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# Egypt's Nile-Red Sea Canals: Chronology, Location, Seasonality and Function

John P. Cooper

## Introduction

The Egyptian Nile was connected to the Red Sea by canal in a number of historical periods – the Persian (Achaemenid), Ptolemaic, Roman and Arab-Islamic. The creation of that connection was a major work of collective civil engineering and individual human effort. However, despite its scale, the canal remains very poorly understood. Little is known of the objectives of those commissioning it, the lives of those excavating and navigating it, its function and relationship to the wider world, or even its precise route through the Egyptian landscape.

This paper draws upon historical, archaeological, cartographic, and remote sensing (satellite) data. It seeks to establish a chronology for the canal's apparently episodic existence, to locate candidate routes for the canals of the various eras, and to assess its current archaeological state. It further uses historical and hydrological data to identify the canal as a seasonal waterway operating only during the Nile flood, and considers the implications of this seasonality for the canal's role within Nile-Red Sea navigation. Finally, it investigates the possible objectives of the canal in the light of this seasonality, and of wider scholarship on the Red Sea. Summary maps of the areas discussed in this paper are provided for reference (Figures 20:1-20:2).

## Historical Data

Accounts of a canal being contemplated, attempted or completed between the Nile and Red Sea appear in the historical record as early as Herodotus. A tradition beginning with him claims that the project was first attempted but abandoned by Necho, probably the Saitic pharaoh Necho II (610-595 BC).<sup>1</sup> Another tradition, beginning with Aristotle, says it was first envisaged by a Pharaoh named Sesostris,<sup>2</sup> for whom the Twelfth Dynasty pharaoh Senwosret II (1845-1837 BC) has been proposed.<sup>3</sup> Aristotle says that Sesostris gave up the scheme “for fear that the water of the river [Nile] should be ruined by an admixture of seawater”.<sup>4</sup> To date, there is no historical or archaeological evidence to suggest that a pre-Achaemenid canal was completed.<sup>5</sup>

1. Herodotus, *Histories* II.158-159; Diodorus Siculus, *Historical Library* I.33.

2. Aristotle, *Meteorology* I.XIV.25; Strabo, *Geography* XVII.I.25; Pliny the Elder, *Natural History* VI.XXXIII.165.

3. Bourdon 1925: 23; Clédat 1924: 63.

4. Aristotle, *Meteorology* I.XIV.25.

5. However, there is evidence for increased settlement in the Wādī Tumaylāt, through which later canals ran, during the Saite period: see Redmount 1989: 176.

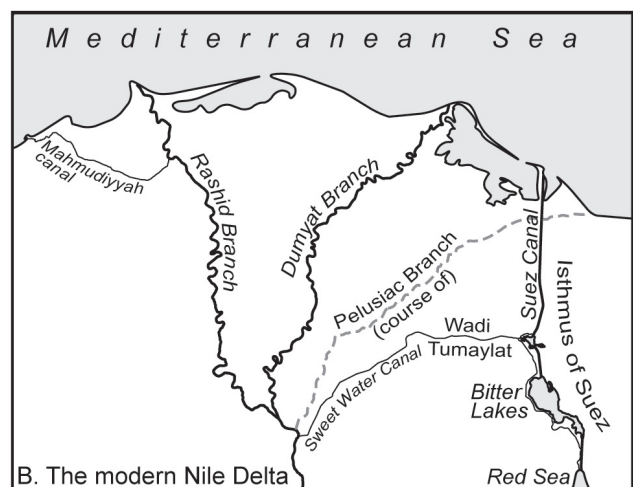


Figure 20:1. The Egyptian Nile and Northern Red Sea (A) and Nile Delta (B), showing principal regions and landscape features discussed in the text.



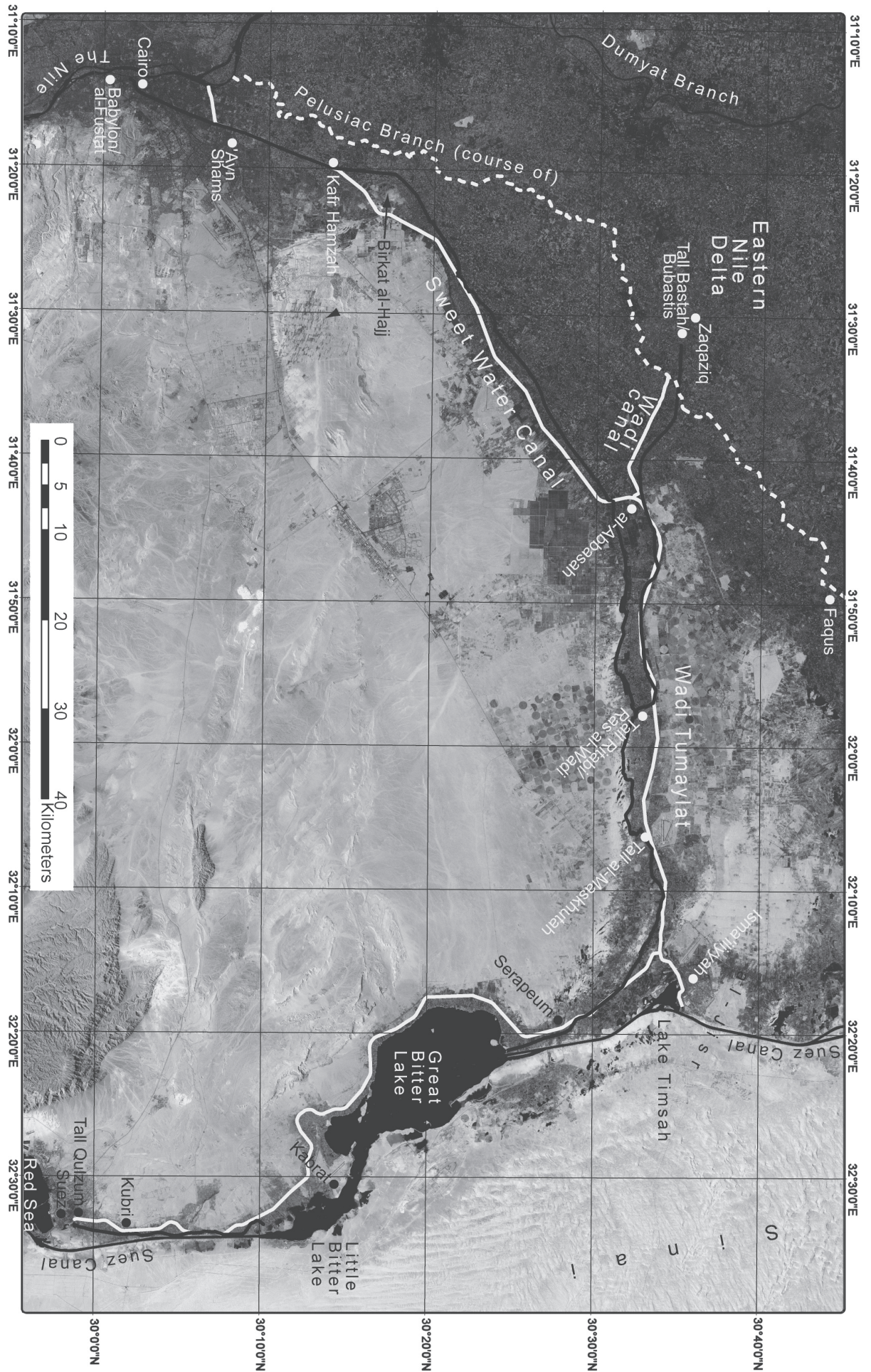


Figure 20: 2. Candidate routes of the ancient Nile-Red Sea canals (black lines) through the Nile Delta, Wādī Tumaylāt and Isthmus of Suez, based on 19<sup>th</sup> and early 20<sup>th</sup> century cartography; showing locations discussed in the text (satellite image: NASA Landsat Program 2000, Landsat ETM+, Orthorectified, USGC, Sioux Falls, 11/11/2000).



