical features of the country, and still further confirming my views as to

the soundness of M. Talabot's Report. Everything that Mr. Talabot gave the key to I saw for myself; and judging for myself, with his Report and Maps in hand, I felt confirmed in the correctness of his views respecting a direct canal across the Isthmus of Suez.

It was, I believe, in the year following this expedition, that certain gentlemen waited on me in London, and proposed to re-open the scheme for a Canal across the Isthmus of Suez. They had no new facts to offer to my consideration, and in all that they stated, I found nothing that engaged any share of my confidence, or that in any way changed my views as to M. Talabot's Report and the character of the project. In dealing with the multitude of schemes from time to time submitted to me, I have uniformly declined to allow my name to be associated with any plan involving the subscriptions of my fellow-countrymen, for which I did not see good prospect of success. Acting on this principle, and feeling that the Suez Canal project, on such foundations, was not a sound undertaking, I declined to be in any way connected with the scheme. I communicated this resolution to the promoters civilly and courteously. I know not why my persistence in it has given them so much offence. For some years past, however, I have been pursued by these parties, in their hired organs, with weekly attacks on both my personal and professional character. As I have said before, I have thought

it most dignified to leave such attacks unnoticed: knowing whence they proceeded, indeed, they appeared beneath notice. Under no circumstances will they ever engage my attention; and it is only when I find a former colleague leagued with my assailants, that it appears to me to be necessary to correct his misstatements.

M. de Negrelli tells you in his letter "For my part, I considered the results of the surveys [of M. Talabot] favourable to the direct union of the two seas; the fact of their being on the same level rendering the construction of locks unnecessary." "However," he says, "I reserved my opinion until my ideas should be confirmed," which did not occur until "after the month of December, 1855," when M. de Negrelli now declares that he "pronounced himself in favour of the direct union of the two seas by a free canal." M. de Negrelli has a perfect right to his own opinion: I only regret that he does not concede to me my right to mine. But, apart from matters of opinion, I cannot but observe, that the elaborate attempt of M. de Negrelli to fix the periods, during which he "reserved" and at which he "pronounced" his opinion, appears remarkable. From the termination of M. Talabot's experiments in January, 1847, to "after the month of December, 1855" (*i. e.* to January, 1856), NINE long years, M. de Negrelli "reserved his opinion." Through all these years,

and even down to the date of his letter to you, he permitted his former colleagues, and the world at large, to believe that he concurred in M. Talabot's report, and that, together with M. Talabot and myself, he had abandoned the project altogether. Even when we all met in Paris in August, 1855, on the very eve of his "pronunciamento," he did not communicate either to M. Talabot, or to myself, the doubts he entertained, or the opinions he "reserved." It was only "after the month of December, 1855," that "his ideas were confirmed." It was only "after the month of December, 1855," I believe, that the Company to which M. de Negrelli has now openly lent the influence of his name and the weight of his authority, assumed a commercial shape.

But M. de Negrelli, I have said, has a right to his opinions. I only wish he would allow me the same right to mine.

"I do not share," he says, "the opinion of my "honourable friend in England, that the Canal with-"out a current must become a ditch, where the "water will be perpetually stagnant." "The Canal "can only be considered as the continuation of the "two seas whose waters meet in the basins. If my "honourable friend will look from the windows of "the building in which he has developed such sin-"gular hydraulic knowledge, he will see that the "reflux of the Thames, as far as Windsor, is caused

"by the rising of the tide and the agitation com-"municated to the river. Notwithstanding that "Windsor is many leagues from the sea, the influ-"ence of the tide on the interior waters is regularly "felt. In the same manner the Mediterranean and "the Red Sea will agitate the Suez Canal. The "waters will rise and fall; in one word, they will "take part in all the movements of the sea."

If "my honourable friend" will stand on the walls of the city from which he has developed such "singular hydraulic knowledge," he will see in the tideless stream below him nothing of the character he describes as occurring in the Thames, which will probably account for his statements, which are indeed as wide of the mark as possible. Because to suppose, for a moment, that there is any analogy between the Suez Canal, 300 feet wide at its mouth, in an almost tideless sea, and a river like the Thames, no less than six miles broad at the Nore, with a rise of tidal water of from sixteen feet to twenty feet, is really, to use a favourite phrase of M. de Negrelli, merely to "PRETEND" to a knowledge of hydraulics.

And if "my honourable friend" is wrong in his analogy, he is equally unfortunate in his special illustration. If, without a shadow of foundation, M. de Negrelli questions my ever having been at Suez, it is not without foundation that I shall question his ever having been at Windsor. Or if

ever, as his language appears to suggest, he has travelled up the river Thames, past the windows of the building in which I "developed such singular hydraulic knowledge," to visit the Royal Castle at Windsor, from whence he saw "the reflux of the Thames, the rise of the tide, and the agitation communicated by the river," he must forgive me for suggesting that the vision must have been under circumstances most dazzling to his clear perception. For, whilst it is quite true, as M. de Negrelli says, that "Windsor is many leagues from the sea," it is equally certain that "the influence of the tide there is" NOT "regularly felt," inasmuch as it is arrested by Teddington lock. Moreover, I must inform M. de Negrelli, that Windsor is twenty-six miles above the reach of the tide of the Thames; and that at no period of the history of the river, even before the construction of the locks, was the tide known to reach within twenty-two miles of that town. In the same manner therefore as the tide agitates the waters at Windsor, M. de Negrelli pronounces that "the Mediterranean and the Red Sea will agitate the Suez Canal." On this point "I do share the opinion of my honourable friend in"—Austria.

But on the graver question that "the waters of the Canal will rise and fall, that they will take part in all the movements of the sea," I "do not share his opinions." Supposing that there was an action of the

733

water to the extent of two feet in the Mediterranean, and of six feet in the Red Sea, which is supposing an extreme case, what effect would such action have on a canal nearly eighty miles in length, with the intervention of the extensive basin of the Bitter Lakes? The matter is easily to be settled by calculation; and I leave it to my honourable and ingenious friend to amuse himself with it in his leisure hours.

I believe that I have now replied to everything requiring an answer in M. de Negrelli's letter. I regret that after leaving M. Talabot and myself to imagine, for so long a period, that he concurred in the conclusions at which we arrived, after the investigation of 1847, he should now have "pronounced" a contrary view. It is some satisfaction to me, however, to reflect, that in the interval our opinions have been confirmed by the investigations of highly scientific and experienced individuals. Amongst other important inquiries on the subject, I would refer to a document issued by the Hydrographic Office of the Admiralty, under the authority of Capt. Spratt, R.N., a Companion of the Order of the Bath, and a Fellow of the Royal Society, who in 1857 made "An Inquiry into the soundness of M. de Lesseps' reasonings and arguments on the practicability of the Suez Canal."

This eminently scientific officer has arrived at the conclusion, after twenty years' hydrographic experience

734

of the Mediterranean, and after the late elaborate surveys and charts of the Admiralty, showing the wave motion and the currents, that the establishment of a Canal "dependent upon, or secondary to, the practi-"cability of making and maintaining a deep entrance "to it from the tideless Mediterranean," is not feasible. "It is necessary and just," he concludes, "to the "commercial interest desiring to embark in the project "of M. Lesseps, to know these important facts, ere "they risk their millions in the undertaking, instead "of discovering them only when swamped in the sands "they will have to contend with; and then to discover "also, when too late to amend it, that Alexander the "Great was wiser than M. Lesseps admits, when he "listened to the local opinion regarding the influence "of the Nile upon the harbour, if formed to the east-"ward of it."

The opinions expressed by Captain Spratt serve, to some extent, to counterbalance and to console me under the defection of M. de Negrelli. I only regret that my former colleague should not have been permitted to join his new friends, without contributing an attack upon myself. I must frankly say, that such an attack from his pen appears to me to be especially ungenerous, unfair, and unprovoked. What word of unkindness has passed my lips with respect to M. de Negrelli? When did I attribute to him false pretences, and absurd scientific ignorance? So little

735

cause, indeed, had M. de Negrelli for assailing me, that I entertain a belief, almost amounting to conviction, that he never can himself have penned the scurrilous letter of which I complain, but that it was the work of some others, who obtained to it his signature, given without due consideration.

In conclusion, Sir, I will only say that I have—indeed, I can have—no hostility to a Maritime Canal through the Isthmus of Suez. If I could regard such a Canal as commercially advantageous, I have already shown that I should be the first to give it the advantage of my time, my money, and my experience. It was because, after elaborate investigation, and in conjunction with such men as M. Talabot, I arrived at a clear conclusion that the project was not one which deserved serious attention, that I refused to give it support. I should be delighted to see a channel like the Dardanelles, or the Bosphorus, penetrating the Isthmus that divides the Red Sea from the Mediterranean. But I know that such a channel is impracticable,—that nothing can be effected, even by the most unlimited expenditure of time, and life, and money, beyond the formation of a stagnant ditch, between two almost tideless seas, unapproachable by large ships under any circumstances, and only capable of being used by small vessels when the prevalent winds permit their exit and their entrance. I believe that the project will prove abortive in itself, and ruinous

736

to its constructors; and entertaining that view, I will no longer permit it to be said, that by abstaining from expressing myself fully on the subject, I am tacitly allowing capitalists to throw away their money on what my knowledge assures me to be an unwise and unremunerative speculation.

I have the honour to be,

Your most obedient Servant,

ROBERT STEPHENSON.

24, GREAT GEORGE STREET, WESTMINSTER,
July, 1858.

737

The Suez Canal
Authentic Account of the Works, Maintenance, Difficulties, Working, etc.

Compiled from a letter by *Mr. John Fowler* to the London "Times"
Van Nostrand's ENGINEERING MAGAZINE
1869 – Vol. I

738

PORT SAID Harbor - A harbor for the entrance to the canal has been constructed at Port Said by running out into the sea two breakwaters formed by artificial blocks of stone. These are composed of one part of hydraulic lime from France, and two parts of sand obtained on the spot, and are therefore really hard mortar. The harbor is intended to answer the double object of protecting vessels from heavy seas and of arresting the alluvium brought down by the river Nile, so as to prevent choking up the channel.

The western breakwater extends from the shore 2,400 yards in a straight line towards the north, and then with a slight angle towards the east extends 330 yards further. The eastern breakwater leaves the shore at the distance of 1,530 yards of the commencement of the western breakwater, and extends nearly north for a distance of 2,070 yards, at which point it is 760 yards from the western breakwater, and this distance constitutes the width of the entrance.

The portion of the harbor affording shelter to vessels is nearly 500 acres in extent, and, although the depth of water is not sufficient for the largest men-of-war, it is quite sufficient for ordinary merchantmen, if the present depth is maintained.

739

Large quantities of alluvium are constantly brought along the shore from the Nile, and since the construction of the western breakwater this deposit has changed the line of the shore, while large quantities have found their way through the interstices of the artificial blocks of which the breakwater is composed, into the harbor, and are forming deposits there; it will be found necessary to make this breakwater solid. It is possible this outside accretion may require at some future time a prolongation of the breakwater, and it may be that northerly winds will occasionally bring sand into the harbor; but I do not consider such contingencies to constitute any real objection to the design, or likely to be formidable in expenditure, considering the gigantic character and objects of the whole undertaking.

740

Divisions and Sections of the Canal

741

The canal may be conveniently divided into the following portions:

	Miles.
1. Port Saïd through Lakes Menzelah and Balla to near El Ferdam	37
2. From near El Ferdam through the great excavation of Seuil d'el Guise to Lake Timsah	9¼
3. Through Lake Timsah	5¼
4. From Lake Timsah through the excavation of Seuil du Sérapéum to the Bitter Lakes	7¼
5. Through the Bitter Lakes	23¼
6. Through the deep portion of Chalouf Cutting	5
7. Thence to Suez and the end of the canal.	11
Total	99

742

With minute exceptions the whole of the canal is now being excavated and completed according to one or other of the following sections:

1st. 196 ft. width at the surface of the water, and 26 ft. deep for 72 ft. at the bottom. The slopes are two horizontal to one vertical, with one or more horizontal benches of 10 ft. in width, according to the depth of the cutting.

2d. 327 ft. in width at the surface of the water, and a similar depth of 36 ft. for a similar width of 72 ft. at the bottom. The lower part of the excavation is also two horizontal to one vertical, but the slopes above and below the surface of the water are five-to-one, and a horizontal bench of 58 ft. connects the two slopes.

It will be observed in the description of the second section that the slope at the surface of the water is flat (five-to-one), and provision is now being made for protecting this slope with rough stone pitching, trimming the upper slopes, and otherwise treating it as a finished work. This may be safely done, because the section is so arranged that the canal may be widened at any subsequent period without disturbing any of the work already done.

With the first section, however, the case is different. This section has been adopted in the deep cuttings to effect the largest saving possible in the quantity of excavation, and, therefore, if a future widening of the canal is required, one or both side slopes must be thrown back, and a considerable portion of the present work interfered with.

743

As a rule, no stone pitching or other protection against the wash of passing vessels, or wind, or current, has been provided for the part of the canal where this section has been adopted, although the slope at the surface of the water is two-to-one.

At each end of the Bitter Lakes careful provision is now being made by temporary weirs and sluices at the sides of the canal for the admission of water into the lakes from the Mediterranean and Red Seas. This provision has been calculated with reference to the time and quantity of water, and a sufficient margin appears to have been given for possible contingencies.

744

The Works at Suez

745

These consist of an entrance channel into the Red Sea, increasing gradually from 72 ft. in width at the bottom to 980 ft. of a basin or dock, and a considerable extent of reclaimed land.

746

Work Done and to be Done

747

The total quantity of work in cubic-meters of excavation originally required for constructing the canal according to its present dimensions and design was as follows:

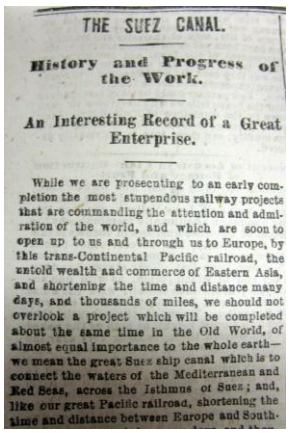
	Cubic meters.
Total work	78,000,000
Work executed up to Dec. 15, 1868	53,000,000
Leaving still to be executed	25,000,000

The number of men, animals and materials which were on the ground and available for the work on the 15th of December, 1868, was as follows:

Workmen	8,213
Camels	368
Donkeys	116
Dredging machines	60
Inclined planes of railways	22

The quantity of work yet remaining is very large, but taking the progress made during the last few months, and applying the same rate for the future, it appears to be possible that in the absence of some unforeseen contingency the canal may be sufficiently completed for the purposes of traffic during the present year.

748



THE SUEZ CANAL.

History and Progress of the Work.

An Interesting Record of a Great Enterprise.

While we are prosecuting to an early completion the most stupendous railway projects that are commanding the attention and admiration of the world, and which are soon to open up to us and through us to Europe, by this trans-Continental Pacific railroad, the untold wealth and commerce of Eastern Asia, and shortening the time and distance many days, and thousands of miles, we should not overlook a project which will be completed about the same time in the Old World, of almost equal importance to the whole earth—we mean the great Suez ship canal which is to connect the waters of the Mediterranean and Red Seas, across the Isthmus of Suez; and, like our great Pacific railroad, shortening the time and distance between Europe and South-

Contemporary newspaper account of the Suez Canal during construction (ca. 1868)

749

Maintenance of the Canal

750

The question of maintaining the canal and its harbor of Port Said permanently open for traffic has excited almost as much professional and public attention as the construction itself, and in some minds probably much greater doubt and difficulty have been felt on this than on any other point.

The difficulties of maintenance may be divided as follows:

1. *The Prevention of Nile deposit from choking-up Port Said.*

The remedy for the mischief, which may be said to have commenced and to be now continuing (and to which we have referred above), is either to admit the sand to pass through the breakwater and then depend upon dredging, or to make the breakwater solid, and encounter the difficulty, whatever it may be, of its greater accumulation outside. The rate of accumulation in the angle formed by the western breakwater was naturally very rapid in the commencement, because the area was small, and the water was impounded in such a position as to be almost without motion; but as the new shore formed by the deposit advances seaward this rate of advance is rapidly and constantly decreasing.

751

The time has not been sufficient to collect adequate observations by which any law or formula could be founded to represent the future rate of the advance, but it is, however, very clear that many years must elapse before the line of shore can possibly reach down to the angle of the breakwater, and it may be that at or near this point the accretion seaward will cease altogether; but the greater probability is that, although it may have become small, it is still going on, and the necessity of extending the western breakwater, at some future time, further into the sea, is likely to be required. No apprehension need be entertained as to the channels and harbor being silted up and destroyed, but at the same time considerable expense in dredging will be constantly required.

2. *The Impossibility of Preventing the Sand of the Desert Blowing into the Canal in Quantities totally Unmanageable.*

This objection has been felt to be one of great weight, and when it was considered generally and without the correction of local knowledge it appeared to be fatal, because if the whole or nearly the whole distance from seas-to-sea had been through a desert composed of fine drifting sand it would have been hopeless to maintain the canal open; but, fortunately, the only portions of the canal which will be liable to be affected by the sand of the desert to any extent worthy of consideration are the two excavations on each side of Lake Timsah – viz; Seuil de Guise on the north, and Seuil du Serapeum on the south.

752

Fortunately, a tolerably satisfactory means of ascertaining the annual amount of drifting sand has been afforded by an investigation lately made during a period of twelve months, and the result is that 40,000 cubic-yards was found to have passed into Seuil de Guise, and 270,000 cubic-yards into Seuil du Serapeum. These quantities, no doubt, are very large, and it is quite possible that during some years they might be exceeded, but the company are making provision to diminish the quantity by trying experiments with trees and shrubs, so as to plant the slopes and the ground for some distance on each side of the canal. It is also probable that water from the fresh-water canal will be made available for forming an extended oasis at and around this portion of the canal.

These operations will be somewhat expensive, although they are doubtless prudent and desirable, but after every precaution has been taken it will be necessary to keep one or two powerful dredges in Lake Timsah to keep the canal clear from drifting sand.

3. *The Difficulty of Protecting the Banks against the Destructive action of the Wave caused by passing Vessels*

It will be found necessary to make a proper and immediate protection of the slopes by stone pitching above and below the surface of the water along the whole course of the canal if the traffic is to be conducted at a reasonable rate-of-speed; the engineers of the Canal Company have arrived at the same opinion. This work will no doubt be executed much more conveniently and economically after the canal is opened throughout, and the large quantity of stone required can be conveyed without charge; but, on the other hand, it will be more difficult to place the stones below the level of the water, and probably the slopes may have sustained some mischief before the work can be done.

753

4. *The Impossibility or Difficult of Supplying the Abstraction of the waters of the Bitter Lakes during the Evaporation of the Summer Months through the Ordinary Section of the Canal between the Bitter lakes and Suez.*

The vast extent of the Bitter Lakes (100,000 acres in superficial area) when connected with the tidal Red Sea by the Chalouf excavation, will produce in the summer months, when the evaporation is greatest, peculiar currents and hydraulic phenomena. The urgent daily evaporation or abstraction will amount to about 250,000,000 cubic-feet of water, and this will be chiefly supplied from the Red Sea, which is far nearer than the Mediterranean, and has a tidal range of about 3 ft. in spring tides, and 2 ft. at neap tides, while the Mediterranean has a far less tidal range. The currents which will thus be created by evaporation and tide will be sufficient to assist or retard navigation, as they will probably approach, if not exceed, two miles-per-hour, but they will scarcely be strong enough to affect injuriously the bottom or sides of the channel through the Chalouf cutting after the proper protection by stone pitching has been carried out.

It is possible that a strong south wind may somewhat increase the velocity of this current by slightly raising the ordinary tide at Suez, and that lateral absorption, evaporation, and waste round the shores of the Bitter Lakes into, and through, the sand of the desert may increase the amount of the water to be daily supplied; but these disturbing causes will not probably be sufficient to make any appreciable difference in the velocity. It would, however, have been desirable, in my opinion, that the canal should have been originally constructed on enlarged dimensions between the Bitter Lakes and the Red Sea, if the resources of the company had permitted.

754

Traction Power to be Employed on the Canal

755

A special committee, or commission, has been engaged for some time in investigating this question, and has considered many expedients and suggestions. At one time it thought that a continuous chain along the bottom of the canal, similar to that used for the ferry at Portsmouth, would be applicable, but it is now understood that steam vessels (except those with paddlewheels) may use their own power, and that any vessel may be towed through the canal by steam tugs, the speed to be limited in all cases, as may be settle hereafter. This is doubtless the best decision, both for economy and convenience.

Several important questions suggest themselves in the working of the canal, such as the impossibility of two large vessels passing each other until the canal is enlarged; but this difficulty must be dealt with by regulations very similar to those adopted on a single line of railway. If, however, the traffic should rapidly become very large, it is possible that several passing places will have to be provided without waiting for the widening of the whole canal.

A strong side wind would also be a considerable difficulty, and occasionally it may be found to be almost impossible to keep a large vessel from the sides of the canal. In the Caledonian canal it is well known that this difficulty is frequently experiences even with small vessels, but in Egypt very strong winds from the east and west are not common, and the difficulty will probably not amount to more than a simple retardation of the speed of the vessel, and the necessity of lowering all masts and rigging capable of being lowered, but one or two attendant tug vessels, when required, can be made available for the purpose of enabling a vessel to keep the channels of the canal. Doubtless many unexpected matters, both of difficulty and convenience, will develop themselves in the working of the traffic, but these will be best dealt with as they arise.

756

Probability of the Use of the Canal

757

The Suez Canal is so peculiar in itself and in the manner in which localities are affected by it, with respect to their maritime distances from each other, that it is almost impossible to foresee the manner and degree in which it will attract traffic to itself. It may, however, be assumed with tolerable safety that, provided the canal be maintained in full depth and efficiency, and the charges made for its use are not unreasonable, the steam passenger and mail traffic now carried on between Europe and India will chiefly pass through the canal. It may with equal safety be assumed that sailing vessels, which would not only require steam tugs through the canal, but also down the Red Sea, will not use the canal. A certain amount of local traffic between the Mediterranean and Red Sea ports will no doubt use the canal.

The great element of uncertainty, and one on which the commercial success of the Suez Canal will chiefly depend, is whether new sailing vessels, with adequate auxiliary steam power, specially adapted to the canal and the Red Sea, will be constructed, so as to divert the large traffic now being carried around the Cape. I think enterprising firms will try this experiment, and if successful, the Suez Canal will secure a great position both for usefulness and profit.

758

The Suez Canal
Van Nostrand's ENGINEERING MAGAZINE
1870 – Vol II

759

THE whole of the land acquired by the Suez Canal Company, between the Mediterranean and Red Sea, for the works of construction and maintenance, amounts to 39-3/4 square-miles, and about 37 miles were required for the construction of the fresh-water canal. The former area was apportioned by the Egyptian Convention of February, 1866, in the following manner:

	ACRES.
Port Said	1062.50
From Port Said to El Ferdane	5831.50
Raz-el-Ech	37.00
Kantara	158.00
From El Ferdane to Lake Timsah	4003.00
Ismailia, on Lake Timsah	2854.00
From Lake Timsah to the Bitter Lakes.	4200.75
Across the Bitter Lakes	3508.85
From the Bitter Lakes to the Lagunes of Suez	1927.40
Across the Lagunes of Suez	889.50
Port of Suez	889.50

760

By the original concession the powers of the Canal Company were not restricted to this area; but they were definitely settled by Napoleon in April, 1864, when, in his character of Imperial referee, he adjusted the difficulties which had arisen between the Egyptian Government and the Company. By that decree he awarded an indemnity of £3,260,000 to be gradually paid by the Egyptian Government in installments, commencing on the 1st of November, 1864, and expiring November 1st, 1879; the sum of £1,520,000 was to be paid as compensation for the substitution of European workmen for Egyptian laborers, and the increased dredging plant; £1,200,000 for the abandonment of certain land rights granted under the concession of 1856, in repayment for the sums expended and works done upon the fresh-water canal; £400,000 and £240,000 as payments in full of all rights to duties levied upon the fresh-water canal.

According to the published accounts of the Company, the total amount raises for the works since the opening of the subscription in France in November, 1858, has been £18,066,262, and the total expenses, including works, material, the purchase of certain lands, the financial, engineering, and general administration, has amounted to £16,174,933, leaving a balance in hand, between the actual outlay and the subscribed capital, of £1,189,781, the concession of the Egyptian Government, and £680,000 of cash-in-hand at Alexandria and Paris.

761

The details of the gross realized capital may be briefly collects as follows:

Shareholders' capital	£8,000,000
Sale of bonds	3,999,996
Egyptian Convention	1,189,781
Imperial arbitration	3,360,000
Rates of exchange	258,852
Various receipts realized by the Comp'y	1,257,636
	£18,066,265

The summary of the expenditure account stands thus:

General expenses of preliminary arrangements, survey, etc., from 1854 to 1859	£1,165,705
General expenses of administration and negotiation between France and Egypt	678,449
Sanitary service, 1868, 1869	24,282
Telegraph service, 1868, 1869	6,800
Transport service, boats, rolling stock, buildings, etc	324,887
Payments to contractors for materials.	688,557
Dredging machines and heavy plant	1,363,848
Workshops	168,830
Works of construction, canals and ports	8,706,866
Miscellaneous	278,499
Expenses of various branches of the Company's management	768,210
	£16,174,933

762

So that the actual amount expended upon the canal has been £161,749.34 per mile. This amount, of course, represents the total outlay, from which have to be deducted the sums to be realized by the sale of plant, the Egyptian concession, the indemnity award, and, to arrive at the actual cost of construction, the expenses of management, a total of £9,394,938 to be deducted from the £16,174934, leaving £6,779,996 as the total cost of construction up to the end of June last, the balance in hand being then, as we have seen, £1,891,332; and, assuming that this balance was found sufficient to complete the works, the actual cost per mile of the canal proper will have been £8,671,328, exclusive of administration, etc.

Now that the long and tedious work is finished, it is but natural that the acclamations which greet the successful severance of the Isthmus should occupy the universal breath, and the admiration of the work should absorb all public thought. But a few weeks, however, and the Suez Canal will be no longer universally regarded as a modern wonder of the world, but as a commercial and maritime convenience, and what is now gazed upon as marvelous will soon become commonplace. Then all the doubts which have been current, and strengthened by the unfortunate grounding of vessels on the inauguration day, ill have been scattered or confirmed; we have M. De Lesseps' assurance that all the fears occasioned by those *contretemps* are groundless; but a short experience of the practical working of the canal will refute or establish theories, and it will be interesting to watch whether the sandbanks, as prophesied by alarmists, will stop the navigation; if the harbor of Port Said will silt up, and the canal become choked, or its banks destroyed. And the time that is needed to test the engineering success of the work will also prove sufficient to establish its commercial prosperity or failure.

763

The competition and advancement of trade seem alike to forbid the latter; and not the canal alone, but the Mediterranean ports also, will share the advantages of the trade it has diverted. The following table, compiled by M. De Lesseps, shows the saving of distances which will be effected by the adoption of the Isthmus route, Bombay being taken as the converging point:

Distances.

European and American Ports.	By the Cape.	By the Canal.	Saving Effected.
	miles.	miles.	miles.
Constantinople	14,760	4,350	10,410
Malta	14,130	4,990	9,140
Trieste	14,420	5,660	8,760
Marseilles	13,675	5,745	7,930
Cadiz	12,584	5,384	7,200
Lisbon	12,950	6,050	6,900
Bordeaux	13,670	6,770	6,900
Havre	14,030	6,830	7,200
London	14,400	7,500	6,900
Liverpool	14,280	7,380	6,900
Amsterdam	14,400	7,500	8,900
St. Petersburg	15,850	8,950	6,900
New York	15,000	9,100	5,900
New Orleans	15,600	9,000	6,600

The average distance being one-half *via* the new route.

764

Even before its completion the Suez Canal was pressed into the service of transporting goods to the utmost of its capacity, and up to the 30th of June last, £136,865 has been realized by tolls. Already, for six years the harbor of Port Said had been a resort for ships. In 1863, 295 ships, collectively of 48,759 tons, had called there. From the 1st of June, 1867, to the 15th of April, 1868, 1,000 vessels, representing 232,000 tons, had entered Port Said – a number which increased during the following year to 1,363 ships, collectively of 637,400 tons. At this present time Port Said forms a depot for no less than seven steam navigation companies – the Messageries Imperiales, the Society-General of Steam Transport, the Marc Fraissinet Company of Marseilles, the Bazin Company, the Russian Company of Navigation and Commerce, a Spanish Steamship Company, the Austrian Lloyds; and an American Company is about to be established with a capital of £6,000,000 with the Mediterranean ports as depots, and trading thence to India and China; while we are of course building vessels specially designed for the new route.

With so much activity, and with hope of so vast a diversion of trade towards the canal, the prospects of the Mediterranean ports are especially flourishing. Marseilles of course will reap the greatest advantage, but all the other towns upon the coast will profit by the benefit of a newly-created trade, or will awake to win back the positions they once held.

765

Liverpool to Bombay, via the Suez Canal

Van Nostrand's ENGINEERING MAGAZINE
April 1870 – Vol. II

766

AT present the public and also commercial men are anxious to know the real value of the Suez Canal, either in a financial point-of-view or in the saving of time in the transmission of goods between England and Bombay. The following figures, which have been compiled by one of the officials connected with the Liverpool Chamber of Commerce, will be read with considerable interest.

From this statement it appears that at the opening of the canal last year, the rate of freights from Liverpool to Bombay, via the canal, was 80s. per ton, but at the present time freights by the same route do not exceed 30s. per ton, overland rates being about the same.

No sailing vessels, it appears, convey goods either via the Suez Canal or overland route, and the following quotations are consequently for steamers alone: Sailing vessels - Average duration of voyage to India - via Cape of Good Hope, 95 days; via overland route, 43 days; via Suez Canal, 38 days; to the United States, 40 days. Steam vessels - Average duration of voyage to India - via Cape of Good Hope, 60 days; via overland route, 43 days; via Suez Canal, 38 days; to the United States, 12 days. Sailing vessels - Average rate of freight per ton to India - via Cape of Good Hope, 35s.; via overland route, 80s.; via Suez Canal, 40s.; to the United States, 10s. Steam vessel - Average rate of freight per ton to India via Cape of Good Hope, 60s.; via overland route, 80s.; via Suez Canal, 40s.; to the United States,30s.- *Liverpool Albion.*

767

The Austrians and the Suez Canal

Van Nostrand's ENGINEERING MAGAZINE
April 1870

768

THE *Pall Mall Gazette* says: *"Though the Austrians were confident in their assumption that the opening of the Suez Canal must redound to their commercial advantage in a degree which admitted of no rivalry by any other nation, the first instance of their profiting by this new route to India, is scarcely a fulfilment of their sanguine prediction. The screw steamer 'Apia,' belonging to the Austrian Lloyds Company, of 1,200 tons burthen - a first-rate vessel, whose departure for Bombay was largely and widely advertised – sailed with a cargo of 130 tons! As the tariff fixed by the company is £3 10s. per ton, while the vessel pays a toll of 12,000 francs (£480) to the canal, and consumes 400 tons of coal on its voyage of 21 days, this beginning is surely not encouraging. Nor is the fact the more cheery that nearly one-half this small cargo was contributed by Venice. The company are evidently not deterred by this one experience, for they have now advertised the 'Sphynx,' to sail 4 weeks hence."*

769

The Suez Canal

Van Nostrand's ENGINEERING MAGAZINE
January–June 1871 – Vol. IV

770

THE Suez Canal has now been a twelvemonth working, and it is officially stated that the receipts average about £20,000 a month, or about £240,000 a year. The headquarters of the Company being in Paris, the war and siege have prevented the usual official report being made, which should have given information regarding the net aw well as the gross revenue; but the statement as to the gross traffic affords some material for a retrospective glance at the anticipations of traffic and profit which were indulged in a twelvemonth since, and which we showed to be exaggerated. The promoters of the enterprise, it will be remembered, did not shrink from calculating on a traffic of 2,000,000 or 3,000,000 tons of shipping per annum, and this immediately; and no doubt if the equal had such a traffic, it would pay very well.

The canal would do very well, we said, if at first 1,000,000 or 2,000,000 tons of shipping annually made use of it. The statistics now published show that the average traffic has not yet reached the figure of 1,000,000 tons – receipts of £240,000 per annum at ten francs per ton only implying a trade of about 600,000 tons per annum. In point of fact, now that we have experience to guide us, the canal has had unexpected luck in obtaining even this traffic. The screw steamers which use it almost exclusively are of a kind which did not exist a very few years ago; and it is certain the promoters could not have foreseen that when the canal was inaugurated, not only would such steamers be in existence, but a number of them laid-up, or about to be laid-up, for a want of business, would be suddenly available for a new venture.

771

But for the remarkable progress of mechanical invention since the canal was commenced it must have been a stupendous failure; and but for the singular condition of the shipping trade at the time of its inauguration, its start, though far short of the promoter's anticipations, could not have been so good as it is.

The practical question now is how the canal is to be kept open; and the gross return will, perhaps, be sufficiently good for this purpose, though we do not know yet what the working expenses have been. It will be ludicrously insufficient even to pay the debenture holders, whose annual claim is double the amount of the gross receipts; but if there is only a surplus of any sort to be dealt with, there will be some possibility of a new organization of the Company, or the purchase of its undertaking by the Egyptian Government.- *Economist*

772

On the Influence of the Suez Canal on the Commerce in Coals of South Africa

Van Nostrand's ENGINEERING MAGAZINE
July–December 1871 – Vol. V

773

THE *Natal Mercury* says that the construction of the Suez Canal will be an advantage to Natal, especially for the commerce in coals. It is quite true that the opening of the canal has entirely annulled the demand for coals along the coast near the Cape, and that steamers bound to and from India will no longer require to coal at any port in South Africa; but it is also true that steamers to and from Suez will have to coal at Aden, where the demand will soon be increased tenfold.

If Natal can supply good coals, no doubt it will find a large demand at Aden. Indian coals are not suitable for steamers, and the coal from England cannot be brought to Aden economically; the supply must, therefore, necessarily come from the mine of the East, and consequently the coals of Natal will find a much better market than if the canal had not been constructed, especially if prepared in agglomerated blocks.- *Mechanics Magazine*

774

The Suez Canal
Van Nostrand's ENGINEERING MAGAZINE
January–June 1872 – Vol. VI

775

THE Suez Canal Company held a special general meeting on the 12th inst., to receive the report of the council, and to consider some new propositions, or rather to be informed of fresh decisions of the council.

The report respecting the working of the canal is very satisfactory. The number of ships passing through the canal has increased from 765 in the whole year 1871, to 200 in the first two months of 1872; and the total receipts from a little over five millions of francs for the former, to two-and-a-half millions for the latter period. The cost of working has at the same time been reduced, and the promised result is that there will be at the end of the present year a clear balance of, at least, £89,200 on the twelve months' working.

The canal is now reported to have an average depth from the extremity of the jetties of Port Said to the roads of Suez, of no less than 8.30-metres, in proof of which the transit of the *Nebraska* is mentioned, a ship of 2,983 tons, and drawing 7.21-metres of water. The reports speak also of the passage without difficulty of the great transports of the English Government, of 3,000 tons burthen, and one of which had 1,421 soldiers on board; of the *Peiho* of the Messageries Company, making the transit in less that 14, and the *Persia* packet in less than 13 hours.

The engineers report, after an experience of two years, that the maintenance of the canal proper will entail an annual expenditure of £33,000 per 500,000 cubic-metres.

Another fact on which the company is to be congratulated, is that the council has only issued twelve millions of the twenty million loan voted in July last.

776

The Suez Canal
Van Nostrand's ENGINEERING MAGAZINE
July–December 1875 – Vol. XIII

777

THE opening of this Isthmus was supposed at one time to restore the Mediterranean ports of France, and especially Marseille, their old splendor, instead of which most of the steamers prefer to proceed direct through the Straits of Gibraltar, thus leaving the French railways in their own greediness. Nor has the French merchant navy been in due proportion benefited by the opening of the new sea road to the Far East.

The French shipping passing through the canal decreases, relatively speaking, from year-to-year. In 1870, 436,000 tons burthen passed through the canal, of which 289,000 were English, and one-fifth, or 84,000 only, French. In 1874, the proportion of French bottoms is found to be reduced to 220,000 tons, or less than one-tenth, 2,423,000 tons having passed the canal, out of which 1,-797,000 were under the English flag. The other navies, although below the absolute figure for France, are progressing more rapidly. Thus, since 1872, four times more Dutch ships used the canal, while the increase of the French navigation was only 40 per cent.

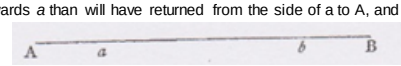
778

On the Reported Current in the Suez Canal
NATURE
July 7, 1870

779

IT is stated on excellent authority that a constant current runs through the central portion of the Suez Canal, from the side of the Mediterranean to that of the Red Sea, and a good deal of surprise has been excited by this apparently anomalous phenomenon. A little consideration will, however, suffice to establish a theory, that constant currents are almost necessary conditions of inter-oceanic canals, and that their absence, not their presence, would be contrary to just expectation. My reason is based on the improbability that a long canal, A B, could be constructed across strata that are almost necessarily inclined in one direction more than another, which should not resist the flow of tidal water from, say, A towards B, more than from B towards A. Wherever this differential aspect is established, a quasi-valvular action is called into existence, and a current along the middle of the canal, in a constant direction, is the necessary consequence.

Let A B be the canal and *a b* the extreme limits of tidal influence. After each successive rise and fall of the tide on either side, more water will have passed from A towards *a* than will have returned from the side of a to A, and more water



will be able to travel from the side of *b* to B, than can get up the canal from B towards *b*. Consequently there will be a constant current in the ultra-tidal portion, *a b,* of the canal, from the side of A to that of B.

780

I have made some inquiries, but am unable to learn what notchings, indentations, or sweeps of the sides of a canal, would exercise the greatest differential effect, at low velocities, of the kind of which I am speaking. However, I hear it is a fact well-known to sailors, that a spar cannot be towed behind a boat, unless with the greatest difficulty, if its small end be foremost, whereas, it is moved easily enough if its thick end be in front. I argue from this that if a number of spars were moored against the sides of the canal, with their large ends toward A, much less strain would be exerted on the ropes by which they were secured when the current ran from A to B, than when it ran from B to A, and consequently that the current itself would be much less resisted in the former than in the latter case.

A succession of very long notches in the sides of the canal would produce identically the same effect, and might call into existence a considerable aggregate of differentia resistances. I constructed a model for the purpose of experiment, but found it much too small to give satisfactory results; nevertheless, I will describe it, in hopes it may save trouble to others in designing a suitable arrangement, for the same purpose, on a larger scale.

781

A notched trough was cut, running up and down in long zig-zags, and its two ends were brought together into the same reservoir. By alternately allowing water to run into the reservoir, and then drawing it off, the effect of the rise and fall of the tide was simulated. I scattered lycopodium on the water, in the middle part of the channel, to show the direction of the current.

I venture to suggest to those engineers who are connected with inter-oceanic canals, the importance of making experiments on this problem, because it may prove to be quite within their means to produce and to regulate a current within such canals, in the direction and of a velocity most convenient to keep its bed clean and serviceable.

Francis Galton

782

Suez Canal Currents

Van Nostrand's ENGINEERING MAGAZINE
January–June 1879 – Vol. XX

783

AT a recent meeting of the French Academy of Sciences M. De Lesseps gave an account of the Suez Canal currents furnished by M. Lemasson, the company's engineer, the result of observations taken since 1871 at Port Said, Suez and other stations. Notwithstanding Lake Timsah and the Bitter Lakes, which form two great regulators, the north and south branches of the canal are not unaffected by each other.

From May to October the winds cause a rise of level at Port Said and a fall at Suez. This difference of level, which reaches about 15.5-inches, leads to a current from the Mediterranean to the Red Sea – a current which, though interrupted by the tides, drives a considerable volume of water from north to south. In winter, on the contrary, the high winds give the Red Sea a level higher by about 12-inches than the Mediterranean, causing a current from south to north.

About 14,126 million cubic-feet or about 400,000,000 tons of water yearly pass from one sea to the other. This, coupled with the tides, tends to neutralize the effects of evaporation from the surface of the lakes and to dissolve the basis of salt in the Bitter Lakes. That basis was 32.8-feet in thickness, but is gradually dissolving, especially in the course of vessels.

The velocity of these local currents varies between Port Said and Lake Timsah from 0.5-feet and 1.3-feet per second; while in the broader part, between Suez and the Bitter Lakes, it is from 2-feet to 3.6-feet per second.

784

The Suez Canal

Van Nostrand's ENGINEERING MAGAZINE
January–June 1880 – Vol. XXII

785

THE total receipts of the Suez Canal for the year 1879 were £1,185,200. This showed a decrease of £58,700 on 1878, which year itself was £37,100 worse than its predecessors. As might be expected, however, the later months of 1879 were much more satisfactory than the previous period of the same year. The receipts for December were £107,600, an increase of £9,200 on the same month of 1878. The return for the first half of January shows an increase on that of the same period last year of £20,800. Should the favorable tendency here indicated continue, they will be another proof of the reality of the improvement that has taken place in the trade of the world-at-large.

786

The Suez Canal
Van Nostrand's ENGINEERING MAGAZINE
January–June 1880 – Vol. XXIV

787

THE revenue of the Suez Canal Company has made a great bound upwards this year. The total receipts to August 31, were £1,100,820. The corresponding revenue in the corresponding period of 1879 did not exceed £800,764.

788

The Suez Canal Tonnage
Van Nostrand's ENGINEERING MAGAZINE
January–June 1881 – Vol. XXIV

789

Of a total of 3,446,431 tons gross of shipping that passed through the Suez Canal in 1880, the share of England was 3,446,431 tons, or more than three-fourths of the whole. The increase, compared with 1879, was from 2,508,524 English, and a total of 3,236,942 tons. Next to England the most marked augmentation was that of the Russian flag, which rose from 8,799 tons to 45,899 tons. French tonnage remained almost stationary, having only advanced from 262,017 tons to 271,598. German rose from 21,548 to 52,551; Austrian, from 51,400 to 103,030; Spanish, from 64,468 to 84,519; Italian, from 94,162 to 104,567; and Dutch from 159,024 to 174,485. All the principal countries of Europe shared in the improved trade with the East in 1880.

790

The Suez Canal
Van Nostrand's ENGINEERING MAGAZINE
July–December 1881 – Vol. XXV

791

THERE have been loud complaints on the part of ship-owners regarding the general management of the Suez Canal, and especially the system of piloting vessels. Thus, in one case, it is stated that a certain vessel could only get a pilot who, not knowing any English, was necessarily unable to give intelligible orders. Hence, four days were consumed in getting from Ismailia to Port Said, the ship having grounded several times, and also got into collision with a steamer. What makes the case worse is, that pilot dues on the canal seem to be decidedly liberal, being £26 a day for the ordinary passage of forty-eight hours. These payments, however, are applied, it is stated, in great part to cover other contingent expenses. Another charge, amounting to £21, in the case of a vessel of 1,211 tons, on the score of light dues, seems to be at all events extravagant; but any excess in this item is, it appears, the unearned perquisite of the Egyptian government. All this, in the case of a vessel of the size named, is in addition to the heavy tolls, amounting to £650. Inquiry into these matters would be highly desirable, especially as the undertaking has an international character, and in which this country has by far the largest interest.

We gave, a short time ago, some approximate figures of the traffic that has passed through the canal the past year. From official statistics now published, it appears that, in the course of 1880, 2,017 ships passed through the canal, with a tonnage, according to official reckoning, of 2,860,448, but really amounting to 4,378,964 tons. The number of hands employed in the navigation was 128,453, the number of passengers 53,517. Of the 2,860,448 tons, official reckoning, 2,247,306 were British, 177,771 French, 75,820 Austrian, 124,083 Dutch, 71,039 Italian, 56,245 Spanish, 38,162 German, 29,607 Russian, 7,203 Turkish, 8,032 Egyptian, while 25,180 tons belonged to other countries.

792

The Suez Canal

Van Nostrand's ENGINEERING MAGAZINE
July–December 1881 – Vol. XXV

793

THE shareholders of the Suez Canal Company held their annual meeting on June 9th, at Paris, when the annual report was submitted and approved. A dividend of 21.89 fr. Was declared, apart from the fixed interest of 25 fr. The report states that the gross receipts have amounted to 41,820,000 fr., and the gross expenditure to 28,841,000 fr., leaving a net profit of 12,979,000 fr.

The most interesting part of M. de Lesseps' report relates to the traffic. During last year 2,026 ships, with a tonnage of 4,344,519 tons, passed through the canal. From 1870 till them the figures had been as follows: In 1870, 486 ships and 495,911 tons; in 1871, 765 ships and 761,467 tons; in 1872, 1,082 ships and 1,439,169 tons; in 1873, 1,178 ships and 2,085,072 tons; in 1874, 1,264 ships and 2,423,672 tons; in 1875, 1,494 ships and 2,940,708 tons; in 1876, 1,457 ships and 2,072,107 tons; in 1877, 1,663 ships and 3,-418,949 tons; in 1878, 1,593 ships and 3,291,535, tons; in 1879, 1,477 ships and 3,-236,942 tons. The receipts during this period rose from 5,159,000 fr. in 1870 to 28,-886,000 fr. in 1875 and 39,840,000 fr. in 1880.

Last year 221 ships, with a total tonnage of 353,985 tons, passed through the canal for the first time. Compared with the previous year, this is an increase of 66 ships and 118,-371 tons. The Ducal Line, Bird Line, Union Line, Rotterdam Lloyd, and Rubattino Company have each added one vessel to their fleet; the China and Japan Line, the Russian Line, and the Austro-Hungarian Lloyd each two vessels; the Anchor Line, Ocean Steamship Company, and the Peninsular and Oriental Company each three vessels; the Orient Line and the Ligne Francaise, connecting Marseilles with the eastern coast of Africa, each four vessels; and the British India Steam Navigation Company, five vessels.

794

A new postal line connecting England and Spain with the Philippine Islands has been started with five ships. A great trade movement has sprung up between Russian and the colonies of the Amoor and island of Saghalien. There are now some twenty vessels carrying on this new traffic independent of the "national fleet," which has also augmented the number of its ships.

Two-hundred and thirty-eight steamers last year carried coal from England to different parts of the Far East; fifty-seven carried rails and railway material to Kurrachee, and two vessels from New York laden with petroleum passed through the canal. There were also thirty-five vessels from Australia, two of which were entirely laden with fresh meat preserved in ice, twenty-seven with Chinese and Japanese products bound for New York, and twenty-six vessels which passed through in ballast to receive cargoes awaiting them in Indian ports.

The report anticipates from the experience of the present year that it will show a still larger traffic than last year, though last year's return already showed, as above seen, an increase of nearly 40 per cent on those of 1879. Since January last the British India Company have created a new regular service between England and Queensland, and all the great regular lines have sent vessels to the traffic.

795

As regards the Ismailia Canal, it has not yielded all the results that might have been expected, owing to the impediments which M. De Lesseps thinks the Egyptian Government , in its own interest, and in performance of its engagements, will soon remove, and in conclusion, as regards the irrigation canal from Ismailia to Port Said, M. De Lesseps has asked the Khedive to authorize him to form an Egyptian Limited Company to carry it out.

Meanwhile, he has formed an association of founders to subscribe, without interest, 200,000 fr. necessary for making the studies and preparing the work. The founders have a right to 10 per cent of the net profits and the reimbursement of their advances when the company is founded. The subscription to this association was immediately covered on the Isthmus, at Cairo, and at Alexandria.

796

Report of the Suez Canal Company

Van Nostrand's ENGINEERING MAGAZINE
July–December 1886 – Vol. XXXV

797

THE report of the Suez Canal Company, read by M. De Lesseps recently, shows the receipts of 1885 to have been 65,049,945 f., and the expenses 31,-021,178 f., leaving a profit of 34,028,767 f., which allows a dividend of 60 f. 40c. The return of traffic – 3,624 ships, of 6,335,753 tons – exceeded by 340 ships and 464,253 tons that of the previous year. The passengers numbered 205,-951, against 151,916 in 1884, and 43,813 of them were English.

The average time of transit was forty-three hours, and though the twelve days' interruption caused by a dredger being run down led to and assemblage of 123 ships, all these got through in three days.

Liberty of traveling by night with the electric light had been taken advantage of by several of the Peninsular and Oriental Company's steamers, one of which thus made the transit in seventeen hours fifty minutes.

Traffic has not suffered from the economic depression, because the reduced dues have allowed the creation of fresh enterprises, or the extension of existing ones.

798

Part 9

Length, Breadth and Depth

Suez Canal Tonnage
Van Nostrand's ENGINEERING MAGAZINE
January–June 1875 – Vol. XII

799

IN making any dock, or harbor, or canal, or any approach to it from the sea, the undertakers of the work have to provide for the maximum size of ships likely to use it.

The three points they have to consider are: (1) of what width are the ships for which they have to provide; for unless the dock-gates, and the channels, and the canal are wide enough, it will be of no use when completed. But width is not the only question. They have also to consider and provide for (2) *the length* of ships. A short, wide ship will be able to navigate in a channel, or in a dock, which would be wholly inaccessible by long, narrow ships; and thus it happens, that in order to provide for long ships, locks must be of great length, basins must be of great area, and the bends and turnings on channels and canals must be carefully and expensively made, so as to avoid anything like sharp curves; but, still further, length and breadth are not the only elements, for there is a third element – viz. (3), depth of ships. It will be useless to provide a broad and well-arranged channel without regard to its depth, or to construct broad and long locks, or docks, or canals, without regard to their depth, for large ships must be deep ships. Therefore, sufficient depth has to be provided; and to provide depth is one of the most expensive parts of the construction or arrangement of the undertaking.

801

800

A dock or canal company having been at the expense of providing adequate length, breadth, and depth, for the accommodation of ships, must necessarily be most equitably remunerated for their outlay, by levying dues on ships on a system founded on their length, breadth, and depth. It is absurd for the shipowner to say to a dock or canal owner, "It is true I occupy so much space in your undertaking; it is true my ship requires so much length, and so much breadth, and so much depth, and you have provided them, but although I occupy that space, and could not get through unless you provide it, still as half my ship is for my own purposes occupied one way, and the other half occupied the other way, I ought only to pay as if my ship were half her actual size." But this is exactly in effect what is urged. On the other hand, we must notice that dock owners are very unfair to steamship owners, when they charge as much for a steamship occupying space for a day or two as they do for sailing ships occupying space for several weeks.

The gross tonnage alone, being founded as it is on the actual cubature of the internal contents of a ship, is the only tonnage that takes into account the three elements of length, breadth, and depth, and for such an undertaking as the Suez Canal, where time is no element in the charge, or for an international ton, it is the best, because it is the only accurate gauge of the description of the ship.

802

And even for charging light dues, the gross tonnage is the correct standard, for the following reason: The payment is made for services rendered. In the case of the steamship *Asia*, formerly of the Cunard Line, when she had on board machinery worth say £50,000, she paid on the register tonnage of say 1,200 tons. She grew old, the engines were taken out, and she was converted into a sailing ship, and was, as a fact, about half her former value, and had to pay dues on the whole tonnage of the hull, or 2,000 tons or thereabouts. Register tonnage has been adhered to by steamship owners, because dock owners do not allow time as an element of charging dues, and the steamship owner looks upon the advantage he gets by paying dues on the register tonnage as a sort of rough and ready compensation for his frequent visits; but admits universally that if time were taken into account, gross tonnage is the proper tonnage on which to levy dues.

And again, as between ship and ship, the gross tonnage is the proper system, because (1) it is the only system founded on the cubature of the hull, and (2) because it is free from any of those disturbing causes arising from deductions for engine-room, and (3) because it leaves the ship owner free to arrange the internal part of his ship as he pleases, instead of having to arrange it (in a way that is fair to nobody) for the purpose of getting a small register tonnage.

The above are some of the reasons in favor of gross tonnage as the basis of taxation for the Suez Canal and of an international ton.

803

Our present net register ton is unjust in the extreme in the case of steamships, both as between steamship and steamship, and as between sailing ship and steamship; and, further, it is monstrously unjust to the shareholders of the canal, and as between nation and nation. No one knows this better than M. De Lesseps. This subject is exhaustively discussed in our number for February, 1871. We, therefore refer our readers to that article, merely mentioning that it was deemed to be of sufficient importance and accuracy to be reprinted by the Board of Trade.

804

THE

NAUTICAL MAGAZINE.

NEW SERIES.

FEBRUARY, 1871.

805

MERCHANT SHIPPING LEGISLATION.

No. II.—ADMEASUREMENT OF TONNAGE.

THE EARL OF HARDWICKE: "I am quite sure that if there are any gentlemen in this room who are not seamen, who are visitors, and are not accustomed to the use of the term 'tonnage,' they will not know what it means; for to this moment I do not know what it means."
Transactions of the Institution of Naval Architects.

OLD TONNAGE LAWS.

So long ago as the year 1422 the shipment of sea coal from Newcastle afforded an opportunity for the then Parliament to try its hand at merchant shipping legislation. It is easy to understand that in the absence of any defined rule as to the measurement of ships, vexatious questions would arise. There probably arose in those early days questions between the supplier of coal and the shipper, the shipper and the carrier, the owner and the master, the port authorities and the shipowner, the crew and the owner and master, besides various questions between other parties—questions, perhaps, but little different in principle from those arising at the present day. It is probable that some one had been carrying too much or had received too little coal on board, or had been paying dues on less than his ship carried; or the carrying power of his ship may have been under-estimated, and over-tested, or the lord of the manor, or the harbour or port or dock authority may not have received a sufficient "groundage" or "poundage," or "barbonrage" or "tonnage fee," etc., etc., for we find in the old measurement Acts such ugly things as "deceits," "new deceits," "new frauds," "deceits and abuses," called by their plain names, and sought to be remedied.

In the year 1422, being the ninth year of the reign of King Henry V., the enactment is recorded that "keels" that carry coals at Newcastle shall be measured and "marked." How they were measured, and how they were marked, are not known; but 226 years after, or in 1648 (temp. Charles I.), "deceits" were referred to, and commissioners were appointed with a view to admeasuring and marking "keels" and other boats used for the carriage of coals in the port of Newcastle, and all other places within the counties of Northumberland and Durham.

By the year 1694 (temp. William and Mary), in consequence of "divers new frauds, deceits, and abuses," the methods of measuring and marking were distinctly laid down by statute. This is

806

so important an enactment that it is well to have it word for word; bearing in mind, however, that it was not intended for general application to all British merchant ships, but only to "keels," etc., carrying coals in Northumberland and Durham. The 6th and 7th William and Mary enacted that "said admeasurement shall be by a dead weight of lead or iron, or otherwise, as shall seem most to the said commissioners, allowing three-and-fifty hundredweight to every chaldron of coals," etc.; and the said commissioners were to "cause the said keels and boats so admeasured, to be marked and nailed on each side of the stern and stern and midships thereof," etc.; and "no such keel or boat shall be admeasured, marked, or nailed to carry more than ten such chaldrons at any one time."

This special system for ships carrying coals in Northumberland and Durham, was subsequently extended to ships used in carrying coals and loading at all other ports in Great Britain, for we find by 13 Geo. III., that all vessels used in loading coals at all other places in Great Britain were to be admeasured "by a dead weight of lead or iron, allowing twenty hundredweight Avoirdupoise to the ton, and marked and nailed as aforesaid, to denote what quantity of coals each will carry up to the mark so set thereon." Still, as applicable only to coal-laden ships, this law continued to be but limited in its application.

Concurrently with the above system for admeasuring and marking coal-laden ships, there existed another and different system for the admeasurement of ships carrying spirits. Owing to the prevalence and success of smuggling in little vessels, the Parliament enacted (8 Geo. I.) "that no spirits should be allowed to be imported in vessels of thirty tons burthen and under;" and "for the preventing disputes that may arise concerning the admeasurement of ships laden with brandy and other spirits," it was also enacted that the following admeasurement rule should be observed: "That is to say, take the length of the keel within board (so much as she treads on the ground), and the breadth within board by the midship beam from plank to plank, and half the breadth for the depth, then multiply the length by the breadth, and that product by the depth, and divide the whole by 94; the quotient will give the true contents of the tonnage."

There was no admeasurement law applicable to the whole British mercantile navy until the year 1773. In that year "disputes" thrust themselves on the attention of the Government. By the Act 13 Geo. III. cap. 74, "one certain rule for measurement purposes was settled and established for all cases."

807

It is unnecessary to give this rule verbatim, but its substance may be stated as follows: It adopted external measurements (not internal measurements, like the Spirit Vessels Act of 6 Geo. I.); the length, less three-fifths of the breadth, was multiplied by the breadth, and again by half the breadth, and the product was divided by 94; the quotient was the tonnage. Moorsom expresses it thus:—

$$\frac{(L - \frac{3}{5}B) \times B \times \frac{B}{2}}{94} = \text{Register Tonnage.}$$

This rule, even quite recently, used to be referred to constantly in advertisements and specifications; it was known as "O. M.," "Builders' Measurement," and the "Old Law." The evil of this "old law" will be comprehended in an instant. So long as the depth of a ship was half her breadth, the tonnage given by the "Old Law" was not far wrong; but every inch by which the depth exceeded half the breadth, gave the shipowner so much carrying power not measured in the tonnage, and therefore not subject to taxation. The result of the "Old Law" was, as Moorsom points out, that of the vessels built under it:—

"The length was about three and a half times the breadth;"
"The depth about three quarters of the breadth;" and
"The form or shape of the body approximating to that of an oblong box."

So long as merchant ships sailed in convoys, or were under some sort of protection from ships of war, these dimensions were no very great evil. The ships were all bad alike, all slow, all "old bruisers;" they kept well together, and they carried large cargoes, and as the tonnage on which they paid dues was often only about three-fifths of their real tonnage, the owners were satisfied. As soon, however, as the long war was over, and our merchant ships had no longer to sail in convoys, the ugly old chests we had built under the "Old Law" were found to be too slow and otherwise utterly unfit and unable to compete with merchant ships of other nations.

This "old law" stands out as a warning and a terrible example to our legislators of the present day. It shows how vicious must ever be any tonnage law that, by its unequal operation as between ship and ship, will encourage the undue development of any portion of the hull of a ship, for it will offer a premium for exceptional arrangements or exaggerated forms. A law that by improperly exempting from admeasurement any part of a ship that ought to be measured, or by improperly including in ad-

808

measurement any part of a ship that ought not to be measured, will lead to the building of monstrosities or uncomfortable and unsafe ships. The present law is intended to avoid all extremes of this nature, for while it makes express provision for the exemption of spaces under erections on deck used solely for the protection of deck passengers and approved for that purpose by the Board of Trade, it does not intend to encourage the erection of dangerous top hamper, or the building of ships with any undue excess of either depth, width, or length. Whether this wise intention of the present law has been really followed in practice by the shipbuilder and shipowner, is another and a special point which will be specially referred to further on. In the meantime, we must continue our consideration of former rules.

Those who admire simple laws for their simplicity alone, cannot fail to admire the "Old Law." It was simplicity itself. It only entailed three measurements, and one subtraction, one division, and two multiplication sums. But against its simplicity, we must place its vices. It is enough for us to rejoice that it has gone the way of a good deal of equally bad legislation. Had it remained as law to this time, the building and sailing of our present ocean clippers and steamers would have been difficult, if not impossible.

In the year 1820 the Board of Trade, or, as it was then known, "the Office of the Lords of the Committee of His Majesty's Most Honourable Privy Council appointed for the consideration of all matters relating to trade and foreign plantations," called on the Admiralty to appoint a commission to consider the question of tonnage. This commission reported in May, 1821. Its report was not attended to, and is now only worth remark on account of one fact, viz., "that its members would have been desirous of removing all doubt on the subject by proposing the admeasurement of that portion of the ship which is included between the light and heavy water lines; but this method has been considered as liable to insuperable objections on account of the *impossibility of ascertaining the positions of these lines* in a satisfactory manner." It may be some consolation to those who advocate the marking of load lines on ships at the present day, to know that others besides the present authorities have found such a course liable to "insuperable objections."

The "Old Law" is as remarkable for its vitality as its vices, for it continued to remain in force for years after it was condemned. In 1833 it was more seriously attacked, this time with better success. A second commission, appointed by the Admiralty at the request of the Board of Trade, reported that "internal capacity

809

will be the fairest standard of measurement, including all those parts of a vessel which, being under cover of permanent decks, are available for stowage," and "that a rule of such general application should depend on the smallest number of measurements necessary to give the figure of the hull, and that it should afford results sufficiently exact for the required purpose by an easy arithmetical process." Rules on these principles became law, and were known as the "New Law" (3 and 4 Will. IV. cap. 56; and 8 and 9 Vict. cap. 89).

This "New Law" was remarkable for two things—first, that the principle on which it was founded is sound and in every respect good; and secondly, that the manner in which that principle was practically applied was essentially defective. The principle is that the "measurements shall extend to the whole internal capacity, and that there shall be included in the measurements *all those parts of a vessel which, being under cover of permanent decks, are available for stowage.*" This principle was then first established, and is the principle on which the present law (Merchant Shipping Act, 1854) is based.

The "New Law" corrected many vices of the Old Law, but owing to the very few measurements it prescribed, it was open to evasions. Certain parts of the ship not affected by measurements continued to be unduly enlarged, and fresh inconsistencies arose. Builders and others, notwithstanding the repeal of the "Old Law," always adverted to it and acted on it; and what is curious, the Government never adopted the "New Law" at all, but took its contracts under the repealed Old Law, or "O. M.," or "B. M." The "New Law" being the only legal measurement, and the Admiralty and other departments, and builders and owners nevertheless using the "Old Law," an awkward state of things came into existence; and in 1849 the shipowners themselves took the matter up, and, at their request, the Board of Trade once more called on the Admiralty, and the Admiralty once again appointed a commission of inquiry.

This third commission rejected the sound principle of the internal measurement of the former commission, and recommended a return to external measurements, and proposed a scheme that was alike notorious for its ingenuity and utter impracticability. It met with much opposition, and its inefficiency was exposed by Mr. Moorsom. It would have given no direct measure of the internal capacity of a ship, and would not have been equally applicable to wooden and iron ships, of the latter of which there were then but comparatively few, although sanguine people looked for an increase in them.

810

But out of this commission, and in an unexpected manner, came good. Notwithstanding the valuable principle established by the second commission, there had not been down to this time any practical method by which the internal capacity of ships could be measured fairly as between ship and ship. One Act of Parliament upset the principles of another; one commission approved of one thing, and one of another. What between the conflicting principles laid down by successive Acts of Parliament, the conflicting and impracticable recommendations of commissions, though much had been done in the way of deliberating, and reporting, and recommending, and confusing, nothing had been effected of any real good, or likely to hit the vices of the "Old" and the "New" Laws.

Moorsom's Law.

In this state of things Mr. Moorsom, who had acted as secretary to the last commission, thought of one of those formulæ invented by Stirling, for measuring spaces "bounded by irregular curves." It was founded on Sir Isaac Newton's discovery of a theorem—a discovery, as Moorsom says, which the immortal author himself considered amongst his happiest inventions, and by which "the areas of all curvilineal spaces, not geometrically quadrable, nor discoverable by any known rules of direct investigation, are so closely approximated as to amount to geometrical exactness." Mr. Moorsom's plan was adopted by the Board of Trade, became the law of the British Empire in 1854, and is now accepted by nearly all the maritime states of the world.

The internal capacity of a ship is, under Mr. Moorsom's rule, intended to be accurately ascertained in cubic feet, and divided by one hundred. Each one hundred cubic feet of space in a ship is then called a ton. It might be called anything, but the term "Ton Register" was an old term and a well-known term, and for want of another and perhaps a better name, "Ton" remains, as applied to the capacity of ships, although it does not continue to mean weight but means space. In the following remarks from this point forwards whenever a "Ton" is spoken of, a "Moorsom Ton" is meant of one hundred cubic feet.

It may be well here to remind the reader that there are two tonnages on the official records of most ships, viz.,—(1) The "Gross Tonnage" or the tonnage (or measure) of the whole hull intended to include the hold between decks, the deck-houses, forecastle, poop, engine rooms, etc.; and (2), the "Register" tonnage, or the tonnage or "measure" under cover, available for goods, or passengers, or stores, after deducting the space occupied or

811

allowed for engines, coals, and crew spaces. It will save much confusion hereafter if we call the gross tonnage, the gross register tonnage, and the register tonnage, the net register tonnage;—and as both these tonnages are entered in the register, this nomenclature will not only be convenient but accurate.

The rule at present in force for ascertaining the gross register tonnage is in substance as follows:—

1. Decks are numbered from below, No. 1 being the lowest deck, No. 2 the next above No. 1, and so on upwards.
2. The "tonnage deck" is the upper deck in ships with less than three decks.
3. The tonnage deck is the second deck from below in all other ships.
4. The spar deck is the third deck from below.
5. The "gross" register tonnage is intended to be the cubical contents of the entire hull of the ship, *i.e.*, of all space below the uppermost deck, plus all permanent closed-in spaces on the upper side of that deck available for cargo or stores, or for the accommodation of passengers or the berthing of the crew.
6. If there is no deck at all, then the whole of the contents of the ship are measured from the upper edge of the upper strake downwards.

Having arrived thus far, having gleaned a few facts as to the history of tonnage, and having ascertained exactly what the present rule is, we must now take up one or two points of special interest. These points all relate to exemptions or deductions allowed to or claimed by the shipowner from the gross register tonnage. These deductions are more or less opposed to the principles of the tonnage rule, they are unequal as between ship and ship; and the further they are carried the less valuable do the results of that rule become, if register tonnage is intended to be and to remain an index of the actual carrying capacity of a ship.

Spar Decks and Spaces on Deck.

All ships pay dock dues, light dues, and other dues on their net register tonnage as stated in the certificate of registry: it follows therefore that the interest of the shipowner is to keep his recorded net register tonnage at as low a figure as possible.

If a shipowner A can so arrange his ship as to give him an available tonnage (measure) of 2000 tons under cover; and if at the same time he can get that ship registered as of 1000 tons, it follows that he A will save, or rather evade, half the legitimate dock dues, light dues, canal dues, and other charges on tonnage.

812

A will increase his profits accordingly. It also follows that if another shipowner B has a ship with tonnage (measure) of 2000 tons, and does not arrange his ship to register 1000 tons, but 2000 tons, that he B will be paying twice as much as A, and will really be paying for A, because as the income derived from the dues on ships is made up of a charge on the whole shipping, it follows that what one ship does not pay other ships must make up.

