The Delta Barrage — the Most Expensive Bridge of Its Time? The First Attempts at Taming the Nile[1]

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Few rivers hold a position in world history as important as the Nile does. The geopolitical situation and the new technical opportunities of the "long nineteenth century" brought an opportunity for the more effective use of the Nile waters for economic purposes. This process was mainly possible through the improvement of irrigation systems and the construction of large water management projects — the construction of dams, reservoirs and canals. Mainstream historiography of modern Nile history has until now always focused its attention on the Aswan Dam; the Low Dam completed in 1902 and the High Dam completed in 1971. Aswan frequently overshadows other projects smaller in size, but often of no less significance. One of these overlooked projects is that of the dam in the Nile Delta which this article will be looking at.

This dam in the Nile Delta, for which English writings have used the French term "barrage" was a project over which discussion began even before the government of Muhammad Ali (1805–1848), although it was upon his instigation that construction began.[2] The primary objective of the project was to increase agricultural yields, in particular cotton production, in Lower Egypt. Other objectives changed over the course of construction work, and this article attempts to analyse whether they were achieved.

The Barrage project can be described as unique in many regards. It was the largest river regulation project of its time, and the first of its kind in the world. It is no exaggeration to say that it was a project which launched the era of large dams on the Nile and other rivers, a project which pushed the borders of imagination further and which demonstrated the potential of new technology and discoveries such as new pumps and construction methods. Construction of the Barrage also involved an unusually large deployment of human resources, mainly through a system of forced public labour (known as *corvée*).[3]

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2 "Barrage" = dam; the project is sometimes termed the "Barrage in the Head of Delta", "Delta Barrage of Lower Egypt" or "The Nile Barrage", but the most widespread term is "the Barrage", a simple and general term which was enough at the time of construction because there were no other similar projects.

3 Public labour on irrigation facilities in Egypt was often described using the French term *corvée*. *Corvée* labour was regularly used to clean irrigation systems and on large projects

The use of foreign advisors, in the first phase French engineers such as Louis Maurice Linant de Bellefonds and Eugène Mougel, demonstrated the great influence France had on Muhammad Ali's Egypt. The use of British engineers Colin Scott-Moncrieff, William Reid and William Willcocks in the project, which began in the 1860s, is in contrast a reflection of the beginning of Britain's dominance of the Nile, which later culminated in what Norwegian historian and geographer Terje Tvedt fittingly terms the creation of the "British River Empire".[4]

When a project of such huge size is beginning, the instigator and his supporters require motivation and a strong vision. Muhammad Ali's vision was to boost yields in agriculture and improve the Egyptian economy, and he was willing to do a lot to achieve this. The French vision included consolidating its position in Egypt and increasing its cultural influence and power in Cairo. For Britain, it began as an endeavour to strengthen its trade interests, then a consolidation of its geopolitical position in Egypt — a symbolic gateway on the route to India and a base for further penetration of Africa.

Over time, the Barrage project represented a commitment to fulfil these visions, and in some cases also a symbol of failure and disappointment. The analysis of the project's objectives and whether they were fulfilled which I am trying to achieve in this article is based on a study of literature, archives at Britain's Foreign Office and technical reports or monographs written in the second half of the 19th century by the engineers directly involved in Nile water management projects. Personal perspectives contained in the memoirs of Linant de Bellefonds and Scott-Moncrieff's biography written by his niece were also taken into account.[5]

Since the Barrage project is not included to a large extent in any contemporary studies, this article can be seen as a missing piece in the mosaic of Nile regulation historiography, which may help move the Barrage project out of the shadows of Aswan where it is unjustifiably located.

EMERGENCE OF THE IDEA — PURPOSE, VISION AND THE FIRST FRENCH BARRAGE PLANS

According to French doctor Antoin Clot, the first idea of building the dam came to Napoleon Bonaparte.[6] During the Egyptian Campaign (1798–1799), Napoleon alleg-

such as the Suez Canal, the Mahmoudiyah Canal, the Ismailia Canal, the Barrage, etc. For more on *corvée*: A. MIKHAIL, *Nature and Empire in Ottoman Egypt: An Environmental History*, Cambridge 2011, pp. 170–200; N. J. BROWN, *Who Abolished Corvée Labour in Egypt and Why?*, in: Past & Present, Vol. 144, 1994, pp. 116–137.