Greek and Roman authors after Herodotus claim that the Achaemenid ruler Darius I (522-486 BC) also attempted a canal, but abandoned the scheme when he too was persuaded that Egypt would be inundated by seawater as a result.<sup>6</sup> In fact, the existence of a completed Persian canal is indicated by the eyewitness account of Herodotus,<sup>7</sup> who visited Egypt some time after 454 BC, and by the discovery in the 19<sup>th</sup> century AD of four Persian stelae positioned along its route – by Tall al-Maskhūtah, and at Serapeum, Kabrat [Kabret], and Kūbrī – and commemorating its completion<sup>8</sup> (Figure 20:2). The relatively well-preserved Persian cuneiform text of the stela found at Kabret reads:

*“Saith Darius the King: I am a Persian; from Persia I seized Egypt; I gave order to dig this canal from a river by the name Nile which flows in Egypt, to the sea which goes from Persia. Afterward this canal was dug thus as I had ordered, and ships went from Egypt through this canal to Persia.”*<sup>9</sup>

Ignoring Herodotus, later Greco-Roman authors claim that the first complete Nile-Red Sea canal was in fact Ptolemaic, with some authors ascribing it to Ptolemy Philadelphus (282-246 BC).<sup>10</sup> The so-called ‘Stone of Pithom’, a stela found in the late 19<sup>th</sup> century at Tall al-Maskhūtah (Figure 20:2), provides epigraphic evidence for the Ptolemaic canal’s completion and use:

*“In the year 16, the third month of .... of His Majesty, they dug a canal, to please the heart of his father Tum [...]. Its beginning is the river (the river arm) north of Heliopolis, its end is in the Lake of the Scorpion, it runs towards the great wall on its eastern side, the height of which is a hundred (cubits?) [...]*  
*... After these things, His Majesty went to Kemeur; he founded there a large city to his sister, with the illustrious name of the daughter of King Ptolemy [i.e. Arsinoë][...] At the first month His Majesty called for transports, ships ... laden with all the good things of Egypt ... to the first general of His Majesty ... they sailed from Kemeur ... the storm. He navigated towards the coast of the Red Sea; he arrived at Khemitit, the end of the land of the negroes [sic.] ... he brought provisions to the king ... on his return he sailed to the island in the Lake of the Scorpion. He brought all the things that are agreeable to the king and to his sister his royal wife. He built a great city to the king with the name of the king, the lord of Egypt, Ptolemy. And he took possession of it with the soldiers of His Majesty and all the officials of Egypt and the land of ... (?);*

*he made there fields and cultivated them with ploughs and cattle [...]. He caught elephants in great number for the king, and he brought them as marvels to the king, on his transports on the sea. He brought them also on the Eastern Canal [...]. There came ships and ships to Kemeur ... there was abundance after scarcity for mankind; there was music, drink, ointment and fine clothing.”*<sup>11</sup>

In sum, the inscription appears to describe the completion of the canal at least as far as ‘the Lake of the Scorpion’, the foundation of the city of Arsinoë in ‘Kemeur’ – apparently on the Red Sea – and the establishment overseas of an Egyptian colony named after Ptolemy, from where elephants were hunted and returned to Egypt, probably for use as war animals.<sup>12</sup>

Exactly when the Ptolemaic canal fell out of use is not known, but it appears not to have survived into the early decades of Roman rule. It, and the port at its mouth, are absent from the 1<sup>st</sup> century AD *Periplus Maris Erythraei*, even though the text does address northern Red Sea ports, and claims to encompass “the designated harbours of the Erythraean Sea and the ports of trade on it.”<sup>13</sup> The subsequent Roman excavation of the canal is attributed in both historical and papyrological sources to Trajan (AD 98-117).<sup>14</sup> Again, the duration of the Roman canal is not known. Papyri refer to maintenance work carried out on it as late as the 5<sup>th</sup> century AD,<sup>15</sup> but these are not explicit that the canal still ran all the way to the sea in their respective times. However, given the apparent increase in activity at the port at the canal’s Red Sea mouth (which was by now called Clysma)<sup>16</sup> in the Late Roman period,<sup>17</sup> it is at least worth speculating that the canal did indeed continue to function at this time, since it might have supplied potable water to an otherwise poorly supplied location, in addition to fulfilling its transport function.

The Egyptian author Ibn ‘Abd al-Ḥakam (died AD 870/1) gathered several earlier anecdotes relating to the canal’s Arab re-excavation in the 7<sup>th</sup> century AD,<sup>18</sup> one of which suggests a recent memory of the Roman canal in the early years of the Islamic conquest. This particular tradition states that ‘Amr Ibn al-‘As, the conqueror of Egypt, wrote to the Caliph ‘Umar in al-Madīnah proposing the re-excavation of the canal as a solution to a Ḥijāzī food crisis. ‘Amr wrote:

6. Aristotle, *Meteorology* I.XIV.25; Strabo, *Geography* XVII.I.25; Diodorus Siculus, *Historical Library* I.33; Pliny, *Natural History* VI.XXXIII.166.

7. *Histories*: II.158-9.

8. Hallberg 1931: 27; Posener 1936: 48-87, 180-8; Redmount 1995: 127-8.

9. Kent 1950: 147; Scheil 1930.

10. Strabo, *Geography* XVII.I.25; Diodorus Siculus, *Historical Library* I.33; Pliny, *Natural History* VI.XXXIII.166-7. Pliny says that Ptolemy Philadelphus failed to complete the canal for the same reason as Darius – for fear of inundation – but follows this by saying that the Red Sea port of Arsinoë was “founded ... by Ptolemy Philadelphus, who ... gave his own name to the river on which Arsinoë stands ...” He thus contradicts himself.

11. Naville 1903: 20-1.

12. Casson 1993.

13. *Periplus*: 51.

14. Ptolemy, *Geography* 132; Lucian, *Alexander the False Prophet* 44; John of Nikiou, *Chronicle* 72.19; Papyri: *P. Oxy* 4070, II. 5-9 (AD 208); SB. 5.7676 (AD 287); *Ivi.* II. 12-15 (AD 297); *P. Oxy* 12.1426 (AD 332); *PSI* 87 (AD 423); *PSI* 689 (AD 423).

15. *PSI* 87 (AD 423); *PSI* 689 (AD 423).

16. Naville 1903: 20-1.

17. Ward 2007.

18. Ibn ‘Abd al-Ḥakam, *Futūḥ* 163-6.



*“You know that before Islam, ships used to come to us carrying traders of the people of Egypt. When we conquered Egypt, that canal was cut, having been blocked off, and the traders had abandoned it.”*<sup>19</sup>

This passage suggests that the canal may still have been in use into the Late Roman period. Indeed, if a description of it in the late 6<sup>th</sup> century AD *Historia Francorum* of Gregory of Tours is based on contemporary information, then the canal’s period of disuse before the Arab re-excavation of it in the mid-7<sup>th</sup> century AD was no more than seven decades.<sup>20</sup> According to Gregory:

*“The Nile, coming from the east, flows to the west towards the Red Sea. At the west extends a veritable lake, like an arm of the Red Sea, which goes towards the east, having a length of around 50 miles and a width of 18. At the head of this lake is the city of Clysmā, which was established there not because of the fertility of the place, for there is nothing so sterile, but because of the port. For the ships that come from India stop there because of the convenience of this port, from where imported merchandise are distributed throughout Egypt.”*<sup>21</sup>

Ibn ‘Abd al-Ḥakam relates further that ‘Umar ordered the re-excavation of the Roman canal in AD 643-4 in order to boost grain supplies to the Ḥijāz in response to famine.<sup>22</sup> It was finally blocked again during the Caliphate of Abū Ja‘far al-Manṣūr (AD 754-75), this time to halt grain supplies to the Ḥijāz, which was in rebellion against the newly established Abbasid regime.<sup>23</sup>

According to al-Kindī, the canal became blocked – he says due to neglect, not wilful closure – at “Dhanb al-Timsāḥ, near Bathā’ al-Qulzum”.<sup>24</sup> Al-Mas‘ūdī places Dhanb al-Timsāḥ one *mayl* (‘mile’) from al-Qulzum.<sup>25</sup> Once its way to the sea was blocked, however, the terminus of the canal soon regressed to the Wādī Ṭumaylāt, within which it still served an irrigational function. By the 12<sup>th</sup> century AD, Abū Šāliḥ says that the canal “...has its end at al-Sadīr in al-Šarqiyyah [province], where there is a dyke.”<sup>26</sup> Al-Sadīr is unknown today, but Yāqūt visited it in the 13<sup>th</sup> century AD, describing it as a “a marsh and bush area in Egypt between al-‘Abbāsah and al-Khashabī into which pours the overflow of the Nile when it rises ... It is the first place you come to in Egypt going from the Levant to Miṣr [Cairo]”.<sup>27</sup> Al-‘Abbāsah still exists today, at the western entrance to the Wādī Ṭumaylāt (Figure 20:2). Yāqūt says that al-Khashabī, unknown today, was three days from al-Fustāt “at the first part of al-Jifār province, when coming

from Egypt, and the last part when coming from the Levant.”<sup>28</sup> That suggests a location to the east of al-‘Abbāsah. Moreover, the Brigade Française map of 1847 labels Tall al-Maskhūtah as “Ruines d’Abou Kashab”,<sup>29</sup> providing an etymological connection between it and the al-Khashabī of Yāqūt. Taken together, the historical data suggest that the 12<sup>th</sup> century terminus of the canal was in the marshes of the central Wādī Ṭumaylāt, between al-‘Abbāsah and Tall al-Maskhūtah – perhaps at the appropriately named Ras al-Wādī (“Head of the Wadi”, beside Tall Ritābī; see Figure 20:2).