The gross register tonnage of a ship is meant to be an exact index of her capacity; and the number indicating that tonnage ought to be a safe figure for assessment. The number representing the net register tonnage is a varying number, and is but too often in steam ships no index of internal capacity. This being so, two questions naturally arise; first, why are tonnage dues now charged on the net register tonnage and not on the gross register tonnage, and secondly, although tonnage dues are now charged on the net register, whether it would not be desirable, and if desirable, whether it is not possible to alter the method of calculating them, and to shift them from the net to the gross register. These two questions open up a large subject, it will be impossible in a short paper like the present to do more than glance at them, which we will do further on. We must first however enquire how the present law of measurement for gross tonnage operates, and how it may be evaded. The principle clearly laid down by the second commission is that internal capacity will be the fairest standard of measurement, including all those parts of a vessel which being under cover of permanent decks are available for stowage. This principle was affirmed by the Third Commission or Committee in the following words:—"That inasmuch as the poops, forecastle, and other covered-in spaces are directly or indirectly a source of earnings for cargo or passengers, those spaces should be all measured." This principle is moreover embodied in the Merchant Shipping Act of 1854, which provides, that besides the spaces below the upper deck, "any permanent closed-in space on the upper deck available for cargo or stores, or for berthing or accommodation of passengers or crew, shall be measured and added to the gross tonnage." A space on the upper deck permanently covered over or closed in may be available for cargo or stores, and yet not be suited or fitted up for the accommodation of passengers, or the berthing of the crew, or it may suit one sort of cargo and not another, and if it is permanently closed in, and if the closing in is sufficient to render it available for cargo or stores (and if cargo or stores are carried there it is available), then under the Act it is required to be included in the measurement. But whilst it is

813

clear that closed-in spaces on the upper deck "available for cargo and stores, etc.," are to be included in admeasurement, it is equally clear that uncovered or unenclosed spaces, even if available for cargo, stores, or passengers, are not to be included. In other words, the law has never contemplated including in the tonnage admeasurement, space occupied by cargoes carried on deck, and not under cover of any permanent erection.

Let us look at fig. 1, a vessel without any deck. Under the Merchant Shipping Act of 1854, the whole of the shaded part is included. Let us look at fig. 2, a vessel with only one deck, there the shaded part is all that is included in the tonnage, but an owner may also carry as much cargo on the deck as he pleases. If he does he earns more freight but he pays no more tonnage dues for his ship than if the deck cargo were not there. Seeing then that the space under the deck is the only space measured for tonnage, it follows that by putting on a deck, he has decreased the tonnage of his ship; it also follows that if he places that deck still lower he will pay still less dues. For example, take an exaggerated case, as in fig. 3, where the deck is shewn low down, the shaded part only will represent the tonnage on which dues would be paid. He then puts shelter for deck passengers over this deck as in a saloon steamer, and still claims to pay tonnage only on the shaded part.

It is open to question whether the whole internal space up to the upper stroke ought not in figs. 2 and 3, to be included in the tonnage. The omission from tonnage would not however be of much importance, if ships of this class with one deck were but few and small, and were confined to river navigation, but so soon as erections and coverings are put over the one deck, and if by erections the space under those erections and coverings are exempted from tonnage in sea-going ships, as will be explained further on (Fig. 12 and 13), a great evil may result.

Let us now take an ordinary ship with two decks and deck-houses, as shewn in fig. 4. Here the shaded parts represent the parts available for the stowage of cargo or stores or the accommodation of passengers, etc. The whole of these parts are intended to be, and ought to be, included in the gross register tonnage. We will now take a three decked ship with deck-houses on the middle of the upper deck and cabins at its sides, as in large ocean going ships, see fig. 5.

The third deck is here referred to in the Act as the spar deck, and on the spar deck are cabins, saloons, etc. The parts shaded are the parts that are intended to be included in tonnage admeasurement. Now the ship sketched in fig. 5, is it is stated an unsafe form of ship,

814

for if a sea is shipped on the upper deck it washes about between the various deck-houses, gets into the engine-room and into the hold, and altogether jeopardizes the safety of the ship. The owner therefore puts yet another deck on and covers up the passages, thus making his ship a four decked ship. He also puts houses on the fourth deck, puts a light rail round it, works his ship on that deck, and carries his boats, steam winches, etc., there. This ship is then represented by fig. 6. The whole of the shaded part is under the letter of the rules liable to be measured for tonnage. The arrangements below the fourth deck in fig. 6 remain precisely as they are in fig. 5, only they are covered over. Now as regards dues the difference between the ships shewn figs. 5 and 6 is this—that in fig. 5, the uncovered unshaded spaces between the deck-houses are not liable to tonnage measurement because they are uncovered, whereas no sooner are the passages covered over than they become liable to measurement, although it is urged that being passages which must of necessity be kept clear of cargo, goods, and stores, they are not, in the words of the Commissioners of tonnage, spaces which being under cover are available for stowage.

Here then we have a broad question to consider, viz., ought the legislature by express enactment to provide that certain spaces under the uppermost deck of a ship shall be exempt from tonnage admeasurement? and if so, what conditions should be attached to the exemption? In considering this question we must always bear in mind that the present law does not provide for any such exemptions. Exemptions have in some cases been claimed notwithstanding the present law. These cases will be referred to further on, but we must now for the moment discuss the question on the understanding that whatever may be done in future the law does not as it at present stands contemplate any exemption of the sort. It will be found on referring to a Blue book on tonnage, published by the authority of the Board of Trade, that in 1866 this subject had been urged on their notice. In that book (page 37) will be found the draft of a clause circulated by the Board of Trade for consideration. There is nothing in the book to show that the Board of Trade either approved of or dissented from the proposal. All they did appears to have been to print the clause and circulate it for consideration. The draft clause was as follows:—

"In cases in which a third deck, commonly called a spar or covering deck, is provided to connect the upper sides of the poop, forecastle, deck-houses, and saloons or cabins with each other, and with the sides of the ship, such spaces under the spar or covering deck as are not included in the poop, forecastle, deck-houses,

815

saloons, or cabins, shall not be included in the registered tonnage of the ship, provided always that one of the surveyors appointed under the fourth part of the Merchant Shipping Act 1854, shall have previously given a certificate under his hand to the effect that the spaces under such spar or covering deck, and not included in the poop, forecastle, deck-houses, saloons, or cabins, are not fitted up for the use of the passengers or crew of the ship, and are not intended to be applied towards the carrying of freight, but are solely covered in for the purposes of securing the safety of the ship and cargo, and the passengers and her crew."

The remarks of the Secretary of the Board of Trade on this draft clause were also circulated, and were as follows:—

"It has been represented to the Board of Trade that steam ships fitted with a poop, a forecastle, and houses on deck, are far more unsafe than ships fitted with a spar or covering deck, because the covering deck connecting the tops of these erections with each other and with the sides of the vessel prevents sea breaking in between and doing damage to the erections on deck, and thereby endangering the safety of the vessel. This has been strongly urged on the Board of Trade by the Institution of Civil Engineers for Scotland, and the Scottish Ship Building Association, by whom it has been represented that these covering decks, whilst they are added solely for the safety of the passengers and crew and the security of the ship, and whilst they do not add a single ton to the capability of the ship for earning freight, are included in the measurement for tonnage, and increase the various dues paid upon tonnage to the extent sometimes of £1,200 a year."

Some shipowners objected to the proposed exemption in the strongest possible manner. Amongst the best objectors were the firm of Messrs. George Smith and Sons, sailing shipowners, of Glasgow. Their letter is printed in extenso in the Blue book referred to above, the substance of their objections is as follows:

1. "An allowance from spar or covering decks, as affording shelter to steerage passengers, and at the same time making the ship more seaworthy, seems only reasonable, were it not that it is likely to be open to abuse unless very carefully guarded; much more carefully we think than the clause embodied in the paper now before us.

2. "Many owners we have no doubt would give full effect to the spirit of the Act as there laid down.

3. "But you are aware that there are shipowners who could not be depended upon, and who would be very unscrupulous in taking advantage of it, and who would require sharp watching.

816

4. "Our main difficulty, however, in regard to the clause, arises from the fact that it virtually gives the large ship a very decided advantage over the small. It is only large ships that can with propriety carry spar decks, and why they should have such advantage now offered them we are at a loss to determine.

5. "If allowance is to be made for spar decks, we fear much you will find small-sized vessels wholly unfitted for carrying them will be constructed to take advantage of the proposed law, and that such an arrangement may tend to make a class of ships be built that will prove unseaworthy from top lumper.

6. "Besides any party putting a spar deck on his ship will only do so if he thinks it will be profitable to him. The shelter thus afforded commanding an increase of passengers on the clear deck he will thus acquire affording greatly improved resource to the officers for seeing that the men are at their duty, it is but right therefore that such space should be paid for.

7. "We would respectfully suggest that in the event of Her Majesty's Government judging it expedient to make any allowance, that allowance should not exceed one half of measurement of the spar deck space. This would keep the owners in check.

8. "Our decided opinion is that the entire closed-in space of every ship, whether under or above deck, should be included in the measurement, from which in all ships, large or small, the space required for the accommodation of the crew should be deducted, and that such space should in no case be occupied either with cargo or passengers under a severe penalty."

As far back as 1850 Mr. Allan Gilmour, who was probably of all shipowners the one at that time best competent to speak on the subject, wrote as follows, viz.:—"I quite agree in the justice and propriety of measuring all poops, roundhouses, forecastles, and every covered-in space on deck that may be used either directly or indirectly by the crew, or made a source of earnings for cargo or passengers."

To Messrs. Smith's objections, Messrs. James and Alex. Allan replied, as steam shipowners:

1. "In the first part of their letter Messrs. Smith state that all sailing vessels are obliged to pay for their full measurement, except where arrangements are made for the crew on deck, and they cannot see on what principle the entire space occupied in steamers for cargo and passengers should not be included in the registered tonnage and dues paid for it, the same as in sailing ships. We answer, neither can we; but they are mistaken if they think that under the proposed change any cargo or passenger space in steamers will be exempt from measure.

2. "At present spar-decked steamers like our *Peruvian* not only have all their cargo and passenger space measured, but they have added thereto 600 to 700 tons *which is neither cargo nor passenger space*, but altogether unproductive; and in altering the law as proposed spar-deck steamers will simply be placed on the same footing as sailing ships.

3. "Messrs. Smith add what seems to us to destroy the force of their objection, 'any party putting a spar deck on his ship will only do so if he thinks it will be profitable.' As owners both of sailing ships and steamers we are satisfied that no shipowner will place a spar deck on his vessel unless it be to increase the safety of the ship, cargo, and passengers; and as the limited portion of such deck space as will be exempt from measure under the new law will not be available for cargo or passengers, the exemption from measure being strictly confined to those spaces which in sailing ships that have no spar deck are exempt, there could be no possible advantage gained in the matter of measurement by placing a spar deck on a ship that had not one. The spaces being free of measurement when uncovered would only be free, and nothing more when covered; covering, therefore, by a spar deck offers no benefit in regard to measurement, and no one would seek to place a spar deck on a vessel merely to take advantage of a law which exempted from measure a portion of ship already exempt."

Above are the pros and cons of the case as it was left in 1866. It must be gone into *de novo* when the new Bill is discussed in Parliament. If, as Messrs. Allan observe, the covering in of space on an upper deck does not in any way add to the freight earning powers of the ship, and if the exempting of space under an upper deck will not lead to the building of unsafe ships, and will not operate unfairly as between ship and ship, and if a practical scheme can be adopted to carry this into effect, then there can be no doubt that Messrs. Allan have reason with them in asking for exemption; but it will be exceedingly difficult to determine without inspecting every ship in which exemption is claimed whether the space can or cannot be used for earning freight, and, if the space cannot be so used on an outward voyage with passengers, whether it can be so used on the homeward voyage when cargo alone is carried. These are difficult points, but they are not insuperable, and it will rest with the shipowners to submit some equitable and workable plan to Parliament if they now wish the exemption to be legalized. The writer of these remarks hopes the shipowner may be able to do this. Every one must agree cordially with Messrs. Smith when they say, "make the law right and then allow each shipowner to construct

his ships in conformity therewith, and as best suited for the intended voyage."

We now have to glance at a very curious state of things as regards covered-in spaces, for whilst discussion has been going on as to whether certain spaces under cover on deck or under an upper deck should or should not be exempted, and if so on what conditions and under what circumstances, and notwithstanding the fact that the present law does not provide for any such exemption,—three exemptions, and to a large extent, have actually been claimed. This state of things has probably come about as follows: The tonnage rule of the present Act provides, as we have seen, that "if there be any permanent closed in space on the upper deck available for cargo or stores, or for the berthing or accommodation of passengers or crews," the tonnage of such space shall be added to the tonnage of the ship. And if there is a "spar deck," or any decks above the spar deck, the spaces between them and the "tonnage deck" shall be ascertained and added. Now it is easy to understand that in some special cases an upper deck may be so covered by houses and other erections, that it is really difficult to say whether the tops of the houses and other erections and the coverings of the passages between them do not form an additional deck, and this difficulty is further increased if the coverings put on the tops of the houses and other erections should happen to present an even and nearly continuous surface sufficient to admit of the ship being worked, and the boats, winches, etc., being carried there.

Let us try and make this clear, see fig. 7. The second deck from below is the tonnage deck, on it is a poop aft with a rail round the top, amidships is a large permanent erection with a rail round the top of it. The bulwarks on the tonnage deck are not shown in the figure. The space under the midship erection is right fore and aft, but the bulwarks are carried up from the tonnage deck, and effectually and permanently close in the sides of the space. Forward is a large topgallant forecastle also with a rail round it. Although the tops of these deck houses communicate with each other by narrow gangways, and although being railed round they afford space on which certain operations connected with the navigation of the ship are carried on, still there is no doubt that a ship like that shown in fig. 7, is not a spar-decked ship, but a ship having closed-in spaces on the upper deck. The roof is available for passengers, the topgallant forecastle is available for stores and for crew, and the space under the central erection is available for stores or for some sort of cargo. Still, so long as it is open at the

ends it is claimed as not liable to measurement. The parts shaded are the only parts that the shipowner generally admits are liable to be included in the gross tonnage measurement of such a ship.

Suppose now, that the permanent erection amidships is extended fore and aft, as shown in fig. 8, though still being open at the ends and closed at the sides, the ship begins to assume the character of a spar-decked ship; still, however, the space under this long erection between the poop and forecastle ought not it is urged to be added to the tonnage of the ship. But, as pointed out above, if cargo and stores are carried under it, it really comes within the letter and spirit of the Act as a "permanent closed-in space available for cargo or stores." Now, let the permanent covering be extended a little further, as in fig. 9, in fact, let it join the poop aft, but not join the forecastle forward, let the fore end still remain open, the sides being carried up and the top railed round, and we have, if not a spar-decked ship, a very near approach to it—still the owner urges that the unshaded part, even if used for cargo, ought not to be measured, because, he says, it is not a "closed-in" space. But let us take an example, and see how far such an argument is good.

Let us suppose that a deck cargo of sheep has been carried on an open deck, and that the ship has taken in so much water over the top sides that many of them have been drowned. Now, as the carrier of cattle and sheep is generally only paid for what he lands alive, and as he may be, and probably is under certain circumstances, held to be liable for the value of any that may be drowned on his decks, it follows that it is to his direct interest to prevent the death of any of his cargo of cattle or sheep. In a recent case, several sheep were drowned when carried as deck cargo, the owner thereupon covered the whole of his ship from poop to forecastle with a permanent covering, leaving at one end an opening of a few feet and making the necessary provision for drainage, etc. Without plenty of ventilation the sheep would be suffocated. This opening as left at the end assists in ventilation, so necessary in the case of a cargo of cattle carried under cover. It also furnishes means of egress and ingress, and the covering provides an extra deck on which the crew can move about when the deck below it is covered with sheep. The erection is permanent, the space under it may not be specially closed in to enable the ship to carry tea, meal, flour, etc., but it is sufficiently enclosed, and is specially closed in and adapted by ventilation, drainage, and otherwise to suit the carriage of another cargo, viz., cattle or sheep. Is not then the space under this permanent covering a "permanent closed-in space on the upper deck available for stores or cargo?" Undoubtedly it

is; and not only does it happen to be available, but it is constructed expressly for the purpose. On what grounds then can exemption be claimed for it? We have only to go a step further, and extend the central structure or erection so as to join the poop and forecastle, and we get really a spar-decked ship. Now, if the top of the deck is railed round from stem to stern,—if the boats, anchors, chains, steam winches, are carried on the upper side of the uppermost deck, and if deck-houses are put on the upper side of it, it is difficult to understand why the upper deck is not a deck as much as any other deck on the ship—but the owner says it is not, and claims that the space is not to be measured, see fig. 10. To exempt the space below such a continuous permanent deck from measurement, as in fig. 10, some shipowners have for some time past had two openings left in some parts of it. These openings are generally wholly or partially battened down after the ship is measured, and the whole deck becomes absolutely continuous, and the space under it becomes available, and is, if not always, at any rate in most cases, used for carrying cargo or stores. The holes, the shipowner urges, make the deck not continuous, and so convert it into something that is neither a deck nor a closed-in space on a deck within the meaning of the Act; but the Act contains no definition of the word deck, and it is not consistent with common sense that two small openings in a permanent and continuous deck, such as those shown by square black dots on fig. 11, should operate more effectively than the ordinary hatchways in rendering the upper deck less a deck. Still, somehow the hatchways have not done so, and the little holes have been thought to do so; and the space between the upper deck and the deck below, although generally available for cargo, is claimed as not liable to be included in the tonnage of the ship.

In a case coming within the writer's knowledge the whole of the 'tween deck of a ship, fore and aft, has escaped tonnage admeasurement, on account of an opening in the fore part of the deck, and this space was equal in tonnage to the tonnage of several coasting sailing vessels. If the space, or any of it, between any two decks of a ship is to be exempted from measurement the exemption ought to be based on some sort of principle, and granted on intelligible and reasonable grounds. Such an important concession as this ought never be granted on such a miserable subterfuge as the temporary opening in a deck. It would be difficult, if space between the two upper decks of a ship be exempted, to say that space between two lower decks shall not also be exempted. It will in fact, if it is ever commenced, be difficult to say where this exempting process is to stop. If it is to be extended to ships with only one

deck, then large openings in that one deck would prevent the ship from having any tonnage at all.

We will now look at these exemptions as affecting safety. There cannot be a doubt that a good freeboard is an element of safety, nor can there be any doubt that a continuous covering does conduce to the safety of a ship when put over such a ship as that figured in fig. 5. But if a good free-board is an element of safety we must not forget that the reverse or top lumper is an element of danger, and if by any encouragement of spar or covering decks, the Government were to encourage top lumper, great evils would result. For example take figs. 12 and 13. If, in such a case as is there shown, the owner could get the unshaded part exempted from measurement and use it for cargo, using at the same time the upper surface of the upper deck for cargo; and if he could build such a ship expressly to avoid or evade measurement, and bring in large profits,—then the law under which he could do so would be vicious in the extreme, and would have the diametrically opposite effect of that intended by advocates for exemption; and it must not be forgotten that in some trades locomotive engines and other heavy weights and cumbrous articles, are carried on the uppermost deck more frequently than in the hold.

Deck Cargoes.

The next point for consideration relates to cargoes carried on the exposed surface of an upper deck. In the following remarks the words "deck cargo" are intended to apply only to such cargoes, and not also to cargoes carried on deck under cover of any permanent shelter or erection.

The law as it at present stands does not prohibit the carrying of deck cargo. A ship may therefore, so far as the statute law is concerned, carry any part of her cargo on deck on any voyage at any time of the year; and the space occupied by deck cargo is not measured, and is therefore not included in the tonnage on which dues are paid.

There are some persons who advise that the carriage of deck cargoes should be prohibited by law, and who believe that deck cargoes have contributed to the loss of many steamships trading from the east coast. It may possibly be so, but there is no absolute proof of it. All we know for certain is that no steamers trading between England and Ireland have been lost from this cause for very many years, and it would certainly be unfair to punish the owners of steamers hailing from the western coast on account of the losses of steamers hailing from the east

coast, even if it were proved that the latter were lost from over-loading or by deck cargoes.

Whether it is or is not safe to carry deck cargoes in some cases, is not a question on which we now propose to touch. Nor do we now propose to enter into the question whether the very great loss of steamships sailing from the east coasts of Great Britain is or is not due to excessive deck cargoes or overloading, or whether that loss may or may not be traceable to a peculiar build of ship encouraged by exemptions from measurement of covered-in spaces and spaces under upper decks.

These questions may fairly come under consideration when looking into the question of "safety and prevention of accidents"; all we propose now to consider in the question of deck cargoes as affecting tonnage admeasurement.

A ship such as that figured in fig. 1, is measured to the top of the upper stroke; she therefore pays dues, if she pays at all, on her whole contents. A glance at fig. 2 will show that if a ship, say a timber ship, carries a cargo of timber, and is filled up to the top of the bulwarks, as she invariably is, the hull up to the top of the bulwarks earns freight. This being the case, it is not at first sight easy to understand why the contents occupied by the deck cargo should not be included in admeasurement, but they are not. There would be no difficulty in measuring the space occupied by deck cargo in the case of timber, or of cotton, or of hay and straw carried on deck in large masses; but if the deck cargo were not timber, or cotton, or hay, or straw, and if it were a miscellaneous cargo, and a partial and varying cargo, there would be great difficulty in measuring it. If the deck cargo were included in the case of a timber ship, it might add 20 per cent. to the tonnage of the ship; but if the deck cargo of a straw barge were included, it would add from 150 to 200 per cent. to her tonnage for a comparatively worthless cargo.

There are cargoes, especially on short voyage ships, that cannot be carried below deck when other articles are carried. For instance, cheese, and tea, and flour could not all be carried together in a small hold. Paraffin, tar, and turpentine cannot be put into the same hold with, say, tea, flour, fruit and vegetables, chickens, sheep, and pigs. Locomotive engines, boilers, tanks, and long iron rods cannot always be put into a hold in some trades, and must be carried on deck, and in the case of ships making frequent calls during a voyage trade would be altogether stopped by prohibiting the carriage of deck cargo.

As an illustration, the voyages made by some of the Scotch

steamers may be taken. The vessel leaves Glasgow with, say, the following things:—Potatoes, flour, oats, wheat in bags, bacon, cheese, pigs, a steam boiler or two, several casks of paraffin, a piano, tables, chairs, looking-glasses, bedsteads, beds, wardrobes, pots, pans, kettles, and various household utensils; a horse or two, a carriage, a few carts, a threshing machine with engine and boiler, some ploughs, harrows, long iron rods, boiler plates, a boat, some sails, ropes, chains, fishing gear, etc., etc.—in fact, a miscellaneous collection of articles required by a population partly agricultural, partly seafaring, and partly manufacturing.

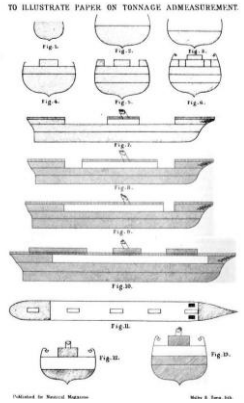
To say that none of these things shall be carried on deck would be the height of absurdity, and would prevent their being carried at all. We will suppose that the ship starts with her cargo stowed as usual, some in the hold, some on deck, and some on the bridge. She arrives at Greenock, where she discharges something and takes in something else; from Greenock she goes to one of the out-of-the-way places in the inner Hebrides, here she discharges, say, some of her eatables and some of the agricultural implements and livestock, and takes on board some salt fish, some periwinkles and some sheep, fowls, and ducks. She goes to a neighbouring island, discharges some furniture, leaves the sheep and some potatoes, etc., and takes on board some more fish, some more periwinkles in bags, and a cow or two. She then makes another call, and goes through a similar process, leaving and taking things at each place, and varying her cargo each time; and she does not do this once only, but twelve or fourteen or twenty times, for she makes a journey from Glasgow round the inner and outer Hebrides, and the coast of Sutherland and Caithness to Thurso and Wick, and back on the round again to Glasgow. If she is not to carry anything on deck, then she must have a separate place in the hold for separate classes of articles. She could not carry sheep and cattle in the same hold with eatables, nor with tar, paraffin, etc.; nor could she carry some large things below without being rendered unseaworthy by excessively large hatchways.

Those steamers do the chief part of the carrying between island and island, and between places on the mainland and the islands. A flock of sheep has to be taken from one island to another, a stack of salt fish from an island to a mainland port, and all these things have to be done while the ship has cargo on board for other places further on. It would be folly to expect her to turn her cargo out of her hold in order to put the inter-in cargo there; and yet, unless she were to do so, she must make use of her deck. Seeing, then, that it is utterly impossible to prohibit the carriage of deck cargo

without stopping trade altogether (and the Scotch boats referred to are only instances on a small scale of the practical impossibility of prohibiting deck cargoes on a larger scale), then the question arises, as the cargoes must be permitted, ought not the uncovered space they occupy to be measured in the tonnage.

To this question the answer is that if the space occupied is to be measured, then, in such a varying trade as this, a measuring officer must always be on board to take the measurements, and the game would not be worth the candle, and the necessary interference would be exceedingly vexatious. The only other way to do it is to measure all ships to the top of the bulwarks or upper stroke. This would be a direct departure from the principle of Moorsom's rule for decked ships, although it would perhaps be a logical way of settling the question; but the effect would be that owners would take away the bulwarks and substitute a netting and a rail, or make the bulwarks so low that the direct effect would be to render the ship absolutely unsafe. So long as deck cargoes are permitted, and that they must be permitted is certain, it appears to be difficult to attempt to interfere with them at all. This being so, the shipowner then asks, "If I am not to be charged dues on that part of my ship occupied by deck cargo, why should I be charged when I put a covering over it that does not add to the capacity of my ship." The answer would appear to be this, viz.: "If you put the shelter on solely for the protection of passengers carried as deck cargo, the Board of Trade will, and do, exempt the space under it from measurement, as in the case of the Irish mail-boats; but if you put it on to shelter other deck cargo, you do so of your own choice and because it suits your trade. It enables you to carry cargo on deck without loss, and helps you to charge better freight, or to insure more regular employment; and further, the cargo, when under cover of some permanent erection, is not deck cargo. If, under all circumstances, you decide not to put a covering on, you need not; but if you do put it on, you must weigh the facts and put it on with your eyes open. One thing is certain, that you will not put it on if it does not suit you, and you will put it on if it does." A reference, however, to the case already mentioned, as to cargoes of sheep carried on deck and under cover, will show that the non-measuring of and charging for space on the upper side of an exposed deck is quite consistent with the measuring of and charging for space under shelter of a permanent erection on that deck. Messrs. Smith, of Glasgow, say, as regards these exemptions under-covering decks—the words are the words of a firm of shipowners, not the words of the writer of this paper—"There are

TO ILLUSTRATE PAPER ON TONNAGE ADMEASUREMENT.



shipowners who could not be depended upon, and who would be very unscrupulous of taking advantage of it, and who would require sharp watching?" and as regards putting on a covering deck, they say, "the shipowner will only do so if he thinks it profitable to him;" and Mr. Allan Gilmour, shipowner, of Glasgow, in speaking of allowances made to the tonnage of steamers, has said, "*I am fully persuaded that no steamboat owner, or steamboat company, however powerful, can give one good or honest reason in justification of the deduction.*"

CREW SPACES.

"A forecastle occupied by seamen is a place not fit to keep a dog in. It is so constructed that the sea can find its way in through the hawse holes, or through the sides, or through the decks, and distribute itself over the floor and trickle over and saturate the bedding; it is constantly filthy from dirt and vermin. No adequate ventilation is provided,—it receives insufferable stenches from the bilge water, the cargo, and the privies and urinals,—it sometimes contains men who are suffering from loathsome and contagious complaints; what little clear room it contains is taken up by ship's stores, and yet the crew are expected to live in it, to be cheerful, to be fit for work, and to be healthy, whatever may be the climate, whatever may be the weather."

This is the substance of complaints frequently made in past years by seamen and by philanthropic gentlemen on their behalf.

The above words may or may not convey a correct impression of the sleeping quarters of seamen then found in our merchant ships. Let us hope that the persons complaining gave expression to their feelings a little too strongly. In some of our large ships, especially in steam ships owned by careful and sensible owners, the accommodation of the seamen is good and his wants are attended to; but that the accommodation for seamen even if originally good is often now allowed to become bad and dirty and unwholesome, that frequently it suffers from the presence of dirt and the absence of light and ventilation, and that the health of the seamen suffers in consequence are facts that cannot be denied.

Under the old state of things ships' crews were generally berthed below deck in merchant ships, somewhere down forwards. If it be possible to find a place on board ship more unhealthy than another in which to berth a seaman, that place must be somewhere under hatches, where he can get but little fresh air, no light, and plenty of bad odours and vermin. Such a place is described by Marryatt and other writers, as a "mess" place in His

Majesty's ships, such a place was the forecastle of our old merchant ships. In the year 1854, the legislature, looking on this state of things as too bad, tried how they could bring Jack's bed-room into the fresh air, and to perch him in a topgallant forecastle. He had suffered for want of the two great essentials—air and light; that should be remedied at any rate. By the Merchant Shipping Act 1854, the space occupied by seamen was declared to be exempt from tonnage admeasurement if it were situated on the upper deck. If it were down below it would continue to be measured and pay tonnage dues. After the exemption was granted for seamen's berths in topgallant forecastles and deck-houses, the construction of these places on deck became more frequent: but as an exemption had now been granted in favour of sleeping accommodation in one part of the ship, the owner soon began to ask why it should not be also granted if good accommodation were provided elsewhere; say, below amidships, forward, aft, anywhere, so long as it is good accommodation. Why, asked the shipowner, should he be compelled to build deck-houses and topgallant forecastles. It will never do, he urged, for the Government to encourage the erection of these places on deck. Besides it was now found that topgallant forecastles had their disadvantages. If they were favourably situated for light and air, they were unfavourably situated for seas and rain and other things. By 1866 they had come to be represented as "damp, cold, unhealthy places on deck, where the men were cold and wet, and got cold, cramps, and rheumatism."

In 1867, the Duke of Richmond, then president of the Board of Trade, conceded the point, and exempted crew space from tonnage wherever it might be situated, provided certain conditions were complied with.

It would in the absence of special circumstances be obviously impolitic for the Government to interfere as regards the number of hands to be employed to do a certain amount of work. It would not do for the Government to decide by a hard and fast law, how many young ladies shall always be employed to make a score of dresses, or how many coalheavers shall be employed to unload a coal barge, or how many sailors shall be employed to navigate a ship. The number of hands to be employed in navigating a merchant ship, how many of them shall be officers, how many engineers, how many A.B., how many O.S., how many stokers, and how many boys, may vary according to service, and must be known best to those interested in the ventures. This being so, the legislature while endeavouring to ensure that the hands who are engaged shall have proper accommodation, leave entirely to the

owners on the one side, and the men on the other, the power and the right of deciding between themselves how many or how few hands shall be employed.

The owner has to determine the number of hands all told for which he wishes to have certified accommodation: he has then to provide that accommodation. To be certified and passed, it must be such as to afford:—

(*a*) Seventy-two cubic feet, and twelve superficial feet of floor space for each seaman.

(*b*) The place must be available for proper accommodation. Securely constructed, properly lighted and ventilated, properly protected from weather and sea, and properly shut off from effluvia from cargo or bilge water.

(*c*) Certain necessary conveniences must be provided.

(*d*) The place must be inspected once, viz., before the deduction is allowed.

(*e*) It must be kept free from goods or stores. The crew are to get a shilling a day for *each* day it is not kept free.

The owner and master are subject to penalties for non-compliance with the law as regards space, etc., whether deduction is or is not claimed for the tonnage.

Here then is a reasonable state of things. The seaman is to be provided with decent accommodation, which is to be kept free from ship's stores, and the owner is to have a consideration for providing that accommodation. This consideration is to take the form of a reduction of the tonnage on which dues are paid.

If this arrangement works fairly on the whole, then it is a good arrangement. If on the other hand it gives a shipowner an excessive allowance for which the seaman gets no advantage or no adequate consideration, it is a bad arrangement and requires reconsideration.

Let us with the aid of a few printed returns, etc., see how i works.

The following is a list of steam ships of various classes:—

Steam Ships.	Net Register. Tons.	Tons deducted for Crew Space.	Number of Crew carried.	Excess allowed at one ton per man.
A	80	24	7	17
B	273	24	17	7
C	391	41	29	12
D	627	57	22	35
E	662	91	49	42
F	1746	184	92	92
G	1110	88	27	61

SAILING SHIPS.

Ships.	Net Register. Tons.	Tons deducted for Crew Space.	Number of Crew carried.	Excess allowed at one ton per man.
H	1444	68	34	34
I	999	57	26	31
K	880	49	26	23
L	699	41	18	23
M	393	32	14	18
N	132	23	6	17

The Act requires that each man shall have seventy-two cubic feet of space, but the above table is computed on an allowance of one hundred cubic feet per man, that is to say, on a ton of roomage for each man, and it will be seen that even at that increased rate of roomage per man, the allowance is in some cases granted for three hundred per cent. above the number of the crew actually carried. If the legislature intended to grant an allowance only for the number of men composing the crew actually carried (and there is no reason to suppose that a greater allowance was intended to be made), then the Act has allowed more than its framers and promoters intended. It is not likely that the shipowner suffers the space not actually used by the crew to lie idle, and if he uses it for stores or cargo, he uses space for which he pays no tonnage dues. In the old act a limitation was fixed by which the deductions for crew space could not exceed one-twentieth of the tonnage of the ship. That limitation was removed by the Act of 1867, and it is a question whether it or some other limitation ought not to be restored. If the shipowner is to be allowed, free of taxation, roomage sufficient for the wants of the crew he actually carries,—and there do not appear to be any good reasons why he should be allowed for more, —then the law which gives him more should be altered. If for instance the register tonnage on which dues are paid were reduced at the rate of 0·73 ton for each man appearing in the articles for the voyage, the shipowner would obtain the deduction due to him, with a margin of three per cent. in addition to the roomage required by law to be allowed for each seaman.

OLD RULES FOR ENGINE-ROOM ALLOWANCE.

The first law for the admeasurement of steam vessels was passed in 1819; by it the "length of the engine-room was deducted from the length of the keel in measuring the length of the vessel for tonnage." This in effect gave the whole section of the ship occupied by the engines as an allowance for propelling power. But

although the contents of the whole section of the ship from the keel to the upper deck were thus allowed to be deducted on account of engine room, it does not follow that the engines and boilers occupied the whole of that section. If the ship were a three decked ship, the machinery and boilers might be below the second deck—still the whole section of the ship from the keel to the upper deck was deducted for engine-room; or the engines and boilers might be in two or more separate compartments with passages between them—still the capacity of the whole section of the ship as far as the machinery and boilers extended was deducted from her tonnage.

There was, however, a provision in this enactment, rendering it illegal "to stow or place any goods (fuel for the voyage excepted) in the engine-room." From the first, therefore, a steam ship has been allowed, on account of boilers and machinery, a greater space than they have occupied. This excess of allowance must have been granted with some definite object—and although that object is not stated, there is little doubt that it was to afford space for the carriage of "fuel for the voyage."

The next law, 4 Geo. IV. cap. 61, contained the same rule, but omitted the prohibition as to carrying goods in the engine-room. In 1834, the second Commission reported, "That in registering the tonnage of steam vessels *instead of deducting the length of the engine-room (according to the present mode) an allowance shall be made of one-fourth of the whole tonnage*," and they added, that "*some legislative provision might now be made to enable His Majesty's Government to alter the proportion of that allowance hereafter.*"

The next law, viz., the "New Law," enacted that "the tonnage due to the cubical contents of the engine-room shall be deducted from the total tonnage." The cubical contents of engine-room were to be ascertained in the following manner:—"Measure the inside length of the engine-room, in feet and decimals, from the forecast to the aftermost bulkhead, then multiply the said length by the depth of the ship or vessel at the midship division, as aforesaid, and the product by the inside breadth at the same division at two-fifths of the depth from the deck, taken as aforesaid, and divide the last product by 92·4, and the quotient shall be deemed the tonnage due to the cubical contents of the engine-room." Thus, still giving the whole section of the ship from extreme bulkhead to extreme bulkhead, but ascertaining the contents more accurately than under the old law. If the engines and boilers were placed close together the section would be small, but if they were spread along the ship in separate compartments, with passages between them, the section would still under the "new law" be excessive. Under that law a

steamer whose gross measurement was 1695 tons, was registered as of 444 tons, so great were the exemptions allowed.

The report of the third Commission, ordered to be printed by the House of Commons, 13th February, 1850, stated that "with regard to the admeasurement of vessels propelled by steam, the whole tonnage shall be calculated as for sailing vessels; and that, in order to carry out the principle which has been laid down of preserving as nearly as possible the aggregate amount of tonnage under the old law, unaltered, it is necessary as heretofore to deduct from the above the tonnage due to the engine-room, measured externally. *But the committee beg to suggest that the deduction of the engine-room is an advantage given to steam over sailing vessels, and is a question which merits consideration by the proper authorities*, although the committee do not deem it within their province to enter upon."

It is clear from this that the gentlemen who reported in 1850, only continued the deduction because it had been previously allowed, and thought it wrong in principle, and certainly did not think that it ought to be increased.

In 1851, Mr. Allan Gilmour, whose name is deservedly honoured wherever it is mentioned in connection with ships and shipping, wrote as follows:—"I am convinced none but those interested in steamers, or those who do not comprehend the bearing of the subject, will oppose the views I set forth in this matter, and I am certain that even they can give no good, sound, or just reasons in support of the allowance. I believe all they can, or do urge, or plead for, is 'Do not ask for a reduction on the allowance of tonnage to steamers, but as an equivalent to sailing ships, insist on an allowance or deduction on their tonnage.' I am opposed to any such arrangements. I maintain that the tonnage of every vessel entering the ports of the United Kingdom, whether British or Foreign, shall be ascertained by one and the same rule, without any allowance whatever, this deduction therefore on the tonnage of steamers ought not to be made any longer. I am fully persuaded no steamboat owner or steamboat company, however powerful, can give one good or honest reason in justification of the deduction. I may safely assert then, that on all hands it is admitted that if an allowance is to be made to steamers, an allowance should also be made to sailing vessels; but I maintain it is decidedly wrong to make any allowance to either, and more especially in the way that is now done to steamers, because I believe that advantage is most improperly used, and an opening is made for fraud and imposition —as there is reason to believe that, in many cases, if not very generally, more space is taken in steamers than is necessary for the

engine-room, and as this additional space allowed is the most buoyant part of the vessel, and where the greatest power of floatation or displacement is, the advantage thereby gained by steamers generally, is also greatly increased."

Mr. Gilmour spoke truly if he spoke plainly, and his words, as the words of a shipowner conversant with the subject, are words of gold.

Mr. Moorsom evidently had no liking for allowing any deduction on account of propelling power in steam ships; but looking to the fact, that such a deduction had always been allowed—also looking to the fact, that it was thought desirable at the time he proposed his scheme that the relative tonnages of steam and sailing ships then existing on the records should not be violently disturbed, he gave a rule in his scheme as follows: "the tonnage due to the cubical contents of the engine-room is to be determined in the following manner, that is to say, measure the inside length of the engine-room between the foremost and aftermost bulkheads, or limits of its length, and having found the transverse areas at those limits to the height of upper deck, and also the area at the middle point between them, in the same manner as hereinbefore described for ascertaining the other areas, then to the sum of the two end areas add four times the middle one, and multiply the whole sum by one-third of the common interval between them, which is the cubical content; and which divided by one hundred gives the tonnage due to the engine-room." The scheme would have given a whole section, and would not have cured any of the vices of the previous law, and it was set aside. It appears from a memorandum issued by the Board of Trade, in November, 1863, that the Bill of 1854, as first introduced, proposed to give a deduction of three-tenths of the gross tonnage to paddle steamers, and of two-tenths to screws, with the proviso that where the horse-power was very small, the actual contents of the engine-room should be measured accurately. To this, two objections were made; first, that nominal horse-power was a matter too vague and inaccurate to form the basis of legislation; and secondly, that the allowance proposed would be unfair between steamer and steamer, and would improperly reduce the reduction for ships of large power. These objections prevailed, and in the amended Bill the rule was altered, but the principle of per-centage was retained in a modified shape.

PRESENT ENGINE-ROOM DEDUCTIONS.

The aspect of the question as regards engine-room allowance was fully discussed in 1867, and has not changed since. The writer of

the present paper cannot, therefore, do better than refer the reader to the Blue book on tonnage, issued by the Board of Trade in that year.* In that book he will find that the question is fully discussed. As, however, this paper would be incomplete if it did not contain a statement of the principles of the rules now in force as contained in the Merchant Shipping Act 1854, and the objections to them, these points are given concisely below, viz.:—

1. The actual cubic capacity of the space necessary for, and solely occupied by machinery and boilers is measured.

2. Coal bunkers are not measured.

3. Where the measured space is in paddle-steamers between twenty and thirty per cent. of the gross tonnage, then thirty-seven per cent. of the gross tonnage is deducted.

4. Where the measured space is in paddle-steamers below twenty or above thirty per cent., then fifty per cent. more than the space due to the measurement is deducted.

5. Where the measured space in screw steamers is between thirteen and twenty per cent. of the gross tonnage, then thirty-two per cent. of the gross tonnage is deducted.

6. Where the measured space in screw steamers is below thirteen per cent. or above twenty per cent. of the gross tonnage, then seventy-five per cent. more than the space due to the measurement is deducted.

A few examples will explain the very unsatisfactory working of these rules.

PADDLE STEAMERS.

For every One Hundred Gross Register Tons.

Gross Register Tonnage. Tons.	Engine-room as measured. Tons.	Allowance. Tons.	Net Register Tonnage. Tons.
100	10	10 + 2 = 12	88
100	20	20 + 10 = 30	70
100	21	37 per cent.	63
100	29	37 per cent.	63
100	30	30 + 15 = 45	55
100	67	67 + 33·5 = 100·5	Nil.

SCREW STEAMERS.

100	10	10 + 7·5 = 17·5	82·5
100	13	13 + 9·75 = 22·75	79·25
100	14	32 per cent.	68
100	19	32 per cent.	68
100	20	20 + 15 = 35	65
100	58	58 + 43·5 = 101·5	Nil.

* J. D. Potter, 31, Poultry. One Shilling. Printed by H.M. Stationery Office.

So that under this absurd system of per-centages, a paddle steamer with an engine-room of twenty-one tons will get an allowance of seven per cent. more than a similar steamer with an engine-room of twenty tons, and a screw steamer with an engine-room of fourteen tons will get an allowance of ten and a quarter per cent. more than a similar steamer with an engine-room of thirteen tons. One ton either way makes this large difference in the amount of deduction. And steamers may really have no tonnage at all on which dues can be charged, indeed, this is actually the case in some steam ships at the present moment. Not only is this so, but with the excessive deductions for crew spaces, as already explained, several steamers have not only no tonnage, but have absolutely a minus quantity.

We have only now to take a few actual cases of deductions from all sources, viz., crew spaces, engine-room allowance, and exemptions of covered-in spaces, to shew how unequal and unfair is the result of these deductions. The ships laden with cotton passing through the Suez Canal afford a fair illustration. About five and one-third bales go to a ton. It follows from a perusal of the following short list, either that the sailing ships and some steam ships are overcharged by Messrs. De Lesseps and Co. and other Dock and Harbour Owners, or that Messrs. De Lesseps and Co. are not properly paid by the owners of the other ships.

SUEZ CANAL.

	Gross Register Tonnage.	Deductions.	Net Register Tonnage.	Bales on Board.	Bales in excess in Steamers' favour.
Steamer A	2815	1006	1809	14,440	
If A were a sailing ship of	—	—	1809	she could carry 9,648	4,792
Steamer B	1407	450	957	9,073	
If B were a sailing ship of	—	—	957	she could carry 5,104	3,969
Steamer D	1417	353	1064	5,639	
If D were a sailing ship of	—	—	1064	she could carry 5,600	39
Steamer E	1355	389	966	4,548	
If E were a sailing ship of	—	—	966	she could carry 5,152	being an excess in favour of sailing ships of 604

The steamers A and B are both fitted with a covered space available for cargo between the poop and forecastle, but not included in the gross measurement. It will be seen how exceedingly unfair is the operation of the present law, not only as between some

steam ships and some sailing ships, but as between steam ship and steam ship, for whilst some steamers carry an enormous excess over sailing ships of like net register tonnage, the law so operates that other steamers cannot carry so much as a sailing ship of the like net register tonnage.

GENERAL CONCLUSIONS.

Gross Register Tonnage.—We have seen that the rule for calculating this tonnage is sound in principle, but that it has been injuriously departed from in the case of closed-in spaces available for cargo, on or under the upper deck. We have also seen that exemption from measurement has led to anomalies, inconvenience, and gross injustice.

Net Register Tonnage.—We have seen that this may be nil.

Spar Decks.—We have seen that spaces under these decks which are required by law to be measured are sometimes exempted. We have also seen that they may be an element of safety in some cases, and an element of danger in other cases.

Closed-in Spaces on Deck.—The same remarks apply.

Crew Spaces.—If the deduction is to be continued, some limitation is necessary, without interfering with the manning of ships.

Engine-room Spaces.—We have seen how absurd, unequal, and unjust is the present law; some rule must be adopted, doing away with the deduction altogether, or, if this is impossible, limiting it to, say, fifty per cent. of the gross tonnage. If the deduction is to be continued, the actual measurement of the space set apart for and used by engines, boilers, *and coals* would, subject to the limitation of fifty per cent., probably be the fairest rule. It would give an allowance for the actual space used for the propelling power; and if Mr. Gilmour's view is right, that no deduction should be given at all, how difficult must the steamboat owner find it to give a good or honest reason why the deduction should exceed the space actually used and required for propelling purposes, or to give any reason, good or bad, why it should absorb the whole, or nearly the whole, of the tonnage on which dues and rates are paid.

Tonnage Dues.—As regards shifting these dues from the net to the gross register, such a plan is impossible so long as the dock authorities adhere to their present unfair plan of charging as much for a day or two as for a month, a plan that bears unduly on vessels making frequent visits or remaining but a short time. It has been admitted on all hands that the gross register tonnage, with an allowance for time, would give the fairest standard for charging

tonnage dues or wharfage and dock rates. Some permissive powers enabling dock authorities to do this, might perhaps be introduced into the new bill with advantage. The Act of 1863 contained a clause to the effect that "any body corporate or persons having power to levy tonnage rates on ships, may, with the consent of the Board of Trade, levy such tonnage rates upon the registered tonnage of the ships as determined by the rules for the measurement of tonnage for the time being in force under the principal Act, notwithstanding that the local Act or Acts under which such rates are levied provides for levying the same upon some different system of tonnage measurement."

It is possible that if the new bill were to contain a permissive clause applicable to gross tonnage somewhat similar, something might be eventually effected. But the whole question is beset with difficulties and with points that cannot as yet be specifically dealt with by Parliament. The writer of these remarks merely throws out the above hint for consideration, in hopes that it may lead to some suggestion of value.

There is, perhaps, another way of settling the difficulty. If the steam shipping interest will not now give up the deduction allowed for engine-room space, but should again succeed in obtaining legislative authority for its continuance, then the sailing ship interest will probably, on what they believe to be equitable grounds, also claim further exemptions. Seeing that it will, in such a state of things, be impossible to return to the true tonnage—viz., the gross register tonnage of steam ships as the tonnage for taxation, the question then is, might not the true tonnage both for sailing and steam ships be reduced alike. What is really wanted to bring about an equitable arrangement, is to bring the tonnage of all ships back from the net to the whole true tonnage, so that the whole tonnage of each ship shall afford a safe figure for taxation; but if it be impossible to revert to the whole true tonnage in the case of steam ships, why should not the desired result be attained by a reduction in the true tonnage of sailing ships equal in amount to the reduction from the true tonnage of steam ships. The tonnage of all ships would then be alike; but instead of all being alike as regards gross register or true tonnage, they would all be alike as regards another tonnage, viz., the net register tonnage, which would be half the true tonnage in all cases.

Suppose, for example, that if every steam ship be hereafter allowed fifty per cent. as a deduction from her tonnage, then let every sailing ship have a deduction of a like amount. Dock owners would alter their rates quickly, and would probably find an equit-

able method for alteration. As regards returns of trade and navigation, seeing that the two tonnages of a ship and all the deductions are recorded in the official registers, the tonnage returns and other statistics could be so arranged, whenever necessary, that they could continue to give information on the present basis, and without making any violent change, and without shewing any decrease in the actual tonnage of the Empire. In making any change all interests would have to be considered, so that the holders of shares in the docks, the owners of steam ships, and the owners of sailing ships may participate equitably.

International Tonnage.—Most maritime countries and states have adopted the principles of the British system of measurements for gross tonnage, but they hesitate to adopt a system of net register tonnage open to such inconsistencies and capable of inflicting such injustice as the British system. In settling the future system of British net register tonnage, the question must be treated on broad and intelligible grounds, in the hope that a system may be devised that can and will be adopted by the whole world.

Administration of Tonnage Laws.—This paper would scarcely be complete, without some reference to existing arrangements for the survey of ships for tonnage and other purposes. At the present moment, no less than three departments have a staff of surveyors of ships. The Emigration Board for Passenger Ships; The Board of Trade for Passenger Steam ships, and for the crew spaces, and lights, and fog-signals of all ships; and the Board of Customs for the measurement previous to registry of all ships. The shipowner reasonably complains of this state of things, for it sometimes happens that the action of the Board of Trade and Board of Customs, as regards tonnage, unexpectedly brings the ship into a different class as regards the Emigration Board, and requires the engagement of extra hands for whom, the shipowner says, he can find no employment. The nomenclature of decks should also be re-settled. All sorts of new names have come into existence, such as awning decks, weather decks, promenade decks, hurricane decks, covering decks, etc., often used without distinction for the same thing. There are also the main deck, the spar deck, the tonnage deck, and the upper and lower passenger decks, and sometimes the orlop deck. The present tonnage law only calls two decks by name, viz., the tonnage deck, and the spar deck. And as under the tonnage law the spar deck is always the third deck from below, it sometimes has a deck and deck-houses above it. It is not always as is supposed, the uppermost deck. Perhaps the best way would be to number all decks from below upwards, as in the present tonnage

law, and to call them the first, second, third, fourth, and fifth decks, as the case may be. These are easy matters, and will no doubt be satisfactorily settled when the New Bill is under discussion in Parliament. We now dismiss the subject of tonnage admeasurement, in the hope that what we have written may be of some use at the present moment. In our next number we propose to consider the question of manning. In doing so we propose to touch on the compulsory apprenticeship system, the register ticket, foreign seamen in British ships, and the training of boys before entry into the merchant service.

The system in use in the Danube is a fairly good system for that river; but we must recollect that it was only adopted failing the adoption of the gross ton. And we must further bear in mind that, although we have only few positive arrangements internationally as regards the register ton, the gross ton is as a fact almost already an international ton; for the gross tonnage, according to our system, is stated on the papers of ships of the following countries: Austro-Hungary, France, Italy, Denmark, Germany, United States; and it is from the gross tonnage so stated, that in many cases, and by various ways, the register ton, or chargeable ton, is arrived at after deduction in foreign ports.

Other systems have been proposed: (1) A fixed deduction; but a fixed percentage, made applicable to all ships, whatever their trade, would e unjust, as it would operate unequally between ship and ship, and because, to meet extreme cases, it would have to be very large. To take an actual case, it would be absurd to say that, because the *Republic*, in making a voyage to the coast of South America, would require say 40 per cent, deduction, another ship, or the same ship, going to New York or to Oporto, should have the same deduction. She would, in fact, in the latter case, have a deduction for space in which it would be well known that she ought to carry cargo. In one case there would not be deduction enough, and, in the other, cargo would be carried in the deducted space; or, if not, what is worse, it must remain idle, or be filled with a dead weight of coals that are not wanted. How these arguments apply at all against gross tonnage, pure and simple, it is difficult to see.

Another proposal we have seen is that, having fixed the gross tonnage, there should be deduced therefrom a register tonnage that shall be less than the gross tonnage, according to the nature of the service of the ship; that is to say, a long-voyage ship should have 30 per cent deducted; a short, foreign-going voyage ship, 20 per cent, and a coaster 10 per cent.

This would have involved the following awkwardness:

(1) An addition of about 20 per cent to the dues paid by all home trade coasting steamships. In some cases 40 per cent.

(2) An addition of about 13 per cent, in some cases more, to the dues paid by short-voyage foreign-going steamships.

(3) An addition of 3 or 4 per cent to the dues paid by all other steamships.

(4) The alteration of the official register tonnage where a steamship is laid-on for fresh voyages.

Seeing then that by such a system whatever tonnage is to be adopted is to be deduced, and is to be a fixed proportion of the gross tonnage for each class of ship, it will be much better to adopt the tonnage (gross) at once, and then, if necessary, to make a reduction of 10, 20, 30, or 40 per cent in the rate of dues. Ship owners have, however, in the case of the Suez Canal a right to demand that the charge shall be made on the net register tonnage, for Mons. De Lesseps pledged his word that it should be so charged, and, on the faith of his word, they have specially constructed ships for the Canal. 841

It was argued against gross tonnage for the Suez Canal, that it would be unjust between three classes of ships: A, high-power, passenger; B, cargo, full power; C, auxiliary; but by charging on the register ton we should be practically shutting out auxiliary screws, and favoring the high-class freight-earning mail steamer; whereas a charge on gross tonnage, which leaves the owner free to use his space as he likes, is a charge on the whole venture, and not on the least valuable part of it.

One very important fact is, that by charging on the gross tonnage every owner is at liberty to vary the internal arrangements of the ship as trade requires, while by charging on the present register tonnage, the full-powered monopolist's steamer obtains an immense advantage, and is able to carry passengers, which, as freight, are in some cases, the best paying of all cargoes.

As a ton for the Suez Canal, we think we must say, failing the gross tonnage, the Danube rules for net tonnage now proposed are the best rules. They are, at any rate, better than a fixed proportion of the gross tonnage for many reasons, but especially for the reason that they will lead to the construction of large and light cool engine-rooms, and save the country a good deal of expense in connection with sending home invalided engineers and stokers. A fixed percentage once allowed for machinery would lead to the direct contrary, and would be very damaging to the personnel of the Mercantile Marine; and they are better than a sliding scale of percentages, which is satisfactory to no one but the ship owner who, by a juggle in constructing his ship, is able to shift the charges on to some one else. – *The Nautical Magazine* 842

Part 10

A Trip Across the Desert

843

Between Days on the Suez Canal
Scientific American Supplement
July 20, 1901

844

OFF SOKATRA, May 10 – In 1869 the Suez Canal was opened to the world, a supposable photograph of the attendant ceremonies being still on sale at Port Said, wherein the figure of M. De Lesseps stands conspicuous in the foreground. Since that auspicious day the maritime history of the world has been revolutionized, 95 per cent of all steamers trading between Europe and the East now using this great waterway.

A rough estimate gives no less than half-a-million as the average number of persons passing through yearly. The twelve months ending in April of last year recorded 3,605 steamers as traversing the canal, aggregating more than eight million tons. Comparatively few are American; of three-hundred in January last, but two sailed under the Stars and Stripes. These were the *Buffalo,* from Gibraltar to Manila, and the *Alexander,* from Manila to Norfolk, both carrying war material. The largest steamer of her class to go through was the North German Lloyd *Grosser Kurfurst,* in November. Of 13,000 tons burden, her English cabin passengers alone numbered three-hundred. In addition to those steamers actually traversing the canal, over five-hundred last year landed cargo or passengers at Port Said, while two or three times a week boats leave these for the Levant, Jaffa, and Beirut.

This half-way house between East and West, with its forty-thousand or more inhabitants, can hardly be longer considered the international dumping-ground of refuse villany; nor can it continue to claim the proud distinction of being the wickedest town of two hemispheres. 845

From the Mediterranean approach, after sighting the spidery lighthouse at Damietta, little is apparent except another tall column and the felacca-rigged dhows of the Arabs. The shores are so extremely low that buildings in the town first come into view, then the statue of M. De Lesseps, and the fine breakwaters, inside which a fleet of steamers of all nations may be seen, generally engaged in the very disenchanting operation of coaling.

Port Said is of necessity visited by all voyagers – everybody goes ashore, if for no other reason than to escape the blackening ordeal of his ship. It cannot be said that the town offers anything very attractive in itself; a fine beach, a boulevard along the water, a main street which suggests a toy bazaar, and a seven-story building of brick and iron being all that the casual traveler notices. This "Eastern Exchange Hotel and Clubhouse," however, is the first really fine edifice erected here, except the handsome and far more picturesque headquarters of the canal company, surrounded by lawns and flower-beds. The hotel is the only one under English management, and here one may find late newspapers and view an endless number of manufacturers' samples and framed cards. The building cost nearly half-a-million dollars, and was the first hotel in Egypt lighted with electricity.

The streets, wide, dusty, unpaved, are filled with a motley company. Egyptians, men and women draped in somber black, brown Arabs, ebony Sudanese, mingle with Europeans of every color and cline, while English, French, and Arabic are heard equally. 846

Rates of toll for the canal may be altered, but only after three months' notice in the capitals and principal parts of all nations most concerned. These are never to exceed ten francs-a-ton of capacity, or for each passenger, and have already been twice reduced. Despite that fact, the steamer carrying the Amherst Eclipse Expedition to Singapore paid 800 pounds in dues, even with this expenditure saving more than two-thirds the cost going around the Cape, to say nothing of time.

The rules governing passing craft appear to be strict. Written information as to his ship must be handed in by each captain – her name, nationality, and draft, the port of sailing and destination, as well as his own name and that of owners and charterers and the number of passengers and crew. Naturally, nothing must be thrown overboard, especially ashes and cinders; but also nothing to be picked-up, notice of any article lost overboard being left at the nearest station. No guns shall be fired, and no steam whistle blown except in cases of extreme danger.

We are rather gruesomely reminded that burial in the canal banks is strictly forbidden. All sailing vessels above fifty tons must be towed; above one-hundred tons must also take a pilot, and no sailing craft may navigate at night. While pilots are compulsory, the entire responsibility still rests with the captain. If local pilots know the canal better than a stranger, it is argued that the captains appreciate more thoroughly the peculiarities and steering capabilities of their own ships.

847

Pilotage dues are only $5; but, at night, rates are doubled. If a collision appears unavoidable, all ships are instructed to run aground to avoid it, the sandy and yielding nature of shallows near the banks offering the less of two evils. But no other ship is permitted to help off a grounded one.

Each vessel, on arrival at either end of the canal, must be entered at the Transit Office, and is then supplied with an extra rudder, for more instantaneous control, and at night each must also carry, on its bow, an arc light of sufficient power to show the channel for 1,200 meters ahead, and, when "split," to be capable of illuminating around the vessel an area not less than 200-meters in diameter…

848

Suez Canal Navigation Highlights

Steamship Mutual / Suez Canal Authority

Based on the SCA "Rules of Navigation" (2007 Edition)

849

Introduction

850

Further to an incident occurring to a Club entered vessel whilst conducting a transit of the Suez Canal the Loss Prevention Department would like to bring to the attention of Members and their vessels the following areas of navigational interest from the Suez Canal Authorities 'Rules of Navigation' which must be borne in mind by all Deck officers engaged in navigating vessels through the Suez Canal.

851

Responsibilities

852

All vessels and the Master and Owners thereof, by the action alone of navigating in the canal bind themselves to the conditions laid down in the Suez Canal Authority Rules of Navigation and to which they acknowledge being familiar with, and conforming with said contents.

In particular, Members must remain aware that any vessel transiting the canal or at its associated ports or roads is responsible for any damage or consequential loss it may cause either directly or indirectly to herself or to canal property, personnel or any third parties. Such vessels are deemed responsible without the option to release themselves from responsibility by limited liability. Moreover, the vessel and its owners guarantee to indemnify the Canal Authority in respect of any claim arising against them by reason of any damage they may cause either directly or indirectly to a third party. Finally a vessel and her owners wave the right to claim against the Canal Authority for any damages caused to them by a third party whilst in the canal.

As the results of any incident which may occur in the canal the Canal Authority may delay a vessel for the purpose of investigating any claim or dispute that may arise, or due to any formal or informal complaints that may arise, or for an alleged violation of the rules of the canal or due to security reasons. A vessel may also be delayed until any damage to ship, hull, fittings or any other concerns have been made such that the vessel is deemed capable of completing a safe passage through the canal. If a vessel is detained for whatever reason no claims for damages from vessel or owners will be entertained by the Canal Authorities. 853

Navigational Requirements

854

Vessels will not be allowed to the transit the canal in any of the following cases:
1) If her Tropical loadline is submerged or her loadlines not clearly visible.
2) Any vessel considered by the Canal Authorities to be dangerous to navigation.
3) If a vessel has a list of more than 3-degrees.
4) If trimmed such that her maneuverability is affected.
5) If a vessel is loaded such that she is very tender or her stability is a cause for concern.
6) If a vessels maximum draught exceed the canal maximum permissible drafts.
7) If a vessel is carry dangerous goods and not complying with the requirements of the Rules of Navigation in respect of said goods.
8) If a vessels deck cargo is protruding from the vessels sides in such a manner that it is endangering the safety of the transit.

All vessels transiting the canal must have an operational main engine RPM indicator and rudder angle indicator available in the wheelhouse. In the event of the RPM indicator being defective then a vessel will still be permitted to transit the canal, however, if the RPM indicator is still defective on the second transit and each following transit then an additional due of US$4,500 will be payable. If the rudder angle indicator is defective then the vessel will not be permitted to transit the canal, or may transit the canal towed by Canal Authority tugs. 855

Prior to transit all vessels must ensure their steering gear, engine room machinery, telegraph, VHF, radar, bridge-engine room communication systems, whistles and, as mentioned above, main engine RPM indicator and rudder angle indicator are all in good working order. All vessels, not fitted with a main engine telegraph logger must maintain bridge and engine room movement books during their transit.

All vessels transiting the canal are to be provided with a searchlight on their bow meeting numerous specifications as laid-down by the Canal Authority; the Rules of Navigation should be referred to for the full specifications as to what is required.

All vessels entering, transiting or leaving the canal must take a pilot, however, the Canal Authority may assign a tug master on vessels of less than 1,500 S.C.GRT (Suez Canal GRT) or a coxwain on vessels of less than 800 S.C.GRT in place of a pilot. In some cases an extra pilot will be required, such as on vessels exceeding 80,000 S.C.GRT, Lash vessels of over 35,000 S.C.GRT, all fourth generation container ships and third generation container ships of over 60,-000 S.C.GRT. In addition additional pilots will be required on vessel having restricted visibility from the bridge, or on any vessel with a draft of greater than 16.15 m (53 ft.). 856

All vessels must comply with the requirements of the International Regulations for Preventing Collisions at Sea (COLREGS) whilst in the canal and all waters connected therewith.

The Master of a vessel or his qualified representative must be present on the bridge at all times, and any peculiarities with regard to the shiphandling of the vessel must be brought to the attention of the pilot upon boarding the vessel. A bridge, engine room and anchor watch must be maintained, as applicable, whilst a vessel is in canal waters.

The duties of the pilot will commence and cease upon entering or leaving the entrance buoys at either Port Said or Suez, and the pilot will only give advice on courses to steer, engine movements etc. The responsibility for the safe navigation of the vessel remains with the Master at all times. If, in the interests of dispatch, it is deemed appropriate for the pilot to give helm and/or telegraph orders and instruction to attending tugs, then any such order will be deemed to have been given by the Master, and the responsibility will rest with same.

In cases of bad weather the canal authority may authorise Masters to bring their vessels into the entrance of the canal to facilitate safe board for the pilots. 857

Upon boarding a vessel a pilot will hand the Master a Declaration of Navigability which is to be completed by the Master, signed and then returned to the Pilot.

During navigation all vessels should stop when the passage ahead is not clear, and slow down when passing collapsed or banks under repairs, as well as when passing vessels in sidings or cuts, or dredgers or any other floating units made fast.

With regard to navigation within the canal, the following activities are prohibited:

1) Anchoring or the use of thrusters within the canal, except in the case of absolute necessity.
2) The use of automatic pilot when in the canal is absolutely forbidden, hand steering is to be engaged at all times whilst underway.
3) The sounding of the whistle is forbidden except for the sounding of authorised or required signals.
4) Blinding lights shall not be directed at the bridge or in any direction which would interfere with the safe navigation of other vessels. 858

Vessels transiting the canal are restricted in the maximum transit speed permitted based on vessel type and location within the canal as shown in the table below.

Maximum Suez Canal Transit Speeds

Location	Tankers Group	Other Vessels
Port Taufic – Gineifa with a head current	6 Knots	7 Knots
Port Taufix –Gineifa with a stern current	7.5 Knots	8 Knots
Gineifa – Kabret	7.5 Knots	8 Knots
Kabrey– Deversoir	8 Knots	8.5 Knots
Deversoir – Port Sand	7.5 Knots	8 Knots

For vessels that are particularly slow, additional dues may be levied.

For vessels with a draft exceeding 12.8 metres (42 ft.), the vessel shall observe the same speed as stated above for vessels in the tankers group, however, this does not apply to container ships. If a vessels transit speed is equal to her critical main engine RPM then the vessel should contact the Canal Authority and advise them accordingly. 859

Although no maximum or minimum distances to be maintained between vessels within a canal convoy are specified, vessels shall ensure they observe the maximum permitted transit speeds as tabled above, and maintain an adequate distance to the vessel ahead and astern. This is to ensure that they can take suitable positive avoiding action in the case of the vessel ahead suffering engine/steering failure and/or running aground, and such that they can advise vessels astern in case of an incident with own ship, such that the vessel astern has as much warning as possible so as to take suitable avoiding action. Distances to vessel ahead and astern should be monitored during the Canal transit and any concerns raised with the pilot(s) onboard such that distances can be increased if this is deemed necessary.

860

Use of Tugs

861

The Suez Canal Authority has various requirements concerning the mandatory escort of vessels by Authority tugs, the principle ship types affected being VLCC's, ULCC's, LPG/LNG and large bulk carriers, the various requirements for the number of tugs depend on a vessels S.C.NRT (Suez Canal Net Tonnage). There are various other requirements including tugs being required to escort loaded semi-submersible vessels and drillships, and the full various requirements for the imposition of tug can be found in the Rules of Navigation.

The Master of a vessel having use of a tug placed at his disposal has the executive control for the maneuvers of the tug and his vessel. As stated previously, for expediency, orders may be given directly by a Pilot with the Masters agreement. However, any damage of accidents resulting directly or indirectly from the use of a tug by a vessel, including damage to the tug itself, whatever the circumstances of the incident, the vessel and Master of the vessel will be held responsible.

The Canal Authority may impose the requirement to take one or more tugs during a canal transit, whenever the Authority deems this necessary for the safety of the vessel or the canal. This may apply to any vessel without mechanical power, whose machinery is or becomes disabled, has malfunctioning steering, or which may become unmanageable for any reason, or having engine or steering problems for the second time during a transit.

Vessels with poor wheelhouse visibility due to deck cargo or other obstructions shall be towed through the canal. 862

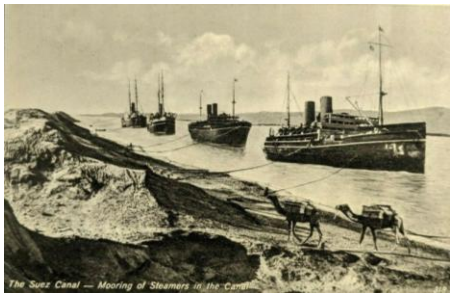
Mooring Boats and Moorings

863

Vessels transiting the canal are to be provided with mooring boats by the Canal Authority, with one boat required for vessels up to 5,000 S.C.GRT, and two for larger vessels. These boats are to be hung off utilising ships lifting gear such that they are ready for immediate use, and it has to borne in mind that these mooring boats are quoted as having a gross weight of 4 tons, including crew, especially if it is planned to use a ships provisions cranes. If a vessel is unable to lift the mooring boat(s) and does not have or is unable to use her lifeboats then she will have to be escorted through the canal by a tug.