4 T. TVEDT, *The Nile in the Age of the British, Political Ecology and the Quest for Economic Power*, London 2016.

5 M. DE BELLEFONDS LINANT, *Louis Maurice, Mémoire des principaux travaux d'utilité publique exécutés en Égypte depuis la plus haute antiquité jusqu'à nos jours*, Paris 1873; M. A. HOLLINGS, *The Life of Sir Colin C. Scott-Moncrieff*, London 1917.

6 Antoine Clot (also known as Clot Bey) was a French doctor and a participant in Napoleon's expedition to Egypt.

edly pronounced his prediction that one day the Rosetta and Damietta branches of the Nile would be dammed, improving sailing conditions and irrigation.[7] It wasn't until Egypt's ruler Muhammad Ali, however, that a specific plan to build a dam was conceived, with the planned construction playing an important role in Ali's agricultural reforms.

The need to regulate the Nile was closely related to the expansion in cotton growing which occurred in Egypt over the course of the 1820s, assisted among other reasons by the spread of high-yielding long staple cotton.[8] Growing long staple cotton required a general change in irrigation systems, which mostly worked on the basis of "basin irrigation".[9] In contrast to so-called winter crops, such as wheat, barley, flax, clover, tobacco and beans which only require water and inundation in the network of canals and banks during the Nile's September culmination, cotton — a summer crop — required year-round irrigation and protection from mud.[10] Damming the Nile would involve an overall increase in the water level during the river's low period, and thus also an increase in water levels in the irrigation network canals, which furthermore would not need to be so deep. Another effect was meant to be better protection from siltation, which otherwise had to be regularly removed utilising significant human resources. Linant de Bellefonds calculated that over 13 million cubic metres of silt had to be removed each year, requiring 27,404 workers working for 100 days.[11] It is clear then, that the principal objectives of the planned dam were to improve irrigation in the Delta and to regulate the Nile. Another anticipated benefit of damming the Nile was the linking of the two (at the site of the branching of the river, all three) banks. Thus, the dam was also to function as a kind of bridge, and so was an important transportation node.

In 1833, Muhammad Ali entrusted French engineer Louis Maurice Linant de Bellefonds with preparing the first project. He came up with the idea of constructing dams on both branches of the Nile as close as possible to the point where they divided at Kafr-Mansour and Derrawé (approx. 10 km from the point of division). The dams were to include regulators which would affect how much water would flow in the

7 R. H. BROWN, *History of the Barrage at the Head of Delta of Egypt*, Cairo 1896, p. 1. Major Brown worked as an Inspector General of Irrigation in Lower Egypt, but he also looked at water projects from a historical perspective. His professional knowledge, excellent local knowledge and the fact he was personally involved in many projects mean that one can utilise his works still today, although they are dated.

8 Long staple cotton spread within Egypt after 1821 thanks to French textiles engineer Louis Alexis Jumel. It replaced the previously most widespread, but poorer quality short staple cotton and replaced wheat as Egypt's most important crop. Egypt soon became a cotton superpower. For more on this topic: R. J. OWEN, *Cotton and the Egyptian Economy 1820–1914: A Study in Trade and Development*, Oxford 1969.

9 Basin irrigation — for 5000 years the only irrigation method used in Egypt. Floodwater was transferred to a network of canals and then held there with the use of small banks and basins. Gradually replaced from the beginning of the 19th century by a more effective year-round irrigation system. S. RUSHDI, *The Nile River, Geology, Hydrology and Utilitization*, New York 1993, pp. 213–214.

10 OWEN, pp.8–9.

11 BROWN, p. 2.

Rosetta and Damietta branches in the summer and supply the three main irrigation canals which were also planned to be constructed.[12] During the Nile flood season, the regulators were to be open with the water left to flow freely and they would not be headed up.[13] It was planned that the dams be built on dry land with the water flowing around them through canals which would be filled in once construction was complete, filling the reservoir.[14]

Linant's option had a rival in the form of a different proposal. This involved the construction of two solid dams, one in Beni Salama on the Rosetta branch, and the other in Dégoné on the Damietta branch. Instead of smaller regulators, the dam would have had one large sluice which would open during the flood season. Water was also to pass over the top of the dam.[15]