The Islamic era is thus the only period for which historical sources offer an interpretation of the timing of both the instigation and abandonment of the canal. The duration of earlier manifestations of the canal is not known with any certainty. However, these do appear to have acquired some longevity: the surface-ceramics results of the Wadi Tumilat [Ṭumaylāt] Survey carried out by the University of Toronto<sup>30</sup> in the 1970s-80s suggests a strong correlation between levels of settlement activity in the wadi on the one hand and, on the other, the eras during which the historical and epigraphic evidence indicates that a Nile-Red Sea Canal existed.<sup>31</sup> This suggests that the canal, at least as far as the wadi, was a successful project with an enduring legacy.

### The Landscape

The excavators of the Nile-Red Sea canal took advantage of three natural features of the Egyptian landscape to effect their project: the Nile Delta, the Wādī Ṭumaylāt, and Isthmus of Suez (see Figures 20:1-20:2). The Persian and Ptolemaic canals rose from the Pelusiac branch of the Nile near Bubastis. The later Roman and Arab canals separated from the main Nile at modern Cairo, and followed the eastern fringe of the Delta as far as the Wādī Ṭumaylāt. All then utilised the Wādī Ṭumaylāt, the depression left by a bed of an ancient Nile branch that had issued into the Isthmus of Suez as recently as 4000 BC.<sup>32</sup> The Isthmus itself provided the final conduit: this lowland corridor is part of the African-Dead Sea Rift system, dividing the African tectonic plate from the Sinai subplate (Figure 20:1).<sup>33</sup>

The location of the start of the Persian-Ptolemaic canal near Bubastis is not known precisely, but the general area is some 8 m above mean sea level. Meanwhile, the Roman-Arab canal began at modern Cairo, an area some 19 m above sea-level. By the time it reached the central Wādī Ṭumaylāt and the vicinity of Lake Timsāḥ, the unified

19. Ibn ‘Abd al-Ḥakam, *Futūḥ* 164-5.

20. Gregory of Tours, *Historia* I.10.

21. In Bourdon 1925: 5; my translation.

22. Ibn ‘Abd al-Ḥakam, *Futūḥ* 162-3.

23. Al-Balādhurī, *Ansāb* 3.269.

24. Al-Kindī’s lost work *al-Jund al-Gharbī* is cited in al-Maqrīzī (*Khītat*: 3.474).

25. Al-Mas‘ūdī, *Murūj* 4.97.

26. Abū Šāliḥ, *Tārīkh* v.ξ.

27. Yāqūt, *Buldān* 3.61.

28. Yāqūt, *Buldān* 2.445.

29. Brigade Française 1847.

30. Holladay 1982, 1987; Redmount 1989.

31. Redmount 1989: 176.

32. Clédat 1924: 52; Bourdon 1925: 18; Butzer 1976: 13, 24; Said 1993: 5.

33. Dubertret 1970; McKenzie *et al.* 1970; Jarrige *et al.* 1986: 129.

route of these canals was some 5 m above sea level. From there, it passed along the southern Isthmus, filling the below-sea-level depressions of the Great and Little Bitter Lakes before entering the sea at Suez (Figure 20:2).<sup>34</sup>

A little-understood earthwork observed in the northern Isthmus of Suez has been interpreted by some as an alternative canal to that just described, connecting the Pelusiac branch of the Nile to Lake Timsah and thence the Red Sea at Suez.<sup>35</sup> It has been suggested that this work was perhaps a Pharaonic frontier canal,<sup>36</sup> the abortive canal of Necho,<sup>37</sup> or even the route of the (or a) Ptolemaic Nile-Red Sea canal.<sup>38</sup> The work comprises two ridges resembling canal banks, separated by an 80 m-wide ‘bed’: sections of it can still be seen on satellite imagery (Figure 20:3).<sup>39</sup> While this earthwork demands renewed study and further understanding, it is difficult to see how it can have been a canal. Just north of Ismailiyyah, it crosses al-Jisr [‘el-Guisr’], a limestone ridge traversing the Isthmus that rises to 16 m above sea-level, and which represented a formidable barrier even for the 19<sup>th</sup> century AD engineers of the Suez Maritime Canal. The bed of the putative canal rises to 14 m above sea-level:<sup>40</sup> it surely cannot have carried navigable water along this section, since there is no hydrological head from which this water could be drawn. Perhaps the work was a demarcation of Egypt’s Asian frontier, as Shea suggests.<sup>41</sup> In any case, this paper concentrates instead on the route passing through the Wādī Ṭumaylāt.

### The Route

The historical sources give us some limited indication of the routes of the ancient canals. Herodotus put the offtake of the Persian canal “a little above Bubastis ... by Patumus”.<sup>42</sup> Bubastis, at Tall Bastah, is a known location, by modern Zaḡāzīq (Figure 20:2), but Patumus is not. Strabo says the Ptolemaic canal had connected to the Nile “... at Phacussa ... Here are both the city Bubastis and the Bubastite Nome”.<sup>43</sup> Modern Fāqūs, probably ancient Phacussa, is too far north – and at just 5-6 m above sea-level too low in altitude – to have been the start-place of a canal passing through the Wādī Ṭumaylāt (Figure 20:2). We can only conclude broadly, therefore, that the Persian and Ptolemaic canals began somewhere in the vicinity of Tall Bastah. The route of the Persian canal in the Wādī Ṭumaylāt and Isthmus is further suggested in broad terms by the four stelae, already mentioned, commemorating its construction.

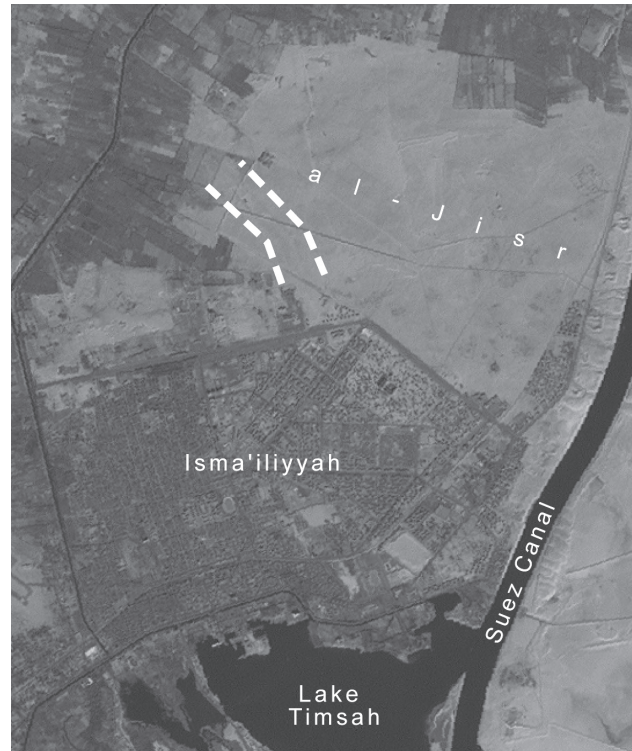


Figure 20:3. Traces of a canal-like earthwork crossing al-Jisr [‘el-Guisr’] north of Isma‘iliyyah can still be seen on recent satellite imagery. Despite the 14 m elevation of its bed above sea-level, the earthwork has been interpreted by some scholars as a Nile-Red Sea canal (satellite image: NASA Landsat Program 2000, Landsat ETM+, Orthorectified, USGC, Sioux Falls, 11/11/2000).