To enable all vessels to be made fast to the canal bank, if this becomes necessary, at least 6 floating mooring lines are deemed necessary by the Canal Authority. It is also further stated that all vessels should have fire wires made fast both forward and aft to enable the vessel to be moved in case of emergency.

864



865

Emergencies

866

Whenever a vessel which under any circumstances causes or finds obstruction in the channel she must immediately warn other vessels in the vicinity by sounding 4 long blasts on her whistle to mean 'the channel is not free.'

This signal must be repeated every 3 minutes until concerned vessels have answered in the same manner. As soon as they hear the signal mentioned, these vessels must take steps to stop and commence a radio watch to received full details of the alert given by the vessel which sent the original warning signal. The other vessels shall then maintain a radio watch until advised otherwise.

If, when a vessel is approaching or passing a dredger and suffers an engine or steering failure, such as to make the vessel Not Under Command as per the definition in the Collision Regulations, then the vessel has to give the signal: one long blast followed by two short blasts on her whistle.

If a vessel is underway and has to stop in an emergency, she must, if other vessels are following, attract their attention by giving 5 or 6 short blasts on her whistle, supplemeneted by four of five long flashes with the aldis lamp or mast signal lamp and also contact the local movement control office by any means and advise them 'I am reducing speed and may have to stop and make fast'. A vessel stopping accidentally at night, must in addition, immediately replace their white stern light by a red light and the requirement to display the red light on the stern rather than the stern light also applies when a vessel is made fast in the canal for whatever reason.

867

If a vessel runs aground then the vessel must immediately hoist the signal specified in the Rules of Navigation dependent on whether the passage is clear for tugs or not, and contact the appropriate control office advising whether a tug is required or not. In the case of a grounding then the Canal Authorities are empowered to order and direct all operations required to get the vessel afloat and if necessary unloaded and towed. However, the Master and vessel remain responsible for all damage or accidents of whatever kind occurring which may be the direct or indirect consequence of the grounding. All attempts by other vessels to free a grounded vessel are strictly prohibited.

All charges which may incurred by the Canal Authority for towing a vessel post grounding or to refloat, repair or unload a vessel will all be for the vessel and her owners account.

When a collision appears probable, vessels must not hesitate to run aground in order to avoid a collision, and in this regard vessels should be aware of the nature of the canal bottom and banks at all times, so as to, so far as possible, ground on sand if this is possible.

868

In the event that a vessel strands, sinks or runs aground, the Canal Authority, if it deems the vessel to be an obstruction or a menace to navigation, shall of its own accord take such action as may be necessary to remove or destroy the vessel by whatever means it deems necessary, all for the owners costs. The authority may also sell the vessel or wreck at public auction so as to cover all expenses incurred.

In the event of a leak occurring or being discovered on a vessel, the local control office must be informed at once, and vessels in the vicinity must be informed by the vessel sounding a prolonged blast on her whistle and taking all actions to cure the leak. In such a situation the Canal Authorities may take whatever action they deem necessary, including moving the vessel to a berth, taking her to sea or beaching. And needless to say, the vessels owners are responsible for all costs incurred and damages arising either directly or indirectly from any such incident and any associated pollution including costs and compensation.

869

In the event of a fire occuring on a vessel she must immediately inform the local control office and alert vessels in the vicinity by sounding a prolonged blast on her whistle. Vessels in the vicinity, if applicable, shall be ready to change position if it is deemed necessary. Subsequent fire fighting activities onboard will be the responsibility of the Master, however, Canal Authorities will cooperate with the Master for the purpose of conducting the fire fighting operations. If, in the opinion of the Canal Authorities, there is a risk of the fire spreading, they may order any action deemed to be in the best interests of all parties, including removing the vessel to sea, beaching the vessel or moving berth. Vessel and Owners are again responsible for all damage and accidents arising from fire outbreaks and subsequent salvage efforts.

In the event that a vessel opts to moor voluntarily during a sandstorm or fog. She shall sound during the maneuver 6 short blasts on her whistle every 2 minutes. Once the vessel is moored she must ring a bell rapidly for 5 seconds at intervals not exceeding one minute. If the vessel if over 100m in length she will have to ring the bell forward and a gong aft, at intervals of not exceeding one minute. The vessel is to continue making these signals until she is notified that all other concerned vessels have been informed of her mooring.

870

Pollution

Vessels must not discharge any polluting substance into the canal, this includes polluted ballast water, slops, polluted bilge water, oil or garbage. An additional due of US$5,000 is levied for any garbage, waste or objects thrown overboard. Again, any pollution costs, damages and cleanup costs, incurred either directly or indirectly, will be for vessel/owners account.

871

872

Signals

Whilst in the canal a vessel may be signaled by one of the shore stations along the canal bank to conduct movements/actions such as standby to proceed, proceed, make fast, immediate stopping etc. During daylight these signals utilise the standard marine navigational shapes such as a cylinder, ball and cone, and the letter, numeral and substitute code signal flags, at night lights are used; for full details or the various signals given by the various signal stations and their particular meanings the Rules of Navigation have to be consulted.

Numerous day and night signals also exist for use by vessels within the canal, again using navigational shapes, code flags and lights, and these in some cases differ from the signals in standard use. Signals of note include non-gas free tankers, LPG/LNG tankers and tankers carrying dangerous chemicals in bulk having to display a ball above a code flag Bravo during the day and a white light over two red lights in vertical line at night. Also a vessel requiring a pilot is to display a ball above a code flag Golf during the day and 3 white lights in a vertical line at night. Some of the signals displayed by dredgers operating within the canal differ from the requirements of the International Regulations for Preventing Collisions at Sea and deck officers will have to bear this in mind whist transiting the canal; for example, a dredger will display the side on which it is clear and safe to pass with a cylinder by day, rather than two diamonds, and a white light at the yard arm or two white lights in a vertical line on the bulwark by night, rather than two green lights in a vertical line. Again, for all the various signal used by all types of vessels that may be encountered in the canal the Rules of Navigation will need to be consulted.

873

874

Penalty Dues

In certain circumstances a penalty due may be levied on a vessel that does not comply with the requirements of the Rules of Navigation.

If a vessel manoevers in the canal or Port Said or Suez waters without a pilot the canal authority will charge an additional due, for maneuvering in the canal this is presently US$21,500. However, this requirement does not apply if the pilot is for some reason incapacitated and not able to continue his function.

Vessels proceeding in the same direction are not permitted to overtake one another unless authorised by the canal control office. Violation of this rule will attract an additional due of US$43,000.

875

876

The foregoing is not an exhaustive resume of the Suez Canal Authority Rules of Navigation (2007 Edition), merely the highlights with regard to the navigation of vessels through the canal. For the latest requirements of the Suez Canal Authority the latest edition of the Rules of Navigation will have to be consulted.

877

A fine plan for giving safety to all ships in transit is in operation, much resembling the well-known “block system.” The company controls the departure and entrance of all ships, the order of precedence being wholly in their hands, by which not only security, but the speed of mails is ensured. No ship may demand immediate passage for any reason, but preference is given to regular mail steamers under government control. These carry a blue signal, with P cut-out in blank, and a white light at night.

The canal is blocked-out in divisions, and at the head office in Ismailia a dummy model shows the exact position of everything afloat. No vessel may proceed until the way is clear, and a complete system of telegraphic signals ensures this condition. Along the banks are small stations, twelve between Port Said and Suez, each furnished with a high masthead, from which red and yellow balls by day and colored lights by night announce to each vessel whether to proceed through the next division or to “tie-up” and wait for one to go by from the opposite direction. Ships going in the same direction are not allowed to pass one another. Every five or six miles there is a short widening, called locally a “gare.” where vessels make fast. The expression “to gare” is also used.

879

On the eastern bank distances are marked in miles, on the western in kilometers; and buoys, white on the east, red on the west, mark the deep-water channel. Buoy lamps in the lakes are kept alight day and night, supplied automatically with oil for three months.

Before proceeding very far, signals (two red lights above a yellow) informed us that it was our turn to wait the passing of some steamer from Suez. Immediately our speed was slackened, all movement ceasing as we approached the mooring posts. A small boat must always be in readiness for use with each steamer, and, manned by two or three agile Arabs, a dark object shot out from our side, while shadowy forms jumped ashore, making fast, by bow and stern hawsers, to the deeply embedded bollards on the western bank.

At once all our lights were extinguished, the signal that we were fast, and the approaching steamer drew near with much majesty, her searchlight shedding a brilliant glory forward as she silently glided on. Her passengers could make little of us, I fancy, as, according to strict regulations, no lights must be shown by the waiting craft; but the passing steamer, a French mail, was herself gay with lights and people, a pretty spectacle, near and picturesque.

Another followed as we still lay quiet. The welcome signal to proceed, a red light above a yellow, finally flashed forth for us from the station, the Arabs deftly uncoiled hawsers, cast-off, and, jumping into their little boat, were alongside and aboard in an instant, our lights once more awoke, and we proceeded on our quiet way.

881

…All preliminaries being duly adjusted, we started through as a brilliant Egyptian sunset was burning in the west, and a crescent moon looked down through skies of wonderful clearness upon the varied scene. Any town with lights and water may be beautiful at night, and, as we slowly moved away from the anchorage, even Port Said rose to dignity and loveliness, its lamps reflecting long, wavering lines in the still harbor. Eighty-seven miles lay before us, at a speed not to exceed five-and-a-half knots. Sixty-six are actual canal, while twenty-one miles of the navigation run through Lake Timsah and the Great and Little Bitter Lakes. The fact of the route passing naturally through these small bodies of water did not, to any great degree, lessen the labor of dredging. Only in Great Bitter Lake was their sufficient depth for ocean steamers without artificial excavation, and that for a distance of but eight miles. Here steamers are allowed to use their normal speed and may pass without stopping.

On its surface the canal is generally 320-feet-wide; in three places, where the banks are high, aggregating eighteen miles altogether, it is reduced to 195-feet. Its floor measures 72-feet, and the company engage to keep this width dredged to a depth of 26-feet. While the soil is chiefly of sand, there is little rock, soft line or sandstone near El Gisr, sandstone also being encountered beyond Tusun. At Serapeum a few yards of hard gypsum were found.

878

For a short distance from Port Said the Egyptian side shows a narrow plantation of palms and low-growing shrubs, from the depths of which young frogs make insistent music, a cricket or two adding shrill soprano. Beyond the shrubbery, the high moon lighted the shallow Lake Mensaleh into a wondrous sheet of silver, growing wider until no land could be discerned on its farther side. After nine miles it retreats from the canal, leaving a level desert. The eastern bank as well is a low, sandy pain from which evaporating shallow ponds have left a white sediment of crusted salt all over the verdureless country.

As far as El Kantara the low land continues. With a “high Nile” the west side is often overflowed, by which the canal banks are really benefited; the mud deposit, thick and black, strengthening them so that no openings have been forced. At El Kantara the road comes in from Cairo to Jerusalem, less is use now than before steamers went to Jaffa.

Despite the level country on either side, the evening was full of beauty and interest. The marvelous African firmament seemed to disclose more star than one knew before; a gentle wave followed our slow progress, to break in miniature surf now and then on the sandy banks, and our brilliant arc light, sometimes turned from side-to-side, cast a theatrical gleam ahead.

880

Ismailia was reached early in the morning, little but its forest of dhow masts appearing. Near the bank a whole native family seemed to be keeping house in a small rowboat. A man, two women, and a child, evidently recently aroused from their slumbers, had lighted a fire in their tiny craft, over which their breakfast was cheerfully cooking. The pink of sunrise was still flushing the sky, and a Moslem here and there prostrated himself toward the east.

In pale-green perspective the narrow waterway lay between its yellow desert banks, lost astern in early-morning haze, but leading forward into a mysterious shimmering landscape of sunny sand, where faint pictures, drawn in vaporous tints, suggested distant mountains bare and rugged, but softened to mirage effects by the luminous lambent atmosphere.

On we crept, along our silent, stealthy way, while steamers now and then “tied up” for us, dredgers on their huge, unwieldly machines glanced up un-curiously, and occasional stations, with small irrigated gardens and wide verandas, shaded by palms and brilliantly blossoming trees, made oases of coolness and comfort in that dry land of perpetual sunshine. Farther out on the desert were occasional ruins; and a tiny train made noiseless if deliberate progress toward Suez.

882

No perceptible tide or current vexes the Bitter Lakes, the height of their water remaining unvaried, During the winter a current runs northward in the canal, between the lakes and Port Said, and opposite in summer, which perhaps depends on changes of height in the Mediterranean. Little evidence has been found to show that the rising of the Nile affects this current in the maritime canal, although its fluctuations coincide in seasons. But there is communication with Mensaleh Lake, for, when this is filled by the Nile, the water of the canal also becomes fresher as far as El Kantara, the connection taking the form of fresh-water springs at the canal bottom, which sometimes make upheavals of two or three feet. In April, when Mensaleh is low, the canal, as indeed is the case always wit the Bitter Lakes, becomes much saltier than ordinary sea water.

883

Emerging from the canal and rounding a point where the line of dry trees at Port Tewfik tells pitiful tales of heat and drought, anchor was cast in the beautiful bay. Along the curve of the shore lay white Suez, aglow in noonday sun-shine, a long line of green palms at one side. Armies of white gulls sailed serenely through the still, warm air, occasionally descending *en masse* to the pale-green water, there to float serenely in a little fleet, rising and falling on the gentle waves. Back of both towns, and far to the east, the yellow desert lay blindingly asleep in the sun, stretches of endless sand, great, masterful, mysterious, the palms at "Moses' well" rising in shadowy plumes against distant Arabian mountains. 884

West of Suez the gleaming sand crept upward from the plains of Mohaggiara around the bases of the majestic Ataka range, suddenly giving place to their stupendous rock cliffs and precipices. Not one green or growing thing softens their harsh boldness, but the atmosphere takes them in hand, painting elusive tints on foreground and further distance, spreading a pearly opalescence with suggestions of red flame at the heart of things, finally melting away into the far line of open sea horizon.

From the Straits of Jubal at the southern end of the Gulf of Suez, Mount Sinai and Mount Horeb may be seen, conspicuous peaks in the chain Jebel Musa. Through the Red Sea, that hot highway of nations, from which the keels and commerce of the world are never absent; past the port of Mecca, where twenty-thousand and more pilgrims land yearly in their devout journey; past Mocha and its traditions of coffee and Zurkur, largest island of the sea; through the famous Straits of Bab-El-Mandeb, leaving Aden shimmering in the dry heat, and Cape Guardaqui looming astern, we are today striking Sokotra, that strange island under British control, about which so little is known. Fine aloes grow wild, four-thousand or more Arabs inhabit its valleys, and, despite several wrecks on its eastern point, no lighthouse warns of its proximity – dangerous during the southwest monsoon.

885

In 1896 Mr. Theodore Bent induced a steamer bound for Bombay to land him there as a favor, with Mrs. Bent and a friend, and he spent some months exploring and hunting. An article descriptive of those experiences, and of the flora and fauna, the natives and mountain-peaks, is perhaps the only one ever written of an island passed yearly by countless steamers. The method of return to more frequented regions was problematic, but ultimately he reached Aden in the dhow of the local Sultan, at an exorbitant rate of passage, that potentate having ordered all other dhows to refuse him transit that there might be no competition with royalty.

And now the placid Indian Ocean, with its gentle remnant of northeast monsoon, its exquisite climate and enchanting moonlight nights, beckons us onward to the Far Orient. – *Mabel Loomis Todd in Evening Post*

886

Through the Suez Canal on a Man-of-War

by *H.H. Byrne,* U.S.N.
Scientific American
July 19, 1902

887

ABOUT noon, August 14, 1901, the U.S. gunboat *Castine,* then returning from the Philippine Islands, dropped her anchor at Port Tewfik, once called Port Abraham, the southern terminus of the Suez Canal. It is not the city of Suez that is located here, as is generally supposed, for that city lies about three miles to the northwest of this place. 888

Caption: "Entrance to the Red Sea"

The city of Port Tewfik is an exceptionally small place, the inhabitants hardly exceeding a few hundred, in fact the only evidence of life is a few wandering Arabs along the quay, and an occasional donkey or camel. You cannot form your opinion from these observations, however, for at the noon hour very nearly all of the inhabitants are taking their daily siesta, an essential requisite for anyone desiring average health in Egypt. If you wish to see Port Tewfik, go ashore at sunset, then you will see on the water front roadway the inhabitants taking their daily walk or drive; for all are more or less interested in the ships just arrived from the Red Sea and Port Said.

About sunset the pilot came aboard and announced everything ready for our trip "across the desert," which we were to make during the night, an immense searchlight having been rigged over the bow for the purpose. After a few moments' delay, caused principally by the natives remaining on board until the very last second in their efforts to make just "one more sale," we "up anchored" and started our journey.

889

The Great Suez

890

The plans for the construction of the Suez Canal were by no means originated by De Lesseps, for as early as the year 1640 similar ideas were entertained but not matured because of an existing superstition. The Red Sea was thought to be above the level of the Mediterranean and any connection of the two would only result in the disastrous flooding of that entire part of Egypt. De Lesseps, however, deserves the distinction of bringing the possibility of his plans before the eyes of the world sufficiently well enough to warrant its commencement and of directing its construction to complete success.

A company was formed and after obtaining the consent of Egypt, Turkey, Russia, France and Austria, but not of Great Britain, work was actually begun under the immediate supervision of Daniel Lange in the year 1858, just six years after its idea had originated with De Lesseps.

891

In the early part of 1869, that part of the canal between the Lakes and the Mediterranean was opened to traffic. While this section was in progress, there was at the same time a connection being made with the Nile and the lakes and from this vein a connection with the Red Sea via Suez; in 1869 a complete passage from sea-to-sea was announced and in the same year this passage was made by Clarence Paget, an English lord, the itinerary of the trip being form the Mediterranean to Lake Temsah by the smaller or independent route, then through the main canal to Bitter Lake and then by fresh water route into the Red Sea. In addition to irrigating the land in its vicinity, this waterway served as a reservoir to the cities of Port Tewfik and Suez, a decided necessity at those places, for previous to that time, a great portion of the inhabitants used water imported from so great a distance as Cairo and Alexandria.

892

Caption: "The Suez Canal with the Fresh Water Canal 'adjoining'"

In November of the year 1869 the main canal opened for traffic in the presence of the Emperor of Austria, Empress of the French and Viceroy of Egypt. Thus in eleven years the greatest feat ever attempted in engineering was successfully performed in spite of the incessant predictions to the contrary by some of the leading engineers of that time.

In its first stages forced labor was universally used; this was, however, objected to by Egypt and was stopped soon after; in 1862 the waters of the Mediterranean were connected with Lake Temsah by means of an artificial channel independent of the canal. The existence of this and other lakes in the immediate vicinity and by reason of evidence found in the canal's construction, serve only to corroborate the sayings of geologists that the Mediterranean and Red Sea were at one time one body of water.

I will quote here an article taken from the *Edinburgh Review* concerning the possibility of constructing a breakwater at the Mediterranean entrance. It says: *"Any construction attempted so as to form and entrance for the canal will be swallowed up. Every block, every stone will be swallowed up, and we shall not see a single one above the water."*

893

Although in 1869 a passage was made by direct route from England to Australia in about two-thirds the time formerly required, it should be remembered that several years before that time it could be done also, only by a more complicated passage, for as early as 1863 ships leaving Liverpool and Marseilles traversed the Mediterranean bound for the Suez Canal where their cargoes were discharged into lighters of light draught and towed by tugs to Port Tewfik where they were again discharged into large steamers in waiting bound for India, China and Australia.

This seems to have been a complicated mode of transportation, but when the only other routes are considered, those of Cape Horn and the Straits of Magellan with their danger to shipping as well as the increase in distance, it is easily proved that the Suez route was the better of the three.

The advantages of this passage were three-fold, in addition to the facilities gained in shipping, the voyage was made under circumstances more agreeable and in much shorter time to the East, and last but not the least important, it yielded a revenue to the Canal Company much needed at that time, for in view of the adverse predictions as to the canal's success, funds were not freely appropriated by the French government, who were then fostering the enterprise.

894

By 1870 the canal's traffic doubled that of the year previous; in 1875 that number was quadrupled; during the year 1880, 2,026 vessels passed through, or between five and six a day; in 1882 this increased to eight a day; during the year 1890, 3,389 passed through, between nine and ten a day; over 74 per cent of which were British; the total receipts for this year were about $12,500,000, at an average cost of between three and four-thousand dollars' toll for each ship, and of this amount $5,000,000 was spent in the maintenance of the canal, thereby giving a net profit of $7,500,000 to its owners.

In 1873 the charges for tolls were doubled; this action caused the British ship owners to ask for a national conference which was held at Constantinople in December of the same year; this was followed by a protest from De Lesseps; his agent, Mr. Lange, informed those at the conference that unless back dues were paid the canal would be closed to their traffic. After much discussion the matter was compromised to the satisfaction of both parties.

In May, 1883, trouble again occurred between England and the Canal Company, whereupon the former determined to build a second canal; for this purpose a syndicate was appointed and met in November of that year, but before any action was definitely agreed upon De Lesseps compromised by agreeing to reduce rates and to widen the canal. This practically ended trouble of any serious nature between these parties and since that time England has purchased Egypt's shares, whereby she now owns an extensive controlling interest in the administration. 895

In view of the construction of our own canal, about to be begun, a few remarks here on the construction of the Suez will give a faint idea of the labor necessary. When the forced labor was finally prohibited by Egypt the company was confronted by very grave obstacles. Necessity, however, soon invented a steam dredge which after many experiments worked successfully; tracks were built on either side of the route on which these dredges mounted on cars traveled; by means of an arm, an endless chain with scoops attached was so arranged as to drag from the middle of the ditch inward; this dirt was carried away by hand labor, horse, mules and camels. Among the laborers were immigrants from most of the countries of southern Europe; the officials arranged matters so that these helpers would be assorted into gangs of their own nationality thereby averting any race trouble likely to occur. They were paid in money for the amount of work performed, making from 1 to 2-1/2 shillings-a-day. The amount of work done was determined by the cubic contents of earth removed.

In the construction of the canal before it was finally widened the total excavation reached 80,000,000 cubic-yards; this, however, has since been greatly increased, as the latest statistics give a total length of 100 miles (20 miles of which is lake) depth 31.2-feet, bottom width 108.2-feet and surface width 420-feet; these dimensions will allow the passage of any ship drawing not more than 25-feet of water. The British cruiser *Powerful* on her passage from England to China was obliged to go by way of Cape Horn because her draught was above the standard. 896

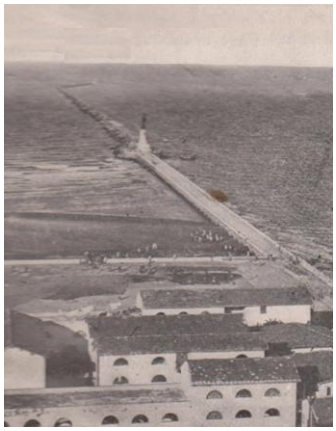
The rules governing ships while making the passage are many; a few of the more important are that every vessel is required to have a pilot; the captain of each ship is required to furnish, before entering, a complete list of passengers on board, for each of which a toll of $2.50 is charges; in cases of merchant vessels and men-of-war a copy of the muster roll is required; all life boats must be rigged inboard, a cutter shall be towed astern carrying the end of a hawser, to be used in mooring the boat aside to allow toe passage of another steamer. Ships having made half the passage are allowed the right-of-way, and mail steamers are allowed the right-of-way at all times.

The total cost of the canal when completed was $102,750,000.

The next place of interest is the city of Ismailia, situated on Lake Temsah; this is the central point of the canal and is a comparatively large town, its inhabitants numbering about 5,000 (mostly French). The homes of the pilots are situated here; there are also hotels, shops, cafes, a theater and a central railway station. The remainder of the trip is of little interest aside from camels and their masters who can be seen bound for different parts of the desert. 897

On arrival at Port Said we completed our journey in fourteen hours. The first thing to take the eye at this place is the activity of the port; here are assembled ships of every nation, some coaling or discharging cargo, while from seven to eight are probably awaiting their turn to enter the canal. The city of Port Said is, in comparison to cities in that part of the world, a modern place; previous to 1860 it was not in existence, but since the building of the canal, it has developed from a camping center into the "halfway house" of the East and West. 898

Caption: "Port Said"



At the latest census it had a population of 10,000, consisting more or less of a mixture, representing every nationality on the face of the earth. The streets are wide and very clean, and as for places of amusement, it has its share of music halls, their incomes being principally derived from travelers stopping at the place on their way through the canal. One of the principal points of interest is the lighthouse, a structure 180-feet-high, and for many miles at sea it determines the entrance of the canal.

Caption: "The Mediterranean Sea from lighthouse" 899

It was in the making of this entrance that De Lesseps found his greatest opposition; his opponents predicted the constant supply of mud and sand brought from the interior of Africa by the Nile would block any plan devised for the canal's entrance at this place. He persisted, however, and constructed two breakwaters, one on either side of the canal to converge toward the sea entrance; these walls were made of stone carried from a great distance and at enormous cost. When partly finished, artificial stone was made on the spot and was use in its completion.

On the western breakwater about a mile from shore is situated the statue of Ferdinand de Lesseps, with his right arm raised and his hand pointing to the south; you almost imagine you can hear him say "My canal." 900

Caption: "The west breakwater with statue of De Lesseps"

Part 11

Short-Cut to Empire

901

A Maritime Turnstile

902

The *Khamsin,* bringing heat and dust from the Sahara, had blown itself out. Now heavy seas were helping pile up cabin sites on the Port Said beach, and massy spray, breaking completely over the western jetty, reached up to where the statue of the Suez Canal hero extends a bronze arm in welcome to this maritime turnstile between East and West
***National Geographic,* November 1935**
RE: introduction to an article written by *Maynard Owen Williams* entitled: "The Suez Canal: Short-Cut to Empires"

903

Making Port

904

"OUTSIDE the long sea wall a small Yugoslav tramp wallowed under a deck load of lumber, her signal flags snapping, her engines at rest. Wrapping himself in an oilskin, the pilot entered the boat at our stern and the hawser was paid-out till solid water slapped the faces of the crew. Then we turned in a half-circle and swung the smaller boat as children play snap-the-whip. Steered nicely to the swaying rope ladder, the agile pilot clambered aboard…"
***National Geographic,* November 1935**

905

A SMALL STEAMER WALLOWS IN THE WHITECAPS OUTSIDE THE PORT SAID ENTRANCE TO THE CANAL

Signal flags snap in the cool, brisk breeze which follows the hot *khamsin* from the Sahara. The men in the pilot boat draw their oilskins more closely about them as their little craft ships spume, and the Yugoslav tramp which has been tossing outside the west jetty puts in for port.

906

Talking Shop

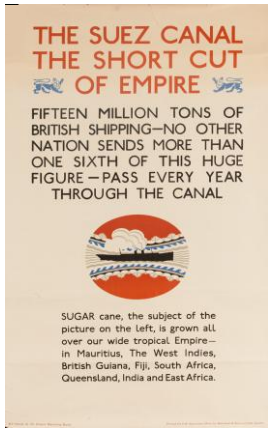
907

"…A landlubber at Port Said does not often have a staunch pilot boat under his command. So we visited the harbor and talked 'shop' – the Canal…"
National Geographic, **November 1935**

908

Singing its Praises

909



"…Those who man the narrow sea lane between the two hugest continents never tire of singing its praises. From Port Said to Port Tewfik, in squealing dredge and quiet office, in lonely station and noisy machine shop, the workers love it. The British most of all – for your Britisher knows the sea and all that pertains thereto…"
National Geographic, **November 1935**
Left: the "Empire Marketing Board" was formed in May 1926 by Colonial Secretary *Leo Amery* to promote intra-Empire trade and to persuade consumers to "Buy Empire." Abolished in 1933, it was actually established as a substitute for tariff reform and protectionist legislation (a system of imperial preference replaced free trade).

910

You Have it, Madam!

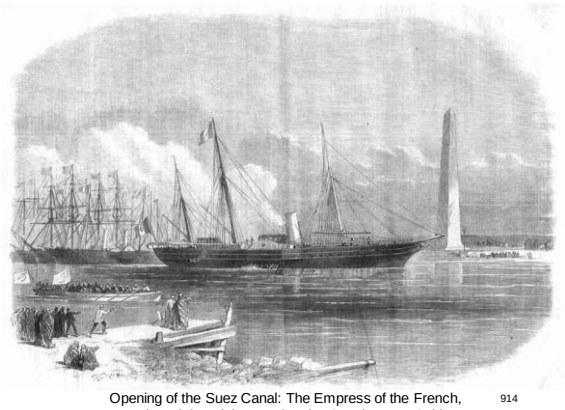
911

"…Frederick Greenwood, entertaining Lord Beaconsfield at dinner, told him that Khedive Ismail's Suez Canal shares could be bought…"
National Geographic, **November 1935**
RE: on November 14, 1875, *Frederick Greenwood,* the editor of the *Pall Mall Gazette,* learned from London banker *Henry Oppenheim* that the Khedive (title of the Viceroy of Egypt under Turkish rule 1867–1914) was seeking to sell his shares in the *Suez Canal Company* to a French firm. Greenwood informed *Lord Derby,* the Foreign Secretary, who notified *Benjamin Disraeli* (1804-1881) - a British statesman of the Conservative Party who twice served as Prime Minister of the UK and held the title: "First Earl of Beaconsfield." As PM, Disraeli moved immediately to secure the Khedive's shares.

912

"…It was nearly six years since the French yacht 'L'Aigle,' with banners flying and the Empress Eugenie on board, had proudly started the procession of 68 ships which, except for four days during the rebellion of Arabi Pasha, has never since stopped…"
***National Geographic,* November 1935**

913

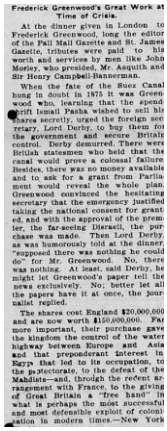


Opening of the Suez Canal: The Empress of the French, on board the *Aigle,* entering the Canal at Port Ssid

914

"…There was no wireless then. But poor communications could not deter Disraeli. The 176,602 shares were definitely offered him on November 23, 1875. On November 24 Rothschilds guaranteed the $20,000,000. On November 25 the contract was signed in Cairo. On November 26 the British Consulate had possession of the shares. Only then did the editor of the 'Pall Mall Gazette' publish the news of the transaction…"
***National Geographic,* November 1935**
RE: on November 23, 1875, the Khedive offered to sell the shares for 100 million francs. Rather than seek the aid of the *Bank of England*, Disraeli asked *Lionel de Rothschild* to loan the funds. Rothschild did so and, controversially, took a commission on the deal (the Rothschild's capital was at risk as Parliament could have refused to ratify the transaction). The contract for purchase was signed at Cairo on November 25, 1875 and the shares deposited at the British consulate the following day. Disraeli told *Queen Victoria*, "it is settled; you have it, madam!" The public saw the venture as a daring British statement of its dominance of the seas. *Sir Ian Malcolm* described the Suez Canal share purchase as, "the greatest romance of Mr. Disraeli's romantic career."

915



GAVE ENGLAND SUEZ CANAL.

Frederick Greenwood's Great Work at Time of Crisis.

At the dinner given in London to Frederick Greenwood, long the editor of the Pall Mall Gazette and St. James Gazette, tributes were paid to his worth and services by men like John Morley, who presided, Mr. Asquith and Sir Henry Campbell-Bannerman.

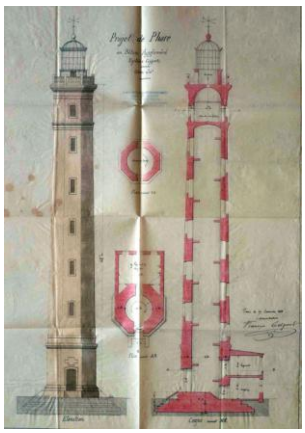
When the fate of the Suez Canal hung in doubt in 1875 It was Greenwood who, learning that the spendthrift Ismail Pasha wished to sell his shares secretly, urged the foreign secretary, Lord Derby, to buy them for the government and secure British control. Derby demurred. There were British statesmen who held that the canal would prove a colossal failure. Besides, there was no money available and to ask for a grant from Parliament would reveal the whole plan. Greenwood convinced the hesitating secretary that the emergency justified taking the national consent for granted, and with the approval of the premier, the far-seeing Disraeli, the purchase was made. Then Lord Derby, as was humorously told at the dinner, "supposed there was nothing he could do" for Mr. Greenwood. No, there was nothing. At least, said Derby, he might let Greenwood's paper tell the news exclusively. No; better let all the papers have it at once, the journalist replied.

The shares cost England $20,000,000 and are now worth $150,000,000. Far more important, their purchase gave the kingdom the control of the water highway between Europe and Asia and that preponderant interest in Egypt that led to its occupation, to the potectorate, to the defeat of the Mahdists - and. Through the redent arrangement with France, to the giving of Great Britain a "free hand" in what is perhaps the most successful and most defensible exploit of colonisation in modern times. - *New York World.*
***Turret Gold Belt*, Volume 6, Number 27, May 17, 1905**

916

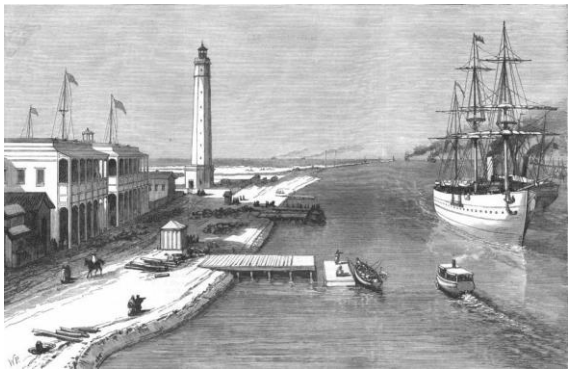
Aperire Terram Gentibus

917



"…We swung past a dredger and were opposite the statue of Ferdinand de Lesseps. The statue which once stood at the end of the jetty, is now miles from the outer buoy. The lighthouse, which was built at the edge of the Mediterranean, is blocks inland. The hundred-mile short-cut is getting longer. If the sea and wind keep on their work, the Sunday promenadeers on the Port Said jetty, which protects the Canal entrance from the Nile mud, may some day be able to walk halfway to Cyprus!…"
***National Geographic,* November 1935**
Caption: "Port Said lighthouse (1869-1870), François Coignet, cont.: Plan, section, elevation"

918



Lighthouse and Breakwater at the entrance of the Suez Canal, Port Said, July 1882

919

DE LESSEPS CONVERTED A SLOGAN INTO A REALITY

On the pedestal of this bronze statue at Port Said appears the Canal builder's ambitious watchword—"Aperire Terram Gentibus" (To Open the Earth to All Peoples). The outstretched right arm points along the "sand ditch" which shortened the route from London to Bombay by more than 5,000 miles. On the jetty stroll straw-hatted Westerners and fez-topped sons of the East, their ladies muffled in veils.

920

A Lockless Sand Ditch

921

Port-Said
The Office of the Suez Canal Company

"…The Suez Canal is a lockless sand ditch connecting two landlocked seas and three lakes. From the average crow's nest one may look down upon the highest earth ridge through which it cuts…"

***National Geographic,* November 1935**

Caption: **"A 100-Mile Ditch in the Desert is the 'Jugular Vein of Empire.' Through the 66-year-old Suez Canal, Great Britain and other powers are linked with their eastern realms. It is Italy's route to Eritrea, Somaliland and Ethiopia."**

922

A Barometer of World Life

923

"…But with industrial Europe at one end and the populations and raw materials of the East beyond, this sand ditch is a barometer of world life. Each separate cargo adds its clue. Coal, moving in the inverse direction; grain brought from unfamiliar fields; wood coming from Burma instead of Kamchatka; the appearance of unusual numbers of ships making their maiden trip; the use of Diesel engines instead of steam or oil fuel instead of coal; the numbers of soldiers sent out and brought back – thus world life registers its symptoms on the records of the Company…"

***National Geographic,* November 1935**

924

SAILS SURVIVE, THOUGH SHOVED ASIDE BY STEAM

Only local fetching and carrying is done by the small, wind-propelled native boats (see Illustration, page 630). Yet the Suez Canal dates from an era when much of the world's commerce was carried by tall-masted sailing vessels.

925

RAKISH SAILING VESSELS SHARE THE CANAL WITH MIGHTY STEAMSHIPS

From the desert, the hulls of these simple craft are hidden, and pointed sails, like slanting quills, write their record of maritime travel athwart an ancient caravan route (see text, page 627). Through the Sweet Water Canal such boats connect with the Nile and often await their turn at the locks of Ismailia or Suez.

926

Making the Dredges Squeal

927

"…In normal times, long this short-cut between hand and mouth, loom and back, and rubber tree and balloon tire, cargoes almost assemble themselves. Freight pays the profits, but it is the demand of the passenger for more palatial accommodations, the vogue for round-the-world cruises, that makes the dredges squeal…"
***National Geographic,* November 1935**

928

929

Longer, Wider, Deeper

930

"…A large proportion of the ships now using the lengthened, widened, deepened canal could have passed through it when it was first opened for traffic in 1869. But larger and finer liners are ever passing this way, coming to the Holy Land and Egypt from the rainbow crowds of Bombay, from Hong Kong with its barrel-chested chair coolies toiling upward toward 'the Peak,' from the cherry blossoms of Japan…"
***National Geographic,* Nov. 1935**
Caption: "Travel poster for the Orient Line service to Australia featuring *Otranto* in the Suez Canal, lithograph, ca.1912"

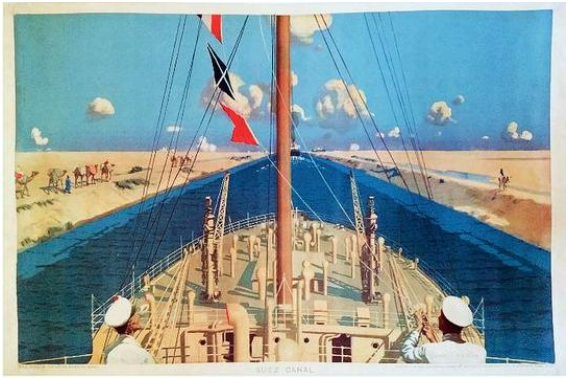
931

By Way of Suez

932

"…Ships, like travelers, are sun hunters, and when the cold winds sweep down from the Grand Banks and ice forms on the rigging, those not needed in the North Atlantic seek the Tropics. Many go by way of Suez…"
***National Geographic,* November 1935**

933



Caption: "Empire Marketing Board - Suez Canal, 1928, by Charles Pears"

934

War and Peace

935

"…According to the Suez Canal Convention of 1888, the waterway is 'always to be free and open, in time of war as in time of peace, to every vessel of commerce or of war, without distinction of flag'…"
***National Geographic,* November 1935**
Caption: "One of two Iranian warships crosses the Suez Canal on its way to take part in a joint training exercise with Syria in the Mediterranean, February 2011"

936

Caption: "*HMS Howe* passing through the Suez Canal in 1944 en route to the British Pacific Fleet"

937

East Meets West (and North and South)

938

"…Between Gibraltar and Massaua the shipping lanes are much the same, although Mediterranean ports furnish considerable cargoes. But once outside the corners of Africa, the ships go their separate ways, following the African coast to Mombasa, Durban, and Capetown; crossing the Equator to Melbourne and Sydney, pushing up the Persian Gulf to Bushire and Basra, entering the roads at Bombay or the treacherous Hooghly, berthing at Colombo or Insulinde, waiting in the Woosung for the Shanghai tender, or steaming past the peerless cone of Fujisan to the harbor of Yokohama…"
***National Geographic,* November 1935**

939

A Home Afloat

940

"…This one with the long, flat decks, tightly sealed, and a single funnel aft is a new oil tanker in from Abadan. That, whose dazzling upper decks are hung with passengers buying trinkets from a tossing bumboat by the cable-and-basket route, is a floating home for those who see the Bay of Naples, the Church of the Holy Sepulcher, Tutankhamen's tomb, India's burning and bathing ghats, Hong Kong's staircase streets, Japan's geisha dances, the Golden Gate, and two world canals – all without closing the wardrobe trunks placed in their staterooms in New York or Southampton months before…"
***National Geographic,* November 1935**

941

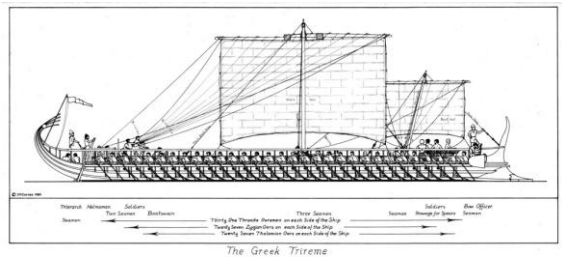
From the Nile to the Red Sea

942

"…Near Suez are the remains of a lock which was part of an ancient canal, begun under Seti I, about 1300 B.C. Rameses the Great, between waging Hittite battles, temple building, and sitting for stone portraits, found time to continue the waterway to connect the Nile with the Red Sea. Necho, son of Psammetichos, according to Herodotus 'was the first to attempt the construction of the Canal to the Red Sea – a work completed afterwards by Darius the Persian – the length of which is four days' journey and the width such as to admit of two triremes being towed along it abreast!' A dream which takes 800 years from the time when one man grabs his pick until another sees triremes passing each other between river and sea is a potent dream…"
***National Geographic,* November 1935**

943

944


The Greek Trireme

- Overall length: around 37m (121-feet);
- Overall beam: 5.5m (18-feet);
- 170-174 oarsmen in 3 files on each side: top file 31, middle and bottom 27-29;
- Oarsmen spaced at 2 cubits (0.888m / 2-feet 9-inches);
- One man per oar;
- Oar length 4.2m (13-feet 8-inches) and 4.0m (13-feet) - short oars at ends of ship;
- Speed: able to cover 184 sea miles at about 7.5 knots without stopping (Athens to Mytilini according to Thucydides);
- Weight (45 tons according to a report for the *Olympias*, a modern trireme reconstruction)

945

Caption: "A side view of a trireme, showing the relative positions of the oarsmen"

"…One of their kings tried to make a canal to it (for it would have been of no little advantage to them for the whole region to have become navigable; Sesostris is said to have been the first of the ancient kings to try), but he found that the sea was higher than the land. So he first, and Darius afterwards, stopped making the canal, lest the sea should mix with the river water and spoil it…"
Aristotle
RE: excerpt from his *Meteorology*

946

"…165. Next comes the Tyro tribe and, the harbour of the Daneoi, from which Sesostris, king of Egypt, intended to carry a ship-canal to where the Nile flows into what is known as the Delta; this is a distance of over 60 miles. Later the Persian King Darius had the same idea, and yet again Ptolemy II, who made a trench 100-feet-wide, 30-feet-deep and about 35-miles-long, as far as the Bitter Lakes…"
Pliny the Elder

947

"…Trajan seems to have kept the Canal in shape. The Caliph Omar had Amr ibn el-Asi restore the Canal to proper working order, but Al Mansur, near the end of the ninth century, wanted to stop the shipment of grain to Arabia, and so it was finally filled in…"
***National Geographic,* November 1935**

948

99 Years

949

"…For 2,200 years, various men were either building a canal, using it, letting it fall into disrepair, or deliberately destroying it. With such a record before them, one might have thought that De Lesseps and the present Company would have planned in terms of centuries. But the 99 years phrase imposed its convention, according to which, in 1968, the Canal will lapse to the Egyptian Government…"
***National Geographic,* November 1935**

950

Path of Least Resistance

951

"…When De Lesseps was barnstorming England on behalf of the Canal, the British had the thought of making a railway do the work. That would take 10 trains-an-hour, night and day. Were the Canal closed, India would be 5,000 more sea miles away…"
***National Geographic,* November 1935**

952

England and the East

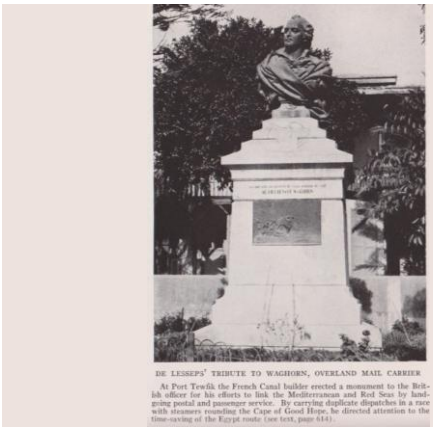
953

"…What broad burlesque it would be today to have Thomas Waghorn appeal to the India Office in London for permission to carry duplicate dispatches on horseback in an attempt to beat existing means of communication between England and the East! Yet it was by carrying such duplicates in competition with the steamers around the Cape of Good Hope – and soundly beating them – that Waghorn convinced the British that a railway from Alexandria to Suez would be a good thing. Ferdinand de Lesseps felt so grateful to this Don Quixote that he erected a statue to Lieutenant Waghorn at Port Tewfik…"
***National Geographic,* November 1935**

954

Caption: "Lieutenant Waghorn, 1845. Portrait of British naval officer Thomas Fletcher Waghorn, who pioneered a new route from Great Britain to India overland through Egypt before the construction of the Suez Canal in the 1860s. Waghorn claimed his route reduced the journey from over 11,000 miles (18,000 km) to 6,000 miles (9,700 km), taking between 35 and 45 days. At the time, steamships carrying mail took about three months to sail via the Cape of Good Hope. From Illustrated London News, 1845, Vol VII."

955



DE LESSEPS' TRIBUTE TO WAGHORN, OVERLAND MAIL CARRIER

At Port Tewfik the French Canal builder erected a monument to the British officer for his efforts to link the Mediterranean and Red Seas by land-going postal and passenger service. By carrying duplicate dispatches in a race with steamers rounding the Cape of Good Hope, he directed attention to the time-saving of the Egypt route (see text, page 644).

956

All in Agreement

957

"…When Napoleon dreamed of divesting Great Britain of her Indian Empire, he had preliminary surveys made with the intention of building a Suez Canal. Lepere, Napoleon's chief road engineer, estimated that the Red Sea level was 33-feet higher than that of the Mediterranean. This miscalculation stopped Napoleon. But not De Lesseps. To him the 33-feet looked smaller than the 5,000 miles to be saved. Then it was shown that the difference in level between the two ends of the canal would, by comparison, make the Dardanelles look like a waterfall…"

***National Geographic,* November 1935**

958

"…De Lesseps appealed to the Viceroy, Mohammed Said Pasha, and heard from his friend these cheering words: 'I am convinced and I agree to your plan: it is understood between us. You can count upon my support.' That was in the middle of November, 1854. In two weeks, De Lesseps had his coveted concession. He thought that the world would demand a slice of the melon. But it was five years before digging began. There was a time when bankruptcy hung over the Canal and for years the interest coupons were not paid…"

***National Geographic,* Nov. 1935**

Caption: "Mohamed Said Pasha, Viceroy of Egypt"

959

Steam vs. Sail

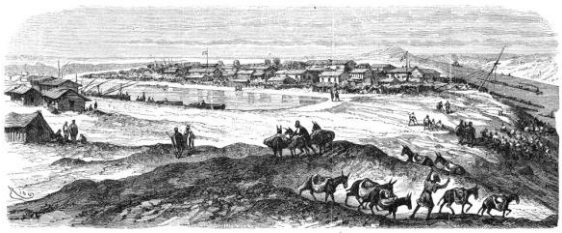
960

"…It is hard to believe that when the Canal was completed steam had not yet won the seas. When its supremacy over sail was proved, the success of the Canal was assured. A sailing vessel might waste the time required to circle the Cape, but a steamer's time, fuel, and bunker space were valuable…"
***National Geographic,* November 1935**

961

Corvee

962

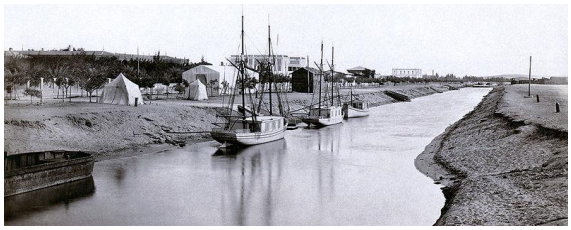


"…Not all of De Lesseps' difficulties were diplomatic or financial. The physical labor of digging a canal under the fierce sun of that desert, with little aid from machinery, was inconceivable. Even a seventy-mile sand ditch is a considerable problem for hand labor, armed only with primitive tools and soft baskets to transport the dirt…"
***National Geographic,* November 1935**
963
Caption: **"Suez Canal Construction - wood engraving, French, 1869"**

"…The Viceroy provided 25,000 workmen for whom the Company furnished food and pay high enough so that conscription was not necessary. But before he would ratify the firman, the Sultan of Turkey insisted upon the suppression of the 'corvee,' or use of forced labor, and this necessitated the wider use of machinery in the building of the Canal. Much modern excavation machinery was mothered by the necessities of the then unprecedented task at Suez. …"
***National Geographic,* November 1935**
964
Caption: **"Using a dredger to construct the Suez Canal, ca. 1860"**

Major and Minor

965



"…It cost $2,000-a-day to bring enough water by caravan to supply 25,000 men, so the Company constructed the second of the two essential canals. The Sweet-Water Canal takes-off from the Nile below Cairo and, splitting into a T at Ismailia, flows to Suez and Port Said. On it are locks by which small boats can step down to the traffic canal…"
***National Geographic,* November 1935**
RE: the Ismailia Canal (formerly known as the Sweet-Water or Fresh-Water Canal) was dug by thousands of Egyptian *fellahin* to facilitate the construction of the Suez Maritime Canal. The Ismailia Canal proper ends at Ismalia. Additional branches connect the canal from Ismailia to Suez and Port Said.
966
Caption: **"The fresh-water canal at Ismailia"**

B.E. (Before Exodus)

967

"…For many miles the Sweet Water Canal follows an ancient bed dating from the time of Tutankhamen. This waterway was first constructed to win from the desert the fertile land of Goshen, where Joseph and his family found a home and where the Israelites were later forced to make bricks without straw under the lash of the Pharaohs. The traveler hanging over the rail at Port Said and watching the fresh water tubing throb with every stroke of the pumps may not realize that this water has come from reconstructed waterworks which first served the people of Egypt before the Exodus…"

***National Geographic,* November 1935**

RE: the "Sweet-Water Canal" refers to a combination of the *Ismailia Canal* and its southern branch to Suez

968

Labor Relations

969

"…From the very first, De Lesseps showed a deep interest in humanitarian measures and from 1856 the employees have shared in the profits. There is a tradition in the Company that a man never quits and is never dismissed. Skilled workers pass an entrance test or come up from the ranks with a year's probation. Many of the pilots have commanded their own ships, but they spend two years on probation. A few picked day laborers attain permanent work…"

***National Geographic,* November 1935**

970

"…Although the model town called Port Fuad, in honor of the present King, was built by the Company on the barren east bank opposite Port Said, with homes and even gardens for skilled workers and laborers, some still prefer to draw a money allowance and live on the west bank near the cafes and movies…"

***National Geographic,* November 1935**

Caption: "Garden City of the Suez Company, Port-Fuad, Port-Said (1919-1924)"

971

With Due Regard for Profit

972

"…Some feel that the Canal pays too well and trade depression has brought some criticism of Canal profits. But the main thing for those who foot the bills is continuous, efficient service…"
National Geographic, **November 1935**

973

"…On the whole, the shipmasters pay the dues with a feeling that a few cents for each thousand ten-miles saved is not exorbitant, and the average passenger is glad to pay the equivalent of $2 to avoid going around by the Cape, especially since the Canal fee usually is included in the price of his ticket…"
National Geographic, **November 1935**

974

The Canal Company

975

"…The Compagnie Universelle du Canal Maritime de Suez is registered as an Egyptian company under Egyptian law, with its main administrative offices in Paris. The president is always French, as are also 21 of its 32 directors and its entire secretariat and higher personnel…"
National Geographic, **November 1935**

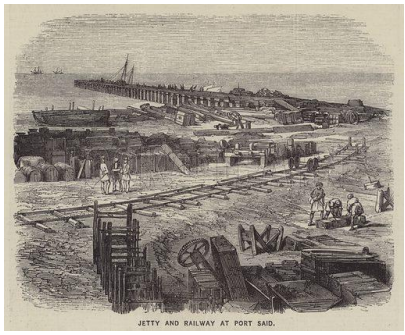
976

"…The general workers are a cosmopolitan group. I found a Corsican and an Italian in charge of one Canal station. At the next, the two men were a Syrian and a Greek…"
National Geographic, **November 1935**
Caption: "Suez Company European workers' housing, Port Tewfik, Suez (1922), Paul Albert, arch."

977

"…The Canal Company does nothing that it can get others to do equally well. When hand labor gave way to machine operation, various entrepreneurs were given the work of excavation and the majority of the digging was done by contractors. Part of the west jetty, made-up of cement blocks worth $65 apiece, was built by contract…"
National Geographic, **November 1935**

978



979

"…The Company had to construct a fresh-water canal and filtering stations in order to carry on its basic work. But it leaves the delivery of the water to others. The personnel has just three things to do: to keep the Canal open, to keep the ships passing through, and to keep the records…"
***National Geographic,* November 1935**

980

Caption: "Office building of the Suez Canal Co., Port Said, Egypt"

"…The maintenance of the Canal and its improvement is in the hands of the Works Department, whose officers are first-class graduates from the Ecole Polytechnique and the Ecole Centrale in Paris. One never knows how much equipment is required in the upkeep of a canal until he accompanies a member of the Works Department through the shops and around the small harbor where the broken-toothed dredges come back to have their dentistry done. It looks as though every disabled or incorrigible piece of wood or metal in that part of the world were dumped about…"
***National Geographic,* November 1935**

981

Caption: "Suez Company workshops, Port Fuad, Port Said (1919)"

982

Caption: "Suez Company workshops, Port Tewfik, Suez (1930), Paul Albert, arch.; Baume & Marpent, cont.: Southern facade"

983

"…Compared with the Works Department, the Traffic Department has a nice clean job. One sees no clutter of papers, no bulky correspondence. The principal officers are recruited from the French Navy…"
***National Geographic,* November 1935**

984

From Sea-to-Sea

985

"…There is, in addition to the watchfulness of captain and pilot, an eye on every ship that goes through the Canal from the time she is sighted in one sea until she is turned loose to shift for herself in the other…" 986
National Geographic, November 1935

"…The British Post Office refused to recognize the Canal for two years. 'Too slow,' they said. Yet nothing but an airplane has equaled the speed actually attained between Port Said and Port Tewfik on the Canal itself. The Traffic Department has some little thornycroft boats which can make the trip in a trifle over two-and-a-half hours…"
National Geographic,
November 1935

987

"…The speed for steamers is 6.21 miles-an-hour, but pilots exceed the limit when side winds prevent the ship from obeying her rudder at a slower speed. The Canal is now 104-1/2-miles-long, jetties have added considerably to its length in recent years…" 988
National Geographic, November 1935

"…During the transit of the Canal two pilots are used, each making one-half the journey. They serve only in an advisory capacity, though many a captain lets the pilot handle the ship as though it were his own…"
National Geographic, Nov. 1935
Above: caption: "A pilot boat on the new extension of the Suez Canal"
Left: caption: "Suez Canal pilots and Egyptian Army officers depart the guided-missile destroyer *USS Mitscher* after a Suez Canal transit, October 18, 2014" 989

990

"…Officers of the Company unhesitatingly sacrifice a single vessel to the common good. A shipload of explosives was sunk near the Port Said waterworks and a cargo of benzene in the Commercial Basin. But ships carrying dangerous cargoes are being removed farther and farther from the main anchorages and as careful a quarantine is kept against spontaneous combustion as against cholera…"
National Geographic, November 1935

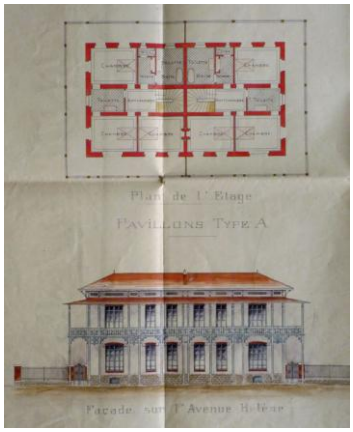
991

La Miserable Ville

992

"…Of the towns on the Canal, only one existed before De Lesseps began his work. Suez, then a miserable Arab village, is now a miserable Arab town…"
National Geographic, Nov. 1935
Above: caption: "Suez, 1839; A lithograph by David Roberts, in *The Holy Land, Syria, Idumea, Arabia, Egypt, and Nubia"*
Left: caption: "Suez, in 1541, in drawing by Dom Joao de Castro (Roteiro do Mar Roxo)"

993

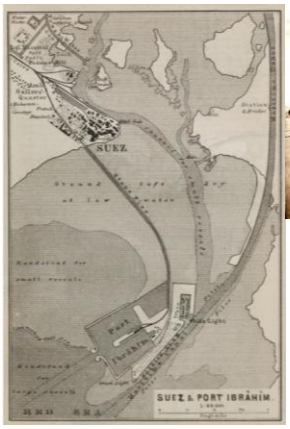


"…A few apartment houses are rising on squares of salt-encrusted land which are filled in to bring them to the level of the street. The Sweet-Water Canal brightens things up and flowers, fruits, and vegetables line its banks…"
National Geographic, November 1935
Caption: "Duplex housing for Suez Company employees, Port Tewfik, Suez (1906), Agence Fabricius Pacha, arch.: Facade"

994

"…Clouds and the softer light that comes with them give to nondescript Suez a beauty such as many a greener, lovelier spot would envy. The upper curve of the Red Sea becomes purest emerald and beside it the tawdry town seems carved from silver and onyx. In the background, their imposing flanks mottled by shadows into a chocolate and coffee marbling, lie the barren hills of Africa…"
National Geographic, Nov. 1935
Caption: "Sunset view from land to Suez Canal Bridge, which links Africa with Asia"

995



"…In the middle distance gray oil tanks seem almost phosphorescent in spite of the brightness of the whole scene, and tall chimneys of the Port Ibrahim refineries rise like full-leaded exclamation points…"
National Geographic, Nov. 1935
Above: caption: "Suez. Port-Ibrahim, dry dock."
Left: caption: "Map of Suez and Port Ibrahim"

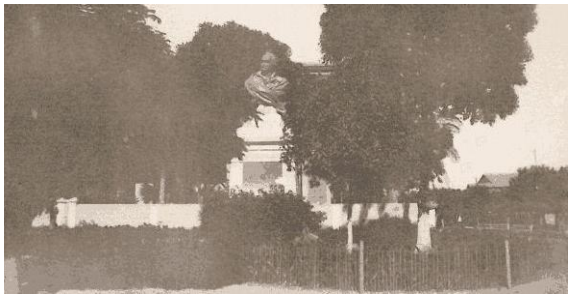
996

Gateway to the East

997

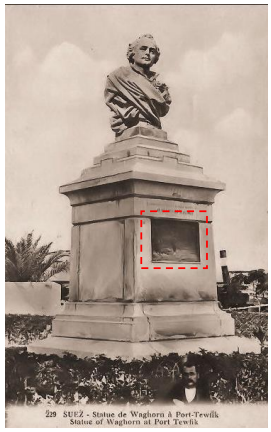
"…Suez has little to do with the Canal. It lies up a creek in which dhows from the Arabian coast are stranded at low tide and is connected with Port Tewfik by a causeway. Port Tewfik, like Port Said, is a byproduct of the Canal. When there was need for land on which to build, the dredges dumped it there…"
***National Geographic,* November 1935**
Above: caption: "View of Suez from the canal in 1982"
Left: caption: "Satellite view of the port and City of Suez, the southern terminus of the Suez Canal on the Gulf of Suez"

998



"…Along the Canal front runs the Avenue Helene, a shady bund with a comradely cafe or two. Nursemaids occupy shaded benches and one healthy little miss of three or four, who had fallen quite in love with Lieutenant Waghorn, stood gazing at his monument for minutes together…"
***National Geographic,* November 1935**
RE: on November 20, 1859 *Ferdinand de Lesseps* erected a bronze bust of RN Lieut. *Thomas Fletcher Waghorn* overlooking the mouth of the Suez Canal at Port Tewfik
Caption: "Statue of Waghorn"

999



Inscription on base:

"*In homage to the memory of a generous though unfortunate man, who alone, without any help, by a long series of labours and heroic efforts, practically demonstrated and determined the adoption of the postal route through Egypt, and the communication between the East and the West of the world; and this was the originator and pioneer of the great Egyptian maritime commerce completed by the canal of the two seas."*

1000

"…Port Tewfik, gateway to the teeming East, is provincial. On the Canal and hence a busy place, it is not a port at all. Ships wait in the Gulf of Suez until the pilot takes them in hand. Ships coming down the Canal don't stop at Port Tewfik. They only drop the pilot and signal 'Full Speed Ahead'…"
***National Geographic,* November 1935**

1001

"…Port Ibrahim is principally a haven for tankers which come there to spew up the viscous crude oil or pump forth a silver stream of refined petroleum…"
***National Geographic,* November 1935**
RE: the *Port of Suez,* located at the southern end of the Suez Canal, is sheltered, except from the South. The port is considered to be a waiting area for vessels transiting the Suez Canal. Today, the port consists of *Port Ibrahim, New Harbour* and *Port Tewfik*. Port Ibrahim accommodates general cargo and passenger vessels; New Harbour accommodates tankers and livestock vessels and Port Tewfik accommodates passenger vessels.

1002

East of Suez

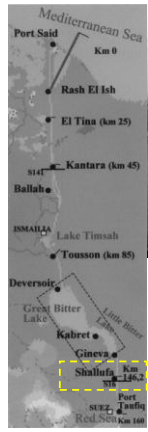
1003

"…To the east of Suez there was formerly a large camping ground for Mecca-bound caravans made-up of swarthy Egyptians, slender Syrians, serious-faced Turks, and Moslems from Turkistan clad in wadded gowns made of bright-colored cloth like upholstery cretonnes, with their women hiding behind horsehair veils. Now this vast expanse is deserted. A single stalking camel or a Bedouin on horseback would make it a desolate picture. Lacking the living element, it is only empty…"
***National Geographic,* November 1935**

1004

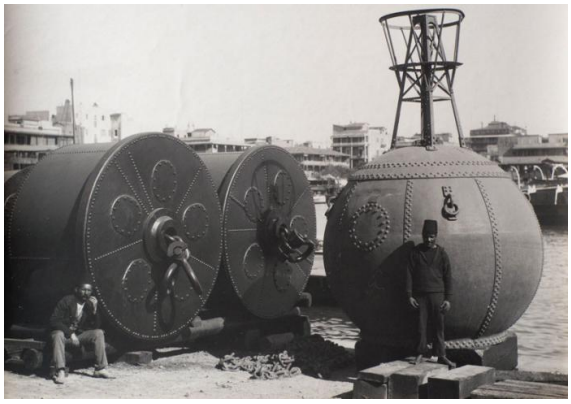
North of Suez

1005



"…The first station north of Suez is Shallufa. Near the small wharf are some brightly painted buoys. At the foot of the signal mast are the canvas balls, cylinders, and cones used to signal to passing ships. Back of the homes and office is a water tank served by a windmill and provided with a filter. A few trees give sparse shade. That is all…"
***National Geographic,* November 1935**
Caption: "Danish tanker at Shallufa, ca. 1916"

1006



Caption: "Canal buoy, Port Said, ca.1909"

1007

"…Along the northern half of the Canal the railway runs just behind these Canal stations and the station master can keep in touch with the world on land as well as the world of ships. But Shallufa is a lonely spot. The visitor is greeted like a prodigal son. Within their limits, and subject to the ever-present telephone, the station masters and their assistants are supreme…"
***National Geographic,* November 1935**

1008

"…Suez has a four-foot tide. The Mediterranean's tide is so slight that sometimes the statement is made that there is none at all…"
***National Geographic,* November 1935**

1009

"…Some ships have a strict mail schedule to keep. Others are unkempt tramps whose engines need no slowing down to keep them within the proper speed. Winds sweep across the desert with tremendous force, although the banks of the Canal, behind which a steamer looks like a procession of masts, protect all but the largest ships. Dredges, with barges alongside, are always shifting their position…"
***National Geographic,* November 1935**

1010

"…The station master knows no favorites. It may cause the captain of a great cruise ship some chaffing at table if he has to tie-up and let a smudgy tramp steam slowly by. But he takes his orders from those who know the Canal and would lose their jobs if they didn't. As the tide ebbs and flows between the Red Sea and the equalizing tanks of the Bitter Lakes, the ship facing the current, be it ragged tramp or well-groomed merchant prince, ties up…"
***National Geographic,* November 1935**

1011

The King's Mail Ties-Up While *Mere Copra* Moves Ahead

Steamers obey the order of the station masters, whose decisions depend on wind and tide. Often the most palatial ships must stop while a "tramp" steams proudly past. 1012

"…I had been past Shallufa several times before I knew how interesting it was. From the upper deck of any decently large steamer one can here trace the course of the ancient canal. Making the moderate depression more conspicuous are haircloth tents of the Bedouins, who plant grain and vegetables in its concavity. The station master of Shallufa uses a section of the ancient canal as a private garden…"
***National Geographic,* November 1935**

1013

A Never-Ending Job

1014

"…That old canal seems a puny thing beside the modern water-rift in the desert. But the same sort of tools and baskets were used in building both. Now there are three different types of dredges at work within a mile of the old canal bed. No two of them seemed to be digging-up the same sort of bottom. The first one visited was scooping up a conglomerate of shells and yellow clay in its 36 sturdy buckets. The next was bringing up blue clay and shale, which it emptied beyond the embankment by means of a long arm…"
***National Geographic,* November 1935**

1015

The Canal is a Triumph of Will Over Apathy, of Water Over Sand

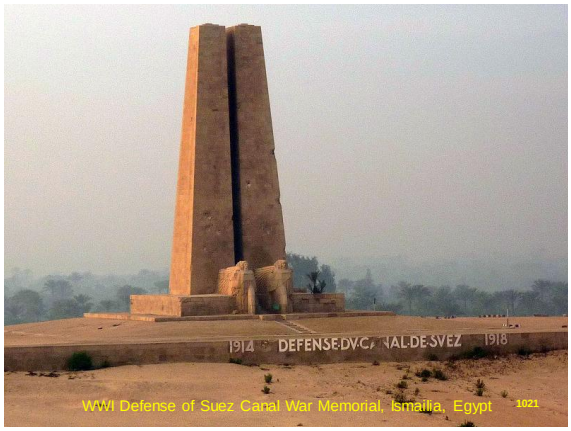
The historic "hyphen 'twist West and East" was started by hand labor, but now several varieties of dredge are used to maintain and deepen the waterway. The slender arm carries a sluiceway along which the sand and gravel sucked up are washed shoreward by water and dumped in the desert. Men are stationed along the sluice to keep the soupy mixture moving. Originally 26-feet-deep, much of the Canal today has a depth of 42-feet, and all but a very few modern leviathans may steam through it. 1016

Caption: "Constantly the Canal is Fighting the Desert. Huge dredges combat the shallowing effects of wind blown sand and make the big ditch even deeper. Here the sand and gravel sucked up from the bottom are being sluiced out through a long, elevated channel and emptied on the bank. Near this spot a Turkish force unsuccessfully attacked the Canal during the World War." 1017

The *Raid on the Suez Canal* (a/k/a "Actions on the Suez Canal") took place between January 26 and February 4, 1915 when a German-led Ottoman Army force advanced from southern Palestine to attack the British Empire-protected Suez Canal, marking the beginning of the *Sinai and Palestine Campaign* (1915-1918) of WWII. Substantial Ottoman forces crossed the Sinai peninsula, but their attack failed – mainly because of strongly held defenses and alert defenders. 1018
Caption: "Ottoman camel corps at Beersheba, 1915"

Caption: "Suez and Sinai region, 1917." The 100 mile-long canal had a railway running along its whole length and was supplied with water from the west. The length of the canal included about 29 miles of the Great and Little Bitter Lake/s and Lake Timsah, which divided the three sectors organized for defense: Suez to the Bitter Lakes; Deversoir to El Ferdan and El Ferdan to Port Said, with HQ and a general reserve at Ismailia. Small detachments guarded the Sweet-Water Canal and the Zagazig supply depot on the main Ismailia-to-Cairo road. 1019

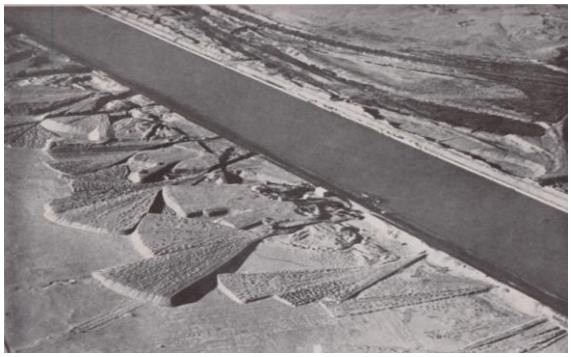
Above & Left: the *Suez Canal Defense Monument* was designed by the French; is 50-meters-high, 240-meters-long and used 4,700 tons of granite. The monument was erected to commemorate the defense of the Canal Zone from the Ottoman Turkish Army during WWI. 1020



WWI Defense of Suez Canal War Memorial, Ismailia, Egypt 1021

"…A machine like a pile driver was breaking a stratum of shell-filled rock south of the Little Bitter Lake, so that dredges could work on it…"
***National Geographic,* November 1935**

1022

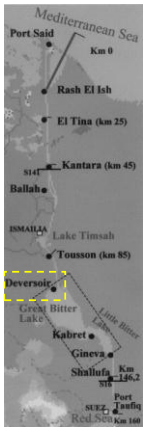


But for a Sea-Level Waterway, Asia and Africa Would Here be One

In the center is a Canal station, with its landing stage. Fan-like dumps show where dredges have piled back the wind-blown sands or emptied loads of dirt or shale excavated from the bottom of the Canal. Traffic on this water highway is a barometer of world trade. Thousands of ships pass through it each year – 5,663 in 1934. 1023

Modulation

1024

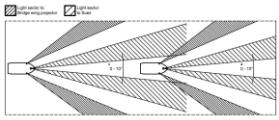


"…The Bitter Lakes give the steamers a chance to speed-up and pass each other without tying up, and they act as a buffer for absorbing the power of the tides from Suez. Beyond Deversoir, the waste weir, where the dredges have piled up a ground plot for one of the prettiest and loneliest of the stations, no tide is felt. At Suez there is a flow for seven hours and an ebb for five…"
***National Geographic,* November 1935**

1025

Let There Be Light

1026



"…When, in 1887, it was decided to use the Canal day and night there arose the question of whether the Canal or the ships should be lighted. The latter was decided upon. A fine experience is to lie flat on the bow above the headlight while its silver beams advance into the mystery of Asia on the one side and Africa on the other. Then another Polyphemus eye far down the Canal turns its lidless stare upon one and comes silently on…"

National Geographic, November 1935

Above L&R: caption: "SH 510 Suez Canal Searchlights are designed for installations on all sizes of vessels using the Suez Canal and comply fully with the regulations of the Suez Canal Authorities. The SH 510 Suez Canal Searchlights are equipped with dual projector lamps with external switchover arrangement in case of burn out."