An independent thirteen-member commission met in 1833 to assess both options. It comprised the following people: General of the Artillery Athem Bey, principal architect Emin Efendi, Chakir Efendi — Muhammad Ali's former sailor and secretary, alongside Soliman Efendi, Ahmed Baroudi and Abdel Waháb, principle engineers of the Delta Barrage, provinces of Sharqia and Giza, Mustafa Rasem, an engineering school headmaster, English engineers Galloway and Wallesfils, Mr Hékékyan, who had British education, French mining engineer Lambert and two French officers, Hoart and Bruneau. Although the British section of the commission advocated the dam with opening and overflow option (probably because similar systems were used on rivers in India), Linant's proposal won out, with preparatory work beginning around 1833.[16]

As I mentioned in the introduction, motivation is required to complete any project. In the case of the Barrage, this involved the motivation and enthusiasm of the main instigator of the construction, Muhammad Ali, who displayed (at least to begin with) great passion for it, expressed in his marked impatience. This was seen in the acquisition of the Sultan's permission to build.[17] On the basis of information from the British diplomatic service, it is highly unlikely that Muhammad Ali asked the Sultan for any permission. Although Sultan Mahmud II's Grand Vizier claimed that the Egyptian governor asked the Sultan for his spoken permission during a visit to Istanbul in July 1846, an appropriate time (the dam's foundation stone was laid in April 1847), there is no written reference to this request in later correspondence, and nothing was discussed in the Sublime Porte, which is rather odd for a project with

12 Louis Maurice Linant de Bellefonds (1799–1883) was a French engineer active in Egypt, who was involved in the construction of the Suez Canal, amongst other projects. He is also known as Linant Pasha.

13 BROWN, p. 6.

14 W. WILLCOCKS, *Egyptian Irrigation*, Vol. 2, London 1913, p. 633. William Willcocks (1852–1932) was a British engineer active in India and Egypt, involved in the construction of the Lower Aswan Dam, among other projects. He wrote a complete summary of Egyptian irrigation which includes a lot of unique data, maps and information.

15 Ibidem, pp. 4–5.

16 DE BELLEFONDS LINANT, pp. 433–435.

17 However, much Muhammad Ali acted as an autonomous ruler, he was officially subject to the power of the Ottoman Sultan in Istanbul. Projects of the huge size the Barrage project officially required the Sultan's consent.

a budget of almost a million pounds; such a request would at the very least lead to discussions in Istanbul. Furthermore, Muhammad Ali had never asked for permission before for any large project and had made arrangements as he saw fit. It would seem, then, that the Grand Vizier's claim was probably an attempt at saving face rather than a reflection of what actually occurred.[18] Evidence of how important the Barrage project and its speedy implementation were for the Egyptian ruler is his instruction to Linant to use stones from the pyramids in Giza to speed up the process. Linant de Bellefonds realised that it would not be a good idea to declare the instruction an act of pure madness and vandalism and so he did not oppose the ruler and he began preparations for the demolition of the pyramid. As he knew that Muhammad Ali could only be persuaded by hard figures, he undertook calculations which showed that the price of one cubic metre of stone taken from the pyramids, including transport, would come to 10.20 piastres, while the price of one cubic metre of quarried stone would work out at a price of 8.35 piastres.[19] Muhammad Ali chose the cheaper option, and thus the economic disadvantage of dismantling the pyramids protected them from destruction.

In the end, the Egyptian ruler's impatience and moodiness proved fatal to the whole Linant project. Preparatory work took place beginning in 1833 with the use of *corvée* labour, mainly involving the collection of material and digging of foundations which would be complicated two years later by a plague spreading amongst the workers. A lack of workers led to work stopping for a number of months. Few workers, problems with material delivery and Linant's absence led to a significant slowing of construction and in 1837 Muhammad Ali, despite the position of the Ministry of Public Works' commission which recommended work continue, decided that the Barrage was no longer a priority, construction was abandoned and the material used elsewhere.[20] Thus, Linant's project came to an end not having managed to achieve the determined objectives.[21]

Following an interlude between 1835 and 1842 when Muhammad Ali expended all human resources into the proven method of clearing and deepening the principal irrigation system canals in an attempt to carry on without the Barrage, a new chapter began in the dam project in 1843. This was down to French engineer Eugène Mougel, who submitted a new dam plan to the Egyptian ruler.[22] Mougel's plan involved the construction of two dams on both Nile branches right at the point where the river separated (in this it was similar to Linant's plan). The plan also included the military

18 The National Archives London-Kew (further only TNA), Foreign Office (further only FO) 881/261, *Correspondence Respecting the Relations between The Porte and The Pasha of Egypt 1850–1852*, London 1852.