The later Roman and Arab canals began in modern Cairo. That the Roman canal passed through “the Roman fort of Babylon” as indicated by Claudius Ptolemy,<sup>44</sup> has recently been confirmed through archaeological investigation at the site, today’s Old Cairo.<sup>45</sup> The radical change in the start-point of the canal from that of its Ptolemaic predecessor is probably to be explained by the dwindling, since Ptolemaic times and before, of the Pelusiac branch,<sup>46</sup> and the resulting need for a larger head of water to serve the canal.

The Arab-era re-excavators of the canal were obliged to find a new connection to the river in the area of what is today Cairo, perhaps in order to avoid areas recently allocated for settlement in the newly established Arab capital of al-Fustāt.<sup>47</sup> They did so at today’s Sayyidah Zaynab

34. Survey of Egypt 1935: sheets 80/60, 84/66, 84/72, 80/72.

35. Sneh *et al.* 1975.

36. Shea 1977; Figueras 2000: 15-21.

37. Longuet 1856; Linant de Bellefonds 1872: 117.

38. Clédat 1920: 103-7.

39. The earthwork is clearly visible in satellite imagery on Google-Earth™, between 30°37’43”N, 32°16’57”E and 30°38’24”N, 32°16’19”E. (accessed 23/01/2009).

40. Linant de Bellefonds 1872: 125.

41. Shea 1977: 36.

42. *History* II.158.

43. *Geography* XVII.1.27.

44. *Geography* 103.

45. The work was carried out by the American Research Center in Egypt, led by Peter Sheehan; see Sheehan, forthcoming.

46. Grover 1877: 451; Toy 1938: 55; Sneh & Weissbrod 1973; Goodfriend & Stanley 1999.

47. Kubiak 1987: 120.



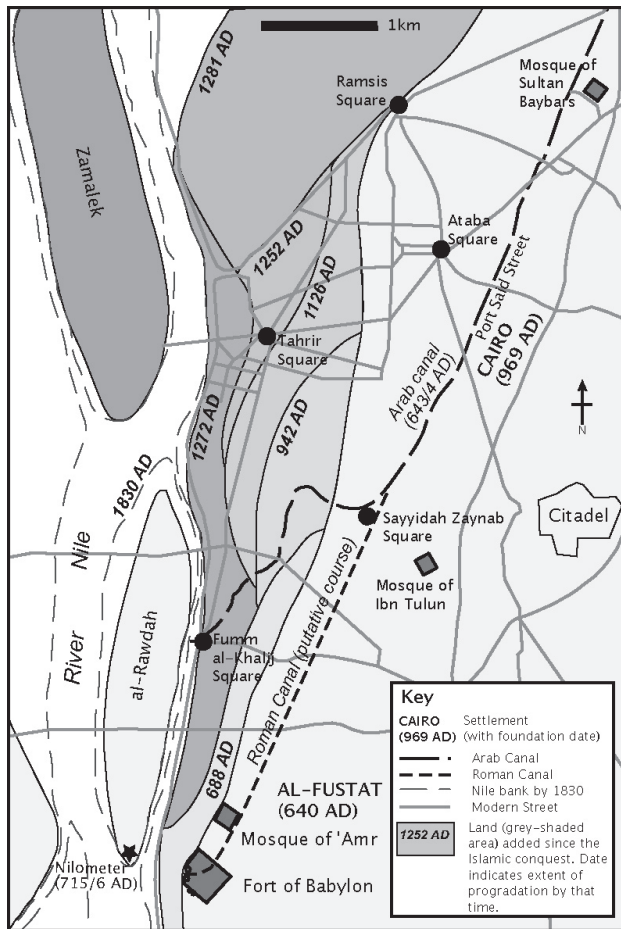


Figure 20:4. The course of the Roman and Arab canals through Cairo, showing major modern streets and the westward progradation over time of the east bank of the Nile (after Hassan 1997: 61; Said 1993: 66-8; Abu-Lughoud 1971: 8).

Square, at a time when the Nile's east bank was considerably further east than it is now<sup>48</sup> (Figure 20:4). The sinuous course of the canal as its mouth pursued the westward migration of the river can be traced in today's street layout. By the start of the 19<sup>th</sup> century, the mouth was at what is still today called Fumm al-Khalij ('Canal-Mouth') Square. Indeed, the Arab canal survived in Cairo as the Cairo Canal until 1899, when it was filled in for sanitary reasons. Further north, the united Roman and Arab canals followed today's Port Said Street through the city.

Outside Cairo, it is no longer possible to follow the trajectory of the ancient canals using visible traces alone. In 1776, the French-Hungarian military officer Baron de Tott had been able to say that the canal of the ancients could be restored to function with only a little excavation work.<sup>49</sup> Now it has almost vanished. Modern urban

development and the extension of irrigation and agriculture across the Delta, Wādī Ṭumaylāt and Isthmus have, with few exceptions, obliterated its surface manifestations. Linant de Bellefonds, chief engineer of the Suez Maritime Canal, reports that the Sweet Water Canal (completed in AD 1863) was dug along the route of the Roman (and therefore also Arab) canal from the edge of Cairo as far as the modern village of Kafr Hamzah (Figure 20:2), and that the Wādī Canal, built in AD 1817-21 and entering the Wādī Ṭumaylāt from the direction of Bubastis/Tall Bastah, occupied an ancient canal bed that was candidate for the Persian-Ptolemaic canal.<sup>50</sup>

Beyond these indications, recourse must be made to regressive cartography in order to locate candidates for ancient canals in the Wādī Ṭumaylāt and Isthmus of Suez, at least as they stood in the 19<sup>th</sup> and early 20<sup>th</sup> centuries AD. Traces of ancient canal have been depicted on modern survey-based cartography since d'Anville in 1765.<sup>51</sup> However, many of the earlier depictions – when the visible traces on the ground were most extensive – are simply too inaccurate, or too lacking in detail, to be successfully geo-referenced onto modern satellite imagery and orthographic grid systems. The cartography of the Napoleonic *Description de l'Égypte* is a case in point (Figure 20:5). While depicting extensive traces of ancient canal throughout the Wādī Ṭumaylāt and southern Isthmus of Suez, the inherent distortions of the cartography, and the lack of topographical detail, make it difficult – particularly in the wadi – to superimpose the Napoleonic data onto the modern landscape with any degree of confidence in the accuracy of the result. However, by the time cartographic methods had become more accurate – for example the 1:25,000 scale series maps of the Survey of Egypt from the early 20<sup>th</sup> century AD<sup>52</sup> – traces of the canal had all but vanished under agriculture, or in any case are not depicted.

A fortunate exception to this situation is this Brigade Française map of 1847, a survey of the planned route of the Sweet Water Canal that took in the entire area of the route of the ancient canal (Figure 20:6). Although the majority of the individual triangulation points used by the surveyors cannot be relocated, the map can nevertheless be geo-referenced within the Wādī Ṭumaylāt with encouraging accuracy. The results, including projections using other cartographic sources, are shown in Figure 20:7. Projections of the course of the canal in the southern Isthmus of Suez are shown in Figure 20:8.

These projections, which I have idealised into a single route in Figure 20:2, stand as a hypothesis of the route

50. Linant de Bellefonds 1872: 126.

51. D'Anville 1765. See also, for example, the *Description de l'Égypte* (Figure 20:3 of this article); Seaton 1830; Linant de Bellefonds 1854; Longuet 1856.