1027

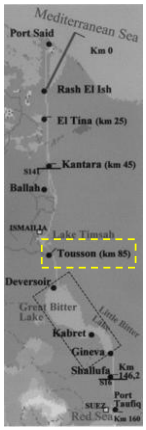
"…Aside from the lighthouses at either terminus, two lights mark-ing the channels at the ends of the Bitter Lakes and an occasional beacon at a curve in the Canal, only the bright stars of the desert light the pathway…"

National Geographic, November 1935

1028

Of Archaeological Interest

1030



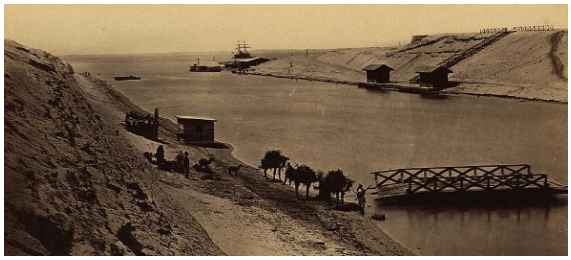
"…The one station between the Bitter Lakes and Lake Timsah is near the Arab village of Tussun, with its whitewashed sheik's tomb standing out at night like a chalk sketch on dark-blue paper. Here the Canal dredges brought up such interesting fossils of Miocene animals and wood that scientists conducted excavations of their own…"

National Geographic, November 1935

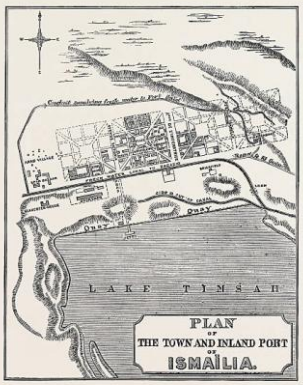
1031

Something From Nothing

1032



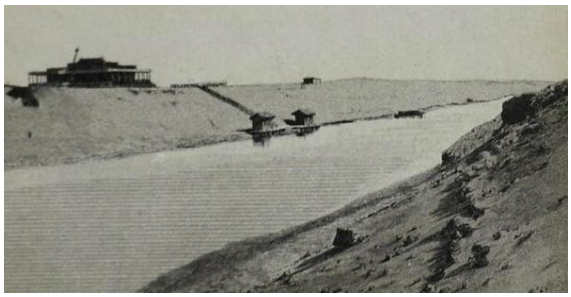
"…Lake Timsah could well be exploited for its beauty. Blue as the sea and caught between golden sands and swamp venture of the deepest green, it has on its north bank the attractive little town of Ismailia, a charming example of something made out of nothing. With every heavy wind the desert tries to recapture the little town. But the inhabitants fight back so successfully with water that the gardens of Ismailia are noted throughout the delta…"
National Geographic, November 1935 1033
Caption: "Lake Timsah, from opposite the Chalet de Lesseps"



"…Fleet sailboats skim the lake. A golf course wallows its way through the sand. A movie or two bravely tries to live up to its advertising. There is tennis and bright-eyed Italian and French girls or little young men with whom to play it. The International Club dances are famous..."
National Geographic,
November 1935
Above: caption: "Lake Timsah and Ismailia"
Left: caption: "Plan of the Town and Inland Port Of Ismailia, 1869" 1034

"…'Barbe du Pasha' trees, so called because their blossoms resemble a pointed beard, shade the streets. Enormous masses of purple bougainvillea and a scarlet-orange flower drape the fences and form arches over the entrances to the well-built homes. In a garden are the ancient monuments found while excavating the two canals…"
National Geographic, November 1935

1035



"…The $200,000 palace which the spendthrift Ismail Pasha built to celebrate the completion of the Canal is now no more and nothing along the Canal today suggests that at the opening ball 6,000 persons – 2,000 of them self-invited – here ate and drank while Ismail celebrated the greatest event of his rule to the tune of millions of dollars in expenses…"
National Geographic, November 1935 1036
Caption: "Palace of the Viceroy at El-Kirs"

Opening of the Suez Canal: The Festival at Ismailia. 1037
From the Illustrated London News for 18 December 1869

"…The house of De Lesseps stands in its lovely garden before which camels pass, unable even by their presence to give a desert aspect to this colorful street overhung by trees. Across the Sweet Water Canal there is a garden where roses somehow preserve the softness of their velvet petals. Yet, were it not for its charming family life, Ismailia would be only a smaller Port Said…"
National Geographic, November 1935
RE: the house was established in 1859 and consists of two floors 1038
Caption: "Chalet de Lesseps at Ismailia"

1039

"…At the corner of Cairo and Constantinople Streets I saw a cross-eyed Arab jealously guarding a half-dozen tomatoes of irregular shape and unimposing size. Near at hand a roadside cobbler, his angle-iron last driven deep into the sands, was replacing the one original bit of a desert man's footwear…"
National Geographic, November 1935

1040

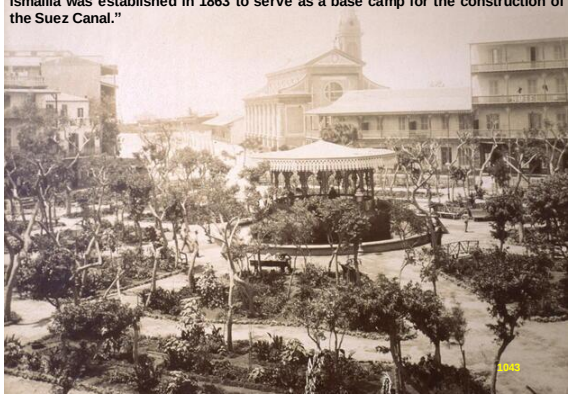
"…There was, of course, that oasis of Islam, always suggestive of cleanliness and quiet, a mosque. Down a dusty street a native wedding packed itself into three or four loose-jointed victorias, while a flock of milch goats rested in the warm sand…"
National Geographic, November 1935

1041

"…As one comes to the station, he sees a bare-legged gardener watering a flower-garden that would do credit to Peradeniya or Singapore, and he realizes that this oasis town is preserved against its enemy, the desert, by little drops of water triumphing over little grains of sand…"
National Geographic, November 1935

1042

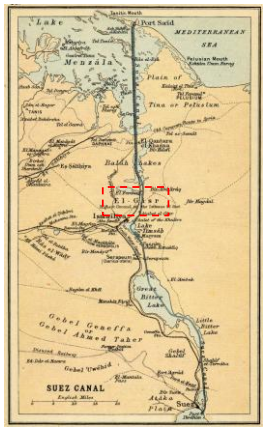
Caption: "Ismailia, Egypt - 1880s - The Ferdinand de Lesseps Square in Ismailia. Ismailia was established in 1863 to serve as a base camp for the construction of the Suez Canal."



1043

El Gisr

1044



"…North of Lake Timsah the canal diggers met with their most serious obstacle. El Gisr, the embankment, here crosses the course of the Canal and made it necessary to remove approximately twice as much material by primitive methods as all the dredges now remove each year. Here 25,000 'jellahin' toiled for two years digging a narrow channel for the dredges. When the waters of the Mediterranean were let into the swamp that is now Lake Timsah, it took five months to fill…"

***National Geographic,* November 1935**

Caption: "A 19th-century map of the Suez Canal in eastern Egypt" 1045

Old in the Time of Moses

1046

"…Qantara – 'the bridge' – marks the ancient route between Africa and Asia, between the Valley of the Nile and those of the Tigris and Euphrates, between many-godded Luxor and Nazareth. Here the Canal splits a land route old as the caravan. By this way came Joseph, sold into Egypt as a slave, later to rescue it from famine. By this route came that other Joseph, with Mary and the Christ Child…"

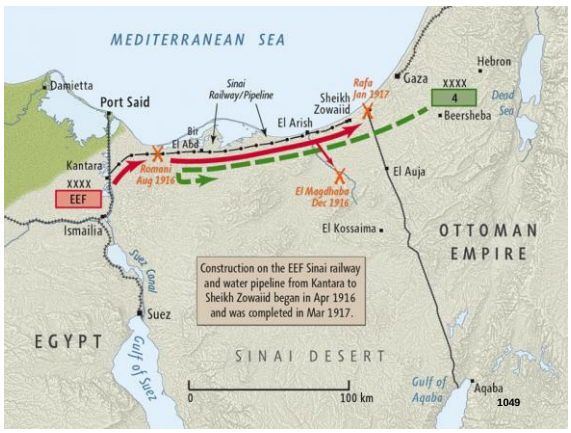
***National Geographic,* November 1935**

Caption: "The ferry at El Qantara on the Suez Canal" 1047

"…During the war Qantara was the military base which saved the Canal and from which Palestine was won from the Turk. A dozen diverse races of Indians, wearing the uniform of British forces, as well as Tommies from the four corners of the Empire, were quartered here…"

***National Geographic,* November 1935**

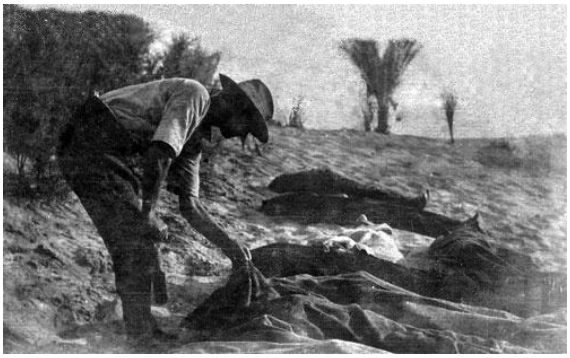
RE: the goal of the *Egyptian Expeditionary Force* (EEF) during the *Sinai Campaign* was to prevent Ottoman attacks on the Suez Canal, The EEF's commander, *Lt. Gen. Archibald Murray,* argued that the canal could best be defended by going on the offensive and seizing control of the *Sinai Peninsula* from the Ottoman Turks. He proposed building a railway and water pipeline from the canal eastwards to a forward staging base at El Arish. Begun in April 1916, this engineering feat facilitated the transportation of forces and provided necessary supplies. The only major battle of the Sinai Campaign occurred in early August 1916, near the oasis town of Romani, where a 16K-strong force from the Ottoman Fourth Army attempted to destroy the advancing railhead. British aerial reconnaissance and effective defensive preparations proved decisive in winning the battle and from then on, the EEF advanced across the Sinai without further serious opposition. On January 9, 1917, Rafa was captured thus, the entire Sinai Peninsula was in the hands of the EEF. 1048



Light Railways for the Suez Canal Defense: Material for a Decauville Line on a Goods Train at Cairo

Light railways are largely used in the new defenses of the Suez Canal. Describing the scene recently, Mr. W.T. Massey writes" Prudence prompted our Command to construct numerous light railways on the eastern side of the Canal, and to lay an elaborate system of pipe-lines for the water-supply. Unless the Turks make similar arrangements over ten times the mileage, they cannot bring an army equal in numbers to that which they have to meet, nor keep them opposite our line for more than two days, even without a shot being fired at them. Our preparations are planned to resist the most serious attacks that could, in any circumstances, be made against Egypt. We have stores carried miles into the desert by rapid little trains, and one-hundred miles of metalled roads." 1050

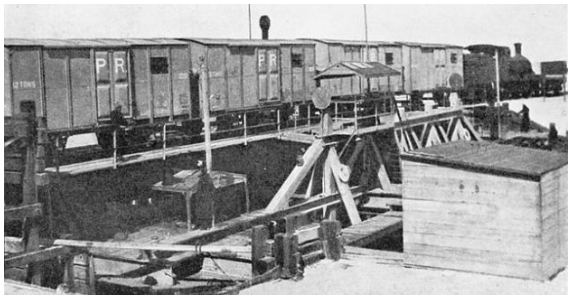
Caption: "Ottoman forces assemble on the Plain of Esdraelon in southern Galilee prior to their expedition across the Sinai to attack the Suez Canal, late 1914" 1051



Caption: "The bodies of Australian and New Zealand dead are prepared for burial following the Battle of Romani, 3-5 August 1916" 1052

1053

Above & Left: *Kantara War Memorial Cemetery* is situated at Kantara East, on the eastern-side of the Suez Canal; 160 km northeast of Cairo, 50 km south of Port Said and 30 km north of Ismailia, on the main Ismailia-Port Said road 1054



"…Trains whistled as they crossed the new bridge that again connected Asia and Africa. Motor lorries roared back and forth. Airplanes circled overhead. Walls of fodder and sup-plies flanked the Canal. Out of the desert warring Aladdins conjured a full-grown military camp…"
National Geographic, November 1935
Caption: "ACROSS THE SUEZ CANAL. A train of twelve-tons freight wagons owned by the Palestine Railways being transported over the famous canal." 1055

Above: caption: "The Sinai Railway was a railway line over 300 km in length that connected Egypt and Palestine along the north coast of the Sinai Peninsula"
Left: caption: "THE RAILWAYS OF PALESTINE and TRANSJORDAN. The three main groups shown are the Palestine, the Kantara Rafa, and the Hedjaz Railways. There are about 700 miles of track and 2,300 wagons in service." 1056

"…The Turk was never able to harm Qantara. But time finished it. No longer does the air of victory hang about the spot. There is little to indicate that trains once passed this way from Cairo to Constantinople (Istanbul) and that for a few months Asia and Africa were linked by rail. Now two small ferries serve to carry the passengers and their baggage from the Egyptian State Railways to the Palestine Railway…"
National Geographic, **November 1935**
Above L&R: caption: "El Kantara, Egypt, ca. 1942. Australian troops leaving the ferry that has transported them across the Suez Canal." 1057

"…A four-car freight ferry hauls itself across on two chains. But when a ship appears, the chains are lowered to the bottom and the sea route of 66 years' standing takes precedence over the land route established more than fifty centuries ago…"
National Geographic, **November 1935**

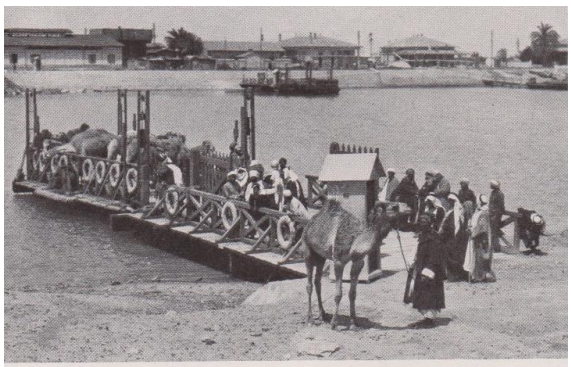
1058

Son of the Desert

1059

"…A caravan of Bedouins was waiting there, its camels being slowly ferried across, a few at a time, to be sold in the rich land of Goshen. The small ferries are worked by hand power, and the Egyptian laborer sought assistance of a desert man in head cloth and camel's hair crown. The Bedouin toiled proudly until the laborer thoughtlessly made fun of him. The dignity of a prince touched the desert man. Before the African bank was reached the Egyptian was sweating under a masterful eye. There was something about the long-gowned son of the desert that made the laborer want to get him ashore…"
National Geographic, **November 1935**

1060



A SHIP OF THE DESERT TURNS UP HIS NOSE AT A MERE FERRY

Asiatic nomads are ferrying their camels across the Canal from Asia to Africa at the spot where the 66-year-old canal interrupts a caravan route which was old in the time of Moses. 1061

Journey's End

1062

"…In pre-war days Port Said was as wide open as the sky and disreputable men and women flocked thither with the riff-raff from passing ships. But soldiers must be protected and Port Said is now a place to which one may take wife and children. The shops seem stocked with deck sports goods or bridge prizes. One can smell the streets of Delhi, the narrow bazaars of Benares, the dampness of Canton, the factories of Japan. But here is a truly lovely vase that carries one back to Kyoto, there some excellent silk from Shantung, there a shimmery veil from the Chowringhee. Port Said has no more nationality than a wireless wave!…"
***National Geographic,* November 1935**

1063

Photograph by Dr. Robert Randell

A LULL IN THE DAY'S OCCUPATIONS IN PORT SAID, THE CANAL'S COSMOPOLIS

Gone is the time when "Little Egypts" picked up carelessly tossed *baksheesh* from the floor. Tonight visitors from many nations will meet in a night club at this midcity hotel. But morning belongs to the natives, who need no newspaper to know what's going on. Port Said, a sandspit-town, born of the Canal and named for the Khedive Said, now has a population of 105,000.

1064

"…The harbor is a place of infinite interest. Fishing boats sweep up the Canal entrance in pairs, dragging a net between them. When evening comes, these sturdy but graceful boats, manned by Italians from Bari, edge up to the pier with three or four men clinging to the long tip-tilted masts and furling the sail, once bloated by the breeze but now hanging in senile wrinkles. Their very mixed catch is sorted and piled up in trays until the shrimps make one's mouth water and even unattractive little fish are so arranged that they see eminently desirable…"
***National Geographic,* November 1935**

1065

Photograph by Dr. Robert Randell

EGYPTIANS AND ITALIANS MATCH THEIR SKILL AS FISHERMEN

Friendly rivals are the Italian, staggering along under a bumper load, and the Egyptian father and son, displaying a basket of whitebait, which looks more like bait than a table delicacy. Fishermen cast their nets near the north entrance of the Canal, and in Lake Manzala, a famous fishing ground behind the native quarter of Port Said, 7,000 boats compete with pelicans, herons, and flamingos for the catch.

1066

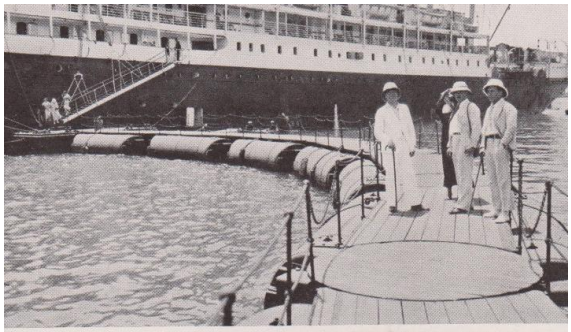
A SMILING SON OF EGYPT OFFERS A TRAY OF HAND-SELECTED FISH

The fingerlings are as much alike as sardines in a can, for Port Said dealers long since learned to sort and arrange their wares to catch the buyer's eye. The mixed haul of fish and crustaceans is painstakingly picked over by hand on the quay and laid out attractively in baskets or trays.

1067

"…The harbor fills and empties in a marvelous way. One liner slides in from the north. Another from Suez has just made fast. Coal barges move out and attach themselves to the flanks of the liners like baby whales or submarines along the mother ship. Pontooned causeways curve out from shore to gangplank. Water barges move into position to pump their load into the thirsty steamers. Tugs hustle here and there…"
***National Geographic,* November 1935**

1068



A PONTOON BRIDGE REPLACES SWARMING NATIVE "WATER TAXIS"

Until a few years ago, yelling boatmen fought for every passenger who landed at Port Said. Now one may walk ashore. Drama has been silenced, color dulled—and efficiency improved. After weeks on shipboard travelers from the Americas, Japan, Indo-China, India, Madagascar, or Australia welcome the chance to stretch their legs, sip a cooling drink on shore, or buy anything from shoddy to treasures in the canal-side city's shops.

1069

"…A traffic cop seems called for, although one knows that each berth is allotted, each movement made in accordance with orders from the handsome Company building with its clean-tiled dome. An hour later, the ships have gone their several ways. The barges have taken their sooty men with shining teeth and eyes back to the coal piles. The harbor is as empty as Wall Street on Sunday. Then a pilot boat plows her way out to the north, a smudge shows beyond the water tower and in a few minutes Sunday morning changes to Saturday night…"

***National Geographic,* November 1935**

1070

Coal Barge and Canal Company Office Serve One End – to Keep Ships Moving

Before a liner enters the Canal at Port Said, its tonnage, cargo, fuel needs, and local passengers are known. A definite berth is signaled, barges heavy with coal and man power hasten to their task, fresh water is pumped aboard, the medical inspection made, and at the last minute Canal pilots arrive to help the ship as far as Inmailia. If the vessel is outward bound, a harbor pilot is assigned to take it to sea.

1071

Port Said's Man Power Long Held the World's Coaling Record

The din is deafening as an endless chain of grimy laborers, yelling and singing, pours basket loads of coal into the ports of a steamer at the Mediterranean gateway to the Suez Canal. To keep out the penetrating dust, cabins and public rooms are sealed and most passengers spend the time ashore. Oil now competes with British coal as a fuel for ships at Port Said.

1072

If Customers Won't Come Ashore, the Store Will Put to Sea

The stop at Port Said is often short and some travelers stay aboard their ships. So the energetic native salesmen prove that the Western World has no monopoly on go-getting salesmanship tactics by taking their shops afloat and tempting passengers over the ship's side with a varied array of merchandise, good and bad. The stock on display in a typical bumboat ranges from machine-made plush and cheap embroidery to genuine oriental rugs. Each sale means lengthy bargaining, with the seller usually naming a price far in excess of what he expects to receive. Purchases are hoisted aboard by the cable and basket route.

1073

"…A sturdy little tug called the 'Titan' lies at anchor in the Commercial Basin. 'Is she as good as her name?' I ask. 'The 'Titan'? Say! If she can't get the ship off, she will get something off the ship'…"

***National Geographic,* November 1935**

1074

"…One wonders what treasure a diver has been seeking under that welter of shipping. 'Coal,' is the reply. Tons-a-day are thus saved from blocking the channel and the coal syndicate divided the product…"
National Geographic, **November 1935**

1075

"…As one watched the fishers dragging in their nets or sweeping in under sunset clouds, hears boatmen arguing over fares, notices coal heavers piling fuel into the side ports of an impatient liner, sees the pilot board a small steamer tossing outside the jetty, or admires the majesty of great mail steamers cluttered about by small craft, he realizes that Port Said is the home of those who go down to the sea in ships, that the tradition of Sidon and Tyre has slipped down the east coast of the Mediterranean to the mouth of this maritime canal…"
National Geographic, **November 1935**

1076

THE CANAL, LIKE MAIN STREET, HAS ITS FILLING STATIONS

Motorboats get water-side service from fuel pumps at Port Said. The Canal area is fenced off from the town, but such barriers cannot counteract the lure of the waterfront. Youngsters—and their elders, too—come down to look at the ships, and perhaps to pick up a few coins from travelers

1077

In the Shadow of De Lesseps

1078

"…Then he goes ashore. Landsmen pounce upon him with silks and cigarettes, Ostrich plumes and post cards. Out on the jetty stands the monument to Ferdinand de Lesseps, the potent-dreamed canal digger, around the base of which the loafers have futile dreams and pretty little girls hold the hands of dotting grandfathers. The wide-swept arm above them, like the inscription on Sir Christopher Wren's tomb in St. Paul's, seems to say, 'If you seek his monument, look about you'…"
National Geographic, **November 1935**
Caption: "Buried in the crypt of St. Paul's, the plaque above his tomb states: 'Reader, if you seek his monument – look around you'"

1079

"…As one sits there on the ever-lengthening jetty in the shadow of that statue, he thinks of a silver ribbon stretching south through the dark desert under a star-strewn sky, with Asia on the left and Africa on the right, while the camels at Qantara roar their protest at this barrier to their caravan route which, till De Lesseps broke its back, had been as old as time."
National Geographic, **November 1935**

1080

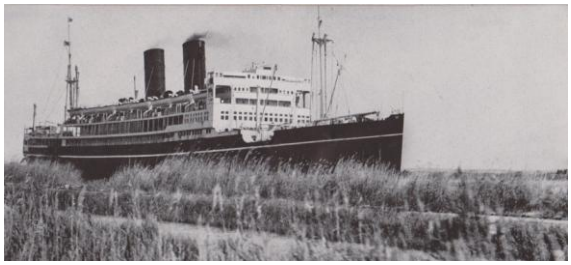
Part 12

Spotlight on Suez

1081

Man-Made

1082



As out-of-place as a camel on the ocean, a seagoing freighter crosses the desert. Invisible to a desert folk two-hundred feet away, the man-made waterway she plies is one of the most important on earth, the 82-year-old Suez Canal through Egypt's golden sands.
***National Geographic,* January 1952**
RE: introduction to an article written by *W. Robert Moore* entitled: "The Spotlight Swings to Suez"
Caption: "A canal-borne liner steaming through grasslands appears as unlikely as a locomotive at sea"

1083

Dig it and They Will Come

1084

"EVEN long-visioned Ferdinand de Lesseps, the Frenchman who brought Suez into being, woefully underestimated its possible usefulness. At best, he thought, the short-cut cleaving the land bridge between Africa and Asia would serve only a few hundred ships a year…"
National Geographic,
January 1952
RE: when the canal opened in 1869, steam had not yet won the seas. In fact, business was so slow its owners faced ruin.
Caption: "Sinai: ancient land bridge between Africa and Asia"

1085

"…Now in a typical year some 11,700 vessels ply the route, bearing more than 72,000,000 long tons of cargo and paying nearly $80,-000,000 in transit fees – 6,200 more ships and 43,-000,000 more tons than the Panama Canal…"
National Geographic,
January 1952
RE: by 1952, the French-controlled Suez Company was fabulously wealthy. Typically, Egyptians hold most canal jobs.
Caption: "Like a ruled line, the world's longest man-made short-cut splits the Sinai Desert"

1086

Guardians of the Canal

1087

"…'To open the earth to all peoples' – this was De Lesseps' conception of the waterway's purpose as expressed in his favorite Latin phrase, Apere terram gentibus. The heroic statue erected in his honor at Port Said seems eloquent of that intention. Of late the giant bronze figure has looked down upon scenes of disorder and tension as nationalistic Egyptians claimed the right to replace British troops as guardians of the canal…"
National Geographic, **January 1952**
Caption: **"His Dream Come True. De Lesseps Stands in Port Said at the Head of His Canal. With no engineering experience, this Frenchman planned, promoted, and built the waterway. He talked Turkey's Viceroy of Egypt into giving right-of-way; four years passed before he raised the capital. Successful in building Suez, he failed when he tackled the mountain-blocked, fever-ridden Isthmus of Panama."**

1088

A Parade of Ships

"…Until Egypt's abrupt scrapping of its 1936 treaty with Great Britain turned the Suez area into an armed camp, one could stand peacefully at the Mediterranean entrance of the canal, on the stone breakwater near De Lesseps' statue, and watch the parade of ships move by. Often I have used that vantage spot to count the varied flags that flutter from sterns of passing ships – proud passenger liners, rust-splotched freighters, and long, heavy-laden oil tankers. All peoples were benefiting, far beyond De Lesseps' dreams…"
National Geographic, **January 1952**

1089

1090

Via Suez

1091

"…This Mediterranean-to-Red Sea channel scooped through Egyptian sand and marsh brings the raw material-rich East closer to the industrial West by the length of a continent. A voyage between London and Bombay via Suez is 5,100 miles shorter than the old sea route looping around Africa's southern tip. Money saved in moving billions of barrels of oil from the Persian Gulf and Saudi Arabia fields alone has totaled more than enough to pay the bill for the canal's original cost..."
National Geographic, **January 1952**
Caption: **"Suez Canal Divides Continents, Links Seas, Saves 5,100 Miles London-to-Bombay. Called 'jugular vein of Empire,' the sea-level ditch is 100-miles-long and an average 108-feet-wide. In 1950 it carried 72,609,-000 long tons of cargo, more than 2-1/2 times as much as the Panama Canal but less than the Great Lakes' Soo Canal. Ferdinand de Lesseps opened the channel in 1869 after 10 years of digging. Last October Egypt demanded that Britain, guardian of the waterway, withdraw her troops, but London reinforced the canal zone with men, planes and warships. Clashes followed."**

1092

Blame it on the Macaroni

1093

"…De Lesseps' success in finally giving substance to his dream was due in part to horsemanship, marksmanship, and macaroni! All three had a bearing on his long friendship with Mohammed Said…"
***National Geographic,* January 1952**

1094

De Lesseps' Ambition

1095

"…As a youth Mohammed Said was fat. His father, the sinewy Mohammed Aly, often put him on short rations and strenuous exercise. Hungry, the youth visited his friend De Lesseps, then a consular officer, and filled his stomach's void with good macaroni. The French official also taught him to ride. The marksmanship incident came later, after Mohammed Said, grown to manhood, had been named Viceroy of Egypt under the Turkish Sultan. A display of accurate target-shooting by De Lesseps gave him his golden opportunity. He told the admiring Viceroy of his ambition to build the canal. His friend immediately pledged support…"
***National Geographic,* January 1952**

1096

Caption: "The painting illustrates the day when contracts were signed. Also seen in green is Saeed Pasha's big build, demonstrating his gluttony."

1097

"…Khedive Ismail, successor to Mohammed Said, likewise supported the project, and it was this free-spending ruler who played host at the fabulous entertainment heralding the canal's opening on November 17, 1869. The French yacht 'L'Aigle,' with Empress Eugenie of France aboard, led the grand inaugural procession through De Lesseps' ditch…"
***National Geographic,* January 1952**
Caption: "The entry into Port Said of the imperial yacht *L'Aigle*"

1098

Making Things Right

"…When De Lesseps had broached his ambitious plan, London at first had opposed it, and the shares he offered failed to attract many British investors. But Queen Victoria's Prime Minister, the astute Disraeli, recognized the mistake and successfully repaired it. Six years after the canals' completion, he borrowed $20,000,000 from the Rothschilds to buy for Britain 176,602 shares offered for sale by the bankrupt Viceroy Khedive Ismail…"
***National Geographic,* January 1952**

1099 1100

1968 or Bust

"…The canal is owned and operated by a corporation called the Compagnie Universelle du Canal Maritime de Suez, incorporated in Egypt. Its 12 directors meet in Paris. They include 16 Frenchmen, who retain permanent controlling interest; 10 British; four Egyptians; a Netherlander; and (since 1948) one American, S. Pinkney Tuck, former U.S. ambassador to Egypt. By the Suez Canal Convention of 1888, the present waterway is 'always to be free and open, in time of war as in time of peace, to every vessel of commerce or of war, without distinction of flag.' When De Lesseps gained his original concession, he secured a lease for 99 years. In normal course, Egypt would be due to gain full control of the canal in 1968…"
***National Geographic,* January 1952**

1101 1102

The Ditch in the Desert

"…As ships grew bigger there was a constant demand for a wider, deeper cut than the original 'ditch in the desert.' 72-feet-wide and 26-feet-deep. Squealing dredges poured out turrets of mud to keep up with requirements. By World War II the channel's width had been expanded to 198-feet and the cut deepened to accommodate vessels with a draft up to 34-feet. The Canal Company has since been pushing an even larger expansion program to handle the greatly increased traffic, particularly behemoth-like oil tankers. Dredgers have set about deepening the channel by another 20-inches to handle ships drawing up to 36-feet of water. This alone involves removal of 6,800,000 cubic-yards of earth and rock…"
***National Geographic,* January 1952**

1103 1104

24/7/365

1105

"…Suez never sleeps. Administrators, pilots, and workmen operate in shifts. Ships move in both directions, day and night, passing in wide spots afforded by lakes. Even so, delays persist. Ships with dangerous cargoes and those carrying royal mail have priority. Those lacking priority must halt. To remove the no-passing bottleneck of the 45-mile stretch between Port Said and Lake Timsah, a new seven-mile bypass has been cut near El Qantara. A tanker mooring station in Lake Timsah has been deepened…"
National Geographic, **January 1952**
Caption: "Suez company's office seems to float in Port Said Harbor. Nerve center of the canal, it directs 24-hour-a-day traffic."

1106

Offspring of the Waterway

1107

"…In pre-canal times there was no Lake Timsah – only a marshy depression. When the northern section of the canal was completed and Mediterranean waters were let in, the lake materialized in five months. The town of Ismailia on its shore, and the gardens now blossoming in the desert sands, also owe their existence to the canal…"
National Geographic, **January 1952**

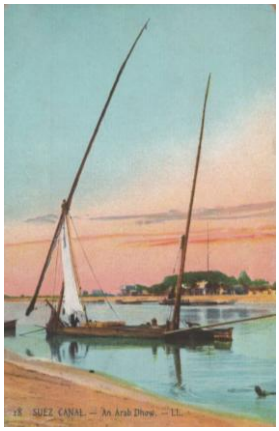
1108

Caption: "When Mediterranean waters flowed into the man-made channel in 1862, they created Lake Timsah at the midway point and, beside it on the upper left, the city of Ismailia. Here the canal, coming in from the upper right, makes a sharp turn toward the Port of Suez."

1109

Similar, But Different

1110



"…Port Said, at the Mediterranean entrance, and Port Taufiq, on the Gulf of Suez at the southern end, likewise are offspring of the waterway, But how they differ! To ships, Port Taufiq is no port, for they pause only briefly here for pilots. Port Said, on the other hand, is as international a spot as one can find. In its shops passengers may buy goods from almost any port on earth. Hawkers on bobbing bumboats display a variety of cloth, rugs, jewels ('all genuine!'), and all sorts of gewgaws. Picturesque argosies glide through the canal beside trim modern ships. They are lateen-sailed cr--aft of the East. Winged with tall, plume-like, tilted sails. When winds fail, their crews harness themselves to lines and tow..."
National Geographic, **January 1952**

1111

Above: caption: "An Arab Dhow in the Gulf of Suez calls to mind the canal's Age of Sail"
Left: caption: "Photographer Alfred Eisenstaedt's iconic image of Egyptian fishing dhows in-line on the Suez Canal, ca. 1960"

1112

Without the Suez Canal,
Bustling Port Said Would be a Bare Sandpit

The city's growth began in 1859 when diggers started erecting huts; now the population is 178,000 and buildings are still going up. Until oil replaced coal, the port was the world's largest and possibly sootiest coaling station.

Bargaining Bumboats Besiege Vessels
Moored at the Mediterranean Entrance

When travelers stay aboard during short stops, Egyptians row out in floating stores and offer everything from gewgaws to genuine oriental rugs. Most water taxis here lie idle, as passengers take the pontoon Bridge (center).

1113

Now and Then

1114

"…Before the big canal could be dug, fresh water had to be brought to the site for workers. It took four years to dig the Sweet-Water Canal, which brings Nile water eastward to Ismailia. There it forks to extend north and south along the Suez Canal route…"
National Geographic, **January 1952**

1115

"…In building the Sweet-Water Canal, workers found plenty of evidence that they were not the first to construct a watercourse through this section of the land. They came upon long-forgotten channels in the natural depression, called Wadi Tumilat, which stretches between the Nile and Lake Timsah. Unlike De Lesseps' big ditch, which cuts the isthmus in virtually a straight north-south line, earlier canals were linked to the Nile. History indicates that the first of these may date back to the reign of Seti I of the 19th dynasty, about 1300 B.C…"
National Geographic, **January 1952**

1116

"…Herodotus, the great Greek historian, records that about 600 B.C. Necho, son of Psametik I, began digging a canal to the Red Sea. He abandoned the project when an oracle warned that the canal might aid an Asiatic invader. A later project was given up because learned men feared that salt Red Sea water would flood the Nile valley. Centuries later, incidentally, Napoleon's engineers made a similar mistake – they calculated that the Red Sea was more than 30-feet higher than the Mediterranean. Actually their level is the same and Suez needs no locks…"
National Geographic, **January 1952**

1117

"…Darius, Persian conqueror of Egypt, eventually completed Necho's canal, 'the width being such as to admit two triremes being rowed along it abreast.' It finally fell into long disuse, but in the year 640 Caliph Omar ordered it reopened. A little more than a century later it was closed again to keep goods from going to Arabia…"
National Geographic, **January 1952**

1118

Key to the Kingdom

1119

"…Suez Canal, most vital link in Britain's lifeline to the East, has never been captured. In both World Wars the Suez Canal was a prize sought in vain by the powers that ultimately lost. Germany's Rommel almost broke through in 1942; Britain's Montgomery chased him back. Turkey tried in vain in 1915. United States Navy Secretary Dan A. Kimball said recently: 'There is no argument – we have to keep the Suez open. That is up to the British at the moment.' In troubled 1952 the free world watches lest the keys fall into unfriendly hands."
National Geographic, **January 1952**

1120

Caption: "Strategic Ismailia lies beside Lake Timsah in the heart of the canal zone. When Egypt threatened the canal. British reinforcements rushed in by air and sea. They took over railroads, public utilities, and El Firdan Bridge (out-of-sight to the right). Egypt's land link with her army in trans-Suez Asia. Runways of Ismailia Airfield (left) and El Firdan field (right) form arrows pointing to Sweet Water Canal (center), which, flowing from the Nile, quenches the thirst of desert communities along the Suez waterway. Road in foreground leads to the Port of Suez."

1121

Part 13

End of Empire

1122

The Future in Question

1123

The question of the future of the Suez Canal Zone has been ever since the end of the Second World War what it remains today. Much that I wrote here in the years immediately after the war might be repeated now. Though there may have been uncertainty about the stages reached in the present negotiations, there has never been any doubt about the essence of the British case.

***The Illustrated London News*, November 14, 1953**

RE: introduction to an article written by *Cyril Falls*, Professor of the History of War, Oxford, entitled: "A Window on the World: Last Phase of the Canal Zone Problem"

1124

Strategic and Otherwise

1125

"STRATEGIC considerations often change with developments brought about by time. A change has occurred here in consequence of the new relations between Greece and Turkey and their common relations with the N.A.T.O. powers, but it does not affect the vital problem of Middle East defence. One may say that the situation in the eastern Mediterranean has been strengthened, that an advanced defensive position of considerable strength has been established. This can not be said, however, to affect the importance of the Canal Zone. The strategic outline is one of the clearest to be found in any part of the world…"

***The Illustrated London News*, November 14, 1953**

1126

"…If the eastern Mediterranean and the Middle East are worth defending, as is admitted by all but a very few, they must be defended in strength. For that purpose no comparable central base can replace the Canal Zone. I spoke just now of repetition, and I may have repeated ad nauseum the value of the double approach…"

***The Illustrated London News*, November 14, 1953**

1127

"…If the Mediterranean could be kept open in time of war, Egypt would afford the best base. If it were closed, Egypt would become virtually the only base – I insert the adverb because a base might conceivably be created at the head of the Gulf of Aqaba, on Jordanian or Israeli territory, or both; but there is none now and the region is thinly inhabited semi-desert, added to which consideration is the fact that Jordan and Israel are on the worst possible terms. Egypt, on the other hand, is thickly inhabited, and its mechanics and artisans and labourers learn quickly…"

***The Illustrated London News*, November 14, 1953**

1128

"…Britain has established in the Canal Zone a vast amount of equipment and huge quantities of military stores, a large proportion of which will not go out-of-date if they are properly looked after. Nowhere else can these advantages be found; nowhere else can they be created…"
***The Illustrated London News*, November 14, 1953**
Caption: "Map of the Suez Canal Zone, 1950-1955 - showing the Royal Air Force Stations and some of the British Army Camps"

1129

Withdrawal Pains

1130

"…It is common ground that the situation cannot remain as it now stands. Whether a Conservative Government in office after the war would have taken a different line to that taken by the Labour Government is a question approaching the academic. Both have, in fact, acknowledged the necessity of withdrawal. But what sort of a withdrawal?..."
***The Illustrated London News*, November 14, 1953**

1131

"…Egypt has admitted the value of the base and that it should be retained. She has also admitted that in certain circumstances British troops should return to the Zone and that meanwhile Britain should play a part in maintaining the base. We all know that the arguments have ranged about these questions. The British have had to take into account the fact that the value of the base would be lessened – and that is putting it mildly – by a hostile Egypt…"
***The Illustrated London News*, November 14, 1953**

1132

"…In point-of-fact, it would be more seriously decreased in time of peace than in war, because protective measures are taken under the stress of war are not practicable in peace. At present Egypt is not essentially hostile. Perhaps she was not even when her former Government was carrying out a policy of outrage in the Canal Zone, which was firmly and successfully resisted, with excellent effects…"
***The Illustrated London News*, November 14, 1953**

1133

"…At the time of writing, it is believed that the negotiations have taken a definite shape. British forces are to leave the Canal Zone within a certain period – one report says eighteen months. Some thousands of 'technicians' are to remain to look after the base. British forces would return only in the event of attack on Egypt or on the authorization of the United Nations. According to surmise, the chief point of difference remaining has been whether or not the 'technicians' should be armed and uniformed, our view being that they must be and that of Egypt the contrary …"
***The Illustrated London News*, November 14, 1953**

1134

Credits and Debits

1135

"…Looking first at the credit side of these discussions, there is no need to insist on the advantages of an agreed settlement. Unfortunately, the debit side is also heavy. The movement of such a body of troops as would be required in the Canal Zone would be fraught with deadly risk if carried out after the outbreak of a major war or even under the threat of war. The temptation to loot would be strong, especially with eager buyers close at hand. A few thousand 'technicians' would find it difficult to protect the goods in the base and in my view impossible unless they were armed and in uniform. Authorisation by the United Nations is a farcical safeguard at present, owing to the constitution of that body…"
***The Illustrated London News*, November 14, 1953**

1136

State of Affairs

1137

"…This state of affairs has led some political supporters of the British Government, in Parliament and outside it, to ask insistently whether we are not going too far, whether we are not, in fact, throwing away the substance for the shadow. We shall, they say, assuredly have to pay for the maintenance of the base; quite probably we shall find ourselves prevented from reoccupying it in force at the moment it is most needed, or suffer terrific loss to our convoys because permission to return has been given too late; then we may find that the removal of high-priced articles which find a ready market has gravely diminished the value of the equipment and stores…"
***The Illustrated London News*, November 14, 1953**

1138

"…They point out that even in Germany, where we have a very large garrison, valuable stores have been stolen and smuggled into the Russian Zone, and ask whether the case would not be very much worse in Egypt. They demand that Britain should even now insist on maintaining a garrison, though perhaps not one of anything like the present strength, in the Suez Canal Zone…"
***The Illustrated London News*, November 14, 1953**

1139

"…It seems likely that only the prestige of the Prime Minister has presented this feeling from becoming more widespread in the Conservative Party. Even now, the unrest might become more marked before the final phase of discussion has ended, especially if the suspicion should arise that we were about to weaken over the point about 'technicians' being armed and in uniform, which is understood to be the last not yet settled…"
***The Illustrated London News*, November 14, 1953**

1140

"…For my part, I have always felt the right-of-re-entry to be the most important of all because, unless this is soundly established, the value of the base may be nullified. In this country the Labour Government – some people seem already to have forgotten which Government it was – admitted United States forces and equipment to our airfields because in the event of war they might not have had time to reach them. We may well have owed the preservation of peace to their presence…"
The Illustrated London News, **November 14, 1953**

1141

"…I am prepared to admit that the situation may appear different, because the presence of British troops was originally imposed upon Egypt, but under the agreement our country has been seeking it would have been in fact the same. It is easy, fatally easy, for the individual Member of Parliament or publicist to declare that we should not give way one foot. The responsibility does not fall on him and he is not called on to carry through the policy of fighting in the last ditch…"
The Illustrated London News, **November 14, 1953**

1142

Caption: "When Doug Findlay signed on at the recruiting office in Edinburgh in 1951 he had visions of a local posting and wowing the ladies as one of the RAF's Brylcreem boys. Instead, he found himself combatting sandstorms, mosquitoes and murderous Egyptians who wanted Doug and his fellow Brits out of the Suez Canal Zone as much as they wanted to go home. *White Knees Brown Knees: Suez Canal Zone 1951-54 The Forgotten Years,* his account of defending the Canal, is guaranteed to raise many a smile, but the book also has a serious side. Its *Roll of Honour* records a death toll of over 1,100 and shows why the Government had to do a u-turn and award the medal Suez veterans should have had half-a-century ago."

1143

For What it's Worth

1144

"…For what my own opinion is worth, I long ago concluded that no possibility existed of carrying on on the old lines and maintaining a great garrison in the Canal Zone in time of peace. The thing is simply not practical. The very grave danger of return under the conditions I have envisaged has perforce to be accepted, like some other strategic commitments to which we object…"
The Illustrated London News, **November 14, 1953**

1145

"…On the right-of-return I feel much more strongly. I sincerely hope it will not be found that those prophets have been correct who have told us that, in default of attack on Egypt and her Arab allies, return to the Canal Zone is to be conditional upon authorization by the United Nations. This would be worse than self-deception. It would be evidence of cynicism, because it would be putting up a pretence, establishing a safeguard in which the authors themselves did not believe. I also hope that, if the protection and maintenance of the base and its stores is really endangered by an Egyptian demand hat it should be entrusted to a body of unarmed men in mufti, that demand be firmly resisted…"
The Illustrated London News, **November 14, 1953**

1146

"…I am making no special aspersions upon Egyptian honesty. All nations contain an unduly high proportion of dishonest individuals. Let it be remembered with shame that some of our own people were involved in the theft and sale of material from the Canal Zone at a time when our garrison there was at full strength. The dishonest belonging to another race are likely to feel even less scruples…"
The Illustrated London News, November 14, 1953

1147

"…It should, however, be made clear that, if the guardians retain arms in their hands, this is for the protection of their trust and that only; they are not there to defend Egypt or the Suez Canal. This is a role which can now be assumed by British forces only in time of war…"
The Illustrated London News, November 14, 1953

1148

"…The main part of the installations, worth hundreds of millions of pounds, must in any case remain, for the good reason that they can not be moved. The cost of moving those which are mobile enough would be very great, and, as I have pointed out, there is no suitable place to which to move more than a fraction of them…"
The Illustrated London News, November 14, 1953
Caption: "British forces which are to evacuate from Egypt by the end of March 1947 leave Abbassia camp in Cairo and set-up temporary headquarters at Fayid"

1149

"…Cyprus has often been mentioned in discussions of the eastern Mediterranean situation. It is by no means without value, but is an isolated island only to be approached through Mediterranean waters and with inadequate port facilities. Cyrenaica, Tripoli, even, should circumstances permit, Jordan and Israel might prove useful in the event of a great war, but without the central base of the Canal Zone would be deprived of a great proportion of their value…"
The Illustrated London News, November 14, 1953

1150

"…Cyrenaica, Tripoli, and Cyprus would certainly serve as stations for forces which might be called upon to move into the Canal Zone, especially land forces which can not move at great speed with their heavy equipment. In these days large numbers of troops without this can be moved quickly by air, and air forces could, of course, reach their airfields almost immediately…"
The Illustrated London News, November 14, 1953

1151

Summing Up

1152

"…To sum up, the revolutionary Government now in power in Egypt has shown more realism in facing the problem than its predecessors. It appears to realise that Egypt would lie in danger in the event of a world war. It is, however, inspired by nationalist sentiments and could not afford to disregard them in the people even if it did not hold them itself…"
The Illustrated London News, **November 14, 1953**

1153

"…I therefore agree completely with the view of Major-General L.O. Lyne, writing in 'Brassey's Annual,' that 'we can retain our present position only at the expense of continued hostility and deteriorating relations with Egypt. No Egyptian political party or individual statesman could possibly ignore the present strong nationalist feelings and demands for British evacuation'…"
The Illustrated London News, **November 14, 1953**

1154

"…I do not consider it worth while to seek to retain our present situation at this cost. But there should be limits to the concessions we are prepared to make. The chief are those of which I have written, the twin safeguards of timely re-entry into the base and proper protection and maintenance of what it contains. It would be weakness to decide that, while these are highly desirable, they can not be won and should be therefore abandoned. This is what was said during the Munich period."
The Illustrated London News, **November 14, 1953**

1155

Last Hurrah

1156

In the decade after the second world war, as Britain struggled to square its diminishing empire with belt-tightening measures at home, it found time to get involved in a war in Egypt. Derek Brown writes about the end of the postwar political consensus.
theguardian.com**, March 14, 2001**
RE: introduction to an article written by *Derek Brown* entitled: "1956: Suez and the End of Empire"

1157

Postwar Blues

1158

"THE Suez crisis is often portrayed as Britain's last fling of the imperial dice. In 1956, the globe was indeed still circled by British possessions and dependencies, from the Caribbean in the west to Singapore, Malaya and Hong Kong in the east. Much of the African map was still imperial pink. In reality, though, the sun had long since begun to sink over the British empire. The greatest possession of them all, the Indian subcontinent, had taken its freedom. Nationalist movements were flourishing in most of the rest, patronised by Soviet Russia and encouraged by the United States in its self-appointed role as leader of the free world. Britain itself was only beginning to emerge from postwar austerity, its public finances crushed by an accumulation of war debt…"
***theguardian.com*, March 14, 2001**
RE: WWII changed the world order profoundly. The emergence of the two new superpowers, the U.S. and U.S.S.R., changed the world's power balance. In the tension that arose between east and west, the U.S. urged the colonial powers of the west, in particular Great Britain, to rid itself of its vast empire.

1159

Anti-imperialism created a new climate in the late 1940s thus, having colonies around the world was no longer politically correct. Great Britain, despite its glorious past was, in the post-WWII period, reduced to a medium-sized European country, both in terms of influence and power. Furthermore, maintaining the Empire became a financial burden too great to bear (the UK needed loans from the U.S. just to maintain its domestic infrastructure). After WWII, decolonization occurred rapidly, but the establishment of a "Commonwealth of Nations" helped maintain Britain's ties to its former colonies (above).

1160

Still Relevant

1161

"…Still, there were powerful figures in the 'establishment' - a phrase coined in the early 1950s - who could not accept that Britain was no longer a first-rate power. Their case, in the context of the times, was persuasive: we had nuclear arms, a permanent seat on the UN security council, and military forces in both hemispheres. We remained a trading nation, with a vital interest in the global free passage of goods…"
***theguardian.com*, March 14, 2001**

1162

White Man's Burden

1163

"…But there was another, darker, motive for intervention in Egypt: the sense of moral and military superiority which had accreted in the centuries of imperial expansion. Though it may now seem quaint and self-serving, there was a widespread and genuine feeling that Britain had responsibilities in its diminishing empire, to protect its peoples from communism and other forms of demagoguery. Much more potently, there was ingrained racism. …"
***theguardian.com*, March 14, 2001**

1164

"…When the revolutionaries in Cairo dared to suggest that they would take charge of the Suez Canal, the naked prejudice of the imperial era bubbled to the surface. The Egyptians, after all, were among the original targets of the epithet, 'westernised (or wily) oriental gentlemen. They were the Wogs…"

theguardian.com, **March 14, 2001**

RE: in Feb. 1899, British novelist and poet *Rudyard Kipling* wrote a poem entitled "The White Man's Burden: The United States and the Philippine Islands." In this poem, Kipling urged the U.S. to take up the "burden" of empire, as had Britain and other European nations. Published in the February, 1899 issue of *McClure's* magazine, the poem coincided with the beginning of the *Philippine Insurrection* and U.S. Senate ratification of the treaty that placed Puerto Rico, Guam, Cuba and the Philippines under U.S. control. *Theodore Roosevelt,* soon to become VP and then POTUS, copied the poem and sent it to his friend, *Senator Henry Cabot Lodge,* commenting that it was "rather poor poetry, but good sense from the expansion point-of-view." However, not everyone was as favorably impressed as TR. The racialized notion of the "White Man's burden" became a euphemism for imperialism and many anti-imperialists couched their opposition in reaction to the phrase.

1165

Take up the White Man's burden -
Send forth the best ye breed
Go send your sons to exile
To serve your captives' need
To wait in heavy harness
On fluttered folk and wild
Your new-caught, sullen peoples,
Half devil and half child
Take up the White Man's burden
In patience to abide
To veil the threat of terror
And check the show of pride;
By open speech and simple
An hundred times made plain
To seek another's profit
And work another's gain

Take up the White Man's burden -
And reap his old reward:
The blame of those ye better
The hate of those ye guard
The cry of hosts ye humour
(Ah slowly) to the light:
"Why brought ye us from bondage,
"Our loved Egyptian night?"

Take up the White Man's burden -
Have done with childish days
The lightly proffered laurel,
The easy, ungrudged praise.
Comes now, to search your manhood
Through all the thankless years,
Cold-edged with dear-bought wisdom,
The judgment of your peers!

Rudyard Kipling, **"The White Man's Burden: The United States and the Philippine Islands, 1899"**

1166

Nasser's Ambition

1167

"…King Farouk, the ruler of Egypt, was forced into exile in mid-1952. A year later, a group of army officers formally took over the government which they already controlled. The titular head of the junta was General Mohammed Neguib. The real power behind the new throne was an ambitious and visionary young colonel who dreamed of reasserting the dignity and freedom of the Arab nation, with Egypt at the heart of the renaissance…"

theguardian.com, **March 14, 2001**

1168

"…His name was Gamal Abdel Nasser…"

theguardian.com, **March 14, 2001**

1169

"…Nasser's first target was the continued British military presence in the Suez Canal Zone. A source of bitter resentment among many Egyptians, that presence was a symbol of British imperial dominance since the 1880s. In 1954, having established himself as uncontested leader of Egypt, Nasser negotiated a new treaty, under which British forces would leave within 20 months…"

theguardian.com, **March 14, 2001**

1170

(AP Wire Photo Map - July 27, 1954) Main Points in Suez Canal Agreement – Suez Canal Zone (A) will be evacuated by all British troops within 20 months but Britain reserves the right to man the large defense bases if Turkey (B) or any Arab state (C) with the exception of Iran becomes the victim of an aggressor, according to British-Egyptian agreement signed in Cairo today. Britain's main remaining bases in the Mediterranean are at Cyprus and Malta.

1171

A Troubled World

1172

"…At first, the largely peaceful transition of power in Egypt was little noticed in a world beset by turmoil and revolution. The Cold War was at its height. Communism was entrenched throughout eastern Europe; the French were being chased out of Indo-China and were engaged in a vicious civil war in Algeria; the infant State of Israel had fought off the combined might of six Arab armies, and Britain was trying to hold down insurgents in Cyprus, Kenya and Malaya…"
***theguardian.com*, March 14, 2001**

1173

The Old Guard

1174

"…British politics, too, was in a state of flux, with a new generation of leaders emerging to preside over belated postwar prosperity. But when Winston Churchill resigned as Prime Minister in 1955, at the age of 80, he was succeeded by the last of the old guard: Anthony Eden…"
***theguardian.com*, March 14, 2001**

1175

"…After a lifetime at the cutting edge of British statesmanship, Eden was a curiously inadequate man. He had the vanity that often accompanies good looks, and the querulous temper that goes with innate weakness. He had been foreign secretary throughout the war and again, under the old imperialist Churchill, from 1951 to '55. For all his experience, he never absorbed the simple postwar truth: that the world had changed forever…"
***theguardian.com*, March 14, 2001**

1176

Nationalization

1177

"…In July 1956, the last British soldiers pulled out of the canal zone. On July 26, Nasser abruptly announced the nationalisation of the Suez Canal Company…"
theguardian.com, March 14, 2001
Caption: "In 1956, the late president Gamal Abdel-Nasser nationalised the Suez Canal and henceforth it has been run by Egypt's Suez Canal Authority"

1178

1179

"…Eden was scandalised and, riding a wave of popular indignation, prepared a grotesquely disproportionate response: full scale invasion…"
theguardian.com, March 14, 2001
Caption: "British Prime Minister, Sir Anthony Eden, in 1956"

1180

"…Nasser's nationalisation of the canal was followed by intensive diplomatic activity, ostensibly aimed at establishing some kind of international control of the strategically vital waterway…"
theguardian.com, March 14, 2001
Above: caption: "Nasser announces the nationalization of the canal, July 30, 1956"
Left: caption "The statue of Ferdinand de Lesseps was removed following the nationalization of the Suez Canal in 1956"

1181

"…It turned out to be a smokescreen for military preparations. In September, Nasser made a defiant speech rejecting the idea of international supervision of an Egyptian national asset. By then, the die was cast…"
theguardian.com, March 14, 2001

1182

THE SUEZ: The Crisis Turns
TIME
September 24, 1956

1183

Nasser's seizure, though it had humiliated the West, had left the West with nothing tangible to complain of. The threat remained only a threat until ships had been stopped or traffic otherwise interfered with. In fact, Nasser has always possessed the physical capability of closing the canal ever since the British evacuated the Canal Zone (he has only to swing shut the railroad bridge), and would still have the capability even after agreeing to any arrangement for international operation short of reoccupation of the Canal Zone in its entirety.

The real point was a point of law and order: it must be shown that other nations cannot deprive the Western powers of their right or threaten their vital interests with reckless impunity. If Nasser got away with his grab unpenalized, other Arabs in other lands might take it as a precedent for grabs of their own - at British and U.S. oil and pipelines. And if Nasser's truculence became a pattern elsewhere, it could destroy all hopes of fruitful cooperation between the world's free industrial nations and the underdeveloped countries.

The new strategy expressed far more accurately the West's hopes of converting the old relationship of empire and colony into a new partnership of mutual respect and mutual profit. For its effect it relied on a simple demonstration of the real value of Western friendship - by the simple process of showing vividly what it costs to be without it.

1185

As the second London conference on the Suez crisis convened last week in the chandeliered conference room of London's Lancaster House, U.S. Secretary of State John Foster Dulles faced a roomful of uneasy men with varying ideas but a common interest. Their interest was to find, through diplomacy rather than war, the way to remove the Suez from the sole control of Egypt's Nasser. The immediate objective was to equip that common interest with a workable bargaining instrument fashioned from the Anglo-American plan for a canal users' association.

As first announced by Britain's Sir Anthony Eden and elaborated by Dulles, the plan had been a challenge backed by the threat of detours around the canal, a sea lift of Western Hemisphere oil, and probably a complaint to the U.N. But, from the moment of his arrival in London, Dulles found only the British and French enthusiastic for this extreme potential of the users' idea - and they were bothered by the realization that the most that they could expect from the U.S. to defray the heavy cost of detour would be loans to pay for U.S. oil imports, not gifts. Furthermore, Nasser was so far proving disconcertingly able to run the canal by himself. As long as the canal remained open, the smaller nations were unwilling to shoulder the extra cost of sending their ships around the Cape. Scandinavia, West Germany and Italy were unhappy at the thought of jeopardizing their trade with the Arab world. Most argued that a boycott would cost them more than it would cost Nasser.

1187

The threat of force all but disappeared from the Suez crisis last week, and a Western strategy of massive but peaceful pressure took its place.

The U.S., Great Britain and France, who had seemed to be moving in divergent directions, came together in a united plan. They confronted Egypt's Gamal Abdel Nasser with the chance to back down from his West-flouting seizure of the Suez Canal or the risk of exposing his impoverished nation to an economic squeeze. The new approach to the crisis was the West's "users' plan," sketched out by U.S. Secretary of State John Foster Dulles, and presented publicly by Britain's Prime Minister Sir Anthony Eden in Parliament.

Under the plan, an association of nations using the Suez would hire its own pilots, regulate traffic and collect the tolls. Egypt would be asked to cooperate, and would be paid for its contributed facilities. If Egypt refused to cooperate, the users would set in motion the grand plan of economic strategy, underwritten by the U.S. and described as the Suez Sea Lift.

Nasser denounced the plan almost before it was fully explained. But that was expected. For it put him on the defensive for perhaps the first time since he seized the canal seven weeks before. It also made clear the real issue at stake. That issue was not the provision of international guarantees for what could not be fully guaranteed: the free passage of the canal. Debate on that point, and there had been a lot of it had always had a curiously unreal quality.

1184

THE SUEZ: The Bargainers
TIME
October 1, 1956

1186

The users' idea in its most extreme concept - as a huge Western economic club to beat down Nasser - had its flaws for John Foster Dulles as well. For the U.S. aim had to be not only to protect its vital interests and those of its Western allies in the Suez and Middle East, but also to negotiate in a manner that did not draw a permanent cleavage between the Western world and the Arab and Asian countries.

So out of these second thoughts, objections and reservations, the diplomats at Lancaster House tried to fashion a single purpose.

What to Seek. Dulles put forward the users' association plan in the most deliberately tentative terms, his speech studded with phrases such as "I suppose," "I would think," "I suggest." "What is it that we seek?" he asked. "It is nothing hostile to or prejudicial to Egypt" but "on a provisional, de facto practical operating basis, a measure of cooperation with Egypt." The association would hire pilots, collect and pay out tolls and fees. Membership, he said, "would not involve the assumption by any member of any obligation," though naturally "it would be hoped" members would voluntarily cooperate.

1188

There came a barrage of objections. Sweden's Foreign Minister Osten Unden, who had been a member of the Menzies mission, urged another attempt to negotiate directly with Nasser. Nasser had offered to renew the guarantees of the 1888 Convention, he pointed out, and offered to have an international body fix tolls. Spain, too, urged "careful study" of Nasser's offer. Italy's Gaetano Martino flatly contested the statement of Britain's Selwyn Lloyd that the 1888 Convention gave users the right to run ships through the canal with their own pilots. "This is juridically not exact," he said, and offered a resolution designed to limit the function of the users' association to negotiation with Nasser. Bluntest was Pakistan. The users' association, said new Foreign Minister Malik Firoz Khan Noon, sounded like "an imposed settlement," and, he declared, Pakistan "cannot associate itself with this proposal."

No Coercion. By its first afternoon the conference was in acute peril of bogging down in irresolution. Dulles recognized the crisis. To reassure the nervous and encourage the wary, Dulles softened the plan still further. There was no intention to coerce Nasser, he said. "Obviously, if Egypt makes it obligatory to use only pilots that are chosen and assigned to it, then I do not see that pilots of the association would practically have very much to do, and that part of the plan would have collapsed." The U.S., even if it wanted to, had no legal power to keep U.S. ships from using Egyptian pilots. As for taking the case to the U.N., as many were urging, Dulles argued that the users' association could best provide "the mechanism for a kind of provisional solution which is precisely the kind the U.N. could seize hold of." It could serve as a "bargaining body vis-a-vis Egypt."

1189

Then he struck at the crux. It was not enough in these times simply to avoid trouble, to get past a crisis. In an extemporaneous speech he pointed out movingly that if the use of force was to be forsworn, nations must join in seeking solutions that are just, as well as peaceful.

The delegates were impressed. Said Sweden's Unden: "I have noted with satisfaction that the proposal has changed considerably since it was presented." But it took another long day of maneuvering until, on the third day, the rangy, loose-limbed skeleton of the Suez Canal Users' Association (S.C.U.A.) was agreed upon. Its declared purpose was "to facilitate . . . a final or provisional solution," and to "seek the cooperation of the competent Egyptian authorities," and "deal with such problems which would arise if the traffic through the canal were to diminish or cease." Recourse would be had to the U.N. "whenever it seems that this would facilitate a settlement." Its membership was opened to the 18 user nations plus any other nation which has 1,000,000 net tons of shipping passing through the canal yearly or uses it for 50% of its total foreign trade (a provision designed to exclude Russia). It will also "study forthwith means that may render it feasible to reduce dependence on the canal." This would include construction of new oil lines and wider use of large tankers.

1190

S.C.U.A. remains loose and only mildly binding, but it provides the canal users with a body that can negotiate with Nasser, move on to other concerted action should he block the canal or prove unable to keep it open. It does this in a manner that avoids, so far, acts that plunge the Suez crisis into full deadlock, yet leaves the Westerners free to keep moving, keep trying to make time work for them instead of for Nasser. "Nasser," explained one Lancaster House diplomat, "is facing in the long run a whole series of developments which will affect the Egyptian economy. His economy is deteriorating now. The long term is going to weigh more heavily than the fact that there will still be a lot of traffic in the canal. You don't always have to wait until it actually works, either, for often you get results when people see that it is going to work." Whether or not Nasser already saw that it was going to work, he showed at least a few signs of uneasiness. In Cairo drugs, cigarettes and whisky disappeared from counters, and merchants tucked rare items away for special customers. The official newspaper *Al Shaab* proclaimed: "We must now prepare for economic war." And there was restive stirring among Nasser's Arab supporters. In Saudi Arabia King Saud invited his old enemy King Feisal of Iraq to Dammam, presumably to discuss their mutual worries over the cost of Western displeasure to their oil revenues. At week's end Nasser hastily left Cairo for Dammam to confer with Saud and Syria's President Kuwatly. By happenstance, that great compromiser and neutralist Jawaharlal Nehru was flying in from India on a long-scheduled visit, might or might not confer with Nasser in the palace of the Arabian King.