19 DE BELLEFONDS LINANT, pp. 433–435. For a brief discussion of the pyramids' demolition: J. D. STANLEY, *Marginalia The Near-Destruction of Giza*, in: American Scientist, Vol. 93, No. 2, 2005, pp. 110–112.

20 BROWN, pp. 6–7.

21 Until work ended, Linant's project cost about £840,000. L. JACKSON, *Statistics of Hydraulic Works and Hydrology of England, Canada, Egypt and India*, London 1885, p. 211.

22 Eugène Mougel (1808–1890), a French engineer active in Egypt, who besides the Barrage project, took part, e.g. in construction of the Suez Canal and the modernisation of Alexandria's port. Also known as Mougel Bey.

fortification of both dams and a roughly 1 km wide promontory between them. Muhammad Ali as an old fighter quickly approved the proposal with hopes to turn the place into a military centre for Egypt.[23] Thus, the project acquired a new military strategic dimension.

The dam on the Nile's Damietta branch was first to be built. The dam was designed to have 71 arches with five-metre openings and two-metre thick pillars between them. Each side of the dam had a large sluice with iron gates, one 13 metres wide and the other 15 metres wide.[24] The Damietta dam measured 535 metres wide and 46-metre-thick, with no complications occurring during construction. The construction of the Rosetta dam began in 1847. It was meant to look the same as its Damietta sister with the difference that there would be ten less arches making it shorter — 465 metres.[25] Construction was accompanied by technical problems caused by the weather, but mainly by Muhammad Ali's impatience, who wanted the dam ready as soon as possible, putting pressure on Mougel. Following Muhammad Ali's death in 1848, he was replaced by Abbas Pasha, who wasn't particularly convinced of the success of the Barrage; the only thing which prevented him cancelling the project was fear of public opinion.[26] In April 1853, Abbas Pasha dismissed Mougel Bey from running the project because he was dissatisfied with the state of work. Mougal had to hand over control and all plans to Mazhar Bey, who "completed" the Barrage in 1861, thirteen years after the death of its main instigator. At that time, the construction included all the pillars of the linked dams, access communication and turrets, such that its key components were ready.[27]

Completion of the construction, however, did not bring the taste of victory. Although the dams could be used to direct the Nile water either to the Rosetta or Damietta branches, it was unable to increase water levels such that they flooded the canals to make the irrigation system more efficient. Immediately following completion of the barrage, not even the total area of cultivated land increased, with Egyptians farming 4,160,169 feddans in 1852, and just 4,053,347 feddans in 1862, a year after completion.[28] In contrast, the dam's role as a communication node, essentially as a bridge, did begin. It was known locally as "*Qanater Foum El Bahr*" — "the Bridges at the Estuary", or "*Qanater El Khairia*" — "Wealth Bridges".[29] Despite the wishes of the late Muhammad Ali, the Barrage never became a military centre for Egypt.

23 WILLCOCKS, p. 634.

24 These locks also gave passage to boats.

25 J. BAROIS, *Egyptian Irrigation*, Paris 1887, p. 47. Willcocks gives the length of the Damietta dam at 10 metres larger, i.e. 545 metres. WILLCOCKS, p. 635.

26 Due to its huge size, the project had received quite significant publicity. Another reason it was under public scrutiny was the huge investment it required. When work was completed in 1861, costs had reached £1,880,000 (not including *corvée* spending). Fortification, construction of links to the canals and the dam themselves cost another £4,000,0000. WILLCOCKS, p. 634.

27 BROWN, p. 17.

28 A. E. CROUCHLEY, *The Economic Development of Modern Egypt*, London 1938, p. 259. For clarification: 1 Egyptian feddan = 4,200.08 m2 F. CARDARELLI, *Encyclopaedia of Scientific Units, Weights and Measures, Their SI Equivalences and Origins*, London 2003, pp. 128–130.

29 TNA, FO 141/555/5, *The Delta Barrage and Proposed Mohamed Ali Barrage,* May 30, 1935.

As such, its objectives remained more or less unfulfilled and furthermore the dams were affected by serious technical problems which occurred right from the first attempt at closing the Rosetta dam gate in 1863. In subsequent years, expert commissions met a number of times and they recommended repairs and strengthening of the dams, but their warnings were disregarded. During the 1867 flooding season it was found that 9 pillars and 9 arches on the Rosetta dam were damaged and part of the dam, probably due to unstable subsoil, had moved downstream.[30] This represented the ignominious end to the period of French plans in the Barrage's history. French influence in Egypt had culminated at the end of the rule of Muhammad Ali, whose reforms had been inspired by France and which were often implemented with the assistance of French advisors. The adoption of Linant and Mougel's plans thus correspond to the pro-French position of the Egyptian government.