52. Survey of Egypt, Giza, 1924-50, but based on survey work carried out during the First World War (1914-18).

48. Said 1993: 66-67.

49. Bourdon 1925: 153.



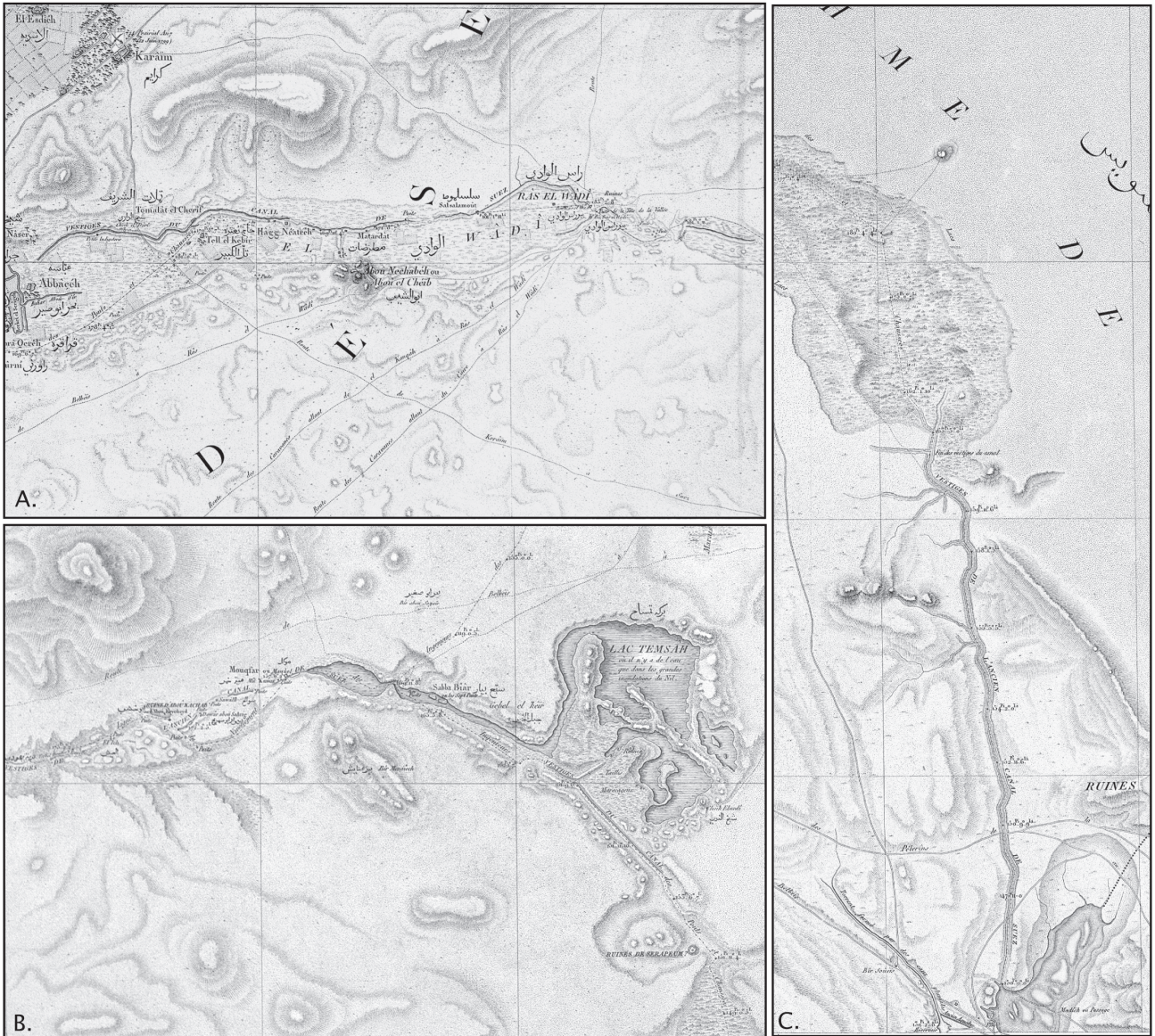
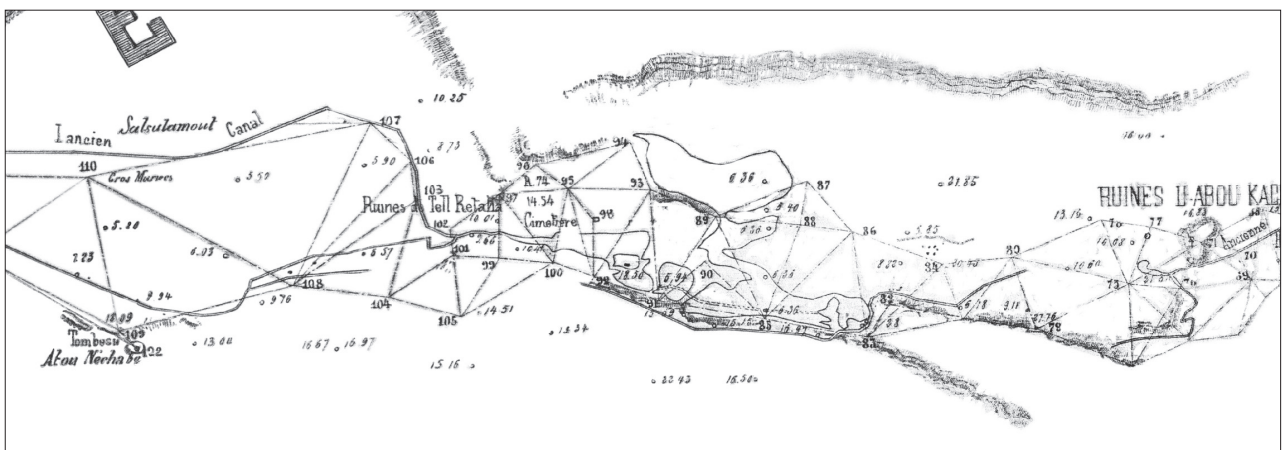


Figure 20:5. The vestiges of the ‘ancien canal de suez’ running through the western Wādī Ṭumaylāt (A.), the eastern Wādī Ṭumaylāt (B.), and the southern Isthmus of Suez (C.), according to the cartography of the Napoleonic Description de l’Égypte (Atlas, feuilles 23, 30 & 31; from the Harpocrates DVD edition of the Description de l’Égypte).

Figure 20:6. The central Wādī Ṭumaylāt: a sample section of the 1847 Brigade Française map, which depicts the contemporary state of canals along the length of the ancient canal routes (Image © Royal Geographical Society).