1191

Deflated Tires. With the terms set, all but three of the 18 nations - Iran, Pakistan, and Ethiopia - indicated that they would join S.C.U.A., although not altogether happily. For both Britain's Eden and France's Mollet, the agreement represented a climb-down - though from an admittedly unsteady perch. In Britain the Tory press was outraged. The *Daily Mail* charged that Dulles had pulled the rug from under Britain's feet. The august *Times* wrote: "Mr. Dulles soon deflated the tires of the new vehicle. The plan has been changed and weakened out of all recognition." France was even more irate. French officials talked of "sellout" and "bitter deception" and blamed the U.S. Said the usually neutralist-minded *Le Monde*: "If it is grave to go to Munich, it is even more so to go there after having sworn a hundred times to do the opposite." Premier Guy Mollet, who only six weeks before had told the cheering Assembly that "we shall impose" international control on Nasser if he persisted in his rejection of it, urgently telephoned Foreign Minister Christian Pineau in London and ordered him to refuse to sign. After an emergency Cabinet meeting Saturday to hear Pineau's report, Mollet announced that France would join S.C.U.A. only with the explicit reservation that "France intends to conserve her liberty of action."

1192

Even as Dulles flew back to the U.S. proclaiming that the conference had made "solid gains," the French and British threw the case into the U.N. The two asked the Security Council to hold an urgent debate of Egypt's "unilateral" act as a "manifest threat to international peace and security."

No one expected that Russia, with its veto power, would let the Security Council take any action, either to undo or punish Nasser's seizure. The U.S. was surprised at the timing, but acquiesced. Said Dulles: "This is an interdependent world, and you cannot thrive and prosper if you deny the principle of interdependence." Taking the case to the U.N. was another way of airing the West's concern, of impressing the world with its urgency and of seeking a settlement by means rooted not in the jungle but in law.

1193

THE UNITED NATIONS: Road to Suez

TIME

October 22, 1956

1194

The first question before the Security Council was: What is Egypt's mood on the Suez question, hard or malleable? Foreign Minister Mahmoud Fawzi, whose ability as a diplomat is best described by the fact that he has held top jobs under both King Farouk and President Nasser, leaned over the horseshoe table and started to talk. First, bald Mahmoud Fawzi recited in his soft voice Egypt's familiar grievances against the French and British. Then he purred: "Foremost in importance [is] a system of cooperation between the Egyptian authority operating the Suez Canal and the users of the canal." When the foreign ministers around the table heard that word "cooperation," they had their answer.

In response to this obvious invitation, the U.S.'s John Foster Dulles made the next conciliatory move. "The essence," he said, "if . . . we are to seek justice, is that the operation of this international utility shall be insulated from the politics of any nation." By his manner, Fawzi intimated his assent; it was obviously time to head off Security Council action on an Anglo-French proposal to condemn Egypt for its canal seizure and explore what Fawzi meant by "cooperation." Fawzi agreed to meet privately with Britain's Selwyn Lloyd and France's Christian Pineau in U.N. Secretary-General Dag Hammarskjold's 38th-floor U.N. offices overlooking the East River. "I will be acting merely as a chaperon," Hammarskjold told Dulles. Said Presbyterian Elder Dulles, with a grin: "My understanding of a chaperon is a person whose job is to keep two people apart. Your job is to get the parties together." 1195

"Words, Just Words." For three days, usually with Hammarskjold just listening, the three foreign ministers talked in the skyscraper suite. The Westerners felt that they were getting Fawzi to concede little. "Words, just words," blurted discouraged Christian Pineau on leaving one session. Said another diplomat: "Fawzi is conducting a striptease, but so far he hasn't shown an inch of skin." At night Hammarskjold sat up late sifting comments of the bargainers and reducing them to essentials.

When the ministers met on the fourth day, Hammarskjold laid before them a set of six principles on which a negotiation of the Suez case could proceed. "Gentlemen, what do you think of this?" he asked. For another three hours the ministers talked, quibbled, phrased and rephrased. By late afternoon they had agreed. Then the Security Council was summoned back into full session, and Dag Hammarskjold read out the six principles on which the three foreign ministers had agreed:

1) no discrimination against transit, through the canal;

2) respect for Egypt's sovereignty;

3) insulation of canal operations from the politics of any country;

4) tolls to be decided by agreement between Egypt and the users;

5) allocation of a "fair proportion" of dues for canal developments;

6) arbitration of the sum to be paid the expropriated Suez Canal Company.

The key point seemed to be No. 3 - the one Dulles had called "the essence" of a just settlement. 1196

"Most Gratifying." Limited as it was, this represented the first important breakthrough in the Suez affair. The diplomats rushed to capitalize on it, and President Eisenhower told his TV campaign "press conference" that "it looks like a very great crisis is behind us." Lloyd and Pineau had booked plane seats for return home, but they postponed their flights. After talking with Dulles, they withdrew their original anti-Egyptian resolution and prepared a new one.

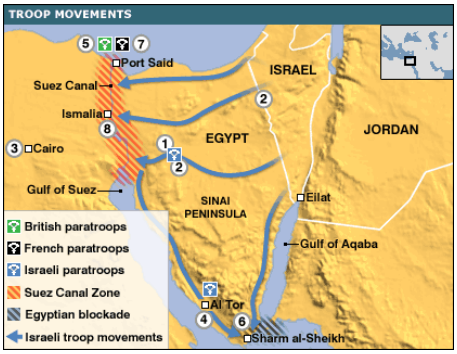
Its first part endorsed the six principles. But it also called on the council to endorse the 18-nations London conference demand for international control of the canal, a demand that Egypt had rejected often and emphatically, and Russia as well. "A beginning has been made," Lloyd told the council. "The hard problems lie ahead." The hardest problem was right on hand - both Fawzi and Russia's Dmitry Shepilov balked at reviving the point of international control. There was little more to be said, so just before midnight the council came to the vote. Nine delegates voted for all the Anglo-French resolution, but Shepilov, with Yugoslavia's Koca Popovic for company, cast Russia's veto against the section calling for international control. The result: the council endorsed only the "six principles" as the basis for further efforts to find a real solution to the conflicting needs of the Suez Canal's users and its Egyptian confiscators. 1197

The foreign ministers scattered to their capitals. But the issue stayed on the U.N.'s agenda, and Secretary-General Hammarskjold went right to work on arrangements for further negotiations to put real meat on the bare bones of principle. The agreement was too vague to promise solid chance of a settlement, and in Cairo, Gamal Abdel Nasser cast fog on the most important of the six principles by asking: "What does Mr. Dulles mean by 'insulating the canal from politics?' The canal still runs through Egypt." The week's events, however, could be counted a broad step toward conciliation and away from the recent angry moment when governments were mobilizing fleets and armies and threatening war over Suez. 1198

Troika

1199

"…British and French troops, spearheaded by airborne forces, invaded the Canal Zone on October 31. Their governments told an outraged world that they had to invade, to separate Egyptian and Israeli forces, and thus protect the freedom of navigation on the canal…"
***theguardian.com,* March 14, 2001** 1200
Caption: "British paratroopers in Port Said, November 11, 1956"



1201


1202

"…The reality was that the British and French, in top secret negotiations with Israel had forged an agreement for joint military operations. Israel, in fact, had the most legitimate grievance of the three invaders, for since the establishment of the Jewish State in 1948, Egypt had denied passage through the canal to any Israeli-flagged or Israel-bound ships…"
***theguardian.com*, March 14, 2001**
Left: caption: "Israeli soldiers in the Sinai wave at a French plane" 1203
Right: caption: "Israeli soldiers in the Sinai dig-in"


Caption: "An Egyptian boy stands near a British tank amid the rubble of destroyed buildings in Port Said after the British and French assault on the city during the Suez Crisis, November 1956" 1204

"…Israeli forces swept into the Sinai desert on September 29, two days before the Anglo-French invasion, and raced towards the canal (one column was headed by a young brigade commander who would go on to become Prime Minister: Ariel Sharon). In less than seven days, the entire Sinai peninsula was in Israeli hands…"
***theguardian.com*, March 14, 2001**
Caption: "Israeli Commander Moshe Dayan in the Suez Canal region during the 1956 war" 1205

"…The Anglo-French invasion was a good deal more ignominious. Just eight days after the first airborne landings, the operation was halted under a ceasefire ostensibly ordered by the United Nations, but in fact dictated by the Americans…" 1206
***theguardian.com*, March 14, 2001**

"…The Egyptian air force had been destroyed and its army mauled – though it put up spirited resistance both in the Canal Zone and in Sinai…"
theguardian.com, **March 14, 2001** 1207
Caption: "Egypt 1956 stamp – 'Defenders of Port Said, Suez Canal'"

Caption: "French troops and Egyptian prisoners of war during the Suez Crisis of 1956" 1208

"…There is little doubt that the invading allies, who had overwhelming military advantage, could have gone on to take undisputed control of the Canal Zone - albeit at a cruel cost…"
theguardian.com, **March 14, 2001**
Caption: "British soldiers sit on a British-made gun they captured from Egyptian forces during the Suez crisis" 1209

Scorched Earth

1210

"…The greatest irony of the operation was that it was totally counterproductive. Far from bolstering Anglo-French interests, it had badly undermined the political and military prestige of both countries. And far from ensuring international freedom of seaborne passage, it had done just the opposite: under Nasser's orders, 47 ships were scuttled in the waterway. The Suez Canal was totally blocked…"
theguardian.com, **March 14, 2001**

1211


Evening Standard

NASSER: THE CANAL STAYS BLOCKED

'As long as a single foreign soldier is on our soil'

'WE WON'T BE TAKEN BY SURPRISE AGAIN'

British protest to Moscow

Hotels ablaze in new Budapes battle

Above: newspaper headline: "Nasser: The Canal Stays Blocked," November 9, 1956

Left: caption "(AP Wire Photo – Nov. 16, 1956) – Arms Search in Suez Canal – British Navy frogmen go below the surface of Suez Canal waters near Port Said in search of forearms thrown away by retreating Egyptians" 1212

The Bigger Problem

1213

It looks as though the biggest engineering problem at Suez will not be the removal of the 50 or so sunken vessels in the harbour and the canal itself, but the re-conditioning or replacement of the canal equipment, particularly the tugs and dredgers, and the re-establishment of the fairway
***ENGINEERING,* November 23, 1956**
RE: introduction to an article entitled: "Clearing The Suez Canal - Urgent Salvage by Anglo-French Forces"

1214

"THE tugs and dredgers that were employed on the canal were all specially made vessels, well-suited for the unique conditions under which they were operated – heavy-duty in restricted areas but under fair-weather conditions. Exactly similar ships are not used elsewhere. It is unlikely that what suitable craft do exist could be spared from their present tasks to form even temporary replacements at Suez..."
***ENGINEERING,* November 23, 1956**
Above L&R: caption: "Salvage vessels and 'air-bag' equipment used during and after the last war have been re-mobilized by the British Admiralty and were among the first units sent to Port Said when the British and French Governments took action in Egypt"

1215

"...The period of adapting or building the craft required, if Colonel Nasser's men not only sunk but also destroyed the Canal Company's vessels, will be far longer than the three-to-nine months that have been predicted for raising the scuttled vessels or removing the other known obstructions..."
***ENGINEERING,* November 23, 1956**

1216

Top: caption: "The entrance to the Suez Canal at Port Said with the blockships sunk by the Egyptians. The canal was closed to traffic for five months while Royal Navy salvage teams worked on clearing them."
Bottom: caption: "Egypt, January 1957 - Salvage work in the Suez Canal is proceeding at a normal rate, a temporary channels for the transit of ships up to 10,000 tons should be opened early in March, and the canal cleared of all its obstructions by May, as anticipated by General Wheeler (U.S.), who organizes and supervises the clearance operation for the U.S. This picture shows crewmen of the German salvage craft *Ausdauer* watching a diver go down in the canal to attach cables to a sunken obstruction. The *Ausdauer* is one of the four German vessels of the U.S. fleet."

1217

The Condition of the Fairway

1218

"…And with any great lapse of time a very serious problem will have arisen due to the sand that will have been deposited in the canal. Continuous dredging was of paramount importance in maintaining an adequate waterway for the vessels that used the canal – indeed, it was not unusual for the largest to scrape the bottom somewhere during transit, despite regular work by the company's dredgers. It is unlikely that the condition of the fairway was improved during the three months in which the Egyptians 'owned' and operated the canal. It is absolutely certain that during the last month of 'armed conflict' negligible action was taken to counter nature's efforts to refill the canal with sand…"
***ENGINEERING,* November 23, 1956**

1219

A Pretty Problem

1220

"…Between 1950 and the end of 1954 it was necessary to excavate 53 million cubic-yards of material to meet the needs of shipping requiring passage. Six months lapse will generate a pretty problem of balancing the deployment of improved dredging equipment against the need to give the first ships room to pass…"
***ENGINEERING,* November 23, 1956**

1221

Return to Good Order

1222

"…The Egyptian Government may or may not own the canal, but it is quite certain that they have neither the money nor the equipment to put it in good order again. They have damaged the canal – even if not irrevocably – but it is only Western Europe, and in particular the United Kingdom, which has the capacity and urgent desire to return to its former good order…"
***ENGINEERING,* November 23, 1956**

1223

Obstructions

1224

"…The first full report of the obstructions caused by the Egyptians reached London last weekend . . . With 20 wrecks in the harbour at Port Said, the total number of obstructions – including two blown bridges – was then put at 50. This figure is based on a full survey within the area occupied by the Anglo-French forces, that is, as far south as El Cap, but only on intelligence reports and aerial surveys along the more extensive southern reaches…"
***ENGINEERING*, November 23, 1956**
Caption: **"Sunken vessels at Port Said. The bucket dredger is the *Peleuse*; behind is the canal salvage vessel *Pollux* with her stern damaged by explosives. The funnel is the hopper *Neptune*."**

1225

"…Taking a 25 ft. draught ship as a measure, only seven of the obstructions (including the bridges at El Ferdan and Ismailia) south of El Cap are assessed to be effective, though four more may offer immediate restriction to the passage of such a ship. Of the ithers, one is probably ineffective and 17 certainly make for no difficulty, as they clear the main channel…"
***ENGINEERING*, November 23, 1956**

1226

Unintended Consequences

1227

"…Though Eden scarcely seemed to appreciate it, Britain was simply no longer capable of mounting a solo imperial adventure. In the Suez operation, British soldiers fought alongside French ones. More importantly, both fading European powers were allied with the youngest but already most potent force in the Middle East: Israel…"
***theguardian.com*, March 14, 2001**
Above L&R: **caption: "1966 Israel Suez Canal Crisis 10th Anniversary Silver Medal"**

1228

"…But it wasn't Britain's military allies which mattered in the final analysis; it was her political foes. They most obviously included the Soviet Union and its allies, who were given a glorious opportunity to attack western imperialism (and deflect world attention from their own brutality in crushing the simultaneous Hungarian uprising)…"
***theguardian.com*, March 14, 2001**
Caption: **"The Hungarian Uprising, Oct. 23 - Nov. 4, 1956"**

1229

"…Much more telling than Soviet condemnation was the disapproval of the Eisenhower administration in the USA. Washington was appalled by the Anglo-French-Israeli invasion of the Canal Zone and the Sinai. The action threatened to destabilise the strategically vital region, and strengthen Soviet links with liberation movements around the world. It raised global tensions in an age dominated by the nuclear arms race and recurring superpower crises. More viscerally, it was viewed with distaste as a nakedly imperial exercise in a post-imperial age…"
***theguardian.com*, March 14, 2001**

1230

Oh No You Don't

1231

"…Eden, a master of self-delusion, thought he had received a nod and wink of approval for the invasion from John Foster Dulles, the U.S. Secretary of State. He should have checked with Dwight D. Eisenhower, who was enraged by the action. He forced through the UN resolution imposing a ceasefire, and made it clear that in this matter at any rate, Britain would have no 'special relationship' with the U.S.A…"
***theguardian.com*, March 14, 2001**

1232

Caption: "President Dwight D. Eisenhower and Secretary of State John Foster Dulles frequently discussed U.S. policy during the Suez Crisis"

1233

Checkbook Control

1234

"…The final straw for Eden came when the Treasury told the government that sterling, under sustained attack over the crisis, needed urgent U.S. support to the tune of a billion dollars. 'Ike' had a crisp reply: no ceasefire, no loan. The invaders were ordered to halt, and await the arrival of a UN intervention force…"
***theguardian.com*, March 14, 2001**

1235

Caption: "An Indian contingent of the United Nations Emergency Force (UNEF) photographed at El Cap, Egypt, following the ceasefire at the time of the Suez Crisis, mid-to-late November 1956"

1236

1237

SUEZ: Problem's Solution?
TIME
May 6, 1957

1238

In the cool of the early morning, *S.S. President Jackson* moved into Suez and took on veteran Egyptian Pilot Mahmoud Metwali. The *Jackson* paid $10,295 in tolls with a polite note indicating that she was obeying U.S. Government instructions to pay under protest. Then, with the U.S. flag flying at the stern and the green Egyptian flag at the foremast truck, President Jackson steamed slowly northward into the canal at the head of a convoy of four ships. Mahmoud Younis, manager of Egypt's Suez Canal administration, wired the twelve passengers a Happy Easter and a pleasant trip. At Ismailia, U.S. Lieut. General Raymond A. Wheeler left his office in the U.N. canal-clearance headquarters, appeared on the canal bank to salute the ship's captain and wave to the passengers.

That evening, as Jackson cleared the northern end of the canal and sailed into the Mediterranean, Egypt's Foreign Minister Mahmoud Fawzi released a letter to U.N. Secretary-General Dag Hammarskjold, declaring: "The government of Egypt are pleased to announce that the Suez Canal is now open for normal traffic." Accompanying the letter was a "declaration" of President Gamal Abdel Nasser's charter for the operation of the canal. The declaration, wrote Fawzi, "constitutes an international instrument," and he asked Hammarskjold to register it as such.

"Very close to unacceptable," said the French. "Vague and elusive," said the British. A U.S. diplomat commented more cautiously: "We're not happy with it; we don't think it's as good as it could be - but it's a lot better than what we started with. We think it ought to be given a try."

1239

Respecting the Spirit. From the preamble to the end of the short (1,000 words) document, it was evident that Nasser was anxious to get business, to show himself conciliatory, and to proclaim Egypt's respect for law. The document declared Egypt's "unaltered policy and firm purpose to respect the terms and the spirit of the Constantinople Convention of 1888."

On one point Nasser was adamant: the canal would be run exclusively by Nasser's Suez Canal Authority, with no advice from anyone. But after weeks of talk in Cairo between Fawzi and U.S. Ambassador Raymond A. Hare, Nasser had gone a considerable way toward meeting the user nations' demands for protection against abuses. His willingness to accept arbitration and the compulsory jurisdiction of the International Court of Justice, his volunteered limitation of toll increases, his undertaking to maintain and improve the canal in accordance with the old company's plans, and his acknowledgement of the old company's rights to compensation, were all clearly stated pledges.

But in response to Hare's pleas for recognition of the right of a user-nation organization to consult and cooperate in the canal's operation, Nasser conceded only that the Canal Authority would "welcome and encourage cooperation" - with "representatives of shipping and trade" - meaning companies, not nations.

1240

Off the Hook. Many of the terms of the declaration can be traced to the ingenious brain of India's Krishna Menon, who spent two days in consultation with Nasser last March. Convinced that it would take months to negotiate a multisided agreement between Egypt and the users while the canal stood idle, Menon seized on the idea of working out the terms as a unilateral pledge and registering it with the U.N. as "an international instrument," thus partially answering the charge that the terms could be changed any time and without notice at Nasser's whim. The terms can still be repudiated - so can the treaty - but at a cost of greater publicity and opprobrium. Reportedly, Nasser also confided to Menon that he was willing to let the World Court settle the question of Israeli passage through the canal, saying: "After some months, the court will probably decide against me, but I will be off the hook with the rest of the Arab world" - which is fanatically opposed to any sign of softness to Israel.

A month ago there was brave talk of summoning Egypt before the Security Council for a reckoning. Last week there was no longer any thought of that. U.S. Ambassador Henry Cabot Lodge declared for the U.S.: "Perhaps no final judgment can be made . . . until it has been tried and in practice." France, Britain and Australia stated subdued reservations, but avoided any irretrievable defiance.

1241

The basic objection to Nasser's offer is that it is a unilateral declaration, which gives the users no sure right of redress in case of abuse. Legal experts found many loopholes Nasser could use, if he chose, to escape the apparent pledges he had made. But given Nasser's good faith, and his need to keep the canal going, the terms seemed workable. Given his bad faith, even a more binding agreement would be worth little. The test of performance by Egypt over the next few months will prove whether Nasser is really prepared to make an honest and workable accommodation for the shipping nations of the world.

1242

The Virtues of Empire

1243

"…The Suez crisis provoked a mighty, if predictable, wave of jingoistic fervour in the rightwing British press. There was a tide of genuine public support for 'our boys' and a widespread mood of hostility towards Nasser…"
theguardian.com, March 14, 2001

1244

"…But at the same time - and arguably for the first time - there was a countervailing popular wave of revulsion against imperialist aggression. Hugh Gaitskell, not exactly the most radical of Labour party leaders, railed passionately against the war. So did Liberals and leftwing groups. Their stand was not hugely popular - the circulation of the 'Manchester Guardian,' which fiercely opposed the war, fell markedly during the crisis - but the anti-war movement was a dramatic, even traumatic, shock for the nation…"
theguardian.com, March 14, 2001
Caption: "Anti-war protesters outside Parliament, September 1956"

1245

"…What fatally undermined the Conservative government, however, was the dissent in its own ranks. Less than 50 years ago, there were plenty of Tories who still believed in the virtues of empire. But there was also a new generation which recognised the damage being done to Britain's real interests in the new world, and which was outraged by Eden's blinkered approach. Two junior ministers, Edward Boyle and Anthony Nutting, resigned from the government in protest against Suez. Among those who stayed on, but who expressed deep reservations about the Suez enterprise, was RA 'Rab' Butler, the man widely seen as Eden's heir apparent…"
theguardian.com, March 14, 2001

1246

Political Fallout

1247

"…Eden himself was shattered by Suez, politically, physically and emotionally. On November 19, just three days before the last of the British invaders finally left the Canal Zone, he abruptly took himself off to Jamaica to recover, leaving behind Rab Butler in charge of the cabinet. On January 9, 1957, Eden resigned. The Conservative mandarins who controlled the leadership promptly took their revenge on Butler, seen as the leading liberal in the party, by elevating the more rightwing Harold Macmillan to Downing Street…"
theguardian.com, March 14, 2001

1248

Change in the Vocabulary

1249

"…It may now seem astonishing to those who were not alive during the Suez Crisis that Britain was prepared to take part in such an imperial adventure so recently. Even to those who clearly remember it - including this writer - it seems an anachronism; an atavistic throwback. In 1956, after all, Elvis Presley was already a star, Disneyland had been opened in California, and British theatre was in the throes of the 'kitchen sink' revolution. And yet, though it took place well within living memory, Suez was also a link with a not-so-distant past in which imperialism was a matter of pride rather than a term of abuse. Indeed, it marked definitively the transition between those two things…"
***theguardian.com*, March 14, 2001**

1250

End of an Era

1251

"…British soldiers would go on fighting in various corners of the shrinking empire - East Africa, Aden, Malaya, Borneo and the Falklands - for another 25 years or so. The difference, after Suez, is that they fought largely to defend local regimes and systems, rather than to impose the will of London…"
***theguardian.com*, March 14, 2001**
Caption: "25,000 servicemen were sent to retake the Falklands in 1982"

1252

"…The years immediately following Suez saw a slew of new countries on the world stage which had formerly been colonies and dependencies. There is little doubt that the end of the imperial era was greatly accelerated by the squalid little war in Egypt."
***theguardian.com*, March 14, 2001**

1253

1254

Part 14

An Engineer's POV

1255

Holding Back the Desert

1256

Without constant dredging, this vital waterway would fill with sand and be reclaimed by the desert
***National Geographic,* January 1957**
RE: introduction to an article written *by Maj. Gen. Glen F. Edgerton, U.S. Army* (Ret.)* entitled: "An Engineer's View of the Suez Canal."
*****General Edgerton is the only American on the board of eighteen experts appointed by the Suez Canal Company to advise on canal maintenance since 1952. Kansas-born Glen F. Edgerton was graduated from West Point at the head of his class in 1908 and became an Assistant Engineer of the Panama Canal directing its construction. After brilliant service elsewhere, he returned to Panama in 1936 as Engineer-in-Charge of Maintenance, and from 1940 to 1944 was Governor of the Panama Canal. Besides serving with distinction in two World Wars, the versatile General has directed UNRRA operations in China, supervised the renovation of the White House, and served in such varied posts as Chief Engineer of the Federal Power Commission and Managing Director and President of the Export-Import Bank. He is a Director of the Panama Canal Company.

1257

Caption: "Major General Glen E. Edgerton (left), director of the UNRRA China office, watching Mrs. Caroline Aprill of UNRRA, herself a Polish refugee, checking Austrian passport aboard the *Marine Falcon,* December 31, 1948"

1258

The Eye of the Beholder

1259

"THE Suez Canal – all-in-all the most influential change man has yet imposed on geography – is many things to many people, quite a few of them surprising…"
***National Geographic,* January 1957**
Above: bird's-eye view of the Suez Canal
Left: Egyptian stamp commemorating the re-opening of the Suez Canal in 1957"

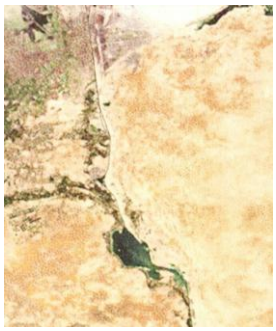
1260

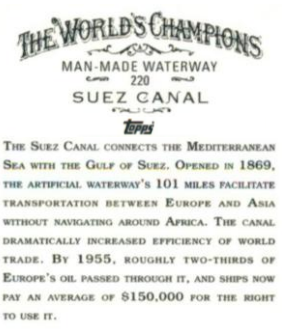
"…As the world well knows, the canal can cause international explosions. To Britain and western Europe it is a veritable life line, and to much of the world a short-cut that makes countless products cheaper because they are more efficiently conveyed…"
***National Geographic,* January 1957**

1261

"…President Eisenhower has called the canal vital to the economy of the United States – 'indeed, to the economies of almost all of the countries of the world.' You get an inkling of what this means when you see a 700-foot supertanker from Kuwait pumping-out crude oil in Philadelphia; that one load, after refining, will fill-up gas tanks of about 300,000 automobiles…"
***National Geographic,* January 1957**

1262





"…American imports through the canal – less than one million metric tons in 1938 but more than 11 million in 1955 – include rubber and much of the manganese we need to harden steel. Europe counts on the canal for half its oil supply, or about 50 million gallons-a-day…"
***National Geographic,* January 1957**

1263

"…Less widely known is the fact that even zoologists take a professional interest in Suez. Thanks to the canal, creatures once at home in the Red Sea – especially the delicious swimming crab 'Portunus pelagicus' – migrated to the Mediterranean Sea and are now caught there in large numbers. As if in repayment, Mediterranean sardines and sea horse swam the other way. The sea horse now abound in the Bitter Lakes, about two-thirds of the way in the Gulf of Suez…"
***National Geographic,* January 1957**

1264

The Biology of the Suez Canal
by *J. Stanley Gardiner*
NATURE
October 4, 1924

1265

THE Cambridge expedition for the investigation of the intermingling of the Mediter-ranean and Red Sea organisms in the Suez Canal left England last week in the Orient liner *Oreades*. The fauna of the Canal, which was opened in 1869, was first studied by Keller in 1882, a later reinvestigation of the fishes being made by Tillier in 1903. The organisms of the Red Sea and the Mediterranean are very different from one another, even though these two seas were connected by a narrow strait, approximately along the line of the Canal, in glacial times.

The barrier to intermingling at that period would seem to have been fresh water, a considerable Nile mouth opening into the centre of the strait. In the time of the Pharaohs a navigable canal was dug, connecting a branch of the delta with the Gulf of Suez, which then extended about 30 miles farther north. By the time of Cleopatra this canal became impassable, owing to Nile silt, but it was afterwards reopened, being finally closed for strategic reasons by the Caliph Almansur towards the end of the eighth century.

1266

French investigations, carried out at Suez when Napoleon was in occupation of Egypt, showed certain Mediterranean jelly-fish, sea anemones, and other forms which did and do not extend to the south out of the gulf of the same name. These, if they passed by the Canal, must have been able to withstand the fresh water in its centre.

The conditions then were the opposite to those of the present day, for the Bitter Lakes have now a salinity of about 77 grams-per-litre, or about twice the salinity of either of the terminal seas. These lakes will be intensively studied, while the fauna of the brine pools in the deserts bordering on the Canal will also be examined.

1267

The Suez Canal Company is giving facilities in respect to boats and by the use of its Canal Stations, and it is hoped to carry the investigation to at least two areas on either side of the Lakes. Each will be intensively collected by trawl nets, dredges, and tow-nets of different sorts, while samples of the bottom and its contained fauna will be obtained by means of the Petersen grab. Similar methods will be adopted at each place, so that comparisons will be possible, not only as to the different species found in each, but also to their relative numbers.

The animals will probably be those which live in more or less moving sand, and special gear has been devised to secure these. Then there are such swimming forms as fishes and a few crustaceans. Hard bottom for the attachment of sedentary organisms would only seem to be present in a limited area in the Lakes, but there are piles and other artificial erections, and sunken vessels, in places; however, the larvae of all are practically free living. The problems before the expedition are to ascertain what forms have passed through the Canal zone from the Mediterranean to the Red Sea and vice versa, when they passed through, whether in the prehistoric period, in the times of the earlier or of the present canal, how they passed through, whether by swimming, by drifting, by attachment to ships, or by other means.

1268

All these facts lead up to the question why some forms of life can get through the Canal and others cannot, and it is hoped that the expedition will throw light on marine migrations in general, the area being one which can be periodically investigated at small cost.

The expedition is in charge of Mr. H.M. Fox, Balfour Research Student of the University, who is responsible for the necessary physical, chemical, and physiological work. He is accompanied by Mr. Robert Gurney, who undertakes the plankton, and by two research students of the University. It has been arranged by a Cambridge committee, of which Sir Arthur Shipley is chairman, and is largely financed by the government grant administered by the Royal Society; collecting gear has been provided by the University and the Natural History Museum. It is a return to the former tradition that the Balfour student should undertake for part of his period of research an expedition to investigate some problem in the field.

1269

The Biology of the Suez Canal

by *J. Stanley Gardiner*
NATURE
December 13, 1924

1270

THE Cambridge and Royal Society Expedition which set out last September to investigate the biology of the Suez Canal (see *NATURE,* October 4, p. 520) arrived at Suez at the end of the month, and at once went under canvas on the shores of the Bitter Lakes, being provided with boats, etc., by the generosity of the Canal Company. Here the members remained for four weeks, afterwards proceeding to Suez for a like period. They are now at Ismailia living on a houseboat lent by the Canal Company, this being towed from place to place as desired. Later they propose to move to Port Said for the last four weeks of their stay.

The Bitter Lakes, which are about 36 kilometres long by 12 broad, becoming much narrower to the south, yielded surprising results. There is a central area of about 6 fathoms, that overlies an extensive salt bed. This is covered by black mud, which proved to be absolutely devoid of life, although the density and temperature of the water immediately over it are relatively little higher than elsewhere ; it may be presumed, however, that the salinity of the Lakes must have decreased since the Canal was opened. This deeper ground merges into extensive areas of shallower waters (G-3 fm.) by the shores, the surrounding land being almost typical desert.

1271

The waters were investigated in 1882 by Keller, who found them almost devoid of life, while Fox now writes enthusiastically as to the richness and variability of the organisms of this shore region. Keller found no anemones or echinoderms, 1 species of crab, 2 sponges, and a very few worms, while Fox records anemones as very common, also a few alcyonaria, echinoderms represented by sea urchins, starfishes, brittle stars, and holothurians, many species of crabs and sponges, with an abundance of worms and representatives of most other groups of organisms, including excellent soles. Bare sand, almost devoid of life, is found in patches, but most of the bottom is covered with a rich growth of algae and phanerogamic plants.

There is a striking average increase in size of some of the individual species of animals as compared with those which Fox previously collected for research purposes at Suez, the most striking being a large black Synapta about 45 cm. long as compared with the usual length of 25 cm. There proved to be considerable diversity of fauna and flora off different shores of the Lakes, and contiguous patches of the bottom were often found to carry different plants and animals, so that the mapping out of the bottom regions proved a task of great difficulty.

1272

"The salt pools on the shores," writes Mr. Fox, "although interesting, have been disappointing owing to the poverty of their fauna. All contain one fish and one gastropod, both species in great numbers. There is no plankton and no other animal. The fish and mollusc both feed on algae. The surprising thing is the high salinity which the fish and mollusc endure. My hydrometer registers 1000 in distilled water, 1204 in saturated salt solution. The Red Sea off Suez is 1031, the Bitter Lakes 1035-1045. These fish and molluscs live happily in 1175" (these are relative figures that may require adjustment for temperatures, etc.)

At Suez the Expedition has been mainly concerned with collecting the fauna and flora for comparison with those of the Bitter Lakes. Exact data as to temperatures, salinities, acidities, etc., have been obtained. There would seem here to be greater variability in the bottom life as compared with the period antecedent to the opening of the Canal. For this reason the Expedition has confined its work to ten selected stations, mostly with soft bottom, only once having visited the "coral" reefs which lie about 3 miles to the south.

The greater part is sand; phanerogamic plants are uncommon, and algae almost absent. The latter, however, occur abundantly under the piers, and Mr. Fox discusses how far the general absence of algae in the Gulf of Suez may be due to an inhibition produced by the intensity of light, the possibility of this as the chief factor being largely discounted by the strong growth of plants in the Bitter Lakes.

1273

The Expedition has also studied with great care the organisms attached to vessels, to piles, and to buoys, cleaned on known dates, and has put out wooden floats. These latter should give data both as to the factors helping in the distribution of the organisms and as to the rates of growth of many forms.

In his comparison of the two regions he has so far studied, Mr. Fox concludes that the fauna on the piles of piers is equally abundant, "but the shallow bottom and coast fauna is more abundant in the Lakes. It seems to me that the richer Lake fauna may depend on the bottom, which is mostly sand mixed with mud. On this the phanerogamic weed grows in abundance and gives cover to animals. Further, detritus feeders like mud. In the Bay of Suez, on the other hand, the shallow bottom is more often sand. There are small areas of sand in the shallows of the Bitter Lakes, and these are devoid of weed and very poor in animals, as at Suez. The difference in richness then may be due to a difference in bottom. The striking facts about the lakes would be that (1) the higher salinity does not prevent a rich varied fauna, (2) it does not inhibit growth in size, (3) there are peculiar effects, such as the sex of Neptunus, almost all males."

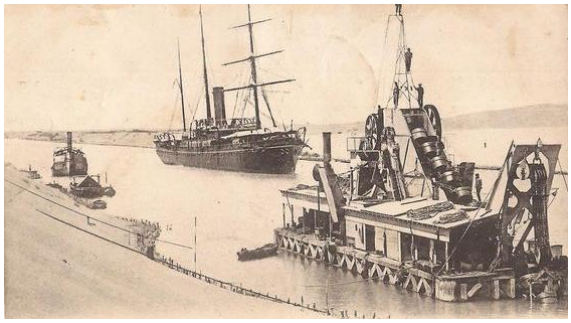
1274

The work of the Expedition has clearly been much expedited and made far pleasanter by the kindness, generosity, and personal interest that has been taken in it, not by the directors alone, but by all the officials of the Canal Company. They have lent boats and camping equipment, carried mails and helped in the commissariat. The head of the Coast Guards has lent launches, and the officials of the Government have uniformly been friendly. The Canal Company clearly has an area under its control of great scientific interest, if periodically examined. The present Expedition can only, at most, map out its different faunistic regions, and it will remain for a further expedition to examine these quantitatively, so that science may get the full value of the present enterprise.

1275

The Most Interesting Thing

1276



"…But to me as a member of the Commission Consultative Internationale des Travaux, the Suez Canal Company's International board of engineering advisers, the most interesting thing about this much-discussed waterway is that it is still being dug. Without continual dredging the canal would become a dry ditch. Winds constantly try to fill it with sand…"
***National Geographic,* January 1957**

1277

Muknessa, Awa and Khamsin

1278

"…Toward the end of November the wind is 'muknessa,' the 'broom.' Near the end of March comes 'awa,' the 'cat's noise,' and then comes the violent 'khamsin,' the 'wind of fifty days.' The khamsin usually lasts only a few hours at a time, but it has been known to take paint off cars and force fine sand into camera shutters and wrist watches. During the worst week on record, in 1911, storms sprinkled into the canal 103 million cubic-feet of sand, more than enough to make a pile the size of the Great Pyramid…"
National Geographic, January 1957

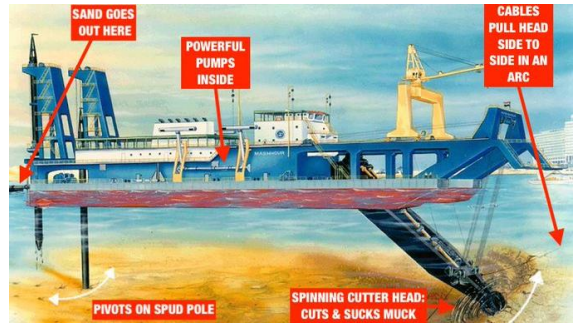
1279

The Challenge

1280

"…Waves and water currents vie with the winds in this work of destruction. Ships' wakes eat insidiously at those beautifully straight banks. In short, the Suez Canal poses one of the toughest maintenance problems of the century. And in addition to maintenance, there must be improvement – to widen and deepen the channel as ships increase in size…"
National Geographic, January 1957

1281



"…This day-in and day-out, in normal times, dredges clank, men shovel muck, and engineers pore over blueprints. In the last eighty years more than a billion-and-a-half cubic-feet of sand and rock have been dug-out of the canal, about six times as much as the original excavation…"
National Geographic, January 1957
Caption: "Cutter Suction Dredge *Mashhour* – Suez Canal Authority"

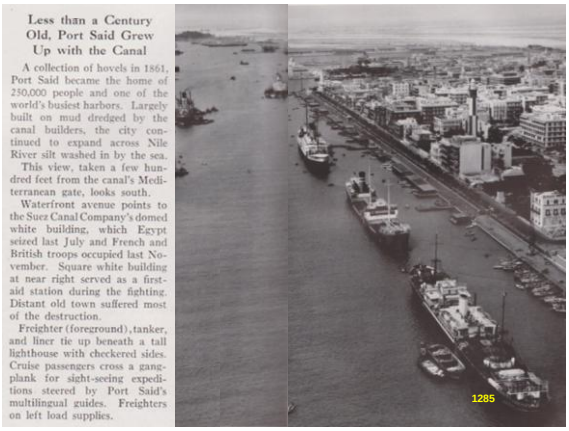
1282

Now Voyager

1283

"…An increasing challenge to the engineer, the canal can provide an unforgettable first glimpse of a new world for the voyager on a cruise ship making a transit in tranquil times. After crossing the Mediterranean, he arrives at Port Said, the canal's northern entrance…"
National Geographic, January 1957
Caption: "Port Said, at the entrance to the Suez Canal from the Mediterranean"

1284



Less than a Century Old, Port Said Grew Up with the Canal

A collection of hovels in 1861, Port Said became the home of 250,000 people and one of the world's busiest harbors. Largely built on mud dredged by the canal builders, the city continued to expand across Nile River silt washed in by the sea.

This view, taken a few hundred feet from the canal's Mediterranean gate, looks south.

Waterfront avenue points to the Suez Canal Company's domed white building, which Egypt seized last July and French and British troops occupied last November. Square white building at near right served as a first-aid station during the fighting. Distant old town suffered most of the destruction.

Freighter (foreground), tanker, and liner tie up beneath a tall lighthouse with checkered sides. Cruise passengers cross a gangplank for sight-seeing expeditions steered by Port Said's multilingual guides. Freighters on left load supplies.

1285

Telephoning in the control tower of the canal building, this Egyptian kept convoys moving.

1286

"…When he reaches the Gulf of Suez at the other end, he will have traveled 100 miles from Port Said lighthouse in about 13 hours, scarcely ever out of sight of seemingly endless sand plains or dunes. He will not pass through the town of Suez at all, but he will be able to see it from the canal's southern exit of Port Taufiq…"

***National Geographic,* January 1957**

1287

L Seen from a Plane Above Gulf of Suez, the Desert Flattens Out Like an Unrolled Map

White specks in the gulf are ships waiting to form a convoy. Road from Cairo skirts the coast beside an oil refinery, continues into the town of Suez, and leaps the causeway into Port Taufiq.

Great Bitter Lake, where convoys pass, lies 30 miles to the north. Beyond, the canal fades into the horizon.

R Clinging to Mid-channel, Ships in Convoy Leave Little Bitter Lake for Port Taufiq

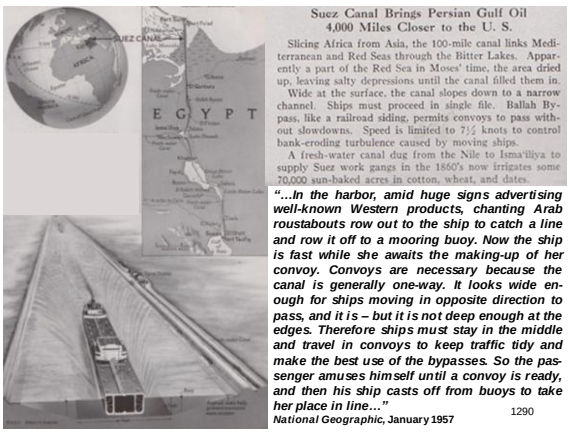
Africa lies on the left, Asia to the right of the canal. Sea turtles have ventured as far as Little Bitter Lake, where the canal widens out. Stagnant mud flats between canal and port are being reclaimed for agriculture. Black square beside canal is a coal depot. Repair docks for Red Sea shipping stand at the canal's southern gate.

1288

"…Port Said . . . Here, wrote Rudyard Kipling, a little garden with hibiscus and poinsettia marks an exact division between East and West, where homesickness is smothered by 'the smell of strange earth and the cadence of strange tongues'…"

***National Geographic,* January 1957**

1289



Suez Canal Brings Persian Gulf Oil 4,000 Miles Closer to the U. S.

Slicing Africa from Asia, the 100-mile canal links Mediterranean and Red Seas through the Bitter Lakes. Apparently a part of the Red Sea in Moses' time, the area dried up, leaving salty depressions until the canal filled them in.

Wide at the surface, the canal slopes down to a narrow channel. Ships must proceed in single file. Ballah By-pass, like a railroad siding, permits convoys to pass without slowdowns. Speed is limited to 7½ knots to control bank-eroding turbulence caused by moving ships.

A fresh-water canal dug from the Nile to Ismailiya to supply Suez work gangs in the 1850's now irrigates some 70,000 sun-baked acres in cotton, wheat, and dates.

"…In the harbor, amid huge signs advertising well-known Western products, chanting Arab roustabouts row out to the ship to catch a line and row it off to a mooring buoy. Now the ship is fast while she awaits the making-up of her convoy. Convoys are necessary because the canal is generally one-way. It looks wide enough for ships moving in opposite direction to pass, and it is – but it is not deep enough at the edges. Therefore ships must stay in the middle and travel in convoys to keep traffic tidy and make the best use of the bypasses. So the passenger amuses himself until a convoy is ready, and then his ship casts off from buoys to take her place in line…"

***National Geographic,* January 1957**

1290

"…For the first 25 miles she moves in the channel dug through marshy Lake Manzala, next to a road, a railroad, and the fresh-water canal branch supplying Port Said. Then dry land appears on both sides, with palms and cultivated splotches on the African side to starboard, Here flocks of storks stand around in migration time. In early winter old canal hands tell passengers to look for blossoms in the trees. The trees are there all right, but the blossoms turn out to be white egrets…"
National Geographic, **January 1957**

1291

Seen from a Ship's Bridge, Africa's Sandy Shore Slips Past a Southbound Convoy
Concrete caissons on right will be sunk in Little Bitter Lake to hold mooring posts.

1292

Seeing Things

"…Portside lies the grayish Sinai desert. Lucky passengers may see a mirage. A cadet-midshipman from the U.S. Merchant Marine Academy at Kings Point, New York, came by on a round-the-world cruise last year and says he saw a gabled house, upside down. Another recalls mountains, right-side up…"
National Geographic, **January 1957**

1293

1294

Right-of-Way

"…Soon the canal seems to divide into two parallel canals, less than a mile apart. This is Ballah Bypass. It allows convoys moving in opposite directions to pass each other with the least possible delay…"
National Geographic, **January 1957**

1295

1296

"…The convoy with the larger number of vessels has the right-of-way. Seen from the convoy, ships in the bypass seem to be drifting in the sands…"
***National Geographic,* January 1957**
Caption: "Ships moored at El Ballah during transit"

1297

Progress South

1298

"…The channel continues through Lake Timsah, meaning 'Lake of the Crocodiles' – there aren't any left – past the docks, beaches, villas, and gardens of Ismail'iliya, 'the emerald of the desert,' on the right. Then comes Great Bitter Lake, where convoys also pass each other; Little Bitter Lake, in which pelicans fish; and the final canal stretch to the Gulf of Suez, an arm of the Red Sea. In ordinary times khaki-clad Egyptian Coast Guard men on camels patrol the banks, alert for hashish smugglers from the Asian side…"
***National Geographic,* January 1957**

1299

"…With progress south comes a rise in temperature. It may have been 70-degress in the Mediterranean, but 100 miles south it can be 100-degrees, making one think of T.E. Lawrence's impression: 'the heat of Arabia came out like a drawn sword and struck us speechless'…"
***National Geographic,* January 1957**

1300

Navigating the Ditch

1301

"…To the passenger, memory of the Suez Canal may recall an Arab on the bank spreading hos prayer rug at sunset, or greenish rays shooting from the sun as it dips below the horizon. To the ships' captain, however, the canal brings recurrent problems. A skipper always worries about his ship, of course, and even entering Hampton Roads or Philadelphia may force him into split-second decisions which, if unwise, could bring disaster. But in the narrow Suez Canal – 'It really is a ditch, you know,' says a captain who has been going through for 20 years – he faces split-second decisions all the way…"
***National Geographic,* January 1957**

1302

"…From the standpoint of the master accustomed to straight steaming in deep water, the most unnerving thing about a Suez transit is the sudden seeming insanity of his ship. 'The old gal forgets all she's ever learned,' one master of a huge tanker told me. 'She acts like a colt in pasture. She's a different baby entirely'…"
National Geographic, **January 1957**

1303

"…The reason is the peculiar action of water confined between narrow banks. True, this sort of thing can occur in a dredged channel in a shallow bay or in any narrow canal. But from what the pilots and masters tell me, I gather that Suez waters play tricks all their own. To cope with them, the shipmaster relies on advice from his pilot; but he remains responsible for everything the ship does…"
National Geographic, **January 1957**

1304

Canal Hydrodynamics

1305

"…I am not a seafaring man myself, but it is easy to understand that there are not only the ordinary currents to be reckoned with, but also the vagrant pressures built-up by the ship herself. To explain: a big ship acts in the canal somewhat like a loose piston going forward in a cylinder of water. As she moves, she pushes water away from her – ahead and to the sides. This creates a depression right where the ship is. The water level drops as much as three feet, and the ship 'squats' while the waves of the displaced water hit the banks and bounce back. When they reach the ship, the effects are often surprising…"
National Geographic, **January 1957**

1306

"…Altogether, currents hit the hull from three directions. There is one current from stem-to-stern. Another, the reflection from the banks, strongly affects the aftermost third of the vessel, possibly making her veer sharply toward one bank in what pilots call 'bank suction.' And finally, a powerful stern wave follows in the wake. This is simply a mass of water seeking to fill the 'hole' the ship herself made. It produces a current in the direction of the ship's progress…"
National Geographic, **January 1957**

1307

"…The pilot's main task is to give constant advice – in effect, orders for the helmsman – to keep the ship in the middle of the channel. In view of all these currents, this is more difficult than it looks at first sight…"
National Geographic, **January 1957**

1308

During a canal transit the pilot is virtually in command. Far better than the captain, he knows the tricky currents that can ground a vessel, given a few seconds' neglect. Gazing from the wheelhouse, this pilot continually instructs the helmsman. He strives to keep in mid-channel and maintain a two-mile clearance behind the vessel ahead, the distance usually required for a supertanker's full stop from 7½ knots.

1309

"…When the ship is on a true course in the center of a straight channel, pressures are equal from both sides if the banks are alike; but if the ship swerves towards one bank, pressures are unbalance unpredictably. They usually tend to push the ship toward the other bank…"
***National Geographic,* January 1957**

1310

"…Where the channel bends, these forces become something to be used, but skillfully and with caution. Entering a curve to the right, the pilot must ease his lumbering charge toward the left bank. The bow meets increasing pressure from that side as distance to the land diminishes. It swings to the right without so much as a nudge from the helm – and that is all right, because that is the way the bow should go. But a heavy ship may come right too fast. Then the landlubber on the bridge might get a shock. The pilot orders left rudder – and it is the only command he has given – to make a right turn!…"
***National Geographic,* January 1957**

1311

A Lot to Learn

1312

"…Pilots will tell you that steering must also take into account the ship's size, shape, and load, its speed and number of propellers, the irregularities of the banks and churned-up bottom, the wind, and probably other things. No wonder a pilot has a lot to learn…"
***National Geographic,* January 1957**

1313

The Chosen Men

1314

"…Who is a chosen man that I may appoint?…"
Jeremiah 49:19

1315

The qualifications of a Suez Canal pilot are above those required of most men in the mechanical field. He must speak at least two languages, French and English, and the work requires a certain delicacy and constant strain uncalled for in the average vocation of a man.
***Popular Mechanics,* July 1909**
RE: introduction to an article entitled: "Work of Pilots on Suez Canal"

1316

"THERE are about 120 pilots on the canal and they receive an average of $3,000 per year for their services. A pilot receive $10 for a night's work. His time of work is regulated by the government. Each pilot takes four or five ships through a part of the canal a week and is required to take several hours' rest after guiding a ship through his district…"
***Popular Mechanics,* July 1909**

1317

"…On the canal proper there are about 80 pilots; twenty of these live at Port Said, 40 at Ismailia, and the other 20 at Suez, thus dividing the canal into three districts. Those at Suez and Port Said are engaged in taking the ships out of the port and bringing them in. Those at Ismailia engage in the navigation of the canal proper."
***Popular Mechanics,* July 1909**

1318

"…Some senior pilots can give orders in any of seven languages, if necessary, but as a rule the pilot's language is English. His orders may come every few seconds:
'Left 10!'
'Ease to 5!'
'Midships!'
Right 5!'
Midships!'
'Steady as she goes!'…"
***National Geographic,* January 1957**

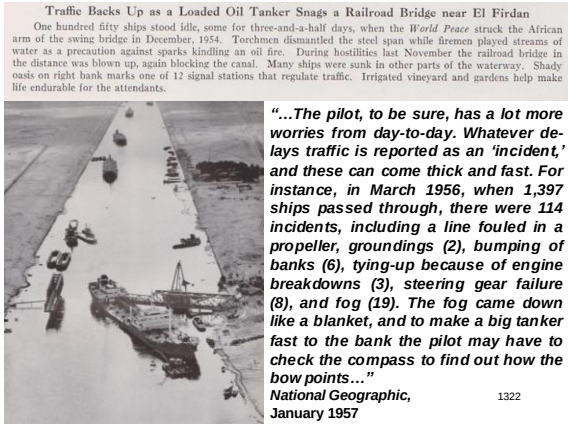
1319

"…Some helmsmen understand blithely but not too well. A pilot once replied to a captain's question with 'all right.' The helmsman took this for an order, and put the helm hard right. He ran aground. Another pilot stood out on the open bridge wing of a passenger ship around midnight and noticed the bow slowly swerving. He shouted an order to correct this. No response. He charged the wheelhouse. Nobody there. The helmsman had left the wheelhouse at the end of his watch without waiting for his replacement. Presumably no less aggrieved was the pilot who, boarding a freighter one night, was grabbed around the neck, lifted into the air, and dropped to the deck. The cargo, it seems, included elephants from India…"
***National Geographic,* January 1957**

1320

Incidents

1321



Traffic Backs Up as a Loaded Oil Tanker Snags a Railroad Bridge near El Firdan

One hundred fifty ships stood idle, some for three-and-a-half days, when the *World Peace* struck the African arm of the swing bridge in December, 1954. Torchmen dismantled the steel span while firemen played streams of water as a precaution against sparks kindling an oil fire. During hostilities last November the railroad bridge in the distance was blown up, again blocking the canal. Many ships were sunk in other parts of the waterway. Shady oasis on right bank marks one of 12 signal stations that regulate traffic. Irrigated vineyard and gardens help make life endurable for the attendants.

"…The pilot, to be sure, has a lot more worries from day-to-day. Whatever delays traffic is reported as an 'incident,' and these can come thick and fast. For instance, in March 1956, when 1,397 ships passed through, there were 114 incidents, including a line fouled in a propeller, groundings (2), bumping of banks (6), tying-up because of engine breakdowns (3), steering gear failure (8), and fog (19). The fog came down like a blanket, and to make a big tanker fast to the bank the pilot may have to check the compass to find out how the bow points…"

***National Geographic,* January 1957**

1322

"FOR three days over 200 ships bound for the Suez Canal were delayed by the worst accident there in its eighty-five years' history. The tanker 'World Peace' was steaming second in a convoy bound for Port Said when her steering gear broke down, and she collided with one of the piers of the El Ferdan road and railway bridge. One of the wings of the bridge collapsed across the deck of the tanker, the other end being jammed into the sand on the banks of the Canal. It took the best part of three days and nights to cut-away the 350 tons of metal on the tanker's superstructure; in addition, there was danger of fire, as the 'World Peace' was loaded with crude oil…"

Newspaper article, 1955

1323

1324

"…Meanwhile, vessels were gathering at Port Said and Suez, and along the Canal stretched the rest of the convoy held-up by the accident. In the Mediterranean and the Red Sea oncoming ships were reducing speed so as to avoid further congestion. The cost of the delay of each vessel was between £1,000 and £3,500 a day. But the shopkeepers and merchants of Suez and Port Said enjoyed an unprecedented boom."

Newspaper article, 1955

1325

"…One tanker lost a rudder in the ditch. Such major mishaps are rare, but even minor mechanical troubles can result in blocking the entire waterway. A tanker, for example, may develop a short circuit in her steering wiring. Although the helmsman puts the wheel over, she does not respond. In the open sea, this would hardly matter, since a second motor cuts in automatically within a minute or less. In the canal, that swerve may mean trouble. If the ships is lucky, she will only 'smell the bottom,' barely touch where the channel begins to slope upward to the bank. But she may hit the bank and stick. The current surges from astern. It may push her stern to the opposite bank, and that end will be stranded too. The traffic stoppage will be complete. It might last an hour, or five, or ten…"

***National Geographic,* January 1957**

1326

Old Hands and Novices

1327

"…'Old hands at canal transits usually stay calm,' a veteran pilot told me. 'Skippers don't always let on when it's their first time through, but we generally can tell. If a master chain-smokes or cracks his knuckles or keeps clearing his throat, he's probably making his first trip through. Then there was a liner captain. We had a little trouble – nothing to worry about – and he looked very calm. But he hopped-up and ordered all watertight doors closed!'…"
National Geographic, January 1957

1328

Rules of the Road

1329

"…Since ships may have to tie-up in a hurry because of fog or sudden emergency, mooring posts are spaced about every 80 yards along the canal. Each ship must carry one or two boats and crews ready to be lowered and take a line ashore at once. Anchors must be ready to let go…"
National Geographic, January 1957

1330

1331

"…Special lights are prescribed for traveling In convoy at night. Usually rented for the trip and hung from the bow is an arc light projector, in a box big enough to hold an operator. It casts a 15-degree beam which can be split so that there will be five degrees of darkness in the middle. Then it illuminates the banks and buoys but will not blind men on the ship ahead (cars on the road along the canal, incidentally, are requested to dim their lights when they meet a ships. Some don't, which upsets helmsmen). To save time, a ship may dump the light box into the water at the end of the canal. It floats, and a launch will pick it up…"
National Geographic, January 1957

1332

"…If the ship stops at night for any reason, a red light must be put on the stern immediately. If it does not show in time, the next ship in the convoy may even have to aground voluntarily to avoid collision. To halt safely, a big tanker needs about fifteen minutes notice, and about two miles of canal…"
National Geographic, **January 1957**

1333

"…Enough water, coal, or fuel oil must be ready for rapid unloading so the ship can be lightened and her draft decreased at least a foot. This is to help refloat her if she goes aground. But if lines, tugs, skill and luck should not suffice, canal authorities reserve the right to blow her up…"
National Geographic, **January 1957**

1334

Report Card

"…The pilot has still other worries, too. He knows that vessels are not supposed to enter the canal unless they hold an internationally recognized certificate of seaworthiness. But before boarding a ship he reads a confidential file of her record in the canal, sometimes an arm-long tale of poor steering, engine breakdowns, and groundings…"
National Geographic, **January 1957**

1335

1336

Harmonic Resonance

"…Staying in step with the convoy makes for more pilots' headaches. The usual transit speed is about seven knots (eight miles-an-hour). But there are ships with a vibration point at seven knots. The vibrations of engines and hull synchronize, and the entire vessel shudders and shakes. Passengers get soup splashed in their laps. The pilot cannot hold his binoculars steady, and the vibrations may damage a ship's wiring. Then the only thing he can do is ring alternately for eight knots, then six, and keep the right average…"
National Geographic, **January 1957**

1337

1338

The Carrot and the Stick

1339

Three Canvas Balls Command Southbound Ships to Tie Up

"…A pilot can't be arrested for speeding in the Suez Canal, but he can, in a sense, be fined. For being as little as three minutes off schedule in passing one of the signal stations spaced six miles apart, pilots have lost part of the bonus they expect for each successful trip…"
***National Geographic,* January 1957**

1340

Many Things to Many People

1341

"…To the pilot, the canal means the daily pressure of exacting work at good pay. To the official in the complex canal administration, it means some 5,000 employees, scores of warehouses and workshops, dredges, tugs, barges, and harbor craft; modern housing for personnel, and medical centers. And for the entire Isthmus of Suez, the big ditch has meant a tremendous change…"
***National Geographic,* January 1957**

1342

Water = Life

1343

"…Exploring here 102 years ago, Ferdinand de Lesseps found 'there lived not even a fly in this appalling desert.' To cross it, his party of four needed 25 camels just to carry water. Today the Isthmus is one of Egypt's richest provinces thanks to irrigation through a fresh-water canal from the Nile…"
***National Geographic,* January 1957**

1344

"…That water can look anything but fresh, though, especially after a few water buffaloes have plunged in. Released from plows and water wheels, the animals submerge like hippos, leaving only their nostrils sticking out. They do this to cool off and escape the flies, of which there now seem to be millions, all annoyingly resistant to DDT…"
***National Geographic,* January 1957**

1345

Keyed to the Canal

1346

"…Some 70,000 acres have been reclaimed from the desert, and the farming population normally numbers about 35,000. In peacetime more than half-a-million live in the five canal towns, where some 9,000 businesses offer work, most of it keyed to the canal…"
***National Geographic,* January 1957**

1347

Big Business

1348

"…The biggest business, of course, is the canal itself. Tolls yielded $93,000,000 in 1955. Half-a-million passengers passed through, along with 107,000,000 metric tons of freight, about five times as much as in 1946…"
***National Geographic,* January 1957**

1349

The Long View

1350

"…In the economist's long view, the canal's opening in 1869 sparked a commercial revolution in the wake of growing industrialization. Copra, tea, and grain came faster and cheaper to the markets of Europe, the journey from Bombay to Marseille, for example, being shortened from 12,000 miles to 5,300. Factories springing up in England, France, and Germany eagerly absorbed raw materials from the shortened route to the East and sent back machinery, textiles, and a flood of consumer goods…"
***National Geographic,* January 1957**

1351

The Way to India

1352

Lacking Breeze, Egyptians Drag a Feluuca Through the Canal

Small Egyptian boats pay no toll. Some are so overloaded that the slightest wave sinks them.

"…The commercial advantages of the canal in turn forced drastic changes in shipbuilding, hastening the decline of sailing ships. Sailing by the perplexing winds of the Red Sea had never been easy, and taking a windjammer through the canal proved too difficult and slow. In the search for speed and profit, steam vessels were rapidly improved. Auxiliary sails soon disappeared, screw propellers became common, and high-pressure boilers were introduced. Comfort followed, too. Englishmen commuting through the canal to India sought cabins away from the sun most of the way: 'port out, starboard home.' The first letters of these words, many British travelers will tell you, became the word 'posh,' meaning the best available…"
***National Geographic,* January 1957**

1353

"…British politicians at first bitterly opposed the building of a canal which would put 'all the coasts of the Mediterranean and Black Sea . . . nearer India than we are.' But once it was there, it became, as Bismarck put it, the British Empire's spinal cord…"
***National Geographic,* January 1957**

1354

An Historic POV

"…To historians a water route linking the Mediterranean and the Red Sea is a story older than the Trojan War. Aristotle, Pliny the Elder, and Strabo, who wrote the most important ancient geography text we have, all ascribe the linking of an arm of the Nile and the Red Sea to Sesostris, King of Egypt. He may actually be a compound of several rulers of 1300 to 1200 B.C…"
***National Geographic,* January 1957**

1355

1356

"…Herodotus insists that the Pharaoh Necho (609-593 B.C.) was first to seek a canal to the Red Sea, and that 120,000 laborers died before the project was abandoned on advice from an oracle…"
National Geographic, **January 1957**

1357

"…Necho's canal was finished by Darius the Great, and a stone tablet in a garden in Isma'iliya proclaims: 'I am a Persian: with the power of Persia I conquered Egypt. I ordered this canal to be dug from the river called Pirava [the Nile] which flows in Egypt to the sea . . .'…"
National Geographic, **January 1957**

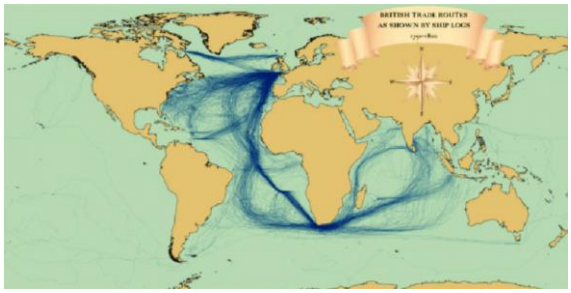
1358

"…The canal was probably silted-up by the time of Cleopatra. But after the defeat at Actium, Plutarch says, she wanted to escape into the Red Sea any way and tried to have her fleet carried over the sand. Shakespeare makes her say that rather than face 'the shouting varlotry of censoring Rome' she would prefer death in 'a ditch in Egypt'…"
National Geographic, **January 1957**

1359

"…Roman sources mention a canal in use during the reign of Trajan. Later the Moslem rulers of Egypt made Mecca and Medina more accessible by 'the canal of the prince of the faithful,' but about A.D. 770 the Caliph Abu Ja'far, the founder of Baghdad, had it filled in to blockade rebels in these holy cities. Depressions supposedly left by this canal can be seen today: in some of them grow beans and sweet potatoes…"
National Geographic, **January 1957**

1360



"…Venetian merchants talked wistfully about cutting the Isthmus of Suez when the Mediterranean, 'the center of the earth' of the ancient West, stagnated after being bypassed by new trade routes around the Cape of Good Hope and across the Atlantic. Cutting of the present canal at last revitalized the Mediterranean, but this geographical surgery was delayed by problems of politics, money, and engineering…"
National Geographic, **January 1957**

1361

Caption: "British trade routes as shown by ship logs between 1750 and 1800"

"…One was the question of water levels. A cautious Pharaoh had built a lock for his canal to guard against the sea rushing into the Nile; and Napoleon Bonaparte, who came to Egypt in 1798 with secret orders to cut right across the Suez Isthmus and grab the Red Sea for France, was led to believe that it was 32-1/2-feet higher than the Mediterranean. No wonder his surveyors erred. Bedouin marauders kept chasing them away from their instruments…"
National Geographic, **January 1957**

1362

An International Enterprise

1363

"…Surveying the Isthmus became a thoroughly international enterprise some forty years later, with engineers from Austria, Sardinia, Spain, Prussia, England, and France working under a Dutchman. They found a sea-level canal feasible because the water levels of the two seas are about equal (actually the Mediterranean is higher in summer, and the Red Sea is higher in winter, by about a foot)…"
National Geographic, **January 1957**

1364

"…The engineers' reports were neglected, however, until they struck sparks in the brain of Ferdinand de Lesseps, a retired French diplomat who was actually no engineer but an irrepressible promoter. De Lesseps had long known the Viceroy of Egypt, Mohammed Said, who as a child was too fat for his father's liking and suffered from enforced fasting and exercise, such as climbing a ship's mast for two hours every day. In the De Lesseps home the boy could fortify himself with macaroni. Later, when he had the power to oblige his friend, he gave him the canal concession in the hope of benefiting Egypt and world commerce…"
National Geographic, **January 1957**

1365

"…After raising money from French investors and the Viceroy, De Lesseps found that the construction was not easy. A contemporary account claims that the laborers, conscripted by the Viceroy but reasonably paid, didn't want to use wheelbarrows at first – 'so much so, that some commenced by carrying them on their heads.' Facing bankruptcy in the midst of building, De Lesseps had to badger the Viceroy for more money, and conscripted labor had to be withdrawn because of political pressure…"
National Geographic, **January 1957**

1366

"…But men rushed in from Italy, France, and the Balkans for 'piecework,' being paid by the amount of earth they dug each day. Despite the claim of a tremendous toil among the workers, a recent study puts their mortality rate lower than those in their home areas. Toward the end, 4,000 men dug more than 20,000 had dug before, thanks to new dredges and excavating machinery that developed a total of 10,000 horsepower. This doesn't sound like much today, but then it was a wonder of the world…"
National Geographic, **January 1957**

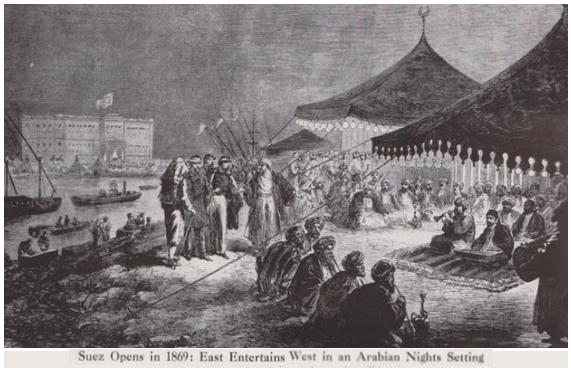
1367

A Day to Remember

1368

"…The opening, on November 17, 1869, was a spectacular affair, attracting royalty from all over Europe. Egypt's Khedive Ismail, a Viceroy of the Sultan of Turkey, welcomed the Empress Eugenie of France, the Emperor Franz Josef of Austria, the Crown Princes of Prussia and the Netherlands, noblemen from Sweden and Russia, and some 6,000 other distinguished guests…"
***National Geographic,* January 1957**

1369



Suez Opens in 1869: East Entertains West in an Arabian Nights Setting

In this old-time illustration Arab musicians play for Western visitors, while fellow Egyptians smoke water pipes. The scene is Isma'illiya, named for the khedive, who erected there a palace with a grand ballroom. Turkey's crescent flag flies overhead.