BRITISH INVOLVEMENT IN THE DELTA BARRAGE — REASONS AND NEW PLANS

As the 1870s began, the Barrage was essentially a failed project which had not achieved its purpose, and as such the question of what to do with it arose. In a letter to the Khedive in 1871, Linant de Bellefonds proposed a one-off investment of £20,000 for the most essential repairs, and further suggested pumping water into the irrigation systems using large steam pumps. His proposal, however, did not receive a sympathetic response. British engineer John Fowler wrote a report five year later, also suggesting the use of pumping stations, but in contrast to Linant he came to the conclusion that it would be more effective to put the failing Barrage into operation despite the fact that costs would be higher.[31] Fowler proposed constructing an additional wall under the current dam wall, creating a kind of water-cushion to protect the wall foundations from the power of the flowing water. The plan also included strengthening and repairing the original dam, in particular the sluices. Total costs were calculated at £1,000,000 to £1,200,000.[32] However, the Egyptian government thought this sum too high and did not accept Fowler's proposal either.

The further fate of the dams in the Nile Delta was affected by Britain's invasion of Egypt in 1882. The immediate reason for the invasion was the country's complicated internal situation as a result of the Colonel Urabi's revolt.[33] Great Britain felt its

30 JACKSON, p. 213.

31 BROWN, p. 24. John Fowler (1817–1898) was a British engineer mainly involved in railways and railway infrastructure (bridges, etc.)

32 BROWN, p. 23; T. MACKAY, *The Life of Sir John Fowler*, London 1900, pp. 264–265.

33 Urabi's revolt was a nationalist uprising in Egypt which occurred in 1882. It was motivated by the population's dissatisfaction with the positions and profligate life of the Khedive and his family, as well as the international control of Egyptian finances, and so also the domestic political situation. Ahmed Urabi was the revolt's leader. The revolt was crushed through British intervention that same year. See cf. J. VALKOUN, *Britská zahraniční politika a Egypt v 80. letech 19. století*, in: Acta Fakulty filozofické Západočeské univerzity v Plzni, Vol. 2, No. 2, 2010, pp. 103–107; J. VALKOUN, *The British Foreign Policy and Egypt in the 1880s*, in: Öt kontinens: Az Új- és Jelenkori Egyetemes Történeti Tanszék közleményei /

interests, which were traditionally of three types — territory, transit and trade/finance — were threatened. Egypt was used for transit to India, Aden, Australia, Hong Kong, Ceylon and Mauritius, connecting with a total of over 110,000,000 citizens. Trade interests were more complex. British ships had dominated Alexandria's port since the 1840s, with, e.g., 187 British ships anchored there in 1845 carrying 46,220 tons of goods worth £869,947, much larger figures than second-placed French traders (68 ships, 11,719 tons at £364,898).[34]

The cornerstone of British trading interests in Egypt was cotton production.[35] Britain's textile industry was reliant on cotton imports. In the 1860s, 80 % of all cotton in British textile plant stores came from plantations in the southern states of the USA. This "cotton dependence" proved to be a big problem following the outbreak of the civil war in April 1861, with the cotton price increasing markedly as the conflict went on. Brazil, India, Turkey or Egypt, whose location, potential for cotton cultivation growth, and high cotton quality were extremely promising, were obvious alternatives.[36] While in 1861, 596,200 kantars of cotton were exported out of Egypt, a year later the figure was 721,052 kantars, and in 1863 it came to as many as 1,181,888 kantars.[37] In terms of British Egyptian cotton imports, in 1861 they imported 365,108 kantars at £1,546,898, a year later it was 526,897 kantars at £3,723,440, and in 1863 a total of 835,289 kantars with a total value of £8,841,557. Imports did not fall below a million kantars nor £12 million in value in subsequent years.[38] Thus, cotton became Egypt's gold, its most important raw material, and British traders were the number one customer.