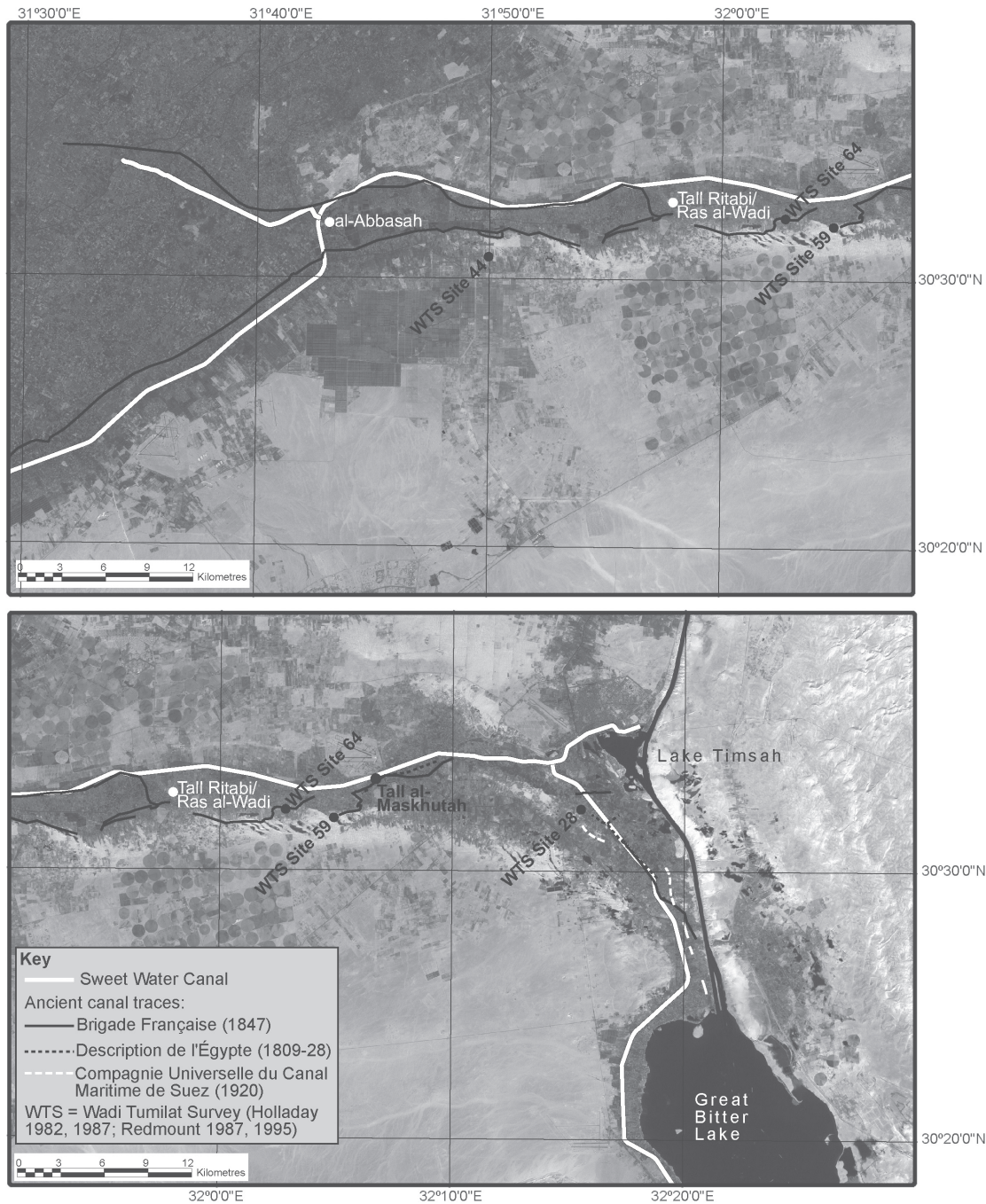


Figure 20:7. Visible traces of ancient canal in the Wādī Ṭumaylāt – as recorded by the Brigade Française, Description de l'Égypte, Compagnie Universelle du Canal Maritime de Suez, and the Wadi Tumilat Survey – geo-referenced and projected onto satellite imagery (NASA Landsat Program 2000, Landsat ETM+, Orthorectified, USGC, Sioux Falls. 11/11/2000).

of the Roman-Arab canal between Kafr Hamzah and the Isthmus of Suez, and of the Persian-Ptolemaic canal in the eastern Wādī Ṭumaylāt as far as Ras al-Wādī (Tall Ritābī), where it seems the two routes converged.

As an additional stage in the process of regressive mapping, this exercise is at least an improvement on recent scholarly assumptions, one of which assumes that the ancient Roman canal followed exactly the route of the modern Sweet Water Canal.<sup>53</sup> The degree to which the resulting

projection is usefully predictive can only be established through ground-truthing fieldwork. Nevertheless, the already mentioned Wadi Tumilat Survey gives some positive initial indications. The surveyors found just four sites (which they numbered 28, 44, 59 and 64) where traces of ancient canal banks could still be located by eye (Figure 20:7). When these are superimposed alongside the geo-referenced Brigade Française data, three of them correlate closely to the course suggested by the Brigade Française, and one not at all. In urban Cairo and the southern Isthmus

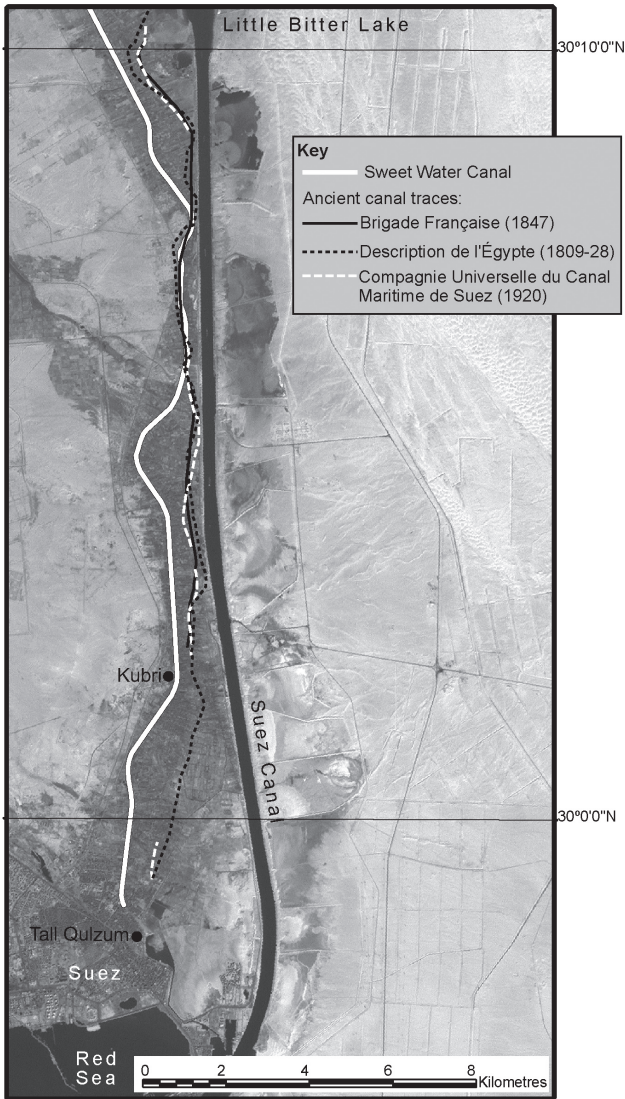


Figure 20:8. Visible traces of ancient canal in the Isthmus of Suez – as recorded by the Brigade Française, Description de l'Égypte, and the Compagnie Universelle du Canal Maritime de Suez – geo-referenced and projected onto satellite imagery (NASA Landsat Program 2000, Landsat ETM+, Orthorectified, USGC, Sioux Falls. 11/11/2000).

– for which more accurate cartographic data exists – the trajectory of the Brigade Française canal is seen to be in broad agreement with these, albeit with some error. We have, at least, a basis for further field investigation.

In terms of identifying still-visible canal infrastructure in available satellite imagery,<sup>54</sup> the investigation has been somewhat disappointing. One site where the traces of the canal are visible by remote sensing is Site 59 of the Wadi Tumilat Survey (30°32'00"N, 32°4'49"E). Another

53. Talbert 2000: pl. 24.

54. The routes were superimposed onto satellite imagery on GoogleEarth™ as well as the NASA Landsat imagery presented here.

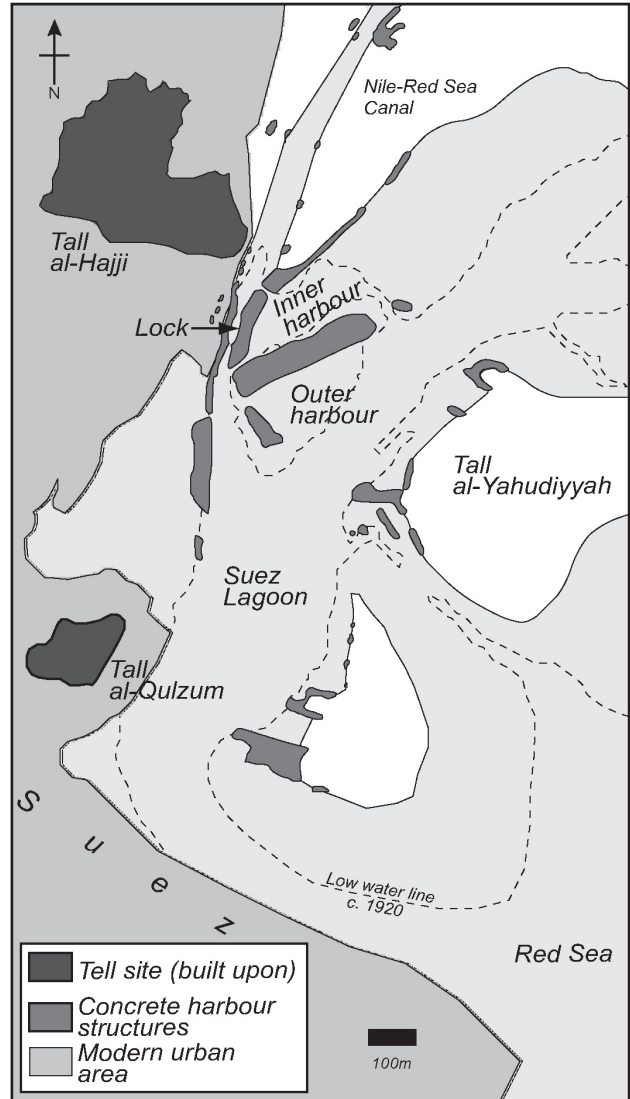


Figure 20:9. Canal mouth and harbour remains at Suez, as recorded by Bourdon (1925: cartes 7,8 & 9).

is where the canal exited the Little Bitter Lake. Here, two canals running in parallel for almost 2 km were recorded by the archaeologist Bourdon<sup>55</sup> and on some early 20<sup>th</sup> century AD maps.<sup>56</sup> Although the canals have been covered by agricultural development, their course is still recognisable in the modern field layout.<sup>57</sup>

The ancient port infrastructure associated with the canal mouth at Suez – Roman Clysma, Arab al-Qulzum – was surveyed and recorded by Bourdon in the 1920s (Figure 20:9): he did not seek to date the concrete structures he re-

55. Bourdon 1925: 109-111

56. Compagnie Universelle du Canal Maritime de Suez 1920; Survey of Egypt 1916, *Shaliḥah Station*, Parts of Sheets 82/750 and 82/765, 1:25,000.