1370

"…Too feed them, Ismail hired more than 500 cooks and 1,000 servants were imported from Europe. The pyramids were lit-up with magnesium flares and Egyptians arrived with wives, children, horses, camels and gazelles…"
***National Geographic,* January 1957**

1371

1372

"…But there were mishaps too. Fireworks went off prematurely and nearly blew-up Port Said. The opera 'Aida,' commissioned for the occasion, couldn't be produced until two years later. An Egyptian frigate stuck in the channel, and a thousand seamen were sent to pull her clear or dynamite her. She came loose at the last minute…"
***National Geographic,* January 1957**

1373

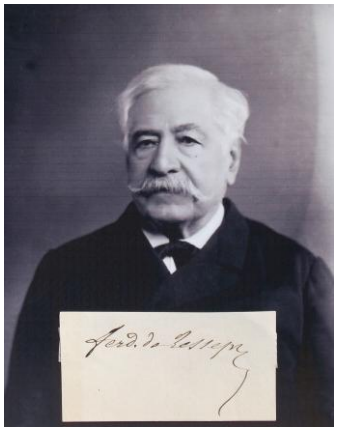
Eugénie's Flotilla of Steam and Sail Makes the First Canal Transit

Sixty-eight ships, with the French empress's yacht *Aigle* in the lead, started from Port Said amid a thunderous cannonade. They reached the Red Sea in four days.

Cheering Arabs lined the parade route so densely that at one point they pushed front ranks into the canal.

Stopping at Isma'illiya, the halfway point, the empress rode a camel. Bedouin horsemen fired muskets as they galloped past her. Ismail gave a ball for 5,000 guests. The spectacle of royalty waltzing shocked Arab sheiks, who relegated dancing to entertainers and dervishes.

1374



"…Canal builder Ferdinand de Lesseps was the lion of the hour. Within a week, in his 65th year, he married a woman of 21, who bore him 12 children. Trying to dig the Panama Canal, he was defeated by yellow fever and engineering and financial difficulties…"
National Geographic, **January 1957**

1375

Caption: "Interview by our artistic correspondent with M. De Lesseps – the constructor of the Suez Canal, surrounded by his family in the Windsor Hotel, New York"

1376

Obsolete From the Get-Go

"…Almost as soon as the canal was opened, it was found to be too snug. One in three ships ran aground the first year. When 416 out of 3,198 ships grounded in the thirteenth year, the canal was enlarged on pressure from ship owners. It grew from a width of 177-feet at water-level and 72-feet on the bottom in 1875, to 500- and 197-feet respectively at present. Maximum draft for vessels was increased from 22-feet in 1870 to 35-feet by 1955, allowing passage of everything afloat except a handful of transatlantic liners, battleships, and carriers…"
National Geographic, **January 1957**

1377

1378

Long-Range Improvements

"…Even so, some of the bigger tankers can pass the canal only when not fully loaded. The channels will have to be widened and deepened further as ships keep growing in size. New bypasses are needed – like railroad sidings – to avoid congestion as traffic continues to mount in the course of normal events…"
National Geographic, **January 1957**

1379

1380

Engineering Oversight

1381

"…These long-range improvements, as well as maintenance matters, are the prime concern of the Suez Canal Company's Board of Engineering Advisers. They keep an eye on technical problems through reports, which are discussed at the annual meeting in Paris. The most recent one was held last November, despite all the fighting along the canal itself…"
***National Geographic,* January 1957**

1382

L British Naval Auxiliary (Left) and French Troops Guard Battle-torn Port Said
R Scuttled Ships Clog the Canal Entrance

1383

"…Among the 18 members are representatives of the Port of London Authority, the Ports of Norway, the Departments of Civil Engineering of Belgium and France, and the Italian Ministry of Public Works. Another member is a former Minister of Public Works of the Netherlands. Most of these men are well along in years. Since I am a member myself and no longer young, I think I may say that this is a very good idea. Young men are needed for action, but older men for judgment and advice…"
***National Geographic,* January 1957**

1384

A Recurring Problem

1385

"…One of our recurring problems is the safeguarding of the canal's banks, because even at the limited speed of 7-1/2 knots the ships churn-up destructively powerful waves. Once a sentry, presenting arms to the flag of a passing cruiser, was swept right into the canal by the cruiser's wash…"
***National Geographic,* January 1957**

1386

Canal Officials' Children Romp in the Wake of a Tanker as if in Ocean Surf

Ship momentarily lowers the canal level, exposing sand along slopes (page 128). Waders, who ran after the ebbing water, rush to escape the tanker's wash. Buoy near Isma'iliya marks 27 feet; mid-channel is 42 feet.

1387

Training-in-Scale

1388

"…Higher speeds tend to multiply the water turbulence and endanger the banks. To find out precisely what pressures the banks must withstand, our board studied the results of tests run in a model of the canal in a hydraulic laboratory in Grenoble, France. The scaled-down canal section was 210-feet-long and 29-1/2-feet-wide. In it a self-propelled model of the hull of tanker, scaled-down from a length of 694-feet to 27-feet 9-inches, made hundreds of round trips until erosion of the banks reached the maximum. The results were checked when the full-scale ship passed through the full-scale canal…"

***National Geographic,* January 1957**

1389

PORT REVEL, France, April 21 (Reuters) – Francois Mayor nudged back on the power and made a subtle adjustment on the wheel as he coaxed his cargo vessel through a narrow point in the Suez Canal - not the Egyptian one, but a replica in the middle of a French forest

***gcaptain.com,* April 21, 2021**

RE: introduction to an article written by *Stephane Mahe* entitled: "On French Lake, Mariners Learn How Not to Get Stuck in the Suez Canal"

1390

"THIS stretch of water was built to train ship captains and maritime pilots how to navigate the Suez Canal . . . The channel is built to one twenty-fifth the scale of a section of the real Suez Canal. Trainees have to steer through scale models of massive container ships without getting stuck. 'It's a bit hard to recreate sandstorms,' said Mayor, the managing director of the Port Revel training facility, built around a lake in eastern France. 'But we have gusts of wind which will push our ship to one side or another'…"

***gcaptain.com,* April 21, 2021**

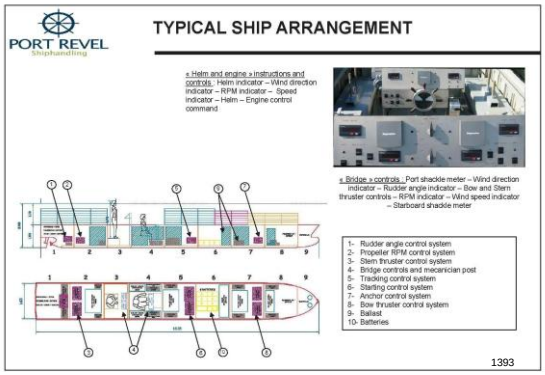
1391

"…During training on the mini-Suez canal, instructors simulate steering problems and engine outages to see how the trainees react. 'You have little space to maneuver. You have to be particularly focused,' said Mayor. Located in the foothills of the Alps, The Port Revel facility is designed to replicate some of the trickiest spots in global shipping…"

***gcaptain.com,* April 21, 2021**

Above L&R: caption: "Francois Mayor, managing director of Port Revel, steers a scaled-down model of a tanker, named the *Brittany,* on a miniaturized stretch of the Suez Canal at the Port Revel Shiphandling Training Centre in Saint-Pierre-de-Bressieux, France"

1392



1393


1394

"…There is also a mini-San Francisco Bay, and an imitation Port Arthur, Texas, for lessons on docking and maneuvering cruise ships and tankers in crowded ports. Underwater turbines replicate currents and waves…"
gcaptain.com, **April 21, 2021**
RE: opened in 1967 and based in a lake in Saint-Pierre-de-Bressieux, France, the Port Revel training facility has instructed +7K captains and pilots how to maneuver large ships. The creation of *Société Grenobloise d'Études Et d'Application Hydraulique* and the *Esso Oil Company* in 1952, the training course pays special attention to detail; from the design of the waterways to the machine used to generate waves and currents (it even has the ability to simulate steering failures and engine problems so trainees can learn how to respond).
1395


1396

Findings

"…The findings were startling in several ways. What struck me most was this: to speed-up from 7 to 7-1/2 knots, a big tanker must develop twice as much engine power; and most of this power flows into the currents and whirls, causing them to damage the banks and channel slopes all the more…"
National Geographic, **January 1957**

1397

1398

Asphalt Mattresses

1399

"…We have tried a lot of tricks to save those banks. Here's the latest: asphalt is poured on a framework of steel and wire mesh. The result is an asphalt mattress, to be slid over the canal slopes. Then the churning currents won't undermine the banks so quickly…"
***National Geographic,* January 1957**

1400

For the Good of the World

1401

"…Improvements now planned look ahead all the way to 19-70. Whether they will be made, and just when they may act-ually be finished, cannot now be said for certain. But I am confident that men will keep digging the Suez Canal as long as ships sail the seas in peace, for the good of all the world."
***National Geographic,* January 1957**

1402

Part 15

Six Days in June

1403

A Rumor of War

1404

Down the slopes of Tiberias, Herod's city, came rumbling Israeli Sherman tanks en route to battle. Beneath them lie the placid waters of the Sea of Galilee – and on the Syrian bluffs, above the waters where Peter fished, was the low haze of artillery smoke and the high, black, waving plumes of air strikes.
***LIFE* magazine, June 23, 1967**
RE: introduction to an article written by *Theodore H. White* entitled: "Mideast War"

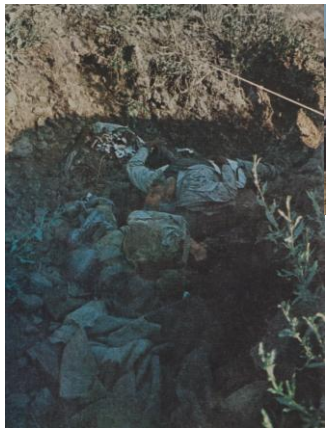
1405

Victors, Not Victims

1406

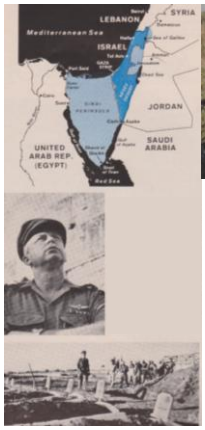
"…The Israelis themselves wonder how to absorb their victory, what can be done with it. Their armor stands an hour's push away from a naked Damascus, two hours from Amman, four hours from Cairo, They are confused by the prospects. It is difficult to look forward – and impossible to look back. Had the cast of history gone the other way, they would be victims, not victors…"
***LIFE* magazine, June 23, 1967**
Top: caption: "As Israeli troops took up positions on the east bank of the Suez Canal, one soldier was so overjoyed that he jumped into the canal itself"
Bottom: caption: "An Israeli colonel in command of the armored brigade that raced on to the canal sprawls over a map of the Sinai desert. 'If I had the go-ahead,' he said, 'I could be in Cairo in six hours.'"

1407



Above: caption: "The Israeli army had its armor mauled by Syrian guns well dug in, but after 30 hours the Syrians were fleeing and the Israelis were 30 miles from Damascus"
Left: caption: "The Syrians, behind Soviet-designed defenses, fought hard and well and they took heavy casualties"

1408



Above: caption: "Israeli tanks and half-tracks prepare to push on at dawn"
Left: caption: "Map shows how Israel more than quadrupled its size in less than a week of war. Dark blue fixes boundaries as they existed June 4; light blue areas were overrun by the army of Yitzhak Rabin (middle), commander of Israel's land, sea and air forces. General Rabin, a master of sabotage technique and a military planner respected for his cunning, was the man Leon Uris based his fictional character Ari Ben Canaan in *Exodus*. Israeli casualties though low in comparison to Egypt's estimated 7,000 dead, included a high percentage of officers, testifying to the extraordinary *elan* of Rabin's army. At bottom, in a cemetery outside Tel Aviv, each new grave is rimmed with clean white bricks and is piled high with fresh red earth."

1409

Barbarians at the Gates

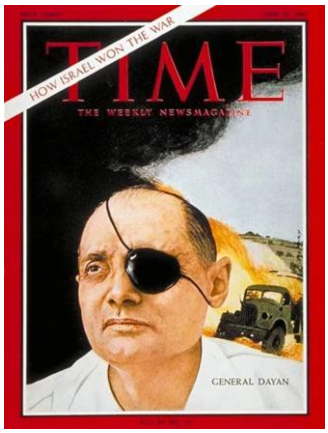
1410

"…The psalm says to lift up one's eyes to the hills whence cometh strength. To the Israeli army, however, the hills have been hills of peril. On the eastern front, two enemies – Syria and Jordan, emplaced on ancient ridges, commanding every yard of Israel's coastal plains. To the south, the Sinai desert; and then, behind Suez, the strength of Egypt, armored by the Russians. Beyond this close-in ring lie Iraq, Saudi Arabia and other Arab nations – in all, some 80 million hostile Arabs…"
***LIFE* magazine, June 23, 1967**

1411

"…Tiny, dagger-shaped Israel, whose 2,700,000 people cling to 7,993 sq. mi. on the shores of the eastern Mediterranean, faced the implacable hostility and cocked guns of 14 Arab nations and their 110 million people…"
***TIME* magazine, June 9, 1967**
Caption: "Map of Israel, before the 1967 Six-Day War'

1412



"…'***It is not difficult for the situation to deteriorate into war, but we have to be strong enough to try all other means. We have to do the utmost to avoid bloodshed on either side of the border.'"***
***Levi Eshkol*, Israeli PM**
RE: Eshkol appointed *Moshe Dayan* as the new Defense Minister and the world waited to see what would happen next.
Left: June 16, 1967 cover of *TIME* magazine featuring General Moshe Dayan

1413

"…This was a situation to be borne with constant attention even while the Arab states continued quarrelsome and divided among themselves. But if they united for war, and if Israel could be caught before mobilization – before its regular army of 50,000 men might reach its mobilized strength of 300,000 – the Arabs might inflict on Israel instant death. Thus, for 10 years, the continued strain on Israeli nerves, the burden on Israeli intelligence and political judgment…"
***LIFE* magazine, June 23, 1967**

1414

"…Israeli tanks, each manned by a single regular of Israel's 50,000-man standing army, waited in convenient tank parks for the two or three reservists required to complete each crew. The tanks were ready to move out, complete with helmets, razors and toothbrushes. Each crew had been assigned battle sectors, rendezvous points and objectives. Israeli Intelligence had tracked the Arab enemy to the last desert dune. The system worked so well that Israel was able to field a fighting force of 235,000 men within 48 hours…"
***TIME* magazine, June 16, 1967**
RE: the article explained how the reserve units of the *Israel Defense Forces* (IDF) went to war, having heard their units named on the radio and making their way to their prearranged transport locations

1415

"…Half the nation seemed to be in uniform. The winding highway from the rugged wooded hills of Jerusalem to Tel Aviv on the coast was crowded with reservists hitchhiking to join their units. In the cities, girls in khaki miniskirts and pertly cocked overseas caps were on round-the-clock duty at sandbagged gun positions. Middle-aged men volunteered for temporary police duty, and middle-aged housewives enlisted for service as air-raid wardens. Schoolchildren delivered the mail, and university students paid their own way to remote kibbutzim (collective farms) to replace teachers called to arms. In Jerusalem, two wealthy merchant brothers responded to the emergency by paying up five years of back taxes. In Tel Aviv, an army officer and his wife named their newborn son Tiran after the disputed Strait at the mouth of the Gulf of Aqaba, now under Egyptian blockade…"
***TIME* magazine, July 9, 1967**

1416

An Irregular War

1417

"…A year ago, when this correspondent last visited Israel, war in modern fashion had already broken out – irregular war of familiar style. From the Syrian heights above the Galilee an occasional mortar shell fell on an Israeli village – an artillery round, no bombardment but sporadic fire. There were also the saboteurs, mining roads within Israel; the night ambush – one settler killed here, another there; a water line cut, a telephone line ripped out. Casualties few. Yet politically unsettling…"

***LIFE* magazine, June 23, 1967**

RE: an Israeli raid into the Jordanian-occupied West Bank targeting the village of Samua, in November 1966, followed a land-mine attack inside Israel. The raid caused uproar among Palestinians in the West Bank. *King Hussein of Jordan* was aghast. He told the CIA that for three years he had been in secret talks with Israel; his Israeli contacts had sent him assurances there would be no reprisals on the morning of the raid. The Americans were sympathetic and supported a resolution at the UN Security Council condemning the Samua raid. King Hussein imposed martial law on the West Bank and became convinced more than ever that his throne was in jeopardy and that he could be overthrown by angry Palestinians. He feared a coup by radical pro-Nasser officers in the army that Israel could use as a pretext to absorb the West Bank and East Jerusalem. King Hussein did not want to share the fate of the other Hashemite monarch in the Middle East; his cousin and friend *King Faisal of Iraq* (he had been shot in the yard of his palace in a military coup in 1958).

1418

"…The Syrian raiders sought, without success, lodgment in the villages of the Arab minority within Israel, for if Israel's 10% of peaceful Arabs might be converted by terror to an internal guerilla force, no orderly state could function…"

***LIFE* magazine, June 23, 1967**

RE: the *1967 Six-Day War* between Israel and her Arab neighbors came as a result of years of increasing tension and vicious border skirmishes. The border between Egypt and Israel was relatively quiet. However, Israel's northern border with Syria was a flashpoint whereby disputed territory was fought over and Syria attempted to divert the *River Jordan* away from Israel. Meanwhile, Israel was pushing its claims to disputed territory in the border area aggressively by cultivating fields in demilitarized areas with armored tractors. It came to a head with a full-scale air and artillery battle between Israel and Syria on April, 7, 1967 whereby Israel routed the Syrians. Israel was in a mood of national self-congratulation, but some elder statesmen and soldiers were alarmed. In a corridor in the Israeli parliament (the *Knesset*) the military's former Chief-of-Staff *Moshe Dayan* bumped into *General Ezer Weizmann*, former head of the *Israeli Air Force* and now Rabin's number two. "Are you out of your minds?" Dayan said. "You're leading the country to war!"

1419

"…Among themselves Syrian Arabs charged Jordanian Arabs with cowardice – Amman, they insisted, must be made another Hanoi, a base for irregular warfare a la Vietcong…"

***LIFE* magazine, June 23, 1967**

RE: the Syrians sheltered Palestinian guerrillas, who mounted deadly raids into Israel. Unlike *King Hussein*, who the U.S. believed was doing all he could to stop Palestinian infiltration, Syria actively encouraged it.

1420

First Among Enemies

1421

"…A year ago this correspondent found all northern Israel smarting from the pinpricks of the guerillas. The Israeli army command, however, held back. The most important enemy, it insisted, was Egypt, with her Russian armor. Let Israel's government negotiate in any international forum for peaceful settlement of border flare-ups – but if the Egyptian armor moved across Suez to take up positions in the Sinai desert, Israel must mobilize…"

***LIFE* magazine, June 23, 1967**

1422

Suddenly Last Summer

1423

"…Thus, the climate last summer. What caused it to change so swiftly, one cannot yet fully understand. Perhaps rivalry among the Arab states for leadership in the holy war against the Israelis; perhaps a misunderstanding by Nasser of a promise of Russian backing; perhaps a general feeling that America was too tied down in Southeast Asia to support Israel effectively…"

***LIFE* magazine, June 23, 1967**

RE: although Arabs talked a lot about unity, socialism and nationalism, in reality they were deeply disunited. The Syrian and Egyptian leaderships complained about plots allegedly instigated by the monarchies in Jordan and Saudi Arabia. Kings worried that the military populists who led Syria and Egypt would incite revolution. However, Jordan's young ruler, *King Hussein,* remained a close ally of both Great Britain and the U.S. On May 13, 1967, Moscow delivered a warning to Cairo that Israel was massing troops on the border with Syria and would attack within a week. Two Israeli historians argue that the USSR deliberately instigated the crisis in order to block Israel's nuclear ambitions. At the time, a "medium-level" Soviet official told the CIA that the Soviet Union was stirring up the Arabs to try to make trouble for the U.S.

1424

"I knew that war was inevitable. I knew that we were going to lose. I knew that we in Jordan were threatened, threatened by two things: we either followed the course we did, or alternatively the country could tear itself apart if we stayed out"

King Hussein of Jordan

1425

Prelude to Jihad

1426

"…In mid-May, as Israelis tell it, began the nightmare days. On the 15th Nasser's armor began to roll north across the desert, digging-in on Israel's southern frontier – seven divisions, 900 tanks. On May 22 the U.N. Emergency Force was finally withdrawn; the day following came the blockade of Elath, Israel's only southern port, as Nasser closed the Gulf of Aqaba. On May 30 Jordan's King Hussein flew to Cairo and, returning to Amman, announced that his state too, was joined with Egypt in the holy war. From Iraq a new division was marching to bolster Hussein's Arab legions on the western hills…"

***LIFE* magazine, June 23, 1967**

RE: on May 22, 1967, Nasser banned Israeli shipping from the *Straits of Tiran,* the entrance to the *Gulf of Aqaba*, effectively re-imposing the blockade of the *Port of Eilat* that had been lifted in 1956. Israel warned *King Hussein* not to enter the war, however, his mind was made-up. He had placed Jordan's efficient army under the command of a less-than-capable Egyptian general.

1427

"…All this to the obbligato of Radio Cairo and Damascus, both promising, in Arabic and Hebrew, death and extermination to Israel . . . In the Israeli press, fury . . . the cabinet debated whether to wait for American support, or to act on its own…"

***LIFE* magazine, June 23, 1967**

RE: Israeli FM *Abba Eban* decided Israel would have to abide by the American take on events, but IDF generals were getting frustrated (it was no help that Eban irritated the military leadership with his erudite mannerisms). The generals were furious when the cabinet agreed, on May 28, 1967, to wait two weeks. For them it was about much more than the *Straits of Tiran*. Nasser was uniting the entire Arab world against Israel. He had moved divisions into the Sinai desert, making a direct threat to Israel's national borders.

1428

"…By the first week of June, with their army almost fully mobilized, the Israelis were coiled like a spring in full compression. And now there were almost daily Egyptian overflights of Israel's handful of five main airbases. The southern borders began to sputter as sporadic Egyptian mortar fire set wheat fields ablaze on Friday, June 2; on Sunday, June 4, two Egyptian commando battalions arrived in Jordan. Command of Jordan's army had passed, at last, to Nasser…"

***LIFE* magazine, June 23, 1967**

RE: 24 hours after the USSR's warning, *Field Marshal Abdul Hakim Amer* put Egypt's army on full war alert. *Lt. Gen. Anwar al-Qadi*, the Chief of Operations, told Amer that more than half of the army, including some of its best troops, was bogged down in Yemen thus, it was in no condition to fight Israel. Amer reassured him that fighting was not part of the plan; it was just a "demonstration" in response to Israel's threats to Syria. Two days later, Egypt dug itself deeper into crisis by expelling UN peacekeepers that had patrolled the border with Israel since 1956 and moved troops into the Sinai desert.

1429

"…Thus, finally, on Sunday afternoon the Israeli cabinet faced a decision: to wait for diplomatic help, delay which might mean death; or let the army decide time, dimension and method of response to Egyptian attack. Eighteen men met that afternoon and voted yes…"

***LIFE* magazine, June 23, 1967**

RE: on May 23, 1967, Israeli PM *Levi Eshkol* and the cabinet ordered a full mobilization. In 48 hours, 250K men could be put into the field (after compulsory military service, all Israeli men were allocated to a reserve unit until age 50).

1430

The Sands of the Sinai

1431

"…What happened on Monday, June 5, 1967 was more in the nature of Paroxysm than war – or rather, as if an awkward and ignorant hand had been toying with the fuse of a strange explosive of unknown power, and thus been blown to bits…"

***LIFE* magazine, June 23, 1967**

RE: the Israeli war plan depended on a surprise attack ("Operation Focus") which would destroy the Arab air forces on the ground, starting with Egypt. The Israelis had flown hundreds of reconnaissance missions over the years to build-up an accurate picture of every airbase in Egypt, Jordan and Syria. Pilots had a target book, giving the details of their layouts, call signs and defenses. From radio intercepts, they built-up voice-recognition files of the main Arab commanders.

1432

Field Marshal Amer and the Egyptian command were meeting at *Bir Tamada,* an airbase in Sinai. They were just starting the meeting when the first Israeli jets started their bomb runs. One of the generals was so surprised by the attack that the first thing that came to his mind was a coup of some kind. Amer's plane was able to take-off, but at one point had nowhere to land since every Egyptian airbase was under attack.

1433

Caption: "Egypt's air force was decimated by Israel's pre-emptive strike"

Caption: "On the road to the Suez Canal, Israeli soldiers fan out as an Egyptian MiG – one of the few still operational on the fifth day of the war – makes a strafing run. Eight hours later Egypt agreed to a cease-fire."

1434

"…The shattered remnants of the Egyptian army are now flung across the sands of the Sinai desert for 200 miles, from Israel's southern border all the way to the Suez Canal…"
***LIFE* magazine, June 23, 1967**
Caption: "Burned-out vehicles of the Egyptian army liter the Sinai desert"

1435

Not Without a Fight

1436

"…A sense of caution is now the prevailing mood in Israel. Yet it should not be mistaken. Under it is glowing pride and a sense of muscle. Ten years ago Israel celebrated another such victory – and then, like a cormorant used by fishermen, was forced by larger powers to choke-up the fish once caught. This time Israel will not disgorge without a fight…"
***LIFE* magazine, June 23, 1967**
RE: native-born Israelis (a/k/a "sabras" - the Hebrew word for prickly pear) were determined not to repeat what they believed had been the mistakes of Jews in the diaspora; they would always fight back, and sometimes fight first. In 1956, when Israel attacked Egypt as part of a secret agreement with Great Britain and France, the U.S. branded Israel an aggressor and forced it to pull-out of the land it had conquered. This time, Israel's FM *Abba Eban* wanted President Johnson's consent for Israel's fight. The POTUS warned Israel not to fire the first shot; he told Eban not to worry about an Egyptian attack, it wasn't imminent and if it came, "you'll whip the hell out of them."

1437

"Israel will be militarily unchallengeable by any combination of Arab states at least during the next five years"
U.S. Joint Chiefs of Staff
RE: on the eve of the 1967 Mideast War, the western powers had no doubt which side would prevail

1438

"In command, training, equipment and services the Israel army is more prepared for war than ever before. Well-trained, tough, self-reliant, the Israeli soldier has a strong fighting spirit and would willingly go to war in defence of his country."
RE: British defense attache's assessment – from a report on the IDF, January 1967

1439

A Complete Victory

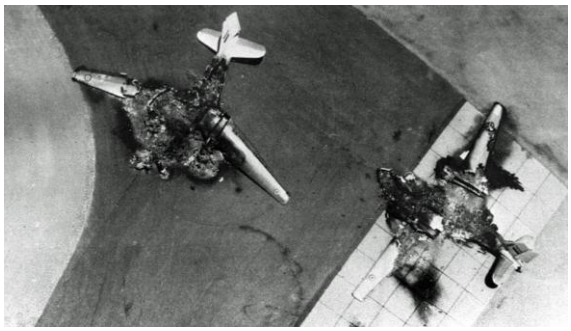
1440

Israel had achieved all its military objectives at a cost of 679 dead and 2,563 wounded, compared to 171 dead in the 1956 Suez campaign. Israeli troops held the entire Sinai peninsula to the east bank of the Suez Canal . They controlled the Gulf of Aqaba, and an Israeli freighter sailed through the Strait of Tiran. Their troops had wrecked the armed forces of Egypt, Jordan and Syria and captured more than 12,000 prisoners.
***LIFE* magazine, June 23, 1967**
RE: introduction to an article written by *Theodore White* entitled: "Scope and Hazard of Victory"
Left: caption: "Israeli troops take up positions on the eastern bank of the Suez Canal"
Right: caption: "First Israeli ship to enter the Gulf of Aqaba since Egypt blockaded it is escorted by an Israeli torpedo boat past Sharm el Sheikh"

1441

"…In stunning predawn air strikes across the face of the Arab world, Israeli jets all but eliminated Arab airpower - and with it any chance of an Arab victory. Without air cover, tanks and infantry under the clear skies of the desert offered little more than target practice…"
***TIME* magazine, June 16, 1967**

1442

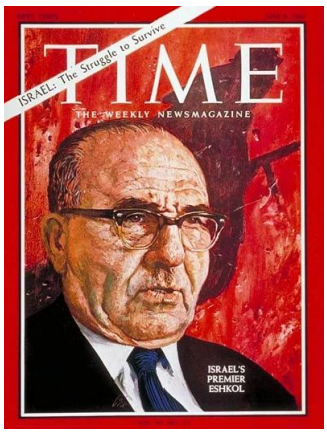


"…In a few astonishing hours of incredibly accurate bombing and strafing, Israel erased an expensive decade of Russian military aid to the Arab world…"
***TIME* magazine, June 16, 1967**
RE: in one day, 400 warplanes of five Arab nations had been destroyed vs. 19 planes lost on the Israeli side
Caption: "Egypt's air force was decimated by Israel's pre-emptive strike"

1443

The Hazards of Victory

1444



"ON the diplomatic front, Israel faced hazards. Premier Levi Eshkol ruled out withdrawal of the old 1949 armistice boundaries: 'The land of Israel shall no longer be a no man's land, wide open to acts of sabotage and murder'…"
***LIFE* magazine, June 23, 1967**
Left: the June 9, 1967, cover of *TIME* magazine featured Israeli PM *Levi Eshkol.* Like many Israeli PMs, Eshkol was also Minister of Defense. He was forced to give the job up in favor of one of Israel's war heroes, *Moshe Dayan.*

1445

"…But the Russians, anxious to recoup prestige among Arabs, were pushing to have the U.N. brand Israel as the aggressor and force her to withdraw to her old boundaries. Premier Kosygin himself came to head the Russian delegation at the U.N…"
***LIFE* magazine, June 23, 1967**
RE: the USSR provided Egypt with a modern air force. In the 1960s Israel bought aircraft from France and tanks from Great Britain. Although Israel had good relations with the U.S., it was not yet the largest recipient of American military aid.

1446

Israel had routed the armies of Egypt, Jordan and Syria. It captured the *Gaza Strip* and the *Sinai Desert* from Egypt; the *Golan Heights* from Syria; and the *West Bank* and *East Jerusalem,* from Jordan. Nasser resigned, but stayed in the job until his death in 1970. *King Hussein* kept his throne and made peace with Israel in 1994. In Syria, the Air Force commander who had been in the ruling junta seized power in 1970. His name was *Hafez al-Assad.* His son, *Bashar,* succeeded him as president upon his death in 2000. Israeli PM *Levi Eshkol* died of a heart attack in 1969. In 1973, Eshkol's successor, *Golda Meir,* was warned that Egypt and Syria were preparing a surprise attack, but the Israelis were suffering from hubris after their 1967 victory. Israel was saved by a massive airlift of supplies from the U.S. Egypt believed it had redeemed its national honor, and its president, *Anwar Sadat,* followed through with his historic peace overture. Post-1967, the U.S. gained a new respect for Israel.

1447

Caption: "Map of Israel, after the 1967 Six-Day War"

O Jerusalem

1448

"…A flag of Zion floats over Jerusalem for the first time since the Romans leveled the holy city 1,900 years ago . . . For the moment the beat and pulse of the entire ancient capital lies in Israeli hands…"
***LIFE* magazine, June 23, 1967**

1449

Caption: "Israeli paratroopers at the newly captured Western Wall"

By the rivers of Babylon, there we sat down, yea, we wept, when we remembered Zion.
We hanged our harps upon the willows in the midst thereof.
For there they that carried us away captive required of us a song; and they that wasted us required of us mirth, saying, Sing us one of the songs of Zion.
How shall we sing the Lord's song in a strange land?
If I forget thee, O Jerusalem, let my right hand forget her cunning.
If I do not remember thee, let my tongue cleave to the roof of my mouth; if I prefer not Jerusalem above my chief joy.
Remember, O Lord, the children of Edom in the day of Jerusalem; who said, Raise it, raise it, even to the foundation thereof.
O daughter of Babylon, who art to be destroyed; happy shall he be, that rewardeth thee as thou hast served us.
Happy shall he be, that taketh and dasheth thy little ones against the stones.

Psalm 137

1450

RE: the psalm is a communal Jewish lament; yearning for Jerusalem while being held in captivity in ancient Babylon

A Bleak Centennial

1451

World: The Suez Canal's Bleak Centennial
TIME
November 21, 1969

1452

A CENTURY ago this week, the French yacht *Aigle*, with the Empress Eugenie aboard, led a convoy of 46 vessels south from Port Said to meet Egyptian warships at Ismailia. Fireworks rocketed above the waterway, while 6,000 guests, including the Emperor of Austria and the Crown Prince of Prussia, celebrated the opening of Suez at a huge ball. Said Builder Ferdinand de Lesseps to the Khedive Ismail of Egypt: "Moses ordered the waters of the Red Sea to retire, and they obeyed him. Today, at your command, they return to their former bed."

Neither revelry nor formal ceremonies will mark the canal's 100th anniversary. The silence along its banks will be broken only by the whine of bullets and the scream of attacking jets. Closed since the outbreak of the 1967 Arab-Israeli war, Suez today is a useless relic of what was once one of the world's busiest waterways that handled an average of 57 ships a day in 1966. Dug-in on opposite banks, the Arabs and Israelis sometimes slip across the canal to launch raids. The canal thus even fails to fulfill its sole remaining function of a moat between enemies.

1453

The outlook for its reopening was never bleaker. The Arabs have called a summit conference at Rabat in December, presumably to coordinate military action against Israel. Their attitude seems to foredoom any U.S.-Soviet peace plan for the Middle East - even if the two superpowers could agree on joint proposals.

Today the only ships in the canal are 15 vessels, which have been trapped in the Suez ever since the fighting broke out 30 months ago. One, the American freighter *Observer,* sits alone in Lake Timsah, 49 miles south of Port Said. The 14 others are bunched together in the Great Bitter Lake. Skeleton crews, who are rotated every three months, maintain the vessels.

Though the crews have a grandstand view of the military fireworks, their biggest enemy is boredom. To while away the time, they take part in lifeboat races and play soccer on the broad deck of the largest ship, the British bulk carrier *Jnvercargill*. They attend church services on the West German motorship *Nordwind* and watch movies on the Bulgarian freighter *Vasil Levsky.* The Polish freighter *Djakarta* even prints stamps for the marooned vessels. Egyptian postal authorities graciously allow the stamps to be used as legal postage; they have become collector's items. Immense amounts of beer are consumed in the heat. Says one crewman: "There must be five feet worth of beer bottles on the bottom around each hull by now."

1454

Most of the world's trading nations are suffering from the loss of the canal. In the first year alone, European countries lost an estimated $1 billion because of the increased cost of sending oil tankers around Africa. India must spend more for grain shipments, and its once profitable exports of iron ore to Europe are no longer economic. For its part, Egypt loses $300 million in annual canal revenues, though $250 million is made-up in subsidies by Saudi Arabia, Libya and Kuwait.

To compensate for loss of the canal, shippers have turned to using huge supertankers of 200,000 tons and more, and to sending cargo from Asia to Europe via Seattle overland to New York. Egypt and Israel are building pipelines to pump Middle East oil to Mediterranean ports. Though a reopened Suez might have a diminished role in world trade, it would still be very busy. Freighters, liners and warships making up 80% of the world's tonnage could travel it fully loaded, as could tankers up to 70,000 tons. Even supertankers, whose fully loaded hulls are too deep for the canal's 38-ft. channels, could take twelve days off the southbound trip by sailing under light ballast through Suez to the Persian Gulf refineries rather than sailing around the Cape of Good Hope.

1455

Beyond the task of raising two sunken ships and a downed bridge, there are few physical barriers to reopening Suez. Most experts agree that the removal and dredging operations could be completed within six months at a cost of $30 million and would restore the canal to its prewar depth. The task, however, will be painstaking and delicate. The engineers must make certain that any unexploded bombs or artillery shells that fell in the canal are fished out before the world's ships pass once more through Suez. One problem that does not worry engineers is silting, since 90% of the normal silt is a result of currents caused by propellers' eroding of the banks. The propellers have not turned since June 1967.

1456

The Yellow Fleet

1457

"…In 1967, the canal became a source of conflict between Egypt and Israel once more. After the Six-Day War, Israel had control of the Suez Canal's east bank, which pushed Egypt to establish a blockade that shut down the waterway. Fourteen cargo ships in the canal were trapped, unable to leave until Nasser's successor as Egypt's leader, Anwar Sadat, re-opened the canal eight years later in 1975. The ships became known as the 'Yellow Fleet' because their decks became covered with sand during the long confinement…"

***latimes.com*, March 26, 2021**

Caption: "Egyptian stamp commemorating Suez Canal re-opening in 1975"

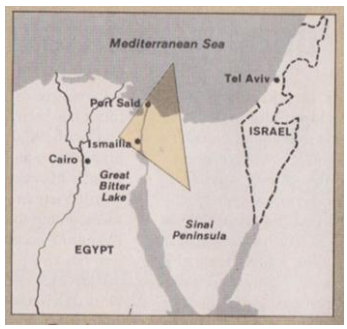
1458

Don't Fence Me In

1459

This is an Israeli nightmare come true: clusters of Soviet ground-to-air missiles point like so many Bedouin lances eastward along the entire Suez flank
***LIFE* magazine, September 25, 1970**
RE: introduction to an article entitled: "Along the Canal, A Fence Across the Sky"

1460



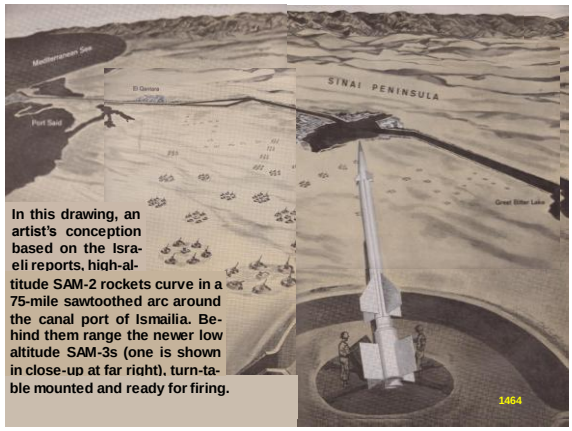
1461

The Gauntlet

1462

"ACCORDING to Israeli aerial reconnaissance and electronic ground monitors, the missile bases now number at least 65. Most, Israelis claim, were installed since the cease-fire began, in open violation of its terms…"
***LIFE* magazine, September 25, 1970**

1463



In this drawing, an artist's conception based on the Israeli reports, high-altitude SAM-2 rockets curve in a 75-mile sawtoothed arc around the canal port of Ismailia. Behind them range the newer low altitude SAM-3s (one is shown in close-up at far right), turn-table mounted and ready for firing.

"…Supplemented by conventional anti-aircraft batteries, this missile 'fence' will stymie Israel's air force, unless it gets a much larger contingent of the fast, maneuverable Phantoms. Retaliatory air raids across the canal at Cairo and other targets might be rendered impossible. Without air cover, Israeli troops entrenched on the canal could then be vulnerable to amphibious attack."
***LIFE* magazine, September 25, 1970**

1465

Caption: "Thundering into the air with a hefty load of fuel tanks and assorted weaponry, a Phantom looks deceptively awkward. Yet it can outmaneuver much lighter planes. Above, before the cease-fire, an Israeli Phantom is fitted-out for combat."

1466

Riding Down the Kill

They call it "The Bludgeon,' and they like it. It is heavily armed, fast and versatile, and can, in the argot of the Israeli pilot, "ride down the kill," which means evade Soviet-built missiles. Asking them to go back to anything less formidable than the Phantom, they say, would be like asking a veteran of the Indianapolis Speedway to go back to bicycle racing.
***LIFE* magazine, September 15, 1970**
RE: introduction to an article written by *Peter Young* entitled: "Israeli Pilots Tell What it's Like to fly 'The Bludgeon'"

1467

1468

The End of a Mighty Leash

"'WE were afraid of it at the beginning,' one pilot confided. 'You can't imagine how fast the thing goes, like riding a mustang, tremendous kick. You feel like the cockpit is miles out in front of you and you're on the end of a mighty leash. It's tugging and pulling at you for all it's worth'…"
***LIFE* magazine, September 15, 1970**

1469

1470

Game Change

1471

"…'Riding down the 'tilam' (Hebrew for missile),' they admit, 'was getting difficult enough before the cease-fire. We probably had nine-to-one odds in our favor. The game has changed now. It's taken on a new dimension. They are improving and we are improving at the same time. You might say we're learning to be more careful crossing the street.' They admit that their wives are getting uneasy. 'They can be a bit of a problem,' said one, 'But what can you do? We're not running an insurance company'…"
***LIFE* magazine, September 15, 1970**

1472

The Art of Evasion

1473

"…I talked at length with one squadron leader, seasoned by more than 200 combat missions, an expert in the art of SAM-2 evasion with three downed MiGs on his efficiency chart. He recalled what it was like flying missions over the canal before the cease-fire. 'Your blood pressure goes up, your heart beats faster. You are tense, but you are not scared. You can see your own positions on the east bank being shelled by Egyptian artillery and that makes you plenty angry. You've got too much to think about, too much to do, too much to watch out for ever to be consciously worried'…"
***LIFE* magazine, September 15, 1970**

1474

"…'Down below, it's all desert, lots of roadway and plenty of missile batteries with their radar and their launcher pointed up at you. You think to yourself, 'Keep your eyes peeled, old boy, the one you don't see will blow you sky-high. You know they're coming with the first puff of sand from below. Then another, and then another. They can take anywhere from five to 15 seconds to get to you, depending on your altitude – small black pinheads trailing orange fire. If you see them first, you alert your co-pilot or he alerts you – 'There's junk at 3 o'clock' or 'There's lots of junk on your side at 9 o'clock'…"
***LIFE* magazine, September 15, 1970**

1475

"…'So you've got to keep your nerve. You evade the first one, then the second, then the third. They come in salvos. I've seen as many as 10 to 14 coming at one time. Sometimes it seems that they are throwing them up just for fun, not aimed at anyone in particular. Some burst in the air and can rock the hell out of you. Others fall back and explode on the ground. So you take a deep breath, dive, drop your load and get out. It can take anywhere from two to four minutes – a long two to four minutes'…"
***LIFE* magazine, September 15, 1970**

1476

The Danger Zone

1477

"…The squadron leader went on, sipping a glass of orange juice. You don't drink anything stronger in the air force. 'Before the cease-fire, they were beginning to get pretty good. The missiles were coming a little bit closer from one mission to the next. Seemed like less were being thrown up just for fun. It wouldn't be easy going back there today. As I said before, I've encountered as many as a dozen at one time. Two dozen would be a different matter altogether'…"
***LIFE* magazine, September 15, 1970**

1478

"…'And now they have the SAM-3s in there. They are more maneuverable, better at low altitudes than the SAM-2, and we all know by whom they are being operated. But I still believe that a barrage of missiles can never defeat a good aircraft flown by a good pilot properly equipped to handle them. The human being is always superior'…"
***LIFE* magazine, September 15, 1970**

1479

Business as Usual

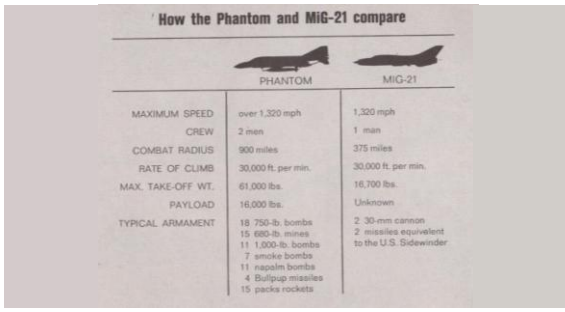
1480

"…There was no bitterness in his voice when asked for his reaction to Egyptian violations of the cease-fire – the new missile bases. 'Sure, we feel frustrated,' he said. 'But we felt that way when the cease-fire was first agreed to. We knew what would happen. We were sure of it. And, as it turned out, we were right'…"
***LIFE* magazine, September 15, 1970**
Caption: "On alert in spite of the cease-fire, pilots of an Israeli Phantom Squadron exchange combat stories"

1481

The Competition

1482



"…And what about his counterpart riding the MiG-21s? 'He's getting better too. But he's still afraid to fight. He makes one run at you, then turns tail and flees for home. We learn from our experiences because the majority of our pilots return home to tell about them. Only one in four Egyptian pilots return safely. They can't learn much that way'…" 1483
***LIFE* magazine, September 15, 1970**

Where the Action Is

1484

"…'And I couldn't care less whether an Egyptian or Russian were piloting those planes today. As long as a MiG-21 is trying to attack me, there could be any foreigner inside and I'd go after him. I know one pilot who dreams every night that he has bagged 10 MiGs. A lot of them are that way. They just can't wait to get back up there where the action is. For me, that's what relaxation is – getting back into your plane and going after the enemy, hitting your target head-on and riding down the kill.'"
***LIFE* magazine, September 15, 1970**

1485

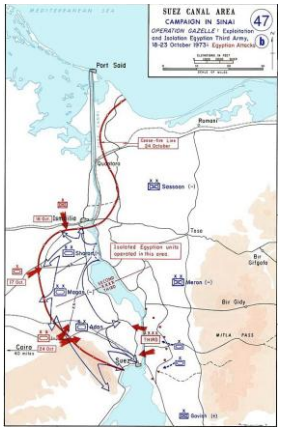
The Battle of Ismailia

1486

On October 6, 1973, Egypt launched "Operation Badr," which prompted the *Yom-Kippur War.* It succeeded in crossing the Suez Canal and establishing bridgeheads on the Israeli-controlled east bank of the canal. Counter-attacks launched by Israeli reserves were unsuccessful. By October 10, 1973, fighting along the front had come to a standstill. In order to relieve Israeli pressure on the Syrians and against the advice of his senior commanders, Egyptian President *Anwar Sadat* ordered an offensive to seize the strategic Sinai mountain passes. The October 14, 1973 offensive culminated in heavy Egyptian losses without achieving any of its stated objectives. 1487
Caption: "Egyptian vehicles crossing the Suez Canal at the beginning of the war"

The west bank of the Maritime Canal was lined with a series of ramparts up to 30m (98-feet) high, which the Egyptians referred to as "strong points." These were used during the opening days of the war to allow Egyptian forces to directly fire on the Israelis situated on the east bank (there were five strong points between the *Great Bitter Lake* and the *Ismailia Canal*). The *Fresh-Water Canal* branched from the Ismailia Canal, running east from the *Nile River* (near Cairo) to *Lake Timsah,* at Ismailia. There were four bridges across the Ismailia Canal.

1488



The failed Egyptian offensive gave the initiative to the Israelis, who immediately launched "Operation Abiray-Lev," aiming to cross the canal between two Egyptian armies in order to encircle Egyptian forces on the east bank and cut their supply lines. After several days of heavy fighting, they were able to secure the roads to the canal and by October 18, 1973, they had two bridges laid-down at Deversoir, at the northern end of the *Great Bitter Lake*. By the next day, there were three Israeli armored divisions across the canal, spanning the entire area between the Maritime and Fresh-Water Canal/s.

Caption: "Map showing Operation Abiray-Lev, including the Israeli attack north toward Ismailia

1489

Ordered to transfer troops to the east bank in order to widen the corridor to the Israeli bridgehead, Israeli General *Ariel Sharon* opposed this strategy, arguing that if he succeeded in his cross-canal mission, the Egyptian Second Army would collapse, thereby eliminating any Egyptian threat to the Israeli corridor and bridgehead.

1490

Caption: "Israeli tanks crossing the Suez Canal"

By the close of the war, the Israelis had advanced to positions some 101 km from Cairo, Egypt's capital, and occupied 1,600 square km west of the canal. They had also cut the Cairo-Suez road and encircled the bulk of Egypt's Third Army. The Egyptians held a narrow strip on the east bank of the canal, occupying some 1,200 square km of the Sinai. It was estimated that the Egyptians had 70K men, 720 tanks and 994 artillery pieces on the east bank of the canal. However, 30K to 45K of them were encircled by the Israelis. When they realized that the IDF canal crossing offensive could result in a catastrophe since the Egyptians' besieged Third Army could not hold on without supply, Egypt's President sought a cease-fire. The Israeli Army had open terrain and no opposition to advance further to Cairo and had they done so, Sadat's rule might have ended. Disengagement talks took place on Oct. 28, 1973, at "Kilometre 101." A summit conference held in Geneva, sponsored by the U.S and USSR followed in Dec. 1973. All parties to the war were invited.

1491

After the failed conference, *Henry Kissinger* started conducting shuttle diplomacy, meeting with Israel and the Arab states directly. The first concrete result of this was the initial military disengagement agreement, signed by Israel and Egypt on January 18, 1974. The agreement commonly known as Sinai I had the official name of, "Sinai Separation of Forces Agreement." Under its terms, Israel agreed to pull back its forces from the areas west of Suez Canal, which it had occupied since the end of hostilities. Moreover, Israeli forces were also pulled back on the length of the whole front to create security zones for Egypt, UN and Israel, each roughly ten km wide. Thus, Israel gave up its advances reaching beyond the Suez Canal, but it still held nearly all of Sinai. It became the first of many such "Land for Peace" agreements whereby Israel gave up territory in exchange for treaties. The canal was re-opened to navigation in June 1975, after clearing the canal of the debris resultant from both the 1967 and 1973 war/s.

Left T&B: caption: "Re-opening of the Suez Canal commemorative coin (1976)"

1492

Part 16

The Latest Improvements

1493

Going Deep

1494

Announcement has just been made that the deepening of the Suez Canal has been completed, and the waterway now has a depth of 29 ft. for its entire length
***Popular Mechanics,* April 1914**
RE: introduction to an article entitled: "Suez Canal Has Been Deepened"

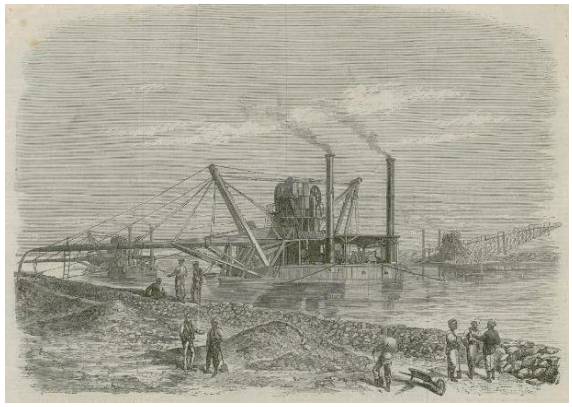
1495

"ORIGINALLY it was planned to give the canal a depth of 26-1/4 ft., and for years after it was completed this depth was maintained. Increase in the size of vessels routed through this short-cut to the Orient made it necessary to deepen the cut, and dredging operations, conducted in the early eighties, added 1 ft. to the depth…"
***Popular Mechanics,* April 1914**

1496

"…Six years ago, the now finished undertaking was begun, and throughout the 100 miles of navigation from Port Said to Suez dredges have removed silt and sand, deepening the waterway to 29 ft. Already proposals are being considered for a further dredging, which will make the minimum depth 30 ft…"
***Popular Mechanics,* April 1914**

1497



The Isthmus of Suez Maritime Canal; Dredger and Elevators at Work 1498

In Comparison

1499

"…The Panama Canal, while but 50-miles-long, cost nearly $300,000,000, as compared with the Suez expenditure of $86,-500,000 for twice the distance. The Panama Canal, however, is 40 ft. deep and 300 ft. wide, while its eastern rival is considerably narrower, only 200 to 265 ft. in width, and is a sea-level excavation mainly through sand."
***Popular Mechanics,* April 1914**
RE: the *Suez Canal* (1869), along with the *Panama Canal* (1914), are the most significant maritime "short-cuts" ever constructed. It brought a new era of European influence in Pacific Asia by reducing the journey from Asia to Europe by about 6K km. Asia became more commercially accessible and colonial trade expanded due to increased interactions. Great Britain, with its far-flung empire, benefited substantially from this improved access. The strategic importance of the Suez Canal endures, mainly because of the Middle-East oil trade and the Pacific-Asian commercial trade.

1500

Above: the journey from the *Persian Gulf* to Northern Europe is particularly impacted by the Suez Canal since a 21K km journey around the *Cape of Good Hope,* taking 24 days, is reduced to a 12K km journey, taking 14 days. Therefore, the Suez Canal allows saving between 7 to 10 days of shipping time (depending on the ship's speed). The Panama Canal considerably shortened the maritime distances between the American East and West coast/s by 13K km. Both the Suez and the Panama Canal/s reduced maritime shipping distances and costs considerably. For example, the Suez Canal shortened the distance of a journey from Rotterdam to Bombay by 41% and shortened the distance of a journey from London to Shanghai by 32%. For the Panama Canal, the improvements in shipping times were even more impressive, with the New York to Los Angeles route reduced by 60%. Major commercial centers could thus be serviced in less time and ships could be used more efficiently (i.e. more trips per year).

1501

Meeting the Need

1502

The Panama and the Suez must grow to accommodate the super-ships that now ply the world's ocean. This is how th-ey'll do it.
popularmechanics.com, **August 18, 2015**
RE: introduction to an article written by *Kevin Dupzyk* entitled: "The Two Greatest Canals in the World Are Getting Even Bigger"

1503

Less is More

1504

"IN 1984 about a million tons of cargo passed through the Suez Canal every day. Last year that number was up to 2.6 million. Over the same period, the number of ships traversing the canal every year dropped, from more than 21,000 to about 17,000. How? The ships got bigger. The highest-capacity container ship at sea today holds more than four times as much cargo as the record holder in 1984. With global demand for imported goods increasing, companies employ the cost-effective strategy of cramming everything on large vessels and making fewer trips…"
popularmechanics.com, **August 18, 2015**

1505

Limited Capacity

1506

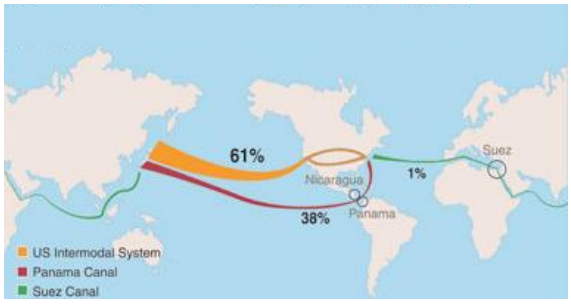
"…Problem is, the Suez Canal and its Western Hemisphere counterpart, the Panama Canal, were not designed to accommodate enormous ships, which hve grown in three measurements: length, width (called beam), and depth in the water (draft). Both canals are scrambling to accommodate the deeper drafts of megaships, which can reach more than 50-feet…"
***popularmechanics.com*, August 18, 2015** 1507

"…The Suez's main canal can move behemoth container ships, with beams up to 164-feet, but only in one direction at a time. Panama's famed lock system is too small in all three dimensions…"
***popularmechanics.com*, August 18, 2015** 1508
Caption: **"Container ship transiting the Panama Canal's locks"**

Remaining Competitive

1509

"…Built in 1869 and 1914, respectively, both waterways require updates if they're to remain competitive with each other. And with a new canal scheduled to open in Nicaragua within the next five years, they need to act quickly…" 1510
***popularmechanics.com*, August 18, 2015**

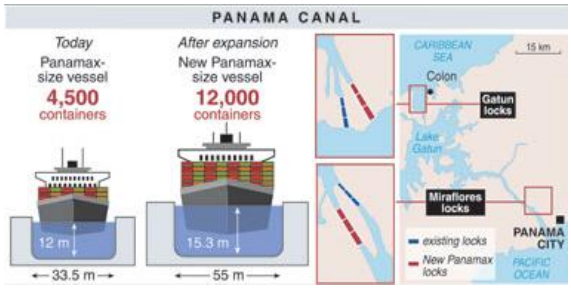


"…Lucrative shipments from Southeast Asia to American ports on the Gulf and the East Coast could travel on any of the three routes…"
***popularmechanics.com*, August 18, 2015**
Caption: **"Main competing inter-ocean routes between Asia and the U.S."** 1511

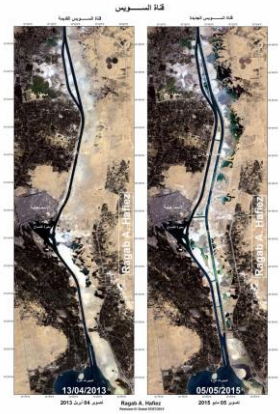
"…The Panama Canal has aged more poorly because of its dependence on locks, which raise ships 85-feet on entry and lower them back to sea-level at the exit. The current locks can handle ships with capacities of up to 5,000 20-foot equivalent units (TEUs, each about the size of a half-length semitrailer). The world's largest container ship, the 'MSC Oscar,' carries nearly 20,000 TEUs…"
***popularmechanics.com*, August 18, 2015**
Above T&B: caption: **"The current (2015) largest container ship in the world, the *MSC Oscar* vs. the *R.M.S. Titanic* (size comparison)"** 1512

1513

"…To expand the canal, workers are deepening and widening the existing route and constructing new locks from 16 rolling metal gates. When completed in April 2016, the new Panama Canal will be able to handle ships of up to 13,000 TEUs - ships longer than a Manhattan city block, with an eight-story building of containers piled on deck…"
popularmechanics.com, 1514
August 18, 2015



Caption: "In recent years, freight traffic travelling from Asia to the east coast of the U.S. has increasingly circumvented the Panama Canal and its restrictions on ship size in favor of the Suez route open to most big vessels. To attract business back, the board of the Panama Canal began work in 2007 to widen the channel to permit the passage of ships carrying a much greater volume of containers. The broader channel would allow for vessels carrying 12,000 TEU containers (TEU, or 'twenty-foot equivalent unit,' is the standard unit of measurement for containers) -- a big increase from the current capacity of 5,000 TEUs." 1515



"…Suez is simpler, lock-free, and large enough to handle oversize ships, but only if they transit in convoys, with bypasses allowing the convoys to pass one another. To allow more room, workers are digging a new canal parallel to 22 miles of the existing one and expanding the current bypasses. The result will be a new 45-mile lane, expected to open this fall, that should reduce ships' journeys by at least 12 hours…"
popularmechanics.com, 1516
August 18, 2015
Caption: "Old vs. new Suez Canal"

1517

Caption: "Over 41,000 workers and 43 dredging machines are working nearly 24 hours-a-day to ensure digging and dredging works are concluded by July 15, 2015. Opening of the enlarged canal is scheduled to occur on August 6, 2015. According to Mohab Mameesh, Chairman and Managing Director of the Suez Canal Authority, 85% of dredging works have been completed, with 219.3 million cubic-meters (7.74 billion cubic-feet) of sand excavated from a total of 258 million cubic-meters (9.1 billion cubic-feet)." 1518

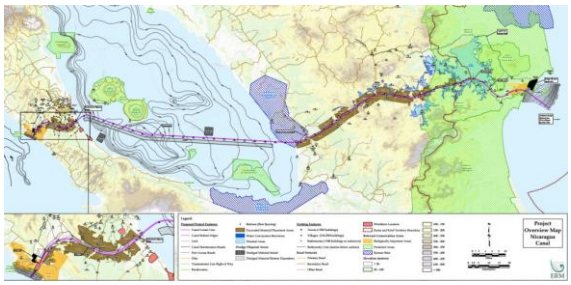
Gaining the Advantage

1519

"…Even when the revisions are complete, however, both Suez and Panama will still be limited. Panama's new locks won't be able to handle ships the size of the 'Oscar,' and Suez will still be mostly one-way. This is what makes the Nicaragua contender so potentially world-changing. In December 2014 a Chinese company, HKND Group, announced a design for a canal that could handle all of today's megaships. A route has already been selected - about 300 miles north of the canal in Panama. The Nicaraguan government has given its blessing…"

***popularmechanics.com*, August 18, 2015**

1520



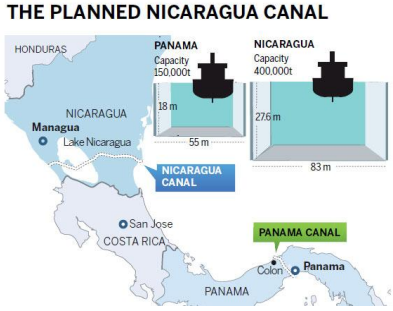
Caption: "Work has begun on the $50 billion Nicaragua Canal The Nicaraguan Congress passed legislation in 2013 to allow the Chinese investment firm HKND to build and operate the canal for 50 years. Responding to accusations that the canal would draw traffic away from Panama, the government insisted that the canal was not built to rival that of Panama's but to compliment it. Advocates of the canal also argue that global shipping will increase to the point where the Panama Canal will be overcrowded, thus necessitating the construction of another maritime link between the Atlantic and the Pacific."

1521

"…Plenty of people, including Eric Farnsworth, vice president at the Council of the Americas, an organization that supports business development in the Western Hemisphere, are dubious that the Nicaragua Canal will actually be completed, freighted as it is with economic and political baggage. But grant that it's up and running in five years, as HKND Group claims, and suddenly the Panama Canal would have to compete directly with a canal built using an additional century's worth of technology…"

***popularmechanics.com*, August 18, 2015**

1522



1523

Oops!

1524

"…Last September Egypt commemorated its Suez Canal project with a set of stamps. One depicted the Panama Canal. To Egyptians it was an honest mistake. To Panamanians, a laugh. To the Chinese, prescient…"
***popularmechanics.com,* August 18, 2015**
Caption: "Stamps commemorating Egypt's new Suez Canal carries an image resembling the Panama Canal"

1525

1526

Means to an End

1527

"…Consumers don't care. To most of us, canals, like stamps, are just a means to get stuff. To the countries that design and maintain the mighty canals of the world, a single waterway can contribute between 2 percent (Egypt) and 6 percent (Panama) to the economy. Their demise could destabilize a nation. You can be sure the race to improve their technology will be heated."
***popularmechanics.com,* August 18, 2015**

1528

Build it and They Will Come(?)

1529

Exactly one year after construction began on an expansion of the Suez canal, authoritarian-minded Egyptian President Abdel-Fattah Al-Sisi is about to throw a party celebrating its completion, Bloomberg reports
***businessinsider.com,* August 6, 2015**
RE: introduction to an article written by *Barbara Tasch* entitled: "'Build it and They Will Come' is Not Enough: Egypt's $8 billion Suez Canal Expansion Sounds Dubious"

1530

Boom or Bust?

1531

"DESPITE the festivities, and the speed at which the project was completed, many experts are questioning whether the $8 billion undertaking will really bring any of its promised economic benefits…"
businessinsider.com, August 6, 2015
Caption: "A cargo ship is seen crossing through the New Suez Canal, Ismailia, Egypt, July 25, 2015"

1532

All Politics is Local

1533

"…And it might be politics, rather than economic necessity, that's driving the biggest expansion to the canal since its opening in 1869…"
businessinsider.com, August 6, 2015
Caption: "A fleet of ships entering the Suez Canal at its inauguration, November 17, 1869"

1534

"…Sisi is a former Army general whose promises of political stability won him enough support to lead the overthrow of an elected Muslim Brotherhood-led government in July of 2013…"
businessinsider.com, August 6, 2015
Caption: "Egyptian President Abdel-Fattah al-Sissi inspects the Suez Canal Expansion Project from a boat on the canal"

1535

"…But an ISIS-affiliated jihadist insurgency in the Sinai and other frequent security incidents throughout the country undermine his major claim for leading the country. Sisi might believe that an impressive but possibly unnecessary infrastructure project is the surest way of securing his rule during an uncertain time…"
businessinsider.com, August 6, 2015

1536

"…Amr Adly, a scholar with the Carnegie Middle East Center in Beirut, told Bloomberg that the expansion of the canal is being used as a tool to prop Sisi's regime. 'Al-Sisi is trying to gain legitimacy through his government's achievements,' Adly told Bloomberg. '[The new canal] shows the government can deliver, it can commit to something and get it done'…"
***businessinsider.com*, August 6, 2015**

1537

Caption: **"Egypt's President Abdel Fattah al-Sisi acknowledges applause as he takes the stage before his address to the 69th United Nations General Assembly at UN headquarters in New York"**

1538

Initiative to Expand

1539

"…The Egyptian Army supervised construction of the expansion. For one year, 400 private companies and 25,000 workers were mobilized. They extracted over 260 million tons of sand, built a new 35-kilometer channel, and widened and deepened 37 kilometers of the original canal. The upgrades will allow two-way traffic and reduce transit time from 18 hours to 11, Bloomberg reports…"
***businessinsider.com*, August 6, 2015**

1540

Caption: **"A general view shows construction at Egypt's New Suez Canal project at the Suez Canal Zone, Egypt, June 13, 2015"**

1541

"…But one expert told Bloomberg that there was little apparent economic necessity for this huge of an undertaking. 'From a shipping industry point-of-view, this initiative to expand the Suez canal was a bit of a surprise,' Ralph Leszczynski, the Singapore-based head of research at Genoese shipbroker Banchero Costa & Co, told Bloomberg. 'There was no pressing need or requests for this as far as I'm aware'…"
***businessinsider.com*, August 6, 2015**

1542

"…The project may still have some economic benefit for Egypt. The Suez upgrade is partly aimed at keeping pace with another major canal: French newspaper 'Le Monde' notes that expansion work on the Panama Canal is set to finish next year…"
***businessinsider.com*, August 6, 2015**
Caption: "Construction of the Suez Canal Extension"

1543

Financiering

1544

"…According to Bloomberg, the investment bank 'Pharos Holding' reported that Egypt's economy grew at over four percent in the nine months before March 2015. According to the bank this expansion is mainly due to infrastructure spending related to the canal upgrade. Egyptians also seem to be support the project, whatever its merits. It only took 10 days for the state to raise over $8 billion to fund the canal upgrade. More than 80% of that total came from the Egyptian public's purchase of state-issued bonds…"
***businessinsider.com*, August 6, 2015**

1545

Reason to Doubt

1546

"…But it's still unclear whether the opening of the canal expansion will produce any actual economic benefits. The government certainly seems to think it will, since it expects canal revenues to more than double from the current annual $5.5 billion to $13 billion by 2023…"
***businessinsider.com*, August 6, 2015**

1547

"…But there's reason to doubt this projection. The expansion won't actually allow larger vessels to use the route. And if anything, gridlock along the canal has actually lessened in recent years: The number of ships using the Suez is 20% lower than before 2008. There would have to be a 9% increase in traffic for the canal to deliver on its economic benefits, but according to a report by Capital Economics, it's 'unlikely' the canal will be able to deliver…"
***businessinsider.com*, August 6, 2015**

1548

"…There could always be a huge bump in global shipping that could radically increase canal traffic: According to the Suez Canal Authority, around 8% of the world's cargo currently passes through the canal. But such an increase doesn't appear to be imminent. And even then, greater infrastructure would need to be built around the canal to absorb additional shipping traffic. 'Build it and they will come' is not enough,' Simon Kitchen, a strategist with Cairo-Based investment bank EFG-Hermes told Bloomberg."
***businessinsider.com*, August 6, 2015**

1549

Invasion Corridor

1550

This summer, President Abdel Fattah el-Sisi of Egypt announced that the Suez Canal would be expanded - to around double its size. The canal is the fastest way to sail from Asia to Europe, a shortcut that brings Egypt $5 billion of revenue a year. But in addition to hosting 10 percent of the world's shipping traffic, the canal is a major conduit for invasive species.
***The New York Times*, November 12, 2014**
RE: introduction to an op-ed article written by science writer *Juli Berwald* entitled: "Under the Ships in the Suez Canal"

1551

"INVASIVE species are one of the greatest threats to biodiversity and ecosystem stability. Yet the Suez Canal expansion is proceeding without any environmental review whatsoever…"
***The New York Times*, November 12, 2014**

1552

Mare Nostrum

1553

"…In September, 18 scientists published a paper in the journal Biological Invasions calling the expansion and lack of environmental oversight 'ominous' because 'the Suez Canal is one of the most potent mechanisms and corridors for invasions by marine species known in the world.' The lead author, Bella S. Galil, from the National Institute of Oceanography in Israel, told me, 'We are playing Russian roulette, not with a bay or a river, but with the entire Mediterranean Sea'…"
***The New York Times*, November 12, 2014**

1554

"…Water in the Suez Canal mostly flows from the Red Sea to the Mediterranean. The new project will involve digging a new canal roughly parallel to the current waterway, and widening and deepening existing sections. This will also allow for a much greater volume of seawater - and sea life - to flow into the Mediterranean. Scientists have already documented more than 350 non-indigenous organisms that have passed through the Suez Canal and established populations in the Mediterranean, and that number is growing. The Mediterranean is colder than the Red Sea, but getting warmer, which means it is becoming more hospitable to the Red Sea's tropical creatures…"
***The New York Times*, November 12, 2014**

1555

"…The nomadic jellyfish (Rhopilema nomadica), originally from the Red Sea, now infests the eastern Mediterranean. Pale blue and measuring about two feet across, with thousands of stinging tentacles, these jellyfish gather in huge swarms each summer - a single swarm can extend more than 60 miles. Fishermen can't fish during the swarming season because the jellies foul their gear and mucus coats their catch. Beachgoers stay home, resulting in estimated tourism losses of several million dollars a year. This species also blocks intake pipes at desalinization and power plants…"
***The New York Times*, November 12, 2014**

1556

Caption: "The Nomad jellyfish (*Rhopilema nomadica*) is native to the Indian Ocean. It forms huge swarms along the Levant coast, eating a hole in the food web by preying on zooplankton."