In 1861, cotton was grown on 250,000 feddans of land, in 1866 the area it was grown on was five times larger, and due to great interest, the area had to be further extended.[39] As previously mentioned, high quality long staple cotton required all-year round irrigation, and as such a working irrigation system was bound up with Britain's interests. The Nile's growing importance for British trading interests is also seen in the fact that in the 1880s regular reports on the state of the river could be read in *The Times*. London, and especially Liverpool and Manchester essentially wanted to know everything about the Nile's fluctuations and thus estimates of cotton yields for the year.[40]

Britain had entered a country in which water management system reform had begun long ago, but the problem was its incomplete nature; the failing Barrage was just

Cinq Continents: Les cahiers du Département d'Histoire moderne et contemporaine, No 1, 2011, Budapest 2012, pp. 107–111.

34 FO 881/44 Stoddart to Palmerston, On Egypt and on the Policy of Great Britain in that Country, February 9, 1847.

35 Since 1820, British companies had played an important role in mechanization of Egyptian cotton production and dominated the industry. W. BEINART — L. HUGHES, *Enviroment and Empire*, Oxford 2007, p. 142.

36 OWEN, pp. 89–90.

37 CROUCHLEY, p. 263. For clarity: 1 Egyptian kantar = 44.5 kg, CARDARELLI, p. 130. Cf. figures J. VALKOUN, *Egypt under Khedive Ismail*, in: Prague Papers on the History of International Relations, No. 2, 2010, pp. 84–85.

38 OWEN, p. 90.

39 Ibidem, p. 89.

40 TVEDT, p. 21.

the tip of the iceberg.[41] Egyptian water management got new wind in its sails with the arrival of British engineer Colin Scott-Moncrieff, who arrived from India in May 1883 to head up the Irrigation Department and Works at the Ministry of Public Works.[42] Other engineers who boosted Moncrieff's team that same year also had experience from India – William Willcocks, Hanbury Brown, Justin C. Ross and E. P. Foster.[43] The transfer of these people from India to Egypt also led to the transfer of know-how, and many features and methods used by British engineers in the construction of India's extensive irrigation system were subsequently used successfully in Egypt too.[44] Moncrieff's engineers had a difficult and thankless task to do, but also enjoyed the respect of their superior. Sir Evelyn Baring, later Lord Cromer, said they did "remarkable work", although on the other hand, *"like all men who have spent most of their lives in India, they were impatient in the event of dispute and were unable to seek compromises"*.[45]

One of the first tasks Moncrieff and his people had to deal with was the issue of the Barrage's future — at the time the largest, and due to its malfunctioning the most controversial, water management project in Egypt. Immediately upon his arrival, Moncrieff was confronted with the opinion of Egyptian and French experts that the Barrage was worthless and could not be used for irrigation in Lower Egypt in future. Although the Damietta dam could not be closed (it did not have a gate) and there were huge cracks in the Rosetta dam spanning two to three arches, Moncrieff decided to preserve the dam because he saw it as an irreplaceable element of Lower Egypt irrigation. He and his colleagues were convinced that the dam had to be tested and then repaired or, if it did not survive the test then build a new dam at the site.[46] First of all, the cracks in the arches were repaired and complete strengthening of the dams was begun, with total repair investments in the first year coming to almost £26,000. As 1884 came to a close, the level of the Nile in the Rosetta branch was 2.20 metres higher, and 0.95 metres higher in the Damietta branch, bringing incredible results in cotton production.[47] While in 1879, 3,186,060 kantars of barley had been produced, in 1884 the figure was 3,630,000 kantars, representing almost half a million kantars

41 The reasons for the poor state of Egypt's irrigation system in the early 1880s were both the country's financial problems, but also the nationalist uprising that had recently occurred, with rebels having deliberately destroyed canals and basins, considering them the centre of foreign powers' interests. Ibidem, p. 20.

42 Colin Campbell Scott-Moncrieff (1836–1916) was a British engineer active in India and Egypt. He was involved, e.g., in building canals on the Yamuna and Ganges rivers. He was one of the most important figures in Britain's reorganisation of Egyptian irrigation.

43 HOLLINGS, p. 201. All the engineers who arrived from India knew each other personally and many had already worked together on other projects — as such the conditions were almost ideal for achieving good results in Egypt.

44 More about irrigation in India: BEINART — HUGHES, pp. 133–139.

45 TNA, FO 633/6 Evelyn Baring to Lord Rosebery, No. 49, February 15, 1886. Sir Evelyn Baring (1841–1917), later 1st Earl of Cromer was Britain's Consul-General in Egypt between 1883 and 1907.