57. The course of the canals is reflected in field patterning visible in satellite imagery on GoogleEarth™ around 30°9'45" N, 32°33'10" E. (accessed 23/01/2009).



corded, but they were clearly extensive, comprising major concrete quay structures, and a putative lock system at the canal mouth. The location of Bourdon's map of the ancient port can be re-established by regressive mapping: overlaid onto modern satellite imagery, it can be seen that much of the port site has been lost to development.

### Scale of Work

This retracing of the route of the canal through the landscape allows us to contemplate the scale of the canal as an engineering project. The Roman-Arab canal comprised some 170 km of excavated channel. From the sections surveyed by Bourdon in the early 20<sup>th</sup> century AD, that canal was about 56–60 m wide.<sup>58</sup> Assuming, for sake of argument, a canal depth of about 2.5 m, that implies the movement of some 25 mn m<sup>3</sup> of earth. Ludwig observed that early 20<sup>th</sup> century canal workers, using traditional tools, shifted 3.5 m<sup>3</sup> of earth per day per person.<sup>59</sup> Applied to the Roman/Islamic canal, that equates to 7.1 mn human workdays and 890 mn basket-loads of earth. On that basis, the Roman canal would take 20,000 people a year to complete. The claim of Herodotus that 100,000 people died in Necho's attempt to excavate the canal may be dismissed as exaggeration.<sup>60</sup> However, Muḥammad 'Alī's excavation of the 80 km-long Maḥmūdiyyah canal to Alexandria begun in 1819 – using corvée labour and hand tools – is reported to have claimed over 20,000 lives:<sup>61</sup> whatever the actual statistic, the canal of the ancients is likely to have been a costly affair in terms of human life.

### Function

Little is known of the navigational functioning of Persian and Ptolemaic canals that rose near Bubastis. However, their Roman and Arab successor, even enjoying an apparently superior offtake some 65 km further upstream, was almost certainly only navigable on a seasonal basis.<sup>62</sup> The ceremonies marking its annual opening – with the breaking of a dam at its mouth in Cairo – are recorded by Islamic-era authors, who in turn attribute pre-Islamic origins to them.<sup>63</sup> In the early centuries of Islam, these ceremonies took place at 'Ayn Shams (Heliopolis) on the Christian festival of the Veneration of the Cross,<sup>64</sup> the Coptic version of which occurs on the seventeenth day of the month of Tūt in the Coptic calendar, corresponding to 14<sup>th</sup> September of the Julian calendar.<sup>65</sup> In the early 21<sup>st</sup> century, that Coptic/

Julian date corresponded to 27<sup>th</sup> September of the Gregorian calendar.<sup>66</sup> However, in the first century of Islam, the festival fell on 17<sup>th</sup> September of the Gregorian calendar, drifting to 19<sup>th</sup> September by the 10<sup>th</sup> century AD. It is perhaps that gradual, ever-later shift within the solar year that in part prompted the abandonment of the festival as the date for the opening of the canal. In the Fatimid period, the ceremony relocated to the canal mouth, and for four years between AD 1005–09 for which the date of the opening of the canal is recorded, the average date was 10<sup>th</sup> September. The average height of the Nile on al-Rawḍah nilometer on those occasions was just over 15 cubits.<sup>67</sup> Hence, the canal was opened just before the river reached the 'plenitude' level of 16 cubits, when the Nile flood was deemed to be complete for the purposes of irrigation and land-taxation. In the Mamluk period, the plenitude ceremony at the nilometer and the opening of the canal took place on the same day.<sup>68</sup> By the Ottoman period, the opening had shifted to the day after plenitude.<sup>69</sup> In the 19<sup>th</sup> century AD, al-Jabartī says the opening took place only once plenitude had been declared.<sup>70</sup>

The implication of these data is that the canal was opened when the Nile was nearing its height, and that it must subsequently have been closed again as water levels fell.<sup>71</sup> Indeed, a papyrus written in AD 710 with Greek and Arabic counterparts urges one Basilius urgently to send equipment via the canal for ships at Clymsa "before the waters of the canal subside."<sup>72</sup> The Arabic papyrus suggests the waters were already subsiding.<sup>73</sup>

We have no direct indication of when water levels in the canal fell below a navigable level. However, a look at the trajectory of the Nile flood suggests that it was unlikely to be navigable much beyond December–January, by which time the river had typically fallen below its start-of-August levels.<sup>74</sup> The AD 710 papyrus was written on the eighth day of the month of Tybi (i.e. 3<sup>rd</sup> January of the Julian calendar and 7<sup>th</sup> January of the Gregorian) and sent to Aphrodito in Upper Egypt, where it arrived on 13<sup>th</sup> February of the Gregorian calendar: it presumably was sent in the expectation, or at least hope, that the recipient would be able to respond with the goods before the waters did indeed subside. That suggests the canal may still have been expected to be operational in February –

58. Bourdon 1925: 109, 111. Herodotus (*Histories* II.158) says that the Persian canal was wide enough for two triremes to row abreast; Strabo (*Geography* XVII.1.26) puts the Ptolemaic canal at 150 cubits wide; Pliny (*Natural History* VI.LXXXIII.165–6) puts it at 100 ft wide.

59. Ludwig 1937: 138.

60. *Histories* II.158.

61. Pudney 1968: 12.

62. Redmount 1995: 134.

63. Popper 1951: 85. Meanwhile, the Greek Orthodox festival of "the Elevation of the Venerable and Life-Giving Cross" takes place on 14<sup>th</sup> September.

64. Al-Mas'ūdī, *Murūj* 2.364; al-Muqadassī, *Aḥsan* 208.

65. Wassef 1991: 2.438–40; Basilius 1991: 2.660; Tisserant 1915: 254; Malan 1873: 5. The Latin Catholic and Greek Orthodox churches

celebrate the feast on 14<sup>th</sup> September of the Gregorian calendar. I am grateful to Dr Frank Trombley for his assistance in establishing the date of the Festival of the Veneration of the Cross: the conversions to the Gregorian calendar are mine.

66. Or, in a leap year, the day after in each calendar.

67. Popper 1951: 191.

68. Al-Qazwīnī 'Ajā'ib 175; Ibn Taghrībirdī *Nujūm* 14–87.

69. Popper 1951: 192.

70. Al-Jabartī 'Ajā'ib 4.80.14.

71. The probable seasonality of the ancient canal was concluded by the Brigade Française (in Redmount 1995: 134).

72. P. Lond 1346 and its presumed counterpart, B.M. Or. 6232 (2).

73. *Wa qad qalla mā'uhu*.

74. Hurst 1952: 241.

although this may have been an exceptional year, or a vain hope.<sup>75</sup> Surviving Roman-era papyri suggest that maintenance work on the canal took place between March and June, by which time the waters, presumably, had entirely drained from its bed.<sup>76</sup> In the early 20<sup>th</sup> century AD, the process of clearing the beds of seasonal canals is recorded as starting at the end of December.<sup>77</sup> In 1638, the visiting Jean Coppin noted that the Cairo canal, the foreshortened successor to Roman-Arab canal, had water in it for three months of the year, which suggests a December date for its closure.<sup>78</sup> More data is required in order to better understand the typical date at which the canal fell out of use.