1557

"…The silver-stripe puffer fish (Lagocephalus sceleratus) crossed through the Suez Canal, and was spotted in the Mediterranean in 2003. An aggressive predator, it now ranks among the 10 most abundant fish in the eastern Mediter-ranean by weight. This boxy fish contains tetrodotoxin, which causes paralysis and, potentially, death. Locals unfamiliar with the fish are catching, selling and eating it. Poisonings requiring hospitalization have now been reported in Egypt, Greece, Turkey, Israel and Lebanon…"
***The New York Times*, November 12, 2014**

1558

"…Near Turkey, two species of Red Sea rabbit fish (Siganus rivulatus and Siganus luridus) have clear-cut hundreds of miles of seaweed forests. The seaweed is habitat for a multitude of species, including many invertebrates, which are prey for carnivorous fish. By destroying this habitat, the rabbit fish collapse the Mediterranean's complex food web…"
***The New York Times*, November 12, 2014**

1559

"…In a region often beset by delays, the speed at which the canal expansion is progressing is impressive. Bonds worth $8.5 billion to fund the project were sold in just eight days. Sixty million of the 140 million cubic-meters of digging were completed by October. Fifteen hundred homes have been destroyed and thousands of Egyptians displaced to make room for the expanded canal, according to local reports. It could all be completed as early as next year…"
***The New York Times*, November 12, 2014**

1560

"…Environmental concerns are not going to stop this project. Ship size and traffic are increasing worldwide. The Panama Canal is doubling its capacity, and Nicaragua is planning to build another canal connecting the Atlantic and the Pacific. Transoceanic canals play a necessary role in globalization, and the Suez is critical to the economic stability of Egypt. But when a construction project of this size is planned, the first step is to perform an environmental impact assessment, followed by a risk analysis and evaluation of measures that could potentially mitigate the harms. These steps must be taken for the Suez…."
***The New York Times*, November 12, 2014**

1561

"…Solutions to the problem of invasive species traveling through canals do exist. Air curtains - essentially walls of bubbles - create turbulent fields that aquatic organisms avoid, although building an air curtain big enough for the Suez could be problematic. Low-frequency sound emissions can also be used to deter animals, though noisy ship traffic may interfere. The most promising technology for the Suez has precedent in the past. In the early 20th century, naturally occurring highly saline Bitter Lakes bisected the Suez Canal, making it difficult for species to cross through. A salinity barrier could be re-established by inserting a high-salinity lock in the canal. We need to immediately begin exploring the feasibility and effectiveness of these, and other, mitigation technologies…"
***The New York Times*, November 12, 2014**

1562

"…The United Nations should pressure Egypt to begin an environmental review. It oversees three treaties - the Convention on Biological Diversity, the Mediterranean Action Plan, and the Division for Ocean Affairs and the Law of the Sea - that have jurisdiction over activities that affect the health of Mediterranean ecosystems and invasive species. Egypt is a party to all of these treaties. But despite my repeated calls and emails to United Nations officers, only two responded to me, and both refused to comment…"
***The New York Times*, November 12, 2014**

1563

"…The overwhelming financial support behind this project is evidence that the cost of an environmental review would not be onerous. Its absence is not just a breach of legal obligation; it puts at risk an ecosystem that would still be familiar to its first students, Aristotle and Pliny the Elder. The ocean that has long been called 'mare nostrum' - our sea - deserves our protection."
***The New York Times*, November 12, 2014**

1564

A Clear and Present Danger

1565

Nomadic jellyfish and poisonous puffer fish are the poster children of an invasion of non-native species into the Mediterranean, with environmental and economic costs
***scientificamerican.com*, January 31, 2017**
RE: introduction to an article written by *Christopher Intagliata* entitled: "Widening the Suez Canal Ushers In Underwater Invaders"

1566

A Humpty-Dumpty Sort of Problem

1567

"THE Mediterranean Sea is home to some 17,000 native species. But it's also home to a growing number of non-native species: 756 at last count. 756 may not sound like a lot, compared to 17,000. 'But this is not arithmetic.' Bella Galil, a naturalist at Israel National Center for Biodiversity Studies in Tel Aviv. 'Those invasive species have a large population, and they rend apart the native food web. They disturb an already stressed community'…"
scientificamerican.com, **January 31, 2017**

1568

"…The invaders she's talking about are central casting for an underwater horror movie. Take the nomadic jellyfish, in huge swarms 60-miles-long, which sent hundreds of people to Turkish hospitals a few summers back. Or a type of pufferfish, extremely poisonous, that occasionally gets fished out, and lands at fish markets by mistake…"
scientificamerican.com, **January 31, 2017**
Caption: "A swarm of the nomadic jellyfish off the coast of Israel, summer 2016"

1569

"…Galil says these bad guys, and many others, have invaded the Mediterranean through the ever-widening Suez Canal. As the canal grows, so do the number of non-native species. And it's a dilemma that's not easily addressed. 'It's a Humpty-Dumpty sort of problem. Once it's broke it's broke. We cannot re-engineer it. It's too complex for us.' Galil and her team outline the scope of the problem in the journal Management of Biological Invasions. [Bella Galil et al., The Enlargement of the Suez Canal - Erythraean Introductions and Management Challenges]…"
scientificamerican.com, **January 31, 2017**

1570

"…Installing locks or salinity barriers could help block future invasions, she says - those methods have worked in other canals. But that's an engineering and governance issue. 'As biologists we've raised our voices. The community is aware of it. The problem is to go beyond this. And to go beyond this we need to go into the regional bureaucracy and the industry.' It'll undoubtedly cost money, too…"
scientificamerican.com, **January 31, 2017**

1571

"…One motivating factor for taking action: Mediterranean beaches are big business. And swarms of jellyfish can quickly drive away the customers."
scientificamerican.com, **January 31, 2017**
Caption: "Blue nomadic jellyfish on the coastal sand of the Mediterranean Sea"

1572

Part 17

Corking the Bottle

1573

An Unfortunate Series of Events

1574

A colossal container ship that ran aground in the Suez Canal on Tuesday has ensnarled one of the world's busiest shipping lanes in a marine traffic jam
***popularmechanics.com*, March 29, 2021**
RE: introduction to an article written by *Jennifer Leman* entitled: "After Six Days Stuck in the Suez Canal, the *Ever Given* Is Finally Free"

1575

Run Aground

1576

"TWO days later, more than 100 container ships are still waiting at each end of the canal as tug boats and dredgers struggle to free the 'Ever Given,' which weighs 200,000 metric tons and stretches 1,300-feet-long…"
***popularmechanics.com*, March 29, 2021**
Caption: "Stranded container ship *Ever Given,* one of the world's largest container ships, is seen after it ran aground, in Suez Canal, Egypt March 26, 2021"

1577

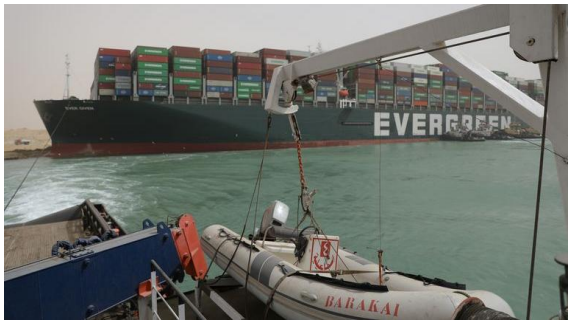
Caption: "An aerial view taken on March 27, 2021 from the porthole of a commercial plane shows stranded ships waiting in queue in the Gulf of Suez to cross the Suez Canal at its southern entrance"

1578

1579

"…'It's just like having an accident on the interstate,' Donald Maier, the Dean for the School of Maritime Transportation, Logistics, and Management at the Cal Maritime, tells Pop Mech. 'That accident shuts down all lanes of travel, and everything will then start to back up.' If the Panamanian-flagged ship isn't freed soon, it could spell disaster for a global shipping industry already hobbled by the effects of COVID-19…"
popularmechanics.com, March 29, 2021

1580



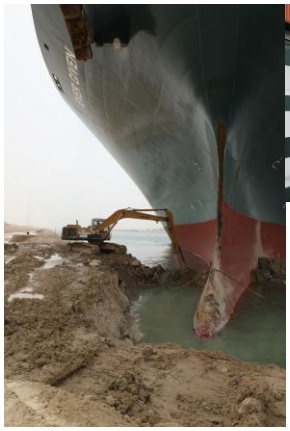
"…The 'Ever Given,' which is owned by the Japanese company Shoei Kisen Kaisha, was on its way to the port of Rotterdam from China when it became stuck after a sandstorm blew through the region. Visibility plummeted and wind gusts reached speeds of up to 31 miles-per-hour…"
popularmechanics.com, March 29, 2021
Caption: "The *Ever Given*, a Panama-flagged cargo ship, is wedged in the Suez Canal and blocking traffic in the vital waterway"

1581

1582

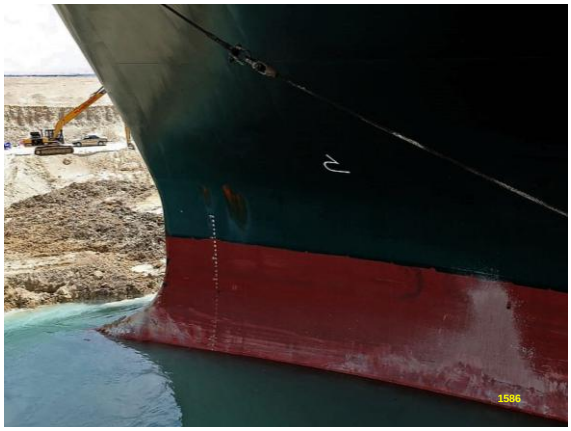
Unstucking

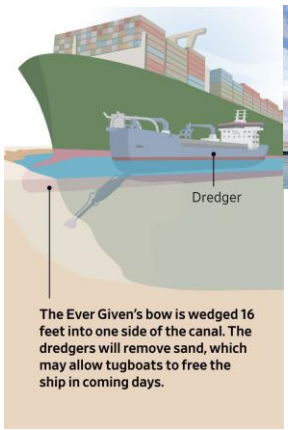
1583



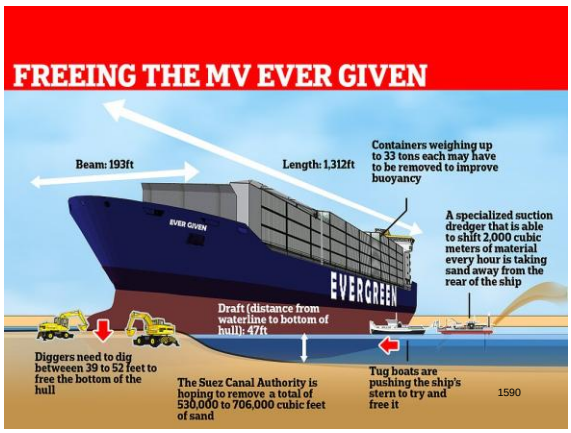
"…In addition to the eight local tugboats working to free the 'Ever Given,' a small fleet of construction vehicles – dwarfed by the size of the 1,300-foot-long ship - has appeared at the shore to dig the giant vessel out…"
popularmechanics.com, March 29, 2021

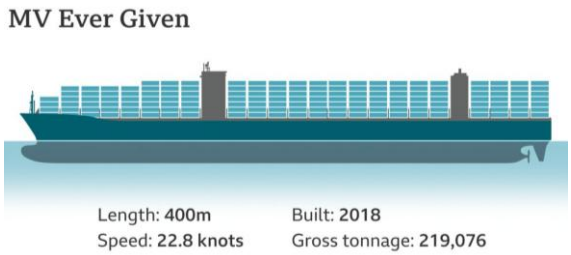
1584





"…However, that effort to free the ship hasn't worked as of Thursday morning, according to a statement provided to the New York Times, and authorities have since brought in a dredger to assist in the efforts…"
popularmechanics.com, March 29, 2021
Caption: "A suction dredger is moved into position at the front of the *Ever Given* where it will attempt to remove sand from around the bow of the ship so it can be refloated" 1588

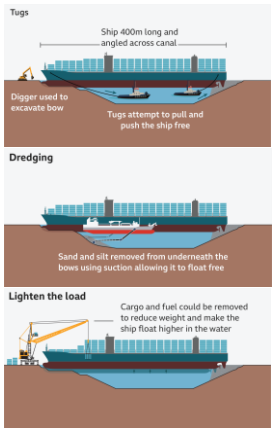




"…The 'Ever Given,' a 1,312-foot-long, 200,000-ton behemoth, beached itself in the canal early Tuesday during a sandstorm. On Friday, dredgers capable of shifting more than 70,000 cubic-feet of material-per-hour and teams of excavators were trying to dislodge the ship, said GAC, a shipping agent at the canal…"
1591
latimes.com, **March 26, 2021**

1592

1593



"…So, now what? The key to 'unstucking' the 'Ever Given' will be lightening the ship's load. One way to do that is to empty the ballast tanks. That solution, however, could destabilize the ship, Captain Morgan McManus, Master, 'Empire State VI,' of SUNY Maritime College, tells Pop Mech. Another option would be to unload the ship's cargo, but that could prove difficult without the necessary equipment readily avail-able. 'In the middle of the Suez Canal, there's no infrastructure for that, so that would mean getting a crane barge alongside and then taking those boxes off one at a time,' says McManus. With a ship as big as the 'Ever Given,' the effort could take weeks…"
popularmechanics.com,
March 29, 2021
1594

Golden Class

1595


1596

"…The gargantuan 'Ever Given,' which the shipping company Evergreen Marine built in 2018, is a Golden-class container ship. It can carry as many as 20,000 20-foot-long shipping containers. The push to build increasingly larger ships may partially be to blame for the Ever Given's precarious situation. 'The scale has gotten so big that a lot of the infrastructure has yet to catch-up with the size of the ship,' McManus says…"
popularmechanics.com, **March 29, 2021**
Caption: **"The stranded *Ever Given* viewed from land on March 25, 2021"**

"…Steering ships of the Ever Given's' size can be challenging, and any evasive maneuvers must be done far in advance to ensure the ship has enough horsepower to make the move in time. It takes a skilled crew to anticipate potential issues. In some cases, a captain may not recognize an issue before it's too late. Adverse weather conditions only exacerbate these challenges. 'It's basically a huge wall,' Steven Browne, the Department Chair of Marine Transportation and International Business and logistics at the Cal Maritime, tells Pop Mech. 'If there's wind from the beam, or the side of the vessel, and you have a lack of steering control, it's very easy for the ship to be turned sideways'…"
***popularmechanics.com*, March 29, 2021**

1597

12%

1599

"…The Suez Canal snakes through Egypt and serves as the sole connection between the Red Sea and the Mediterranean Sea. The 120-mile-long waterway has become a vital shipping passage and can accommodate as many as 50 ships-a-day, quickly linking markets in Asia and Europe. Roughly 12 percent of all maritime trade makes its way through the Suez; it's second only to the Panama Canal, the world's busiest marine throughway…"
***popularmechanics.com*, March 29, 2021**

1600

"…Hundreds of ships have been left waiting in the open sea, tens of billions of dollars' worth of goods lie undelivered and companies the world over are grappling with the possibility of a protracted closure of a waterway through which one-tenth of global shipping passes. There were reports Friday that some companies were already diverting ships away from the Egyptian canal, but they faced a much longer journey around Africa…"
***latimes.com*, March 26, 2021**

1601

"…About 90% of the world's goods ply the oceans, and the plugged artery demonstrates how a single incident can disrupt 'the finely balanced system that we all rely on,' Guy Platten, Secretary General of the International Chamber of Shipping, said in a statement Thursday…"
***latimes.com*, March 26, 2021**

1602

Opened and Closed

1603

"…The Egyptian pharaoh Senausert III, who reigned from 1887 to 1849 B.C., is credited with first digging the canal. According to the Suez Canal Authority, it has opened and closed numerous times since its official inauguration in 1869. In 2015, crews expanded parts of the passage to allow travel in both directions at certain points along the nearly 80-foot-deep waterway…"
popularmechanics.com, **March 29, 2021**
Above L&R: caption: "Left, the Suez Canal in 2014, before its expansion. Right, the canal in 2016, with the new channel."

1604

Déjà vu All Over Again

1605

"…This isn't the first time a vessel has run aground in the Suez Canal. A Japanese container ship, 'OOCL Japan,' rammed into the side of the waterway in 2017. Fortunately, crews refloated the ship hours later. The canal was also closed for three days in 2004 after the Liberian-flagged oil tanker, 'Tropic Brilliance,' became stuck…"
popularmechanics.com, **March 29, 2021**

1606

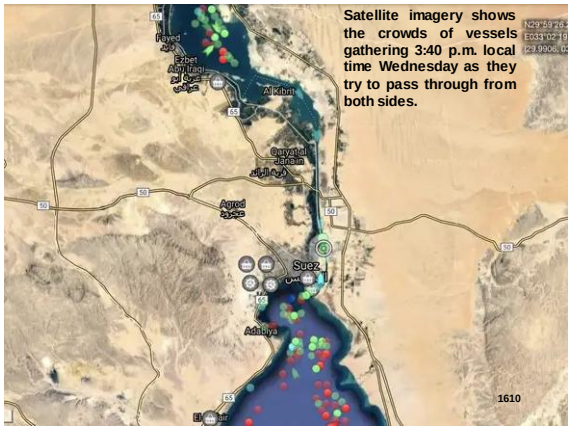
"…The 'Ever Given' also isn't the first ship to stop traffic through the canal. In 2004, the oil tanker 'Tropic Brilliance' got stuck for three days in the canal and needed to be refloated. In 2006, the 93,000-ton Hong Kong-flagged 'Okal King Dor' veered at a wrong angle inside the canal because of high winds and a sandstorm - conditions similar to those on Tuesday - and wound up blocking the waterway. It took four tugboats eight hours to realign it. Later that same year, a British container ship suffered engine failure, ran aground in the canal and held up northbound traffic, forcing authorities to divert ships into alternate branches of the channel. The most recent such incident occurred in 2017, when the 'OOCL Japan' snarled the passageway for a few hours until tugboats pushed it free…"
latimes.com, **March 26, 2021**

1607

Domino Effect

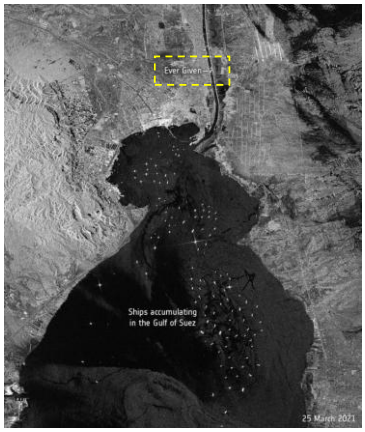
1608

"…Thanks to the COVID-19 pandemic, the global shipping industry has faced several shortages of setbacks in the past year. The obstruction of the canal could set-off a domino effect of delays. 'Just like on the interstate, once that accident is cleared, you still have this bottleneck of everybody trying to rush through,' Maier says…"
popularmechanics.com, March 29, 2021
Caption: "Ships are anchored outside the Suez Canal in Ismailia, Egypt, wait to be able to pass through the canal after it was blocked" 1609



Plan B

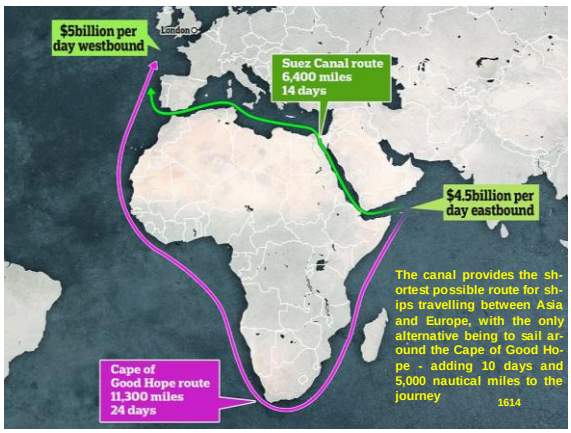
1611



"…Ports strategically plan their labor needs and offloading capacity, so even minor delays can snowball into large delays that have the potential to derail entire supply chains. They could become overwhelmed by the influx of delayed ships on top of ships that arrive on time from other locations…"
popularmechanics.com, March 29, 2021 1612

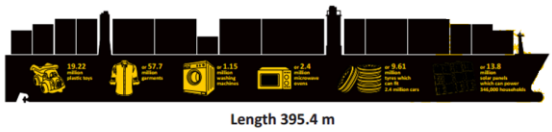
"…And while there may be some wiggle room in a ship's charter to account for, say, the adverse weather or the wait to get into port, 'they usually don't plan on having the Suez Canal closed for days on end,' Browne says. If the blockage lasts any longer, ships stranded on either side of the Suez may decide to turn around and take the scenic route down around the southern tip of Africa…"
popularmechanics.com, March 29, 2021

1613



A Precarious Situation

1615



"…The impacts of the Ever Given's precarious situation could be passed on to customers in the form of additional delays, higher prices, and bare shelves, impacting everything from fuel to sneakers to TVs. 'There is everything on that ship,' McManus says. 'If you buy it in a store, it is on that ship.'"

popularmechanics.com, **March 29, 2021**

Caption: "The *MSC Oscar,* the world's largest capacity container vessel, is 395.4m long and 59m wide and has a record-setting capacity of 19,224 TEUs. The colossal vessel has a deck equivalent to four football fields laid end-to-end and in a single voyage could carry a cargo volume equivalent to 57.7 million garments or 3.4 million microwave ovens."

1616

1617

Free at Last

1618

"Update 03/29/21 10:30 a.m. ET: *Salvage crews finally dislodged the massive cargo ship with some help from high tides. After six grueling days, crews have managed to wrench the 'Ever Given' free from its perch in the Suez Canal. Now that the ship is under way - thanks to high tides and a fleet of tug boats and dredgers - hundreds of vessels that have been stranded on either side of the canal are gearing up to resume their journey along the vital shipping corridor…"*

popularmechanics.com, **March 29, 2021**

Caption: "The *Ever Given* has now been successfully freed from both banks of the canal"

1619

"…It marks the end of an agonizing week for the maritime trade industry - one that saw losses as high as $10 billion per day, highlighted the frailty of an already strained global supply chain, and spurred a slew of incredible memes. So long, 'Ever Given.' We hardly knew 'ye…"

popularmechanics.com, **March 29, 2021**

RE: on March 23, 2021 the *Ever Given* became wedged in the banks of the Suez Canal blocking passage for six days. An estimated 422 ships were stuck waiting at the entrance of the canal for the *Ever Given* to be dislodged.

1620

The Heavens Above

After six grueling days, salvage crews wrestled the *Ever Given* free from its diagonal perch across the Suez Canal on Monday, opening up a chokehold that drove a large portion of the global shipping industry to a standstill. Rising tides helped remove the stuck ship from its watery perch.
***popularmechanics.com*, April 31, 2021**
RE: introduction to an article written by *Jennifer Leman* entitled: "The Moon - Yes, the Moon - Ultimately Freed the *Ever Given* From the Suez Canal"

1621 1622

Secret Weapon

"WHILE a small armada of tug boats, dredgers, and even a backhoe toiled day and night to free the 1,300-foot, 200,000-metric-ton vessel from the Suez Canal, the crews ultimately received the biggest helping hand from a surprising secret weapon: the moon…"
***popularmechanics.com*, April 31, 2021**

1623 1624

Wishful Thinking

"…For days, salvage teams hoped that an unusually high tide, set to peak at around 11:42 a.m. local time on Monday, would help to dislodge the 'Ever Given.' Just before 3 p.m., as the tides rose in the jammed channel, the crews got their wish…"
***popularmechanics.com*, April 31, 2021**
RE: a "Supermoon" (a/k/a "Worm Moon") caused tides to rise over a foot-and-a-half higher than normal in the Suez Canal, allowing the best chance for dislodging the *Ever Given*

1625 1626

Time and Tide

1627

"…Tides mark the rise and fall of sea-level and are influenced by the gravitational pull of the sun and the moon on Earth. Both the alignment and proximity of these cosmic bodies relative to each other influences how waves lap up against the shore. Spring tides, also known as 'king tides,' occur twice each month during the full and new moon - when the sun, Earth, and moon are aligned. 'When you have a new or full moon, you're going to have higher highs and lower lows,' Tamara Burback, an assistant professor of marine transportation at the Cal Maritime in Vallejo, tells Pop Mech (contrary to popular belief, spring tides actually get their name from the term 'springing forth,' and not from the season - they occur regardless of season)…"

***popularmechanics.com,* April 31, 2021**

RE: Spring tides (unusually high tides) occur twice each month during new and full Moons, with the supplemental gravitational effects tending to pull more on the Earth's oceans

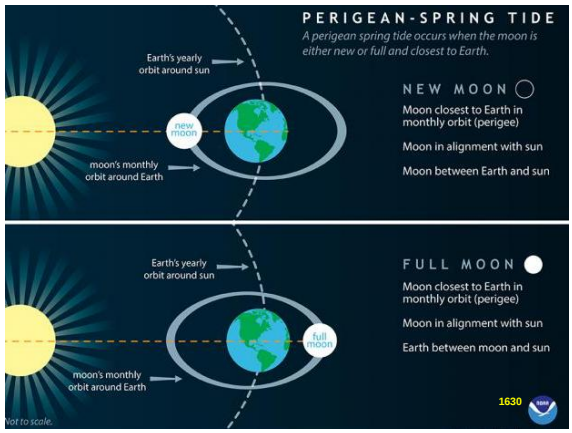
1628

"…Tides are also influenced by how far apart Earth and moon are from each other. Because the moon's month-long orbit around Earth is elliptical, there are points along its journey when it's closer and farther away. These are called perigee and apogee, respectively. During the lunar perigee, the mass of the moon tugs on Earth and expands the tidal bulge. 'We have more dramatic tides during that time,' Burback explains…"

***popularmechanics.com,* April 31, 2021**

RE: when the Moon reaches full or new phase near perigee, the closest point in its orbit to Earth, Spring tides are even higher. The Moon reached full phase on the evening of March 28, 2021 and perigee a day-and-a-half later. Tides peaked around 11:00 am and 11:30 pm local time on March 27, 2021 and each high tide over the next several days was among the highest of the year.

1629



"…Yesterday, March 30, marked the second lunar perigee this month. That means high tides - like the one that freed the 'Ever Given' - are higher than usual. This was critical to the rescue mission. 'Whenever you're trying to refloat a vessel, you're looking for a higher tide than when it ran aground,' says Burback. That way, there's more water to buoy the ship and lift it from the mud. Had the 'Ever Given' run aground during a lower tide, crews might have had a more difficult time freeing the vessel…"

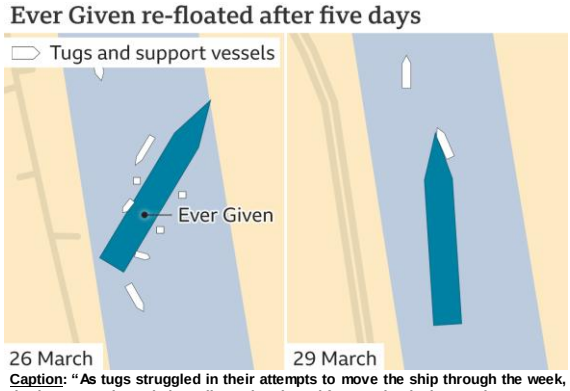
***popularmechanics.com,* April 31, 2021**

RE: although the difference isn't much, a few inches at best, it was enough to assist the pair of powerful seagoing tugs along with eleven other tugboats in pushing the ship back into the channel. By 3:00 pm local time on March 29, 2021 officials reported the ship was freed and underway. Had more time been needed to free the ship, the job would grow more difficult since the Moon moves to a right angle relative to the Sun. This postilion cancels some of the Sun's gravitational pull resulting in high tides that are about 16-inches lower.

1631

Caption: "In this photograph released by Suez Canal Authority, the *Ever Given* is seen being pulled by tugboats in the canal on March 29, 2021. Two tugboats can be seen in the background. Fourteen tugboats helped pull and push the *MV Ever Given* free, ending a week of high drama."

1632



Caption: "As tugs struggled in their attempts to move the ship through the week, dredgers were brought in to dig mud and sand from under the bow and stern of the ship"

1633

Thank the Moon

1634

"…Scientists and sailors have charted the changing tides for eons, so crews working to salvage the 'Ever Given' would have known when to try and refloat the ship. 'I'm sure that one of the first things that people did was say, 'Okay, when is the next high tide event? When is our best bet to throw everything at it and get all of our resources together?' says Burback. 'The moment happened and they were ready to go.' Thanks, moon."

popularmechanics.com, **April 31, 2021**

1635

Minute-by-Minute

1636

Late last month, a colossal container ship called the *Ever Given* ran aground in the Suez Canal, ensnaring one of the world's busiest shipping lanes in a marine traffic jam for six agonizing (and expensive) days. Salvage crews finally wrenched the *Ever Given* free from its perch - with a key assist from the moon - on March 29, but the ship remains anchored in Egypt's Great Bitter Lake for inspection as of press time, with further investigations pending. Here, using publicly available ship tracking data and insight from maritime pilots, *Popular Mechanics* pieces together precisely how the disaster dramatically unfolded in real time. For six long days, the massive container ship stayed stuck in the Suez Canal, capturing the world's attention. Now, ship tracking data and maritime pilots reveal exactly how it got there.

popularmechanics.com, **April 9, 2021**

RE: introduction to an article written by *Brendan Crowley* entitled: "Here's the Minute-by-Minute Breakdown of the Ever Given's Crash"

1637

Killing Time

1638

"ON Tuesday, March 23, at 12:12 a.m. Egyptian local time (EET), the 'Ever Given,' a container ship belonging to the shipping company Evergreen Marine and sailing under the flag of Panama, arrived at Suez Port. Nobody cared. In the darkness, the 1,300-foot-long, 200,000-metric ton megaship joined a group of vessels already idling in the anchorage - an enormous, yet unremarkable addition to a vast, aquatic waiting room at the foot of the Suez Canal's southern terminus. For the next 5 hours and 37 minutes, the 'Ever Given' drifted slowly in a pattern-less pause, killing time before the start of its half-day-plus voyage through the canal to the Mediterranean Sea…"
popularmechanics.com, **April 9, 2021**

1639

Celebrity Status

1640

"…At 5:49 a.m., the 'Mosaheb 2,' an Egyptian tugboat, sidled up to the skyscraper-sized ship, the official indication that the vessel's journey was about to begin. One hour and 53 minutes later, the Ever Given's voyage was over. By then, it was the most famous ship in the world…"
popularmechanics.com, **April 9, 2021**

1641

1642

Storm Warning

1643

"…Days earlier, the Egyptian Meteorological Authority (EMA) had started to issue warnings. Infamous seasonal gusts of hot, dry, and sand-filled air, known as the Khamaseen winds, were sweeping intensely across the country, causing dramatic spikes in temperature and poor visibility. In a forecast for March 23, the EMA warned of 'thrilling winds of sand and dust' and a 'disruption of maritime navigation.' Wave heights on the Gulf of Suez and the Red Sea, the EMA estimated, would reach 10- to 13-feet…"
popularmechanics.com, **April 9, 2021**

1644

Last Line of Defense

1645

"…This information was likely top of mind for the Suez Canal Authority (SCA) pilots aboard the 'Mosaheb 2' as it approached the 'Ever Given' on Tuesday morning. Pilots, who are required aboard all vessels transiting the canal, use their local expertise to verbally direct the navigation of a ship as its captain maneuvers it through the man-made passage. On a normal day, pilots are a formality, a helpful addition to the ship's bridge; when chaos strikes, they can be the last line of defense between a close call and an incalculable disaster…"
***popularmechanics.com,* April 9, 2021**

1646

"…At 5:53 a.m., the 'Mosaheb 2' departed the 'Ever Given,' leaving behind two SCA pilots that would stay in the ship's bridge until it reached Ismailia, a city near the canal's halfway point. There, they would exit the ship and be replaced by new pilots, who would ride with the vessel until its passage through the canal was complete…"
***popularmechanics.com,* April 9, 2021**

1647

The Rundown

1648

"…Captain John DeCruz is an expert in what can unfold on the bridge of a ship like the 'Ever Given' from this point forward. DeCruz is the New York President of the Sandy Hook Pilots, one of a handful of organizations responsible for guiding vessels into and out of New York Harbor. For nearly two decades, DeCruz was an active pilot himself, guiding ships of all sizes through the waters of New York and New Jersey. Before he was a pilot, DeCruz worked on a ship that brought him to the Suez Canal…"
***popularmechanics.com,* April 9, 2021**

1649

"…According to DeCruz, the arrival of the two SCA pilots at the bridge of the 'Ever Given' would initiate a briefing with the captain. 'You find out everything you need to know about the ship,' DeCruz tells Pop Mech. 'If there's any issues that they encountered on the way, you tell them if they're going to encounter any traffic coming in, how many ships we're going to meet. You give the captain of the ship a rundown of everything that we expect to see on that transit'…"
***popularmechanics.com,* April 9, 2021**

1650

Looks Like We Got Us a Convoy

1651

"…At 6:00 a.m., just 7 minutes after the pilots' arrival, Suez Port sprung to life, with a select convoy of the day's largest, top-priority vessels now officially cleared to sail northbound and enter the canal. First in line was the 'Al Nasriyah' of the Marshall Islands, followed in order by the 'Cosco Galaxy' of Hong Kong, the 'Ever Given,' the 'Maersk Denver' of the U.S., and so on. At 6:21 a.m., the 'Al Nasriyah' turned to the north and started its transit to the canal's entrance. The convoy had begun…"
popularmechanics.com, **April 9, 2021**
Caption: **"Forty-six ships transited the Suez Canal on Sunday 11/11/2018 with a total cargo of 3.3 million tons. The south-bound convoy included 26 vessels carrying 2.1 million tons, while the north-bound convoy included 20 ships laden with 1.2 million tons, according to statistics of the Suez Canal Authority."**

1652

"…At 6:51 a.m., the 'Al Nasriyah' arrived at the southern terminus of the Suez Canal. Seven minutes later, while navigating the canal's approximately 4.3-mile gradual opening turn, it was joined at its stern by the 'Mosaed 2,' a local tugboat employed to help direct its passage. Shortly thereafter, the 'Cosco Galaxy' also picked up a tugboat, the 'Mosaed 3,' which positioned itself behind the ship…"
popularmechanics.com, **April 9, 2021**

1653

SOL

1654

"…At 7:18 a.m., the 'Ever Given' entered the Suez Canal, choosing, curiously, to proceed without a tugboat. Unlike pilots, tugboats aren't a mandatory feature of a ship's transit through the canal - the 'Maersk Denver,' trailing the 'Ever Given,' also proceeded without one. However, their usefulness as an extra precautionary measure, particularly during bouts of bad weather, is undeniable. 'If something goes wrong, you have something to help you,' Captain Robert Flannery, an active pilot and the President of New York's Metro Pilots Association, tells Pop Mech. 'They help you maneuver, they help you slow down, they can help guide your bow and your stern, and God forbid you lose an engine or something happens, you got a fighting chance. If you don't have a tugboat, you're shit out-of-luck'…"
popularmechanics.com, **April 9, 2021**

1655

1656

"…At 7:22 a.m., as it took the opening turn of the canal, the 'Ever Given' was alone. Up ahead, the 'Al Nasriyah' was near the canal's 151-kilometer (km) marker - its distance from the northern terminus at Port Said - with the 'Cosco Galaxy' keeping pace. Behind the Ever Given, the 'Maersk Denver' edged toward the canal's entrance. At this moment, the 'Ever Given's' speed, which had been gradually increasing and had already eclipsed the 8.6-knot limit set by the SCA, began to approach eyebrow-raising levels. By 7:29 a.m., as it pulled out of the opening turn, the 'Ever Given' was traveling at 13.7 knots…"
popularmechanics.com, **April 9, 2021**

1657

The Need for Speed

1658

"…When DeCruz watched the Automatic Identification System (AIS) video replay of the 'Ever Given's' entrance to the canal, the number 13 jumped off his screen. Simulated voyages and live experience navigating slightly smaller megaships had made clear to him the dangers associated with such speeds. 'We determined that was too much speed for these ships in a tight area,' said DeCruz. The pilots aboard the 'Ever Given,' however, may have had no choice but to recommend an acceleration to the captain…"
popularmechanics.com, **April 9, 2021**

1659

"…According to a statement issued by the Suez Canal Authority, as forecasted, powerful dusty winds bore down on the canal on Tuesday morning, lowering visibility and gusting at speeds as high as 46 miles-per-hour (mph). If a crosswind of that magnitude struck the 'Ever Given,' the 18,300 shipping containers stacked high above it would have collectively acted as an enormous sail, and caused the ship to drift in the direction of the wind. To effectively counter such a gust, a pilot would likely prescribe increased speed and an angled course against the wind. 'You can't steer straight if it's blowing you sideways,' Flannery says. 'You'll be aground. Speed gets you through it quicker'…"
popularmechanics.com, **April 9, 2021**

1660

The Bank Effect

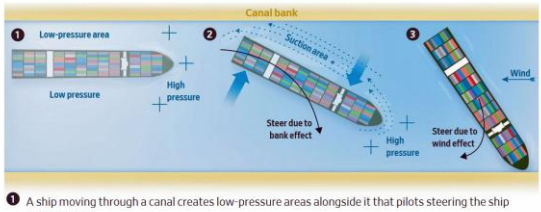
1661

"…At 7:37 a.m., the 'Ever Given,' traveling at 13 knots, appeared to initiate an approximately 2-minute northwesterly push toward the west bank of the canal, a maneuver presumably made in response to winds that had gradually pushed the vessel towards the east bank. At 7:39 a.m., the 'Ever Given' straightened and was again parallel with the canal, but was now sailing close to the edge of the west bank…"
popularmechanics.com, **April 9, 2021**

1662

"…Ships like the 'Ever Given' don't mix well with banks. When a vessel of its size sails alongside one, the strip of water between the land and the ship is squeezed and displaced. As a result, the water's flow quickens, its pressure drops, and, as it shallows in the ship's wake, it sucks downward, like a flushing toilet, pulling in the stern of the vessel…"
popularmechanics.com, **April 9, 2021**

1663



1 A ship moving through a canal creates low-pressure areas alongside it that pilots steering the ship must manage.
2 If the ship encounters a high-pressure area, the combination can create suction — the back of the boat is pulled toward the bank and the bow veers toward the center of the canal.
3 Wind can catch the side of a tall container ship, turning the bow even farther towards the opposite bank.

"…This phenomenon, known as the 'bank effect,' can wreak havoc on megaships, which displace large quantities of water and cannot correct course quickly if knocked-off kilter…"
popularmechanics.com, **April 9, 2021**

1664

Caption: "Large ships can be pushed off course due to the 'bank effect'"

"…At 7:40 a.m., the stern of the 'Ever Given' suddenly swung toward the west bank of the Suez Canal, evidence that the ship had started to bank. As the stern swung clockwise to the west, the bow, pushed by the ballooning cushion of water between it and the west bank, swung clockwise to the east. The 'Ever Given' was out-of-control. 'At that point, due to the displacement of that type of ship in that canal, the water was just taking it wherever the water wanted to go,' DeCruz says…"
popularmechanics.com, **April 9, 2021**

1665

Act Now, Talk Later

1666

"…On the bridge of the 'Ever Given,' the two SCA pilots and the captain now faced an emergency. Action was paramount. There's no time for conversation,' Flannery says. 'You need to concentrate on what you're doing. We act now, talk later.' 'There were two pilots up there,' says DeCruz. 'I guarantee you they were trying everything they could to see what was going on'…"
popularmechanics.com, **April 9, 2021**

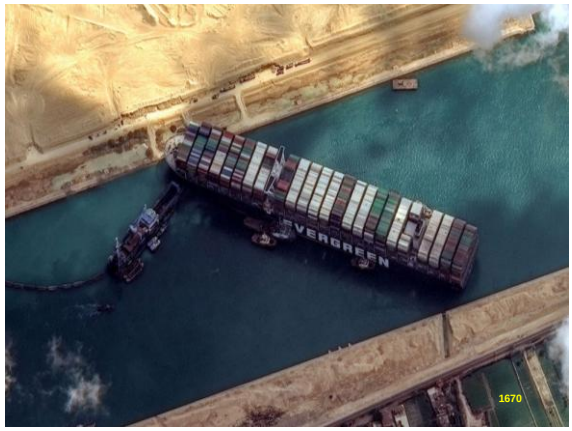
1667

"…At 7:41 a.m., with the Ever Given's bow careening toward the east bank, the only logical navigational option was to turn the ship westward. But, according to DeCruz, at that stage, the suctioned stretch of water between the west bank and the ship's stern was likely too shallow for the vessel to gain the traction needed to change course. 'Once that stern tucked in, there was no way of turning the ship left,' says DeCruz. 'There was nothing there but a limited amount of water. The propeller couldn't do anything and the rudder couldn't do anything."
popularmechanics.com, **April 9, 2021**

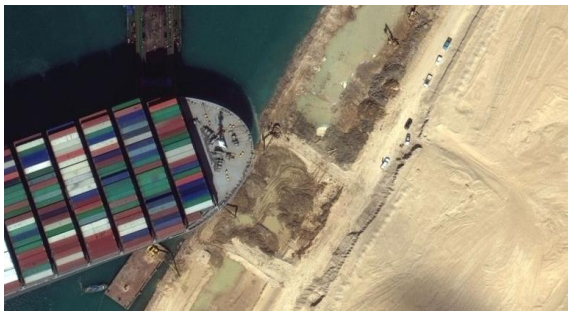
1668

"…At 7:42 a.m., the 'Ever Given' ran aground, driving its bulbous bow into the east bank of the canal at the 151-km marker. A minute later, its stern, drifting clockwise, connected with the west bank. The Suez Canal was officially blocked…"
popularmechanics.com, April 9, 2021

1669



1670



"…When a ship runs aground, crisis management begins instantly on the bridge. According to DeCruz, tugboats must be called and engineers must be dispatched to ensure that the boat is not taking on water or leaking fuel. 'You ain't going nowhere,' said Flannery. 'It's time to make phone calls'…"
popularmechanics.com, April 9, 2021

1671

Refloated

1672

"…One of the Ever Given's phone calls likely reached the northbound 'Mosaed 2' - the aforementioned tugboat trailing the 'Al Nasriyah' - which, at 7:57am, turned on a dime near the canal's 146-km marker, and sped south toward the 'Ever Given.' By 8:17 a.m., the 'Mosaed 2,' along with the 'Mosaed 3,' had reached the grounded ship. Thirty-five minutes after it struck land, the Ever Given's rescue operation was underway. Seven days, six hours, and 48 minutes later, that operation ended. On March 29 at 3:05 p.m., the 'Ever Given' was refloated and, by 3:58 p.m., it had eased back into the canal, en route to nearby Great Bitter Lake for inspection…"
popularmechanics.com, April 9, 2021

1673

Caption: "The *Ever Given* after it was fully refloated in the Suez canal on Monday"

1674

Out-of-Sight, Out-of-Mind

"…As of press time, the 'Ever Given' is still sitting in the Great Bitter Lake. Investigations, undoubtedly, are forthcoming, and blame will surely be passed around to all concerned parties. Eventually, the 'Ever Given' will depart the lake, sail to and through its northern terminus at Port Said, enter the vast Mediterranean Sea, and press onward to its next destination. Out-of-sight, out-of-mind, but anonymous no more."
popularmechanics.com, **April 9, 2021**

1675

1676

Having Another Go

In a rematch of the struggle that dominated global headlines earlier this year, the 400-metre, 220,000 tonne container ship that became lodged in the Suez canal for nearly a week, disrupting trade on a global scale, is having another go
theguardian.com, **August 20, 2021**
RE: introduction to an article written by *Chris Michael* entitled: "Container Ship *Ever Given* Returns to Suez Canal for Another Attempt: Vessel That Caused Global Disruption When it Got Stuck is Heading for the Red Sea Again"

1677

1678

Twice Lucky

"SEVERAL weeks after finally docking at the UK port of Felixstowe – after a months-long negotiation over who should bear the costs of blocking the shipping lane for six days in March – the vessel returned to Port Said, Egypt, on Thursday night. On Friday, the Panamanian-flagged, Japanese-owned ship began its journey through the canal, accompanied by two tug boats, the state-owned newspaper Al-Ahram reported. Live ship-tracking showed the vessel successfully negotiating the early stages of the canal on its way toward the Red Sea…"
theguardian.com, **August 20, 2021**

1679

1680

Blame Game

1681

"…The operation in March to free the ship from the canal caused a backlog that delayed the journeys of hundreds of ships, forcing some to take a much longer route around the southern tip of Africa. A dispute over compensation resulted in the ship being held by Egyptian authorities for months, with its owner, Shoei Kisen Kaisha, arguing the canal authority was at fault for allowing the 'Ever Given' to enter despite poor weather, and the canal authority demanding nearly a billion dollars to cover what it argued were its losses…"
***theguardian.com,* August 20, 2021**

1682

Another Satisfied Customer

1683

"…The 'Ever Given' was released in July after the two sides reached an undisclosed deal, with the owner saying: 'Our company . . . will continue to be a regular and loyal customer of the Suez Canal'…"
***theguardian.com,* August 20, 2021**
Caption: **"After one-hundred days of detention, the cargo ship *Ever Given* raised anchor to leave the Suez Canal, headed for the Mediterranean Sea, escorted by tugs. The container ship ran aground in March and blocked traffic. The compensation agreement signed between Egypt and owners and insurers is decisive."**

1684

"…That appears to be the case as the ship makes its way through the canal with which it will be forever associated in infamy, despite the fact, according to Al-Ahram, it passed successfully through the Suez canal 22 times since its manufacture in 2018."
***theguardian.com,* August 20, 2021**

1685

Caption: **"The *Ever Given* sails through the Suez canal in Ismailia, Egypt"**

Impediment to Traffic

1686

Like a blood clot in an artery, the enormous container ship was stuck in the Suez Canal, cutting-off the flow of goods at a crucial byway in the world's circulatory system of trade. On Monday, March 29, the vessel finally was 'successfully re-floated,' the Suez Canal Authority said. The 1,300-foot-long vessel, the *Ever Given,* initially became lodged in the water-way on Tuesday. While jammed in the canal, the ship had delayed hundreds of other vessels, the AP reported, and cost billions of dollars daily while it impeded traffic The incident was a reminder of the power of choke points to disrupt our fragile global shipping systems.

***popsci.com*, March 29, 2021**

RE: introduction to an article written by *Rob Verger* entitled: "The Ship Blocking the Suez is Finally Unstuck, But We Could See Bottlenecks Like This Again"

1687

Choke Points

1688

"THE ship may now be free, but its obstruction of the pass-ageway is a reminder of the ways that just one bottleneck can interrupt a huge amount of global marine shipping. That's because the Suez Canal is what experts refer to as a choke point, and the world witnessed what happens when a choke point suddenly closes completely…"

***popsci.com*, March 29, 2021**

1689

"…The Suez Canal is crucial because it connects the Red Sea with the Mediterranean Sea, thus giving ships a shortcut while heading from Asia to Europe, or vice-versa. 'It's really important because of its strategic location,' says Wei Liang, a professor of international trade and economic diplomacy at the Middlebury Institute of International Studies at Monterey. Goods manufactured in Asia travel via ship through the Suez heading towards Europe, and so does petroleum. 'A large percent of the oil the European market needs - they have to go through that canal,' she says…"

***popsci.com*, March 29, 2021**

1690

"…Liang defines a choke point as having three character-istics. It must occupy a 'strategically important location.' An-other is that the location is 'controlled by a small number of countries, or one country,' she says (Egypt controls the Suez). Finally, 'a large number of the countries rely on that passageway' …"

***popsci.com*, March 29, 2021**

1691

"…Another global choke point on Liang's radar is the Mal-acca Strait, off the coast of Malaysia. 'It's critically important for China and Japan, in terms of their energy supply,' she says. 'The majority of their energy supply has to come thro-ugh Malacca Strait'…"

***popsci.com*, March 29, 2021**

1692

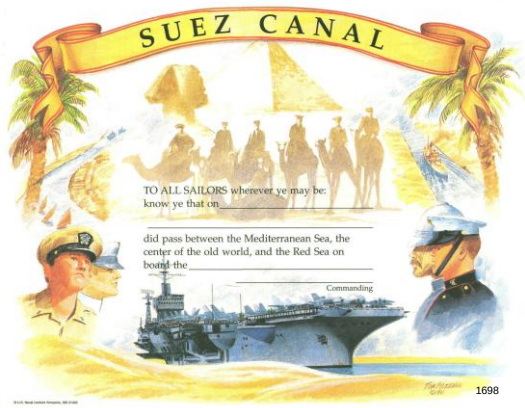
Caption: "The Strait of Malacca is a strategic waterway between Indonesia and Malaysia through which the majority of Chinese imports pass. This narrow waterway also makes the perfect chokepoint from the perspective of India. That's why, it is considered China's achilles heel." 1693

"…Another well-known global choke point is the Strait of Hormuz, off Iran. Ditto, the Turkish Straits…"
***popsci.com,* March 29, 2021**
Left: caption: "The Strait of Hormuz, which inks the Gulf of Oman with the Persian Gulf, is only 21-miles-wide at its narrowest point. Passage through the strait is the only way to move oil from Persian Gulf producers to the world's oceans. If the Strait were to be closed, it would be a massive blow to the world's economy."
Right: caption: "The Turkish Straits are the only waterway connection between the Black Sea and the Mediterranean Sea and more than 3% of the global oil supply passes through them. On average, 50,000 vessels per year transit through the Bosphorus straight and the Canakkale Strait (*a/k/a* 'Dardanelles') or approximately 130 vessels-per-day, with around 20% being oil tankers or gas carriers." 1694

"…Choke points like these can disrupt global economies and trap military ships in vulnerable positions in narrow passageways. Lawrence Brennan, an adjunct professor of law at Fordham University and a veteran of the U.S. Navy, remembers a time when navies avoided the Suez. 'Everybody recognized the possibility of getting either attacked, or stuck, in Suez,' he says. 'Forever, the U.S. Navy did not send warships, in particular aircraft carriers [through it]'…"
popsci.com,
March 29, 2021 1695

Caption: "The aircraft carrier *USS Dwight D. Eisenhower* transiting the Suez Canal" 1696

Caption: "While rounding one of the many turns in the Suez Canal, the U.S. Navy aircraft carrier USS AMERICA (CV 66) leads an echelon of ships North en route to the Adriatic Sea. Also pictured is the Los Angeles-class submarine USS OKLAHOMA CITY (SSN 723), while Egyptian water taxies jockey for position in the congested waters of the canal. The America's Battle Group will take-up position in the Adriatic off the coast of Bosnia and Herznegovina, to support NATO peacekeeping operations during Operation JOINT ENDEAVOR." 1697



1698

Bottlenecks

1699

"…A related idea is a bottleneck. Keenan Yoho, an adjunct operations researcher with the RAND Corporation, says that definition of a bottleneck is straightforward. 'It's a place where the demand exceeds the capacity,' he explains. He cites the ports of Los Angeles and Long Beach as a bottleneck in the United States, where ships line up to unload their containers…"
***popsci.com*, March 29, 2021**
Caption: "The traffic jam in the waters off the Port of Los Angeles continues to get worse, with a new record of 70 cargo ships waiting to get into the LA and Long Beach ports – up from 60 that were spotted last week. The bottleneck at the port is due partly to the shortage of trucks and drivers to pick up goods."

1700

"…Right now there's a tension at the heart of the system that moves goods around the world. Huge cargo vessels carry as many as 20,000 standard shipping containers. 'We have a very, very efficient system,' he says. 'But it's also very fragile and brittle, because of these choke points.' Close a choke point or a bottleneck, and disruptions can escalate exponentially…"
***popsci.com*, March 29, 2021**

1701

"…The effects can linger even after the bottleneck is freed up. 'What's going on in the Suez right now - that is a tidal wave that is building,' he adds. The wave will be felt in the form of ships eventually arriving in the Port of Rotterdam in Europe. An estimated 51 ships traverse the Suez daily, on average, Yoho says…"
***popsci.com*, March 29, 2021**

1702

Long-Term Strategies

1703

"…There are methods to cope with a bottleneck, says Yoho. 'There's only three ways to manage it - you can build more resources, you can go around it, or manage what goes in it, which is about prioritization,' he says (case-in-point: states prioritizing who gets a COVID-19 vaccine). In the case of the Suez, ships can certainly go around the continent of Africa, but they pay a price. The detour adds about 10 days onto the travel time and about $300,000 worth of fuel, according to Yoho's estimate. 'No one likes to transit that route, because the seas are rough,' he adds…"
***popsci.com*, March 29, 2021**

1704

"…Building more resources, too, is a key way of coping and creating resilience. Of course, it would be nice if there were two Suez Canals, each of which allowed for two-way traffic their entire length, but Liang, of the Middlebury Institute, points to a freight railroad that connects China with Europe and transits through Kazakhstan. Initially, she says, the railway project was dismissed as an expensive 'very random idea.' But the disruptions of the pandemic helped the railway's cause. 'If you look at [it] after COVID, actually this freight railway becomes very popular, because it can avoid those kinds of airport or maritime shipping [delays].' In short: overland routes are a good alternative. So is a company looking to other locations to manufacture its goods…"
***popsci.com*, March 29, 2021**

1705

"…She also argues that companies should plan in advance for disruptions to global trade. 'They cannot just say, 'Oh, we live in this 21st-century, highly globalized world, we should be able to get everything just in time,' she says. Planning for 'interruption' should be part of the company's long-term strategy."
***popsci.com*, March 29, 2021**

1706

Lesson Learned

1707

Grounding of the container ship in a southern section of the canal in March delayed the passage of hundreds of vessels through the waterway
***theguardian.com*, May 16, 2021**
RE: introduction to an article entitled: "Suez Canal Starts Work to Extend Double Lane After *Ever Given* Grounding"

1708

ASAP

1709

"EGYPT has started dredging work to extend a second lane that allows for two-way traffic in a southern section of the canal near to where a giant container ship got stuck for six days in March. The state-owned Suez Canal Authority (SCA) announced last week that it was planning to extend a second canal lane that opened in 2015 by 10km to make it 82km long, and would widen and deepen a single lane stretch at the southern end of the canal. The work had begun following directives from Egyptian president Abdel Fattah al-Sisi 'to immediately start implementing the proposed development plan and put in place a timetable for completion as soon as possible,' the SCA said on Saturday.…"
***theguardian.com*, May 16, 2021**

1710

"…The grounding of the 440-metre-long 'Ever Given' container ship in a southern section of the canal from 23 to 29 March delayed the passage of hundreds of vessels through the waterway, disrupting global trade. The new project will extend the two-way section south of the Great Bitter Lake and will be carried out in part by the largest dredger in the Middle East, the 'Mohab Mamish,' which arrived in Egypt last month…"
***theguardian.com*, May 16, 2021**

1711

"…The 'Ever Given,' still loaded with thousands of containers, is being held in the Great Bitter Lake between two stretches of the canal, amid a dispute over an SCA compensation claim against the ship's Japanese owner Shoei Kisen…"
***theguardian.com*, May 16, 2021**
Caption: "The *Ever Given*, a Panama-flagged cargo ship, is seen in Egypt's Great Bitter Lake"

1712

"…The six-day blockage in March disrupted global shipments. Some ships were forced to take the long alternate route around the Cape of Good Hope at Africa's southern tip, requiring additional fuel and other costs. Hundreds of other ships waited in place for the blockage to end. About 10% of world trade flows through the canal, a pivotal source of foreign currency to Egypt. About 19,000 vessels passed through the canal last year, according to official figures."
***theguardian.com*, May 16, 2021**

1713

God Willing

1714

DUBAI, Jan. 16 (Reuters) - A project to expand parts of the Suez Canal is expected to be completed after two years of work in July 2023, the Chairman of the Suez Canal Authority (SCA) said on Sunday
***reuters.com*, January 16, 2022**
RE: introduction to an article entitled: "Suez Canal Expansion Due to Finish in July 2023"

1715

"THE SCA announced accelerated plans to extend a second channel of the canal and to enlarge an existing channel after the 'Ever Given' container ship ran aground and blocked the waterway for six days last year. 'The project will be completed in 24 months. We started in July 2021 and God willing we will finish in July 2023,' Chairman Osama Rabie said on the sidelines of an event in Dubai…"
***reuters.com*, January 16, 2022**

1716

"…Ships pass through the canal in convoys, and the extension of the second lane would increase capacity by six ships, Rabie said, without giving further details. The southernmost 30 km of the canal, where the 'Ever Given' became grounded, is set to be widened 40 metres eastward and deepened to 72-feet from 66-feet, according to previously announced plans. 'This will improve ship navigation by 28% in this difficult part of the canal,' Rabie said. The Suez Canal Authority and its companies were developing the entire project, he said…"
***reuters.com,* January 16, 2022**

1717

Everyone's Canal

1718

"…Asked about shipments of Iranian fuel or oil passing through the Suez Canal despite U.S. sanctions on Iranian oil sales, he said: 'There's no discrimination when it comes to a country flag on ships, and Iranian oil does pass through the canal.' Lebanese armed group Hezbollah imported Iranian fuel last year, a move it said was aimed at addressing shortages. Shipments were routed via Syria to avoid complications with sanctions."
***reuters.com,* January 16, 2022**

1719

Caption: "The Suez Canal, which is the short way for Iran to send a ship to Syria, but it cannot be a heavy ship, submerged more than 20 meters in water"

1720

Part 18

Competition is a Sin

1721

Suez Canal Tolls
Scientific American
May 26, 1883

1722

ONE of our English contemporaries, alluding to the fact that the present Suez Canal brings in dues in the amount of £10,000 per day, thinks there is not much doubt but that a second canal would pay well, and that ship owners would only be too glad to have two passages through the Isthmus; for to say nothing of the gain of time owing to their being less traffic through each, the two canals would compete with each other, and the mutual reaction would, as in the case of two railways to the same place, make the rates go down. No nation has a tithe of the interest England has in the undertaking, and he hopes our commercial magnates will not so long delay in obtaining the necessary concession as to enable some other nation to step in and bear it off before them.

1723

Suez 2(?)

1724

UK prepared to play leading role in project given new impetus by *Ever Given* blockage, say sources
***theguardian.com*, April 1, 2021**
RE: introduction to an article written by *Flora Lopi* entitled: "'Suez 2'? *Ever Given* Grounding Prompts Plan for Canal Along Egypt-Israel Border"

1725

Alternatives

1726

"THE blockage of the Suez Canal by the beached 'Ever Given' container ship has prompted fresh international efforts to find an alternative to the world's most important shipping corridor. UN officials are understood to be reviewing plans to construct a new canal along the Egypt-Israel border, having previously dismissed ideas for a much longer route through Iraq and Syria as too hazardous…"
***theguardian.com*, April 1, 2021**
Caption: "Border between Egypt and Israel in the Red Sea resort town of Taba"

1727

"…The blockage of the Suez Canal is estimated to have cost hundreds of millions of pounds, as well as threatening Europe's vital supply chains from Asia, bringing everything from toilet roll and iPhones to takeaways and PPE…"
***theguardian.com*, April 1, 2021**

1728

"…The UN had previously commissioned a feasibility study from the international tunneling company OFP Lariol, which estimated 'Suez 2' could be dredged within five years. The canal would run in a near straight line into the Gulf of Aqaba in the Red Sea. 'Technology has moved on considerably since the excavation of the first canal in the 1850s,' said the study's author, Iver Shovel. 'A separate issue is the slight fall in sea levels in the Mediterranean that may happen once we flood the new canal, which could lead to wider and longer beaches'…"
***theguardian.com*, April 1, 2021**

1729

"…Another alternative the UN is looking at involves recreating an ancient passage to the Nile from the Red Sea. 'It's an exciting idea,' said Mo Sez, a regional expert in water division management, whose staff are managing a feasibility study of the area. Although maritime engineers have warned that the river would not have capacity for 20,000-container 'megaships' such as the 'Ever Given,' transferring goods to flotillas of smaller boats could provide a modern solution. Felucca operators could carry as much as 28% of the Suez cargo volumes, or less. Camel trains would be on standby should water levels in the Nile drop…"
***theguardian.com*, April 1, 2021**

1730

"…Questioned whether such a scheme remained feasible, a spokesperson said: 'See those pyramids? We built those, didn't we?'"
***theguardian.com*, April 1, 2021**

1731

April Fools!

1732

An 'April Fools' news article claiming the United Nations is looking into building a second Suez Canal appears to have been taken wholly seriously by major Turkish media outlets
***businessinsider.com*, April 2, 2021**
RE: introduction to an article written by *Mia Jankowicz* entitled: "Turkish Media Outlets - Including the BBC - Fell for an April Fools' News Story That Said the UN Was Planning a Second Suez Canal for Egypt"

1733

Fake News

1734


World ▸ Europe US Americas Asia Australia Middle East Africa Inequality Global development

Suez canal

'Suez 2'? Ever Given grounding prompts plan for canal along Egypt-Israel border

UK prepared to play leading role in project given new impetus by Ever Given blockage, say sources

Flora Lopi

The blockage of the Suez canal by the beached Ever Given container ship has prompted fresh international efforts to find an alternative to the world's most important shipping corridor.

"ON April 1, The Guardian published "'Suez 2'? Ever Given grounding prompts Plan for canal Along Egypt-Israel border," an article that rapidly gained attention given the current international interest in the canal. The article said that the UN was studying the feasibility of a second channel along the Egypt-Israel border…"
***businessinsider.com*, April 2, 2021**
Caption: "A screenshot of The Guardian's April fool article, as of 7pm March 31" 1735


BBC NEWS | TÜRKÇE

Haberler Video Spor Ekonomi Bilim Teknoloji Sağlık

'2'nci Süveyş Kanalı projesi': BM yeni deniz yolu alternatiflerini inceliyor

3 dakika önce

Manşet haber

AKP kongreleri ve toplumsal eylemler, vaka sayılarının artmasında ne kadar etkili oldu?