46 HOLLINGS, p. 201. They also worked on an option should the dam not survive the test. Moncrieff noted that the Barrage would either survive or fall — in any case this would not be a waste as it would open the space for construction of a new better dam.

47 HOLLINGS, p. 202; BROWN, p. 38.

more.[48] The Nile's level was higher in subsequent years, but the growing demands on the dams just made their poor state even worse, and they could not be improved with mere partial repairs. Thus in 1885 support of £1 million was approved for the irrigation systems and it was decided to undertake a general restoration.[49]

The main phase of the general restoration took place between 1885 and 1891 and this is mainly linked to engineers Willcocks and Reid. Following the partial success of 1884, the importance of the Delta Barrage was once again acknowledged, once again becoming the number one irrigation project. Yet neither the engineers, nor Sir Evelyn Baring were sure that the restoration would succeed, and in a May 1887 letter Sir Evelyn asked that Reid's placement from Indian service be extended, as he considered his presence at this "key project" was essential while also acknowledging that he did not know whether the project would be successfully completed.[50] Although he was unsure of the outcome, in the end they managed to strengthen the dams' foundations and equip the sluices with new gates. The Barrage succeeded in raising the water level in the irrigation canals by more than one metre, allowing for year-round irrigation in the whole Delta region. With the water level in the canals higher, there was no longer any need for them to be so deep, and as such they required less clearance and less frequent clearance. This fact led to the abolition of *corvée* labour in Egypt.[51] The complete revitalisation of irrigation, the largest part of which was naturally the Barrage repair, let to a massive growth in irrigated land and a doubling in cotton production between 1888 and 1892.[52]

CONCLUSION — THE BARRAGE AS THE MOST EXPENSIVE BRIDGE OF ITS ERA, OR A SUCCESSFUL PROJECT?

After fifty-eight years, the objectives which Muhammad Ali had once set for dam construction in the Nile Delta had finally been achieved. There was significantly improved exploitation of the Delta's potential. Although the Barrage's existence had been threatened a number of times and its purpose had not been achieved for a very long time, in the end it became a key part of Lower Egypt's irrigation system. The total costs of its completion are hard to quantify but they certainly exceed £10,000,000. In subsequent years, the Barrage became part of a massive water management structure which Britain built on the Nile. Its objective was to exploit the river's potential to the maximum extent and make as much land as possible fertile in order to achieve economic profit. Other water projects included dams further upstream, of which the most well-known is the already mentioned dam in Aswan. The objective of these other projects were essentially those of the Barrage in the Nile Delta, but multiplied

48 OWEN, p. 197.

49 BROWN, p. 40.

50 TNA, FO 633/5 Evelyn Baring to Mr. Sanderson, No. 183, May 2, 1887.

51 TVEDT, p. 23. For a brief history of other projects and Egyptian irrigation J. VALKOUN, *The Struggle for Water: The British and the Modernization of Egyptian Irrigation*, in: The Twentieth Century, No. 2, 2009, pp. 93–103.

52 CROUCHLEY, p. 148.

many times over. The Delta Barrage is now an obsolete dam which has stood since the 1940s in mere silent commemoration of its long-ago engineers, and as a link between the Nile's banks.

THE DELTA BARRAGE — THE MOST EXPENSIVE BRIDGE OF ITS TIME?
THE FIRST ATTEMPTS AT TAMING THE NILE

ABSTRACT

This article analyses the problems of the first attempts at modernization of the Egyptian irrigation systems on the Nile River in 19th century. The focus is on the construction of the barrage in the head of Delta. This project, commenced by Egyptian ruler Muhammad Ali (1805–1848), was intended to improve the irrigation of Delta and thus increase agricultural revenues, primarily with regard to the cotton production. The engagement of French foreign advisors such as engineers Louis Maurice Linant de Bellefonds and Eugène Mougel in the first phase of the project demonstrates the great influence France held over Muhammad Ali's Egypt. The involvement of British engineers Colin Scott-Moncrieff, William Reid and William Willcocks in the later phase of the project, which began in the 1860s, in contrast reflects British economic interests and the rising of Britain's dominance on the Nile.

KEYWORDS

The Delta Barrage; Nile Barrage; Egyptian Cotton; Hydraulic Engineers; Egyptian Agriculture, Nile Irrigation; Linant Pasha; Mougel Bey; Colin Scott-Mocrieff; Rosetta Dam; Damietta Dam

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