This seasonal nature of the Nile-Red Sea canal has implications for its function. Except perhaps at the very height of the flood, this was probably a canal used by flat-bottomed Nile vessels rather than sea-going ships, assuming a need to maximise the duration of its usage and avoid groundings. The Fatimid author Ibn Ṭuwayr reports that transshipment of goods onto seagoing vessels had taken place – two centuries before his time – at al-Qulzum.<sup>79</sup> Such transshipment might also reflect the existence of some sort of lock at the Red Sea mouth of the canal, which would have helped conserve water levels in the canal against dwindling supplies and Red Sea tidal variation, and thus extended its season. Both Strabo and Diodorus Siculus<sup>80</sup> attribute a lock to the Ptolemaic canal. Bourdon also identified at Suez what he interpreted as a lock among the concrete quay structures he identified at the site of the canal mouth.<sup>81</sup>

Two authors give times for the journey through the canal: Herodotus says that the journey through the Persian canal took four days;<sup>82</sup> Ibn Ṭuwayr, that the trip through the longer Islamic-era canal took five.<sup>83</sup> However the journey is unlikely to have been of the same duration in both directions: in the Isthmus in particular, winds prevail from the northerly quarter, requiring towing in the canal sections, and beating against the wind through the Bitter Lakes. Bourdon<sup>84</sup> identified towpaths on the vestiges of the canal he located in the Isthmus area.

The seasonality of the canal also has implications for our understanding of its relationship with broader Red Sea maritime activity. For example, a canal that was typically

closed by January or thereabouts did not fit comfortably with the outward journey to India, which would have taken place once the southerly winds prevailing in the southern Red Sea had abated in March.<sup>85</sup> According to the 15<sup>th</sup> century pilot guide written by Ibn Mājid, the departure to India was to be made before 7<sup>th</sup> May, and to Hormuz by 10<sup>th</sup> June, with a second window open between early July and early August.<sup>86</sup> Earlier, in the 1<sup>st</sup> century AD, the *Periplus Maris Erythraei* says that departures should occur in July.<sup>87</sup> The Nile-Red Sea canal was closed throughout the period of these recommendations. The departure from India on the northeast Monsoon could, broadly speaking, be made at any time between October and March.<sup>88</sup> Pliny says that the Roman-era return journey was made in December-January: returning vessels would find the canal closed until September.<sup>89</sup> In the medieval period, Ibn Mājid counsels departure from India late in the monsoon, with vessels reaching the Red Sea at the level of Jiddah as late as July:<sup>90</sup> even so, the canal would not be open for another two months.

The active seasons of the canal and the India trade were, therefore, fundamentally out of sync. This of course does not demonstrate that the *port* of Clysmā/al-Qulzum was not involved in the Indian trade – in the Islamic era at least it certainly was, at least until its abandonment the Fatimid period.<sup>91</sup> However, the canal would not have been open at al-Qulzum to greet returning vessels or see departing vessels on their way, thus requiring either a land journey to and from the Nile, or the warehousing of goods until the canal was open. This disjoint between the season of the canal and that of the Indian Ocean trade, argues for a function for the canal related to more localised trade within the Red Sea, perhaps with a military-strategic dimension.

The traditions recorded by Ibn ‘Abd al-Ḥakam regarding the early Islamic re-opening of the canal suggest that, during its Arab incarnation at least, food supply to the Ḥijāz was its priority function. A number of themes emerge from these accounts: that the canal was excavated in order to increase the scale of grain exports, camel caravans having proved inadequate; that the project met with opposition from the Coptic establishment; that a forward market in Egyptian grain certificates developed in the Ḥijāz in anticipation of the grain’s arrival; and that “food, textiles, onions, lentils and vinegar” were to be sent by that route.<sup>92</sup>

75. I wish to thank Dr Federico de Romanis and Dr Frank Trombley for their assistance in interpreting the dating of this papyrus.

76. For example, Papyrus *Ivi* II: 12-25 (AD 297) refers to labourers being paid for work on the canal on 9<sup>th</sup> April, the date of contract, and in the middle of Payni (26<sup>th</sup> May-24<sup>th</sup> June).

77. Nile Commission 1925: 70.

78. Coppin, *Relation des voyages* 75.

79. Ibn Ṭuwayr *Nuzhat*: 203.

80. Diodorus Siculus, *Historical Library* I.33; Strabo, *Geography* XVII. I.25.

81. Bourdon 1925: 143-4

82. Herodotus, *Histories* II.158.

83. Cited by al-Maqrīzī, *Khīṭat* 3.475.

84. Bourdon 1925: 109-10, 112, 125, Carte 1.

85. Findlay 1882: 37; Admiralty 1892: 8; Morgan & Davies 1995: 27.

86. Ibn Mājid, *Fāwa'id* 225-6, 243-4

87. *Periplus* 39, 49, 56.

88. Tibbetts 1971: 375.

89. Pliny, *Natural History* 6.106.

90. Ibn Mājid, *Fāwa'id* 230-1.

91. For al-Qulzum’s place in the Indian trade, see Ibn Khurdādhbah, *Masālik* 153-4; Ishāq ibn al-Husayn, *Ākām* 405; Ibn Zulāq, *Fadā'il* 3.2.685. For its demise, see Ibn Ṭuwayr in al-Maqrīzī, *Khīṭat* 1.579; al-Idrīsī, *Nuzhat* 4.348; Yā'qūt, *Buldān* 4.160; al-Dimashqī, *Nukhbāt* 165; Abū al-Fidā', *Taqwīm* 1.23; al-Nuwayrī, *Nihāyat* 1.242.

92. Ibn ‘Abd al-Ḥakam, *Futūḥ* 165-6.



Later Egyptian authors say the ships sailing for the Ḥijāz had carried barley and wheat.<sup>93</sup>

The cycle of the Egyptian grain harvest fits quite comfortably with the season of the Nile-Red Sea canal. The Egyptian harvest took place between February and April,<sup>94</sup> depending on location, at which time the Nile was too low for easy bulk transportation. Instead, the harvest was stored in local granaries until the Nile began its rise, and was on its way before the river burst its banks and threatened to flood the granaries.<sup>95</sup> Thus the Nile-Red Sea canal would be opening just as the grain was on its way down the Nile. Klunzinger<sup>96</sup> notes that a number of agricultural regions of the Nile Valley, such as Nagada, were *awqāf* (Islamic endowments) allocated to the tomb of the Prophet in al-Madīnah: if these do not directly indicate the function of the canal, they at least underline the relationship of grain supply between Egypt and Arabia.

Did this pattern apply to earlier eras? The traditions cited by Ibn ‘Abd al-Ḥakam and already discussed hint that exports of some kind to Arabia via the canal had also been a feature of the Roman era. Given this more ‘localised’ perspective for the canal – centred on the Red Sea itself rather than distant trade into the Indian Ocean – Trajan’s excavation of the canal should also be considered in the light of his annexation of the Nabatean kingdom in AD 105, and thus of the extension of Roman naval and military power towards the Red Sea and Arabia.<sup>97</sup> Creation of the canal also coincided with the peak of activity at the quarry sites of the Eastern Desert:<sup>98</sup> did it also play a role in the transportation of Eastern Desert stone to the Nile? Sidebotham has suggested that the canal served just such a bulk-transportational function.<sup>99</sup> Given the Stone of Pithom inscription, imperial expansion and access to elephant hunting in the Red Sea hinterlands certainly appear to have been the Ptolemaic objective. From this perspective, for the Arabs, Romans and Ptolemies, the canal served strategic interests within the Red Sea region. Only for the Persians did the canal serve a more distant objective, in the repatriation of the spoils of empire.<sup>100</sup>

Of course, one should not overlook the fact that the canal served purposes other than connecting the Nile and Red Sea. Its waters allowed the extension of agriculture and settlement deep into the Wādī Ṭumaylāt. It should therefore also be understood as part of the Trajanic drive, for ex-

ample, to expand Egyptian grain production in the service of Rome.<sup>101</sup> Finally, the Arabic sources suggest that the Islamic-era canal project met initially with vocal Egyptian resistance: the canal’s function as a statement of raw power and imperial intent – and thus as a component of Egypt’s politically constituted landscape – should not be forgotten.

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93. Eutychius, *Naḍm* v 4; Abū Ṣāliḥ, *Tārīkh* 3.1.566r.

94. Fuller 1829: 165; Poole 1844: 100.

95. Lindsay 1968: 12, 145.

96. Klunzinger 1878: 271 f.

97. However, de Romanis (2002: 21-3) argues that the longevity of the Trajanic canal argues for the supremacy of its commercial function over a military-strategic one.

98. Sijpesteijn 1965: 111.

99. Sidebotham 1989: 488, 1991: 17.

100. For a discussion of the place of the canal in Persian imperial policy, see Cataudella 1999; Tuplin 1991; Hinz 1975.

101. Sijpesteijn 1965: 109-111.

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