İngiltere'de hükümetin hazırladığı ırkçılık raporu tepkilere yol açtı

CANLI Kadıköy'de toplantı ve gösteri yürüyüşleri yasaklandı

Seçtiklerimiz

"…Several Turkish outlets appear to have taken it at face value, including BBC News Türkçe, which reported the story. 'The eyes and ears of the world were there! UN stepped in, rolled up sleeves for 2nd Suez Canal,' read the headline used online by major national paper Hürriyet…"
***businessinsider.com*, April 2, 2021**
Caption: "A screenshot of the now-deleted BBC Turkey article" 1736

"…T24, an online Turkish news outlet, also published the story. The pages have now been deleted, but can be found via Google's cache. Unfortunately, it was a spoof. The article - written by 'Flora Lopi' - cited 'sources' such as 'Iver Shovel,' 'international tunneling company OFP Lariol,' and 'Mo Sez, a regional expert in water division management.' The Guardian went all in and created a fake Twitter account for 'Flora Lopi,' who played along with the joke on social media. The apparent mistake was first reported by online news portal Gazete Duvar…"
***businessinsider.com*, April 2, 2021**

1737


Yeni Şafak

İsrail ve İngiltere Süveyş'i bypass edecek kanal için harekete geçti

SAVAŞ ERKEN ÇIKTI

Yeni zirveyi yaşıyoruz

Süveyş'e ikinci kanal projesi

Süveyş Kanalı'nı kapatan gemi alıkonulacak

Hürriyet

Dünyanın gözü kulağı oradaydı! BM devreye girdi, 2. Süveyş Kanalı için kolları sıvadılar

"…Middle East Eye Turkey correspondent Ragıp Soylu, who tweeted images of several print front pages that Insider has not been able to independently confirm…"
***businessinsider.com*, April 2, 2021** 1738

"…The fake story created a lot of excitement when it was first published, and 'Suez 2' briefly trended on Twitter in the UK. It's not a surprise - the 'Ever Given' has dominated the news cycle ever since it was grounded in the crucial waterway. The 220,000-ton container ship completely blocked one of the world's most important trading routes, choking the supply chain - and sparking endless memes. The ship was eventually freed on Monday, after six days, and the accumulated backlog of vessels is slowly passing through the channel…"
***businessinsider.com*, April 2, 2021**

1739

"…The Guardian updated its story, marking it 'April Fools,' as of noon on April 1, as is traditional with spoof stories. A spokesperson for the BBC told Insider: 'BBC Türkce is committed to accurate and impartial journalism. Once we verified that the Suez article was a hoax it was immediately taken down. We apologise to our audiences for this error.' T24 and Hürriyet did not immediately respond to Insider's request for comment."
***businessinsider.com*, April 2, 2021**

1740

Fact vs. Fiction

1741

The U.S. considered a proposal to use 520 nuclear bombs to carve out an alternative to the Suez Canal though Israel in the 1960s, according to a declassified memorandum
***businessinsider.com,* March 25, 2021**
RE: introduction to an article written by *Marianne Guenot* entitled: "The U.S. Had a Plan in the 1960s to Blast an Alternative Suez Canal Through Israel Using 520 Nuclear Bombs"

1742

20/20 Hindsight

1743

"THE plan never came to fruition, but having an alternative waterway to the Suez Canal could have been useful today, with a cargo ship stuck in the narrow path and blocking one of the world's most vital shipping routes…"
***businessinsider.com,* March 25, 2021**
Caption: "Image of the *Ever Given* blocking the Suez Canal"

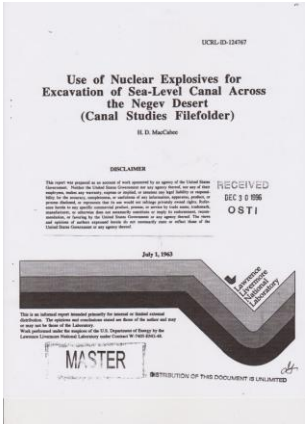
1744

The Memorandum

1745

"…According to the 1963 memorandum, which was declassified in 1996, the plan would have relied on 520 nuclear bombs to carve out the waterway. The memo called for the 'use of nuclear explosives for excavation of Dead Sea canal across the Negev desert'…"
***businessinsider.com,* March 25, 2021**

1746



UCRL-ID-124767

Use of Nuclear Explosives for Excavation of Sea-Level Canal Across the Negev Desert (Canal Studies Filefolder)

H. D. MacCabee

DISCLAIMER

RECEIVED
DEC 3 0 1996
OSTI

July 1, 1963

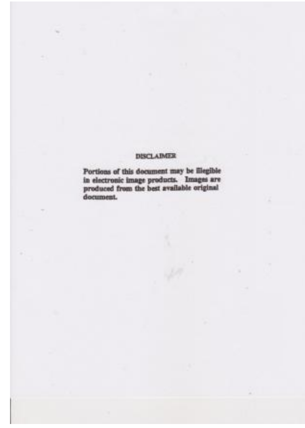
Lawrence Livermore National Laboratory

This is an informal report intended primarily for internal or limited external distribution. The opinions and conclusions stated are those of the author and may or may not be those of the Laboratory.
Work performed under the auspices of the U.S. Department of Energy by the Lawrence Livermore National Laboratory under Contract W-7405-ENG-48.

MASTER

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

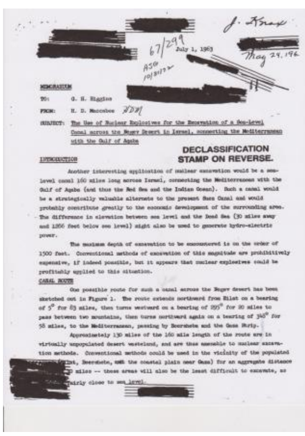
1747



DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.

1748



[redacted] J. Knox [redacted]

67/299 July 1, 1963 May 24, 196

ASG 10/31/72 [redacted]

MEMORANDUM

TO: G. H. Higgins

FROM: H. D. Maccabee HDM

SUBJECT: The Use of Nuclear Explosives for the Excavation of a Sea-Level Canal across the Negev Desert in Israel, connecting the Mediterranean with the Gulf of Aqaba

DECLASSIFICATION STAMP ON REVERSE.

INTRODUCTION

Another interesting application of nuclear excavation would be a sea-level canal 160 miles long across Israel, connecting the Mediterranean with the Gulf of Aqaba (and thus the Red Sea and the Indian Ocean). Such a canal would be a strategically valuable alternate to the present Suez Canal and would probably contribute greatly to the economic development of the surrounding area. The difference in elevation between sea level and the Dead Sea (30 miles away and 1266 feet below sea level) might also be used to generate hydro-electric power.

The maximum depth of excavation to be encountered is on the order of 1500 feet. Conventional methods of excavation of this magnitude are prohibitively expensive, if indeed possible, but it appears that nuclear explosives could be profitably applied to this situation.

CANAL ROUTE

One possible route for such a canal across the Negev desert has been sketched out in Figure 1. The route extends northward from Eilat on a bearing of 5° for 83 miles, then turns westward on a bearing of 295° for 20 miles to pass between two mountains, then turns northward again on a bearing of 345° for 58 miles, to the Mediterranean, passing by Beersheba and the Gaza Strip.

Approximately 130 miles of the 160 mile length of the route are in virtually unpopulated desert wasteland, and are thus amenable to nuclear excavation methods. Conventional methods could be used in the vicinity of the populated [redacted] Eilat, Beersheba, and the coastal plain near Gaza) for an aggregate distance [redacted] miles -- these areas will also be the least difficult to excavate, as [redacted] fairly close to sea level.

[redacted]

1749

UNCLASSIFIED

1750

[redacted] Page two.

COSTS

In the absence of accurate profiles of the route and accurate information on costs of mass-produced nuclear explosives, a very crude first approximation to costs of such a canal is given here.

Assuming (very roughly) an average depth of cut of 750 feet, this dimension controls and leads to a device spacing of 1300 feet (using 2 megaton devices buried at a depth of 1300 feet) in order to get a channel width of 1000 feet in rock.[1]

Assuming a hole drilling cost of $200 per foot for 1300 foot holes, and a shot cost of $250,000, we are led to a total single shot cost of $ 0.5 x 10^6, and at a spacing of four shots per mile, a cost of $ 2 x 10^6 per mile.

Thus; Nuclear Shot Cost:	130 miles x $2 x 10^6/mi	= $260 x 10^6
Conventional Excavation:	30 miles x $3 x 10^6/mi	= $ 90 x 10^6
Engineering, Auxiliary Construction and Safety Program		= $150 x 10^6
15% Allowance for Contingencies		= $ 75 x 10^6
Approximate Total Cost		= $575 x 10^6

CONCLUSION

The results of this crude preliminary investigation indicate that a sea level canal across Israel appears to be within the range of technological feasibility. It is more difficult to judge its economic feasibility, but some information may be gained by noting that the Suez Canal Company was offered $80 x 10^6 as compensation when Egypt nationalized the Suez Canal, and this figure is probably only a percentage of its real value.

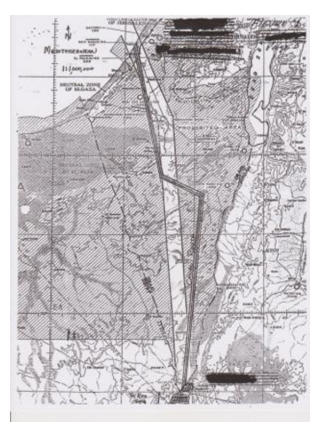
Another problem which has not been considered is that of political feasibility, as it is likely that the Arab countries surrounding Israel would object strongly to the construction of such a canal.

HDM:js

[1] See Table 3.2 p. 3-14 of the Panama Canal Report by Graves et. al

[redacted]

1751



1752

"…The historian Alex Wellerstein called the plan a 'Modest proposal for the Suez Canal situation' on Twitter on Wednesday:

Livermore report from 1963 on the feasibility of excavating of a canal through Israel with 2 Mt nuclear devices, spaced at 4 per mile for 130 miles = 520 nukes = 1.04 Gt of explosives! "Another problem which has not been considered is that of political feasibility..." 10:23 AM · Feb 13, 2018·Twitter Web Client…"
***businessinsider.com*, March 25, 2021**

1753

"…The memorandum was from the U.S. Department of Energy - backed Lawrence Livermore National Laboratory. It suggested that an 'interesting application of nuclear excavation would be a sea-level canal 160-miles-long across Israel.' Conventional methods of excavation would be 'prohibitively expensive,' the memo said. 'It appears that nuclear explosives could be profitably applied to this situation.' The memo added that 'such a canal would be a strategically valuable alternative to the present Suez Canal and would probably contribute greatly to economic development'…"
***businessinsider.com*, March 25, 2021**

1754

"…As part of the pricing model, the memorandum estimated that four 2-megaton devices would be needed for every mile, which Wellerstein calculated as meaning '520 nukes' or 1.04 gigatons of explosives, he tweeted…"
***businessinsider.com*, March 25, 2021**

1755

"…One possible route the memorandum proposed stretched across the Negev desert in Israel, connecting the Mediterranean to the Gulf of Aqaba, opening access to the Red Sea and the Indian Ocean…"
***businessinsider.com*, March 25, 2021**

1756

"…The laboratory noted that there were 130 miles of 'virtually unpopulated desert wasteland, and are thus amenable to nuclear excavation methods.' The 'crude preliminary investigation' suggested that using bombs to create a canal through Israel 'appears to be within the range of technological feasibility,' the memo said. But the memo conceived that one problem, which the authors had not taken into consideration, might be 'political feasibility, as it is likely that the Arab countries surrounding Israel would strongly object to the construction of such a canal'…"
***businessinsider.com*, March 25, 2021**

1758


EXTRA

Los Angeles Examiner

RACES COMPLETE

EGYPT INVADED!

Israeli in 75 Mile Push Past Border

"…The 1963 memorandum had also come less than a decade after the Suez crisis, a conflict for the control of the strategic waterway which was a defining event in the Cold War"
businessinsider.com, **March 25, 2021**

1759

"…The memo came as the U.S. Atomic Energy Commission was investigating using 'peaceful nuclear explosions' to dig out useful infrastructure, Forbes reported in 2018. There were also plans to use this method to dig out a canal in Central America, Forbes reported…"
businessinsider.com, **March 25, 2021**

1760

Apples and Oranges

1761

The Panama Canal is, inarguably, a remarkable feat of engineering. Most people know that it's an artificial construct connecting the Atlantic and Pacific Oceans, but it certainly wasn't a matter of simply digging it out of the earth in a matter of months.
forbes.com, **August 23, 2018**
RE: introduction to an article written by *Robin Andrews* entitled: "This Is How America Nearly Nuked a Canal Through Central America"

1762

False Start

1763

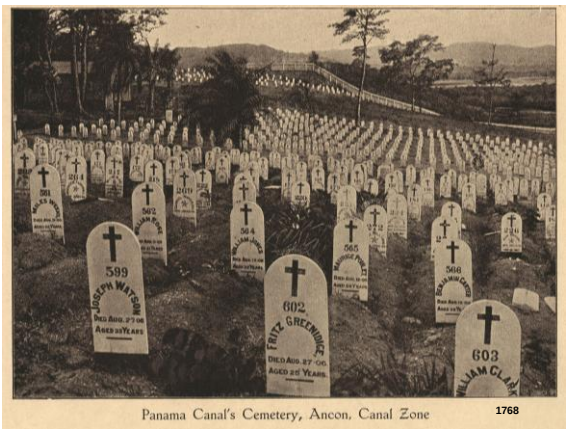
"THE French, buoyed by their recent success at carving out Egypt's Suez Canal, were the first to give excavation and construction a go in 1881, about a century after the Spanish military outlined their plans to do just that – but it proved to be too difficult, and, succumbing to diseases they didn't fully understand, workers died at a breathtakingly high rate. The British, along with the now-defunct Republic of New Granada, thought about giving it a try too, but they never got started…"
forbes.com, **August 23, 2018**
Caption: "Granite monument to honor those who died in the French attempt to build the Panama Canal in the French Cemetery, near Paraiso, Canal Zone, Panama"

1764

1765

1766

"Over to Panama, it was the same way - bury, bury, bury, running two, three, four trains a day with dead Jamaica Niggers . . . It did not matter any difference whether they were black or white . . . They died like animals."
S.W. Plume
RE: testimony before House of Representatives hearings. For every eighty employees who survived six months on the *Isthmus of Panama,* twenty died. Manual laborers experienced the highest risk of disease and death. The main killer of West Indian laborers was malaria whereas yellow fever killed most Europeans (West Indians laborers were immune from yellow fever from birth). In 1920, *Phillipe Bunau-Varilla,* a French canal official, described the effects of yellow fever as, "defying all precautions, laughing at all remedies." From 1885 onwards, the death toll rose due to the ravages of yellow fever, malaria, typhoid fever, smallpox, pneumonia, dysentery, beriberi, food poisoning, snakebite, sunstroke, syphilis, tuberculosis, landslides, railroad accidents and suicide. The total number of deaths is unknown, but is believed to be +20K for the French effort alone.
1767



Panama Canal's Cemetery, Ancon, Canal Zone
1768

A Land Divided, A World United

1769


"…The U.S. had already built a railway across the isthmus by 1855, but they were also keen on the idea of a canal. After the French plans were sold to the American government, its engineers achieved a feat no-one else could: a 82-kilometer (51-mile) aquatic highway was born in 1914, after 10 years of painstaking work…"
***forbes.com*, August 23, 2018**
Caption: "The *USS Missouri*, an Iowa-class battleship, passes through the canal in 1945. The 108' 2" (32.96m) beams of the Iowas and preceding *South Dakota-class* were the largest ever to transit the Canal."
1770

"…The region was revolutionized, and, until control was handed over to Panama in 1977, the U.S. ruled the waters…"
forbes.com, August 23, 2018
Caption: "U.S. President Jimmy Carter and the head of Panama's military government General Omar Torrijos signing the Panama Canal Treaties, Sept. 7, 1977"

1771

Pan-Atomic

1772

"…In the 1960s, the powers-that-be decided that Panama Canal wasn't enough. There was simply too much land still in the way, and it would be rather useful if, somewhere along Central America, a new route could be dug out. Fortunately, science had seemingly provided an answer to an impatient U.S. government: why not simply use a series of colossal nuclear weapons to literally carve a hole through hundreds of kilometres of rock? This was to be the Pan-Atomic Canal. Here's the story of why it never came to pass…"
forbes.com, August 23, 2018

1773

The Nuclear Age

1774

"…It must have been strange to live in America during the Cold War, particularly in the 1950s and 1960s. Nuclear weapons were clearly in vogue, and superpowers sought both quality and quantity. Their brinkmanship intensified so quickly after the end of the Second World War that, at one point, both were thinking of detonating a nuclear weapon on the surface of the Moon. Until the Partial Test Ban Treaty came into force in 1963, you could test nuclear weapons not just underground, but wherever you wanted: underwater, in-atmosphere, and – as 1962's Operation Fishbowl program demonstrated with freakish zeal – in outer space…"
forbes.com, August 23, 2018

1775

Caption: "Nevada saw a huge range of nuclear warhead test detonations during the Cold War. Before atmospheric tests were banned, you could even see nuclear warheads being fired out of artillery cannons, like this one."

1776

The AEC

1777

"…Back then, the U.S. had an agency named the Atomic Energy Commission (AEC), and they didn't just have a lot of ideas, but a lot of power: thanks to a directive signed by President Truman in the summer of 1946, they had influence or direct control over scientists and technicians that had built the bomb in the first place, as well as their research facilities. The AEC would eventually be abolished in 1974 after being accused of flouting countless safety procedures, but in the interim, they certainly made their mark on U.S. nuclear policy…"
***forbes.com,* August 23, 2018**

1778

Atoms for Peace

1779

"…Enter, Project Plowshare (PP), brainchild of the AEC. Like the Soviet's 'Nuclear Explosions for the National Economy' program, the aim here was simple, yet insane: would it be possible to use nuclear weapons, buried underground, to dig rather useful holes?…"
***forbes.com,* August 23, 2018**

1780

"…Both were oxymoronically known as peaceful nuclear explosions (PNEs), a concept dreamed up even before Trinity – the code name for the first detonation of a nuclear weapons – took place in New Mexico back in July 1945. The founders of PP were convinced that, if the layperson saw how these otherwise abhorred weapons of mass destruction could be used benevolently, then public opinion could be swayed in their favour…"
***forbes.com,* August 23, 2018**

1781

"…In total, 151 'experiments' were carried out in total, by both sides, from 1957-1975 for the U.S. and 1965-1989 for the USSR. The tests had multiple purposes, from excavating fossil fuels and creating spaces for future mining to burning out gas field fires and – yes – creating reservoirs, ports and canals…"
***forbes.com,* August 23, 2018**

1782

"…To the U.S.' credit, they only carried out 27 of these PNEs which, as you'd expect, heavily irradiated the landscape, making any further endeavours pointless. Out of the USSR's 124 explosive experiments, it seems that only one ended up leading to an actual, practical result: a dam in Kazakhstan. Despite being enemies, it seemed that even then, science – albeit reckless science – had no boundaries, with both sides exchanging data at several international summits on PNEs…"
forbes.com, **August 23, 2018**

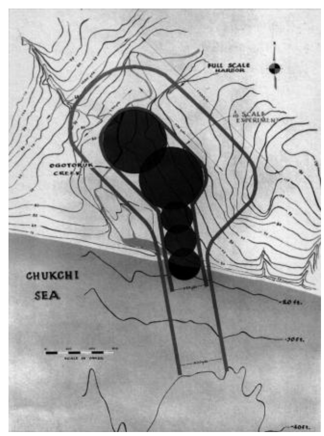
1783

"…The AEC, as part of the government's 'Atoms for Peace' initiative, kickstarted PP in June 1957. After validating some theoretical ponderings with a test in Nevada later that year, they began drawing up plans that, for the most part, were designed to speed-up civil engineering projects. All the while, increasingly potent warheads were throwing chunks of the Nevada desert sky-high, with the July 6th, 1962 Sedan crater – generated by a 104-kiloton warhead – holding the record for the largest ever generated during PP, coming in at 100 meters (328-feet) deep. Forgetting that pesky radioactivity, the potential for speedy excavation was clearly there, so the AEC, advised by the newly formed Plowshare Advisory Committee, ploughed ahead…"
forbes.com, **August 23, 2018**

1784

Operation Chariot

1785



"…As recalled by the World Nuclear Association's blog post on PP, there was once a plan, as part of Operation Chariot, to build a fossil fuel-shipping harbour – one originally the size of Delaware – at Alaska's Cape Thompson using a handful of buried nuclear weapons.
forbes.com, **August 23, 2018**
<u>Caption</u>: "Five nukes, one brand-new, irradiated harbour"

1786

POPULAR MECHANICS

WRITTEN SO YOU CAN UNDERSTAND IT
VOL. 113 NO. 3

We're Going to Work Miracles

The atom's power is ready to unlock a treasure chest of arctic oil, dig open an Alaskan harbor, open the spigot for Colorado's shale . . .

By Dr. Edward Teller

WHEN YOU LOOK AT A MAP of Alaska, you will observe Point Hope, at the northwest corner, projecting out into the Arctic Ocean. Above Point Hope the shore is exposed to the polar ice pack—which even in summer is never far offshore. Ships can travel north of this point only one month in twelve.

But below Point Hope, the shore swings to the southeast and the sea is free of ice three months of the year. Nearby are coal deposits and, somewhat farther, oil that might attract commerce except for one vital lack: There is no harbor, no good anchorage for seagoing ships.

If all goes well we expect to make an artificial model harbor on this bleak coast in the spring of 1961. It will be a small harbor, and yet it will be an

Dr. Edward Teller, "father of the hydrogen bomb," is director of the University of California Radiation Laboratory at Livermore

"…The Hungarian-born American theoretical physicist Edward Teller played a key role in PP. Known as the father of the hydrogen bomb after successfully encouraging the U.S. government, via Presidents Roosevelt and Truman, to develop such a program in the 1950s, he was also a proponent of PNEs. Writing in 'Popular Mechanics' back in March of 1960, his article, boldly entitled 'We're Going To Work Miracles', advocated for the creation of an artificial harbour at Cape Thompson. Describing it as an 'experiment of great hope for the future,' the creation will appear 'in a matter of milliseconds by the explosion of five nuclear bombs, having approximately as much power as 500,000 tons of TNT'…"
forbes.com, **August 23, 2018**

1787

In a matter of milliseconds, five nuclear bombs will blast open a new harbor in Alaska. The channel will be 1800 feet long and 750 feet wide; the inner harbor, about a half mile long and a quarter mile wide

Deep-buried bombs fling only surface material into air. Radioactive substances stay near the zero point

experiment of great hope for the future. The harbor will be excavated in an instant —in a matter of milliseconds—by the explosion of five nuclear bombs having approximately as much power as 500,000 tons of TNT.

In that tiny interval of time this energy will move 20 million tons of earth and rock. It will blast out a channel 1800 feet long and 750 feet wide and at the same time create an inner harbor a quarter of a mile wide and half a mile long. The minimum water depth will be around 30 feet.

The site is 100 miles north of the Arctic Circle, below Point Hope and Cape Thompson, at the mouth of Ogotoruk Creek.

Project Chariot, as the harbor is called, may become very worthwhile in the years to come, but it is intended mainly as a demonstration that will usher in the age of peaceful uses of atomic explosions. We expect to show that this new kind of power can perform large earth-moving jobs with proper safety and at less cost than conventional methods.

98 POPULAR MECHANICS

1788

The remote site was chosen deliberately to allay any fears of radioactive contamination. However, there will be very little contamination. To accomplish this, we will use a trick to prevent the possible escape of radioactivity.

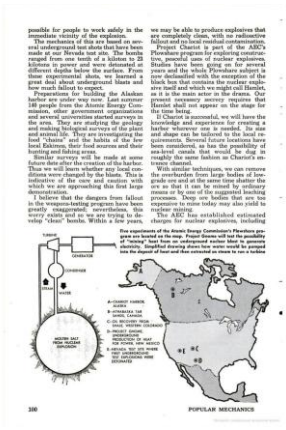
If the nuclear devices were to be exploded at shallow depths, almost all radioactive particles would be thrown up into the atmosphere. So we will bury the bombs deeply enough to keep 90 per cent of them in the small ones and possibly 100 feet for the larger ones. Each blast will transmit its energy to the rock above it, flinging only the surface materials into the air.

Project Chariot estimates that 99 percent of the radioactive byproduct will be trapped at the deep zero points and we hope that it will remain practically immobilized in the fused rock. It is possible that we shall succeed even better and that all but a very small percentage of the radioactivity will be trapped underground. However, in a short time, possibly two weeks, it will be

Shading indicates Project Chariot harbor; the blue line shows how harbor can be enlarged, if desired

MARCH 1960 99

1789



possible for people to work safely in the immediate vicinity of the explosion.

The mechanics of this are based on several underground test shots that have been made at our Nevada test site. The bombs ranged from one tenth of a kiloton to 25 kilotons in power and were detonated at depths from 160 to 1,200 feet. From these experimental shots, we learned a great deal about underground blasts and how much fallout to expect.

Preparations for building the Alaskan harbor have been under way for more than 146 people from the Atomic Energy Commission, other government organizations and several universities started surveys in the area. They are studying the geology and making biological surveys of the plant and animal life. They are investigating the Eskimos, the Indians and the Aleuts who feed Eskimos, their food sources and their hunting and fishing areas.

Similar surveys will be made at some future date after the creation of the harbor. We will be interested to see how the conditions were changed by the blasts. This is indicative of the care and caution with which we are approaching this first large demonstration.

I believe that the dangers from fallout in this harbor-blasting program have been greatly exaggerated; nevertheless, this worry exists and so we are trying to develop "clean" bombs. Within a few years, we may be able to produce explosives that are completely clean, with no radioactive fallout and no local residual contamination.

Project Chariot is part of the AEC's Plowshare program for exploring constructive, peaceful uses of nuclear explosives. Studies have been going on for several years. The first of these to be completed is now declassified with the exception of the block box that contains the nuclear explosive itself and which we might call Hamlet, as it is the main actor in the drama. Our present military secrecy requires that Hamlet shall not appear on the stage for the time being.

If Chariot is successful, we will have the knowledge and experience for creating a harbor wherever one is needed. Its size and shape can be tailored to the local requirements after the many factors involved have been considered, as has the possibility of sea-level canals that would be dug in roughly the same fashion as Chariot's entrance channel.

By these techniques, we can remove the overburden from large bodies of low-grade ore and at the same time shatter the ore so that it can be mined by ordinary means or by one of the suggested leaching processes. Deep ore bodies that are too expensive to mine today may also yield to nuclear mining.

The AEC has established estimated charges for nuclear explosives, including

Five experiments of the Atomic Energy Commission's Plowshare program are located on the map. Project Gnome will test the possibility of "mining" heat from an underground nuclear blast to generate electricity. Simplified drawing shows how water would be pumped into the deposit of heat-and then extracted en steam to run a turbine

POPULAR MECHANICS 100

1790

Project Chariot in Alaska not only will test the possibility of excavating a harbor by nuclear bombs but will also make accessible nearby coal and oil deposits. If needed, the harbor can be expanded in the red line

their emplacement by the commission. Estimates range from a half million dollars for a few-kiloton yield to a million dollars for multikiloton. The cost per pound of yield is only a little more. Future developments may decrease the charges. For the kinds of work we have in mind, we believe the nuclear explosives are cheaper than conventional explosives. It is not economical to do work that is quite impractical by any other means.

People talk about putting the cart before the horse, and in this absurd age this is not so unusual; all of us have seen horse carried along in trailers. In a somewhat similar way, we hope to use the concentrated energy to make available more of the old conventional fuel which nuclear energy is supposed to replace. In particular we might use nuclear explosions in oil production.

The fuel for a fusion bomb will become a nuclear reactor emits dangerous radiations and so needs heavy shielding, which makes it clumsy as a motor for a small vehicle. Furthermore, an accident to any moving vehicle might be a disaster, as there is no late real trouble. If fusion products stored up in the reactor got loose, there will be enough concentrated radioactivity in the neighborhood to constitute a serious hazard. So we are investigating the possibility of light and compact energy-storage that is gasoline or oil remains better than anything else known or expected. Yet our in-

MARCH 1960 101

1791

We're Going to Work Miracles

(Continued from page 101)

Ordinarily oil wells would then be drilled into the shattered area to pump the liquefied tar to the surface where it could be refined into various petroleum products.

An even more difficult and ambitious project is to use the explosion, as it is undertaken, to extract the hydrocarbons that are trapped in the oil shales of Colorado, Utah and Wyoming. An experiment is being considered for performing an explosion in this area. In this case much more heat is required to liberate the oily substance from the rock. Also, the rock in the nuclear explosion will not suffer. Actually the explosion is considered only for the purpose of breaking the shale. Once this is done, one might start an underground fire in the shale itself. Then, as the fire slowly drives out some of the valuable hydrocarbons.

Experiments Needed

But this is all speculation; we have had no experience in shattering or heating or modifying an underground petroleum deposit. Our present ideas may be all imperfect. The probability that either project will succeed may not be very high, yet success would increase the world's available supply of oil by billions of barrels. It is also possible that the rewards may be very, very great. What we should like to do is to perform exploratory explosions in a really safe manner and observe the results. The results may be surprising and all surprises will be of great importance.

If producing oil may be called a dream, we might be excused if we call the next possibility a real pipe dream. This has to do with producing heat underground and then mining the heat and changing it to electricity. Because of the heat changes that we know will occur, we cannot say whether a pipe or system of pipes can be installed in the hot area cheaply enough and whether the pipes will stand many consecutive explosions, or that we can draw off the heat at a sufficient rate.

Project Gnome will tell us a great deal about this method of producing electricity. The plan is to explode a 10-kiloton device in a thick bed of natural salt 1200 feet below the surface of the earth. The fact that salt is very dry, hence very little steam will be created that could dissipate the heat. We hope that the blast will melt considerably more than 1000 tons of material, creating a pool of molten salt having a minimum temperature of around 1500 degrees. Air or water will be circulated in the pipes through this reservoir of heat and the re-

(Continued on page 295)

POPULAR MECHANICS 278

1792

sulting superheated air or steam would be used to drive turbines for generating large electrical powerplant. Project Gnome is a very small scale experiment, for economic power production thermonuclear devices in the megaton range could be used to create vast underground deposits of heat. When this will become possible and whether it will become economic important, we certainly do not know.

We believe we will be able to produce new things underground that we can later mine. We can make isotopes underground, which is the process of changing the atoms. We might be able to produce diamonds, not of gem-stone quality but as a fine powder which has industrial uses.

There is enormous potential in using nuclear explosives to provide the special heat and pressure needed to carry out strange chemical reactions that may produce entirely new types of materials never seen on the face of the earth. The problems are: to produce them from materials which are already present in the underground deposits; to get the product out of the formation, in the form of a fluid — but more than anything else to recognize which are the really interesting materials one can obtain this way.

Water Important

A fluid that is even more important than oil is ordinary water, and it has been proposed that we regulate the flow of water by the creation of underground lakes with nuclear explosions. One suggestion is to shatter a formation so that a subsurface flow of water would be trapped in the shattered area, from which it could be pumped. There is a chance that the water would be contaminated by the explosive and react with those with it. Our present experience indicates that any leaching would be so slow that the radioactive products would have decayed to a safe state by the time they have moved a significant distance. Nevertheless, this uncertainty is one that we must strive to produce clean explosives, and until we have clean explosives, we must proceed with the greatest caution.

Nuclear explosions could be used to produce underground cavities for gas storage and to decrease the cost of hydroelectric projects.

There have been suggestions that we could bomb a hurricane out of existence. The energy released by the condensation of rain in a hurricane is too great. Another proposal has been to use a nuclear explosion as a trigger that would modify climate or weather. The late mathematician John von Neumann suggested that a nuclear explo-

(Continued on page 295)

POPULAR MECHANICS 280

1793

sion could throw up dust of the right particle size. The particles should be bigger than the wavelength of sunlight so they would shut out the sunshine, but they should be smaller than the heat radiation emitted by the earth. Thus the usual balance between heat coming in and heat radiation would be changed in the region where the explosion has produced dust. In this way, we could govern much bigger energies than that of the explosion itself. There is a chance that we really could influence the weather.

For the time being, we are not planning anything along these lines. Weather modification is mentioned only as an example of the possibilities that might arise in the distant future.

Nuclear science is still a very new and untried enterprise. It cannot progress without two necessary ingredients—careful thought and careful experiment. So far we have tried to give the problems careful thought, but we have not had the chance to experiment. The field is full of new possibilities. It may well be that the main application of nuclear energy will be along lines of which no one has yet thought.

★ ★ ★

Supersonic Waves Detect Cancer Tissue

Russian engineers report that they have developed a machine that is quicker than X rays in detecting changes in human body tissues that give first warnings of cancer. The machine, they say, directs ultrasonic waves into the body and measures the difference in their passage through healthy and abnormal tissues. It's as simple as having an X ray, the engineers say, and without any radiation or other dissertible dangers.

Called U222-4, the apparatus was developed over the last three years by Mstislav Gurevich, a radio engineer at the USSR Academy of Medical Sciences' Institute here in Moscow. Gurevich stressed the fact that the device doesn't detect cancer as such, nor does it indicate if the tissue differences are harmful. That decision is left for the doctor.

The machine, about the size of a large refrigerator, can measure changes in human tissue composition down to one percent or less. The U222-4 has an oval-shaped probe that is placed against the surface of the body's skin. Each is then covered by a rubber pad coated with glycerine or water. When the sound waves are sent through the body, their reaction is noted on a small round tube-like screen. Places as small as one centimeter in width in any part of the body leading to harden or decay can be detected.

POPULAR MECHANICS 282

1794

"…He optimistically suggested that much of the radiation would be buried deep underground, and that it would be possible within 'two weeks . . . for people to work safely in the immediate vicinity of the explosion'…"
***forbes.com,* August 23, 2018**

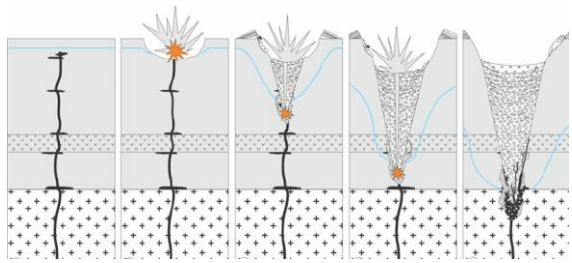
1795

"…Fortunately, reason prevailed after perfectly understandable complaints by the local Inupiat Eskimos and conservationists were heard loud and clear. The fact that the cost of such a program would be nothing less than extortionate probably played its part too…"
***forbes.com,* August 23, 2018**

1796

Tests and Results

1797



"…Admittedly, these experiments did provide geologists with a decent amount of strange data. Yours truly would end up using some of this information to aid in the development of his doctoral thesis. As it turns out, the discrete blasts created by subterranean nukes formed craters in a very similar way to volcanic systems known as maar-diatremes…"
***forbes.com*, August 23, 2018**
Caption: "Growth of a maar-diatreme volcano. The first explosions are close to surface and a maar develops. With the consumption of groundwater during eruptions, a cone of depression develops in the groundwater table."

1798

"…Speaking of which, one of the more socially consequential PP tests, the Cannikin shot, also provided a rather useful, underappreciated clue for volcanologists investigating eruption triggers. This blast – one of a regional series – took place in the face of enormous protests on Amchitka Island, part of the volcanically active Aleutian Islands Arc up in Alaska. One of those protest groups sailed into the area on the fishing boat 'Greenpeace,' and the rest, as they often say, is history…"
***forbes.com,* August 23, 2018**

1799

"…The explosion itself created a little slumping, but it failed to generate any major quakes or explosive eruptions, as some thought it might. This once again demonstrated that, in the face of nature's rage, nukes are pathetic little fireworks…"
***forbes.com,* August 23, 2018**

1800

"…Tests like this made it clear that there was a mathematical relationship between depth, energy and crater dimensions. As this was being elucidated in several scientific papers of the time, like this one, geoscientists used this information to help them distinguish between volcanic and impact-generated craters too…"
***forbes.com,* August 23, 2018**

1801

"…Scientific data aside, the PNEs remained experimental, with no engineering projects – not huge natural gas wells, nor harbours on the western seaboard of South America, nor a canal across Israel's Negev Desert – ever escaping from what was probably the world's strangest boardroom…"
***forbes.com,* August 23, 2018**

1802

Thinking Out Loud

1803

"…At one point, PNE's were thought of being used to literally propel vehicles through space. You'd think this would have been scrapped fairly sharpish, but the plan, conjured up by defence contractor 'General Atomics' in 1958, was thought to be somewhat plausible. It existed until 1965, where fears regarding fallout and the Partial Test Ban Treaty stopped it in its tracks…"
***forbes.com,* August 23, 2018**

1804

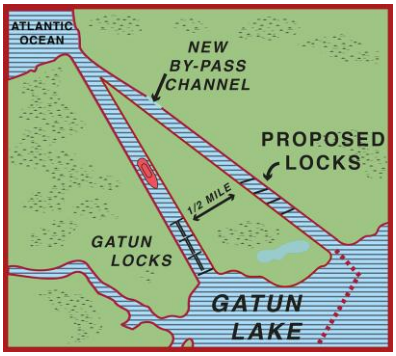
"…Alongside Operation Chariot, it seemed that the Pan-Atomic Canal was the only other scheme that almost made it to fruition. The canal, which would provide both militaristic and trade support to the U.S. and its allies, was a decidedly serious proposal. After all, American ingenuity had achieved an unparalleled engineering feat in the region half-a-century earlier, so why not double-down on what the nation was clearly quite good at?…"
***forbes.com,* August 23, 2018**

1805

Panama Canal v2.0

1806

"…So, in the early-to-mid-1960s, plans were drawn up to create a nuclear-forged sequel to the Panama Canal. The Interoceanic Sea-Level Canal Study, as it was technically referred to, was in fact a third generation scheme, with the first two cropping up, before being nixed, in 1939 and 1946 respectively. The former was designed to just increase capacity, whereas the latter was aimed to provide a back-up in case the original was attacked with nuclear weapons…"
***forbes.com,* August 23, 2018**
RE: in 1939, *Congress* approved a six-year, $277 million expansion project for the *Panama Canal*. The new lock chambers were to be 200-feet longer and 30-feet wider than the existing locks and placed at a safe distance from them. Excavation began July 1, 1940 and continued until May 23, 1942, when Secretary of War *Henry Stimson* terminated the project as funding shifted to other war-related priorities. Nearly 13 million cubic-yards of material had been removed from Atlantic and Pacific approach channels, which lay dormant until Panama began construction of a new set of locks in 2007. Investigations under *Public Law No. 280* (approved December 28, 1945) disclosed that only an Isthmian sea-level canal could meet the future needs of interoceanic commerce and national defense. 1807



Map of proposed third set of locks planned by the U.S. Army in 1941 1808

"…The cost, according to a series of 1964 Congressional hearings, would be anything between $620 million, if nukes were used, to $13 billion, if they weren't. The economics of the situation seemed promising, so in 1967-1968, the U.S. Army Corps of Engineers sent 50 geologists to look for the best possible routes through Central America…"
***forbes.com,* August 23, 2018**

1809

"…Paths through Nicaragua, Panama and Columbia were identified, with Mexico having been ruled out earlier on in the process. According to this rather thorough review on the history of the plots to expand the Panama Canal, the best of these would still require as much as 1.53 billion cubic-meters (2 billion cubic-yards) of material to be blasted out of the way. That's roughly equivalent to throwing 592 Great Pyramids of Giza into the air in all directions, so clearly, you'd need a fair few atomic firecrackers…"
***forbes.com,* August 23, 2018**

1810

"…The project began to precipitate back in early 1957, when it was discussed at a symposium hosted by what was then known as the University of California Radiation Laboratory at Livermore. Back then, per Slate, there was a large margin of error on the specifics, with as little as 26 to as many as 764 bombs being proposed to complete the project. This sounds entirely maniacal to you and I, but back then, the idea was seen as such a good idea that, four months later, the AEC founded PP…"
***forbes.com,* August 23, 2018**

1811

"…As time went on, it was agreed that the U.S. would use multiple 2, 5 and 15-megaton nuclear weapons – the last of which is 1,000 times the powerful than the bomb dropped on Hiroshima, by the way – to progressively dig out the canal. So-called Buggy tests were carried out in Nevada, using multiple low-yield nuclear weapons, buried beneath the ground several hundred meters apart, to create a ditch. At the same time, larger nuke shots nearby were used to provide a scalable comparison…"
***forbes.com,* August 23, 2018**

1812

Route 25

"…The 1969 white paper on Route 25, one that would have pierced Colombia, makes for an insightful, utterly surreal read. It discusses the Atrato-Truando pathway, which was the best option thanks to its remote location; it notes how large river sections would need to be diverted as a result, which would require decades of additional construction work to maintain post-excavation…"
***forbes.com,* August 23, 2018**

1813

1814


TECHNICAL REPORT NO. 6

CHANNEL STABILIZATION
INTEROCEANIC SEA-LEVEL CANAL
LOWER ATRATO RIVER PORTION, ROUTE 25
COLOMBIA, SOUTH AMERICA

by

C. P. Lindner

October 1969

Committee on Channel Stabilization
CORPS OF ENGINEERS, U. S. ARMY

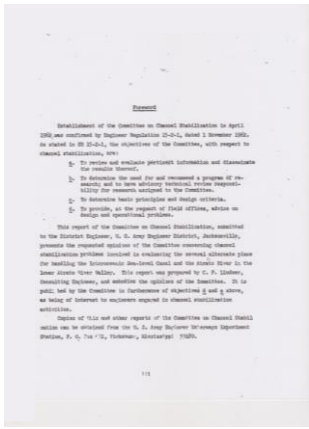
THIS DOCUMENT HAS BEEN APPROVED FOR PUBLIC RELEASE AND SALE; ITS DISTRIBUTION IS UNLIMITED

1815


PRESENT MEMBERSHIP OF COMMITTEE
ON CHANNEL STABILIZATION

J. H. Evans	Office, Chief of Engineers	Chairman
C. G. Lipscomb	Lower Mississippi Valley Division	Recorder
D. C. Sanderson	Missouri River Division	
R. H. Pore	Lower Mississippi Valley Division	
J. E. Morley	Vicksburg District	
W. E. Isaacs	Little Rock District	
E. S. Mathis	Southwestern Division	
H. A. Smith	North Pacific Division	
J. B. Tiffany	Waterways Experiment Station	
G. B. Fenwick		Consultant
C. P. Lindner		Consultant

1816


Foreword

Establishment of the Committee on Channel Stabilization in April 1968 was confirmed by Engineer Regulation 15-2-1, dated 1 November 1968. As stated in ER 15-2-1, the objectives of the Committee, with respect to channel stabilization, are:

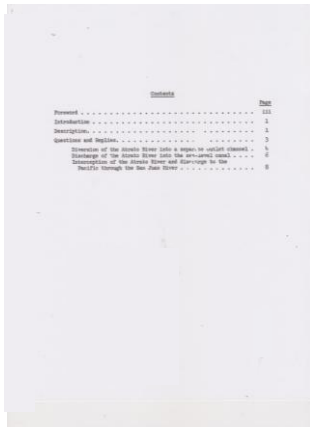
1. To review and evaluate pertinent information and discriminate the results thereof.
2. To determine the need for and recommend a program of research; and to have advisory technical review responsibility for research assigned to the Committee.
3. To determine basic principles and design criteria.
4. To provide, at the request of field offices, advice on design and operational problems.

This report of the Committee on Channel Stabilization, submitted to the District Engineer, U. S. Army Engineer District, Jacksonville, presents the requested opinion of the Committee concerning channel stabilization problems involved in evaluating the several alternate plans for handling the Interoceanic Sea-Level Canal and the Atrato River in the Lower Atrato River Valley. This report was prepared by C. P. Lindner, Consulting Engineer, and embodies the opinions of the Committee. It is published by the Committee in furtherance of objectives 3 and 4 above, as being of interest to engineers engaged in channel stabilization activities.

Copies of this and other reports of the Committee on Channel Stabilization can be obtained from the U. S. Army Engineer Waterways Experiment Station, P. O. Box 631, Vicksburg, Mississippi 39180.

iii

1817


Contents

1818

CHANNEL STABILIZATION, INTEROCEANIC SEA-LEVEL CANAL
LOWER ATRATO RIVER PORTION, ROUTE 25
COLOMBIA, SOUTH AMERICA

Introduction

1. On 21 March 1960, Mr. E. W. Eden, Jr., Chief of the Intercoastal Canal Studies Branch, U. S. Army Engineer District, Jacksonville, presented a paper to the Corps of Engineers Channel Stabilization Committee in which he described the physical features of the Lower Atrato River and Valley and requested the Committee's opinions on channel stabilization matters in connection with the alternates being considered for the handling of the river and canal in that area. The alternative plans included: (a) Route 25A which would provide for separate channels for the canal and river with a short diversion of the river near Bautata and an additional short diversion farther downstream that would divert the river from its present distributaries to Bahia Colombia; (b) the Bautata Realignment in which the river and canal also would be carried to the Atlantic Ocean in separate channels, the river in this case being diverted from a point about 16-1/2 miles above Bautata on a direct line to Bahia Colombia; (c) the Atrato Valley Realignment in which the river and canal would occupy a single channel leading from the existing river channel at a point about 9 miles above Rio Sucio essentially on a straight line to Bahia Colombia; (d) a channel on the latter alignment for the canal only, through some local dredging would be carried thereby, with the upper Atrato River water discharged to the Pacific Ocean by means of facilities similar to those included in the Colombian Choco plan.

Description

2. The Lower Atrato River occupies a channel about 50 ft deep and 1000 ft wide. As a result of the large channel section, river slopes are low as are the velocities associated therewith, except during floods of substantial magnitude. It appears that for average discharge the mean

1819

velocities below gage 17 near Bautata are below 2 fps and the mean velocity at gage 16, about 12 miles upstream from Rio Sucio, is about 2.5 fps. Measurements made at gage 16 for a discharge of spout 200,000 cfs, very close to bank-full, indicated maximum velocities on the range at the depth of the meter to be 4.5 or 5 fps. The maximum velocity so measured was only a moderate amount greater than the mean. At bank-full discharge is not far divergent from the average annual flood discharge, it is to be expected that the less frequent floods would produce velocities that are capable of eroding the riverbanks though, where the banks are tough, the erosion may be slow.

3. The valley through which the lower Atrato River flows is a wide, alluvial plain with a very mild slope toward the ocean. The banks of the river are comparatively low. The Jacksonville District has stated that the average maximum elevations as far upstream as Rio Sucio are only 5 to 10 ft above mean sea level. It is believed that the higher elevations are to be found on the natural levees. The banks, even at low water, extend above the water surface only from a very minor amount to a maximum of about 12 ft at gage 16. The floodplain is thickly covered with vegetation which reduces its effectiveness for carrying flood flows.

4. Depth-integrated sediment samples taken near gage 22 during discharges that varied from 130,000 to 187,000 cfs indicated a total suspended-sediment load varying from 290 to 750 ppm. Visual observation on 20 February 1960, when the river was at a low stage, revealed a sediment-laden river with a distinct muddy plume in the ocean beyond the major distributary. It was believed that the suspended-sediment content at that time near Rio Sucio could have been between 200 and 300 ppm. A bed-load sample taken near the mouth of the river was composed essentially of fine-grained material, 70 percent finer than a 200-mesh sieve. As far as the Committee is aware no other bed-load samples have been taken or analyzed.

5. Core borings of importance to this report were taken only along Route 25A, although a number of pborings were made east of this route and the river. According to the District's report to the Committee, the borings indicated the Atrato alluvium to be composed of soft generally gray inorganic silts slightly sandy to a depth of about 50 ft with underlying

1820

gray inorganic silts with clay.* Except for possibly the 20 or 25 ft of peat encountered in three of the borings, nearly all of the material was smaller than a standard 200-mesh sieve. Discussion brought out the fact that in the three farthest downstream borings a sandy layer or stratum was encountered, and that except for these and the peat cover, the material was plastic. Despite the reportedly low, undrained shear strength of the samples, the banks both above and below water are comparatively steep; in fact, on one of the cross sections exhibited, the upper part of one bank was essentially vertical for about 30 ft, and the above-water banks observed at Rio Sucio were vertical or nearly so. The fact that the borings were not close to the riverbank may be significant, however.

6. Except for the stretch extending from near Rio Sucio to the lower end of the cutoff below the mouth of Rio Bagarora, the lower Atrato does not manifest the sinuosity common for low-velocity streams in flat, delta-type floodplains. This may be due to the comparative youth of the floodplains, to the normal low velocity in the streams, and to the erosion-resistant characteristics of the soil. It seems apparent that meandering of the river downstream from the cutoff has been extremely slow. It was noted, however, that once the cutoff was opened it developed rapidly, indicating that where soil and slope conditions are such as to increase the erosive capability, more rapid bank caving can take place than has occurred on most of the lower Atrato River. It is worthy of note, however, that where meandering has been most intense, the amplitude of the bends is not in excess of ¾ miles.

Questions and Replies

7. In his presentation to the Committee, Mr. Eden asked certain specific questions which will be repeated below, followed by discussion where needed and the opinions of the Committee. In order to avoid repetition, it may be stated that wherever bank stabilization is required, the articulated concrete mattress as employed at the Lower Mississippi River is the type that is recommended for the lower Atrato area, because the river and the projected excavated channels are deep and the banks of the

1821

river and any channel to be excavated will be almost entirely underwater at all times. According'y, a mattress that can be placed underwater to great depths is required.

Diversion of the Atrato River
into a separate outlet channel

8. Question a. "In your opinion, will the diversion channel meander to the extent that it is possible the sea-level canal prism would be encroached or remaligned? Can you comment on the certainty of this event--could recapture be anticipated within project life (50 years)? ... when should they [bank stabilization measures] be provided?"

9. Question b. "Will bank stabilization measures be required along the sea-level canal prism if the Atrato River is diverted? If required, what type would be recommended?"

10. Question c. "Recognizing that it is difficult to make quantitative estimates of the maintenance requirements of the sea-level canal, could the Committee indicate qualitatively the impact of the diversion of the Atrato River on main-enance requirements of the sea-level canal? Can erosion due to cave wash be anticipated of such severity as to require revetment?"

11. Route 25A.

a. Reply to Question a. The continuity of both the river and the diversion near Bautata to the canal makes imperative the provision of revetment on the entire west bank of this diversion channel and on the riverbank a short distance upstream and a lesser distance downstream from the diversion. The revetment should be installed at the time of canal and river diversion. Shoaling in the canal is expected that ends in Bahia Colombia will not require revetment.

b. Reply to Question b. Bank stabilization measures should not be provided along the canal prism except, perhaps, where and if the canal impinges upon the old river channel in the vicinity of Bautata, in which case protection of the plug may be required. Shoaling that may result from bank recession caused by cave wash and tidal flow can most economically be cared for by periodic maintenance.

c. Reply to Question c. As this connection applies only to diversion of the Atrato River in a separate outlet channel, the intent of this question is not entirely clear. If, under the Route 25A plan, the river is carried down the

1822

canal instead of diverted, the revetment requirements would be substantially increased, and the maintenance requirements, especially those resulting from the shoaling caused by the saddy freshwater-saltwater interaction, would be greatly increased. The erosion due to cave wash should be cared for by maintenance rather than prevented by revetment. Remarks given below under "Discharge of the Atrato River into the Sea-level Canal" apply here equally well.

12. Bautata Realignment.

a. Reply to Question a. The Bautata Realignment diversion channel will be several miles from the canal at all points under this plan. Assuming that the soil information obtained, including the observations regarding the stability of the banks, is applicable to this route, it is considered unlikely that the diversion would capture the canal within the next 100 years. This conclusion is based on the concept of low slopes and velocities during average discharge conditions, and on the opinion that the velocities and slopes will not be sufficiently increased by the shortening, which is all within the tidal reach of the river, to substantially increase the rate of erosion. However, judging from the maximum amplitude of the bends in the present river, it is unlikely that the meander pattern which would develop in the diversion would ever be close enough to intercept the canal prism. Nevertheless because of the features connected with the diversion allignment and the impossibility of predicting with exactitude the action of a stream in an alluvial channel, especially one which has deviated from an entering regime, it is believed appropriate to provide for a moderate amount of bank stabilization along the diversion channel. Initially, revetment along about one-fourth the length of the diversion is suggested. Revetment should not be installed until a meander trace or pattern has been fiorly established. It is believed that this may be 10 years after completion of the diversion.

b. Reply to Question b. The answer to this question is essentially the same as given above for the Route 25A. Revetment of the canal banks should not be provided, but periodic maintenance should suffice and be most economical. This, of course, assumes that tidal velocities will not be sufficient to cause any substantial bank erosion and weakening in the soils indicated by the borings as being present.

c. Reply to Question c. If the river is carried down the diversion channel instead of the canal, the reply to this question is essentially the same as given above for Route 25A. Should the combined discharge be carried in the canal, the revetment requirements would be increased, but to

1823

dredging maintenance necessitated from the source discussed below in paragraphs 27 to 29 inclusive would be extensive.

Discharge of the Atrato River
into the Sea-level Canal

13. Question a. "If the Atrato River is permitted to enter and discharge through the sea-level canal, what in your opinion are the bank stabilization measures required? When should they be constructed?

14. Question b. "Would you comment at least qualitatively on the impact of the Atrato River discharge on anticipated maintenance?"

15. It is assumed that these questions are intended to apply to the plan designated as the Atrato Valley Realignment or any plan in the lower Atrato Valley in which the canal and river both occupy the same channel.

16. Reply to Question a. Bank protected by the District stow that for the Atrato Valley Realignment plan there would be a large difference in elevation during floods between the present elev.ion of the river and the lower level that would occur in the combined channel at the point of diversion. Apparently a control or drop structure in the Atrato would be required. Whether or not the need for such a structure could be avoided by storing the combined channel further downstream is a matter that would require further hydraulic study by the District. If the control structure is capable of providing an extremely high degree of flow regulation, only a very minor amount of revetment should be needed as the velocities caused by the headwater flow would be low at all times. Assuming, however, that the drop structure would provide little or no flow regulation, this plan should provide for revetment of the channel on the entire west of about one-half the length. This conclusion is based on the presence of erodible lenses or layers in the borings and on the possibility that the soils along this realignment may be inferior from the standpoint of reservoir-bility to those shown by the borings and by the observed riverbanks. However, in any channel to be used by shipping, it is important that its length not be increased greatly and it is desirable to restrict to that which can be easily negotiated by the ships that will transit the channel. The bank stabilizing revetment should not be terminated until a water

1824

1825

1826

1827

Big Bang Theory

1828

"FOR a quarter of a century, dreamers and hardheaded businessmen as well have been conjuring up new schemes to jockey huge ships across the aggravatingly skinny, but mountainous, strip of land connecting North and South America . . . the fondest dream of all has been a colossal sea-level ditch. Today, that idea is no longer a dream. It may happen – and soon. It can be done without squadrons of earth-moving monsters – at one-third the cost they would involve – and will result in an ocean-to-ocean river four times wider and twice as deep as the present canal; a 'ditch' big enough to take the world's largest tankers and carriers – something the present canal won't do…"

***Popular Mechanics,* June 1964**

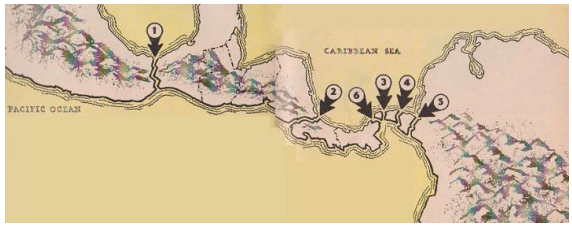
1829

Where, When and How?

1830

"…The question no longer 'Can it be done?' It is 'Where, when and how can we dig it?' Scientists and engineers working with the U.S. Government's Panama Canal Company, the Atomic Energy Commission and the Army's Corps of Engineers already have most of the answers. Where? Near the Panama-Columbia border. When? Within five or six years. How? By means of thermonuclear excavation based on new techniques..."
***Popular Mechanics,* June 1964**

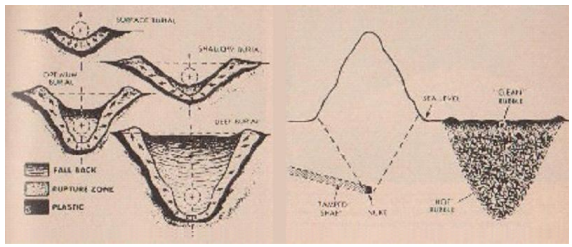
1831



"…The best route, from an engineering standpoint, lies along the Sasardi and Morti Rivers in Panama (see map), some 110 miles east of the present canal. If Panama is ruled out, the canal will be cut farther east, in Columbia, following the Atrato and Truando Rivers . . . Actually, some 30 routes across Central America were studied by the Canal Company. These were narrowed to five by the A.E.C…"
***Popular Mechanics,* June 1964**
Caption: "Five possible routes for a new canal have been selected from 30 alternates. They include: 1. Tehuantepec, through Mexico; 2. Greytown–Salinas Bay, across Nicaragua; 3. San Blas, through Panama; 4. Sasardi–Morti, through Panama; 5. Atrato-Truando, via Panama and Columbia; 6. Present canal."

1832

Nuclear Cratering



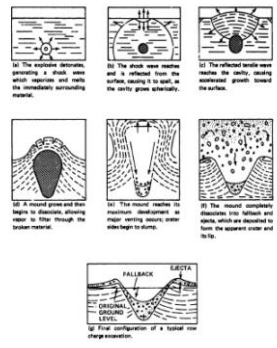
"…The new canal will be dug with clean 'nuclear explosives' – basically hydrogen bombs. They will be used in a 'row charge' blasting technique that digs sharply defined chasms with little need for earth moving equipment…"
***Popular Mechanics,* June 1964**
Left: caption: "Crater profiles show how shape of ditch can be determined by depth at which explosive charge is planted. In these sketches, (+) indicates charge."
Right: caption: "Single charge, if buried deeply enough, as shown above, will not only level an entire mountain, but will throw rubble so that it falls back, filling the ditch"

1833

1834

"…Atomic energy scientists want the record straight on 'nuclear cratering.' Their unique 'row-charges' will not just loosen earth and rock for removal by power shovels and trucks. They will make a canal! This is the key to the trick. The A.E.C. developed the method in a series of Nevada tests. Eight more blasts, spread over four years, will be sufficient to refine the system…"
***Popular Mechanics,* June 1964**

1835



NUCLEAR CRATER FORMATION

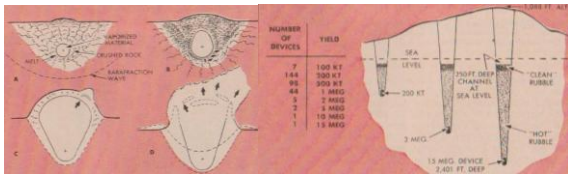
1836

Diffusion Blasting

1837

"…The real secret of the new technique is called 'diffusion blasting,' first developed with conventional explosives and more recently applied to nuclear devices…"
Popular Mechanics, June 1964

1838



"…Engineers have worked out formulas that tell them what size charge to use, and how deep to bury it in order to blast out a particular size and shape of hole. They can produce ready-made railway cuts, steep walled craters, or even remove mountains. They can so arrange their blast that the debris will fall into a gorge and form a precisely located dam of specific dimensions…"
Popular Mechanics, June 1964
Left: caption: "Bubble development in an underground nuclear blast progresses as shown in sketches above in this four-stage alphabetic sequence. Blow occurs via the tamped hole where the charge was inserted; it appears here in stage C"
Right: caption: "Sasardi-Morti canal route would call for 302 nuclear devices with a total yield of 170 megatons equal to 170 million tons of TNT. To cut a sea-level ditch in simultaneous explosion, bomb depths would vary as shown here."

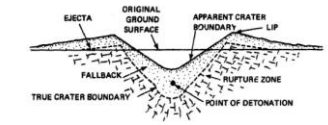
1839

How Does it Work?

1840

"…How does it work? Charges are placed so that the distance between them is little more than the radius of a single crater. When the charges detonate simultaneously, there is a 'doubling effect' at the points where the impact of one charge meets the punch of its neighbor. Not only does this remove 20 percent more material, but it forms a long, smooth walled trench instead of a line of craters. Even more astounding is the odd fact that row-charge excavating throws the dirt neatly to the sides of the trench; none goes out the ends. Experts suspect that a vacuum forms along the sides of the long row of explosives . . . It's hard to imagine a row of explosives producing a straight, smooth-sided, clean-bottomed trench with the dirt and rock piled neatly along the sides and none thrown out the ends. But that's what happens in a 'row-charge'…"
Popular Mechanics, June 1964

1841



Apparent Crater - That portion of the visible crater which is below the original ground surface.

True Crater - The entire void initially created by the explosion including both the apparent crater and the broken and disarranged fallback material.

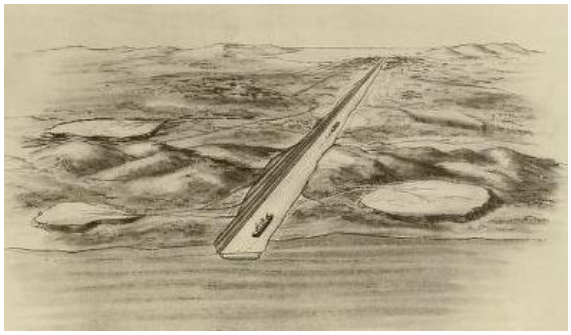
Fallback - Material thrown into the air by the explosion, which does not have sufficient horizontal velocity to escape the crater area and thus falls back into the void initially created by the explosion (true crater).

Ejecta - Material thrown into the air by the explosion with sufficient horizontal velocity to escape the crater area. Ejecta landing just outside the void created by the explosion forms part of the crater lip.

Rupture Zone - The region bounding the true crater in which material has been sufficiently stressed to cause fracturing, crushing, and some slight local displacement.

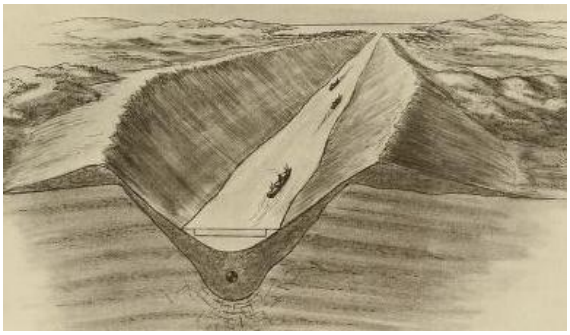
CROSS SECTION OF A ROW CRATER

1842



Caption: "Ship passing through a single-lane conventionally dug canal, showing the navigation prism. Maximum ground elevation shown is 300-feet. The navigation prism is 550 by 75-feet."

1843

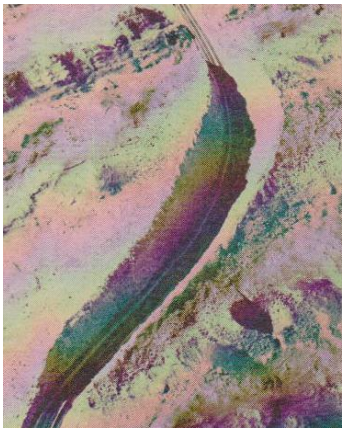


Caption: "Ship passing through a two-lane canal excavated by nuclear means, showing the navigation prism. Maximum ground elevation shown is 1,000-feet. The navigation prism is 1,000 by 75-feet."

1844

Project Carry-All

1845



"…One such experiment is 'Project Carry-All,' a plan to cut a railroad and highway pass two miles long through California's Bristol Mountains. It calls for 22 nuclear explosives adding up to 1,730 kilotons. If Carry-All is undertaken, it will give the world a good look at nuclear earth moving…"
Popular Mechanics, June 1964

Caption: "Project 'Carry-All' in California proposes a road and rail cut through mountains with nuclear charges to test canal project feasibility. This is a model."

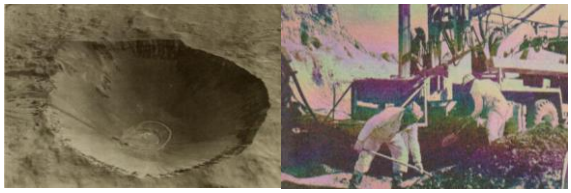
1846

What About Radioactivity?

1847

"…What about radioactivity? Five days after the Sedan blast, engineers began working at the crater lip. Six months later, an A.E.C. photographer tramped a zigzag course through the knee-deep, powdery fall-back down to the crater's floor and photographed a four-man team. The radiation level was so low that they did not need protective clothing. …"
Popular Mechanics, June 1964

1848



"…Within five years, the A.E.C. contends, radiation will be 100 time less than the Sedan count. This cannot be called a health hazard. But, it can be measured, and the limited nuclear test ban treaty specifies that underground blasts may nor result in any radioactivity outside the national boundaries. Hence, diplomatic agreements must be forged before work can start…"
Popular Mechanics, **June 1964**
Left: caption: "Sedan, July 6, 1962, 100 Kiloton – the thermonuclear explosion occurred 635 feet below surface and excavated a crater 1,200 feet in diameter and about 320-feet-deep with a volume of about 6.5 million cubic-yards"
Right: caption: "Engineers and scientists conduct a post-shot examination of the rubble at the lip of the Sedan crater in order to determine radiation and make-up of debris"

1849

What Would it Cost?

1850

"…What would a nuclear-dug canal through the Isthmus cost? The Sasardi-Morti route is now estimated at $500 million – far less than the $5 billion estimate for doing it conventionally and one-third less than an estimate made four years ago, thanks to new developments in handling our newest earth mover – the atom."
Popular Mechanics, **June 1964**

1851

Almost Doesn't Count

1852

"…At the end of the day, it was assumed that a mixture of conventional digging procedures, as well as a few nuclear weapons, would be used to create the Pan-Atomic Canal through Colombia. Things were almost ready to set this $2 billion scheme in motion…"
forbes.com, **August 23, 2018**

1853

"…By 1969, however, the atmosphere had changed somewhat. Several test shots designed to round off the canal digging studies were cancelled citing concerns over radiation release. A 1970 report, spearheaded by the respected Corps of Engineers brigadier general Charles Noble, advised against the plan, noting that it was not economically viable, and would endanger both the environment and various indigenous populations. 'Although we are confident that someday nuclear explosions will be used in a wide variety of massive, earth-moving projects, no current decision on U.S. canal policy should be made in the expectation that nuclear excavation technology will be available for canal construction,' the report concluded…"
forbes.com, **August 23, 2018**

1854

"…It wasn't just the Pan-Atomic Canal that was losing steam: PP in general was losing support, both within and without the halls of power. Environmental and economic concerns abounded, and even the most 'successful' tests – those that created wells into natural gas supplies, like the Rio Blanco series – couldn't be reasonably justified…"
forbes.com, August 23, 2018

1855

"…As the curtain began to fall on PP, the Pan-Atomic Canal was put out of its misery. On June 30, 1975, PP was officially terminated. The following spring, after so many tests had already been carried out, the U.S. and the Soviet Union signed the Treaty on Underground Nuclear Explosives for Peaceful Purposes, which set yield limits on subterranean nuclear blasts. If either nation wanted to, it could still conduct PNEs in the territory of other consenting countries, and scientific cooperation was encouraged. It ultimately came into force on December 11, 1990, shortly after the Soviet PNE program was shut down – and just two weeks before the Soviet Union came to an end…"
forbes.com, August 23, 2018

1856

"…But the PNE project remained experimental, after the U.S. found that 27 experiments with PNEs heavily irradiated the landscape. The Atomic Energy Commission was also abolished in 1974. Meanwhile, the Lawrence Livermore National Laboratory still exists. According to its website, it is dedicated to 'ensuring the safety, security and reliability of the nation's nuclear deterrent.'
businessinsider.com, March 25, 2021
Caption: "The Lawrence Laboratory National Laboratory (LLNL) was established in 1952 at the height of the Cold War. Its mission was to meet urgent national security needs by advancing nuclear weapons science and technology."

1857

"…The Panama Canal itself didn't get a twin in the end, but it was ultimately widened over the last decade, all without the aid of any nuclear explosions…"
forbes.com, August 23, 2018
Caption: "Artist's rendering of the new third set of locks. Note the water saving basins to the right of the lock chambers."

1858

Predicting the Future

1860

"…That March 1960 issue of 'Popular Mechanics' didn't just contain fairly erroneous predictions by Teller regarding the future of nuclear explosion usage. Right next to his piece lay 'An Eye On Space,' composed by Dr. Dan Posin, a professor of physics at De Paul University. In it, he predicts that lunar landings would occur no later than 1965, with human missions to Mars and Venus taking place by 1970 at the latest. 'If I were leading a program of manned exploration, I'd vote for space ventures in this order: our Moon, Venus (closer to us than Mars), Mars, the Moons of Jupiter, the Moons of Saturn," he concludes, before asking the reader: 'Ready to buy your ticket?'…"
forbes.com, **August 23, 2018**

1861

"…It's certainly a shame that, nearly half-a-century after footprints were made in the Sea of Tranquillity, a human mission to Mars – let alone Europa or Enceladus – still seems a generation away. Looking over such buoyant, ambitious predictions about the future of humanity's scientific progress, like this one, is normally a melancholic process. Then again, there are exceptions. It's good to know that, for whatever reason, our worst instincts are, on occasion, curbed, whether we're talking about nuking the Moon or irradiating Colombia."
forbes.com, **August 23, 2018**

1862

Joining of the Waters

1863

SUEZ CANAL
AUTHORITY
شريان الحياة

1865