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# THE MESOPOTAMIAN DELTA IN THE FIRST MILLENNIUM, BC

J. F. HANSMAN

Various proposals regarding the nature of the geological processes which have influenced the formation of the Mesopotamian Delta over the past millennia have been advanced in several recent papers. The present writer assesses some of these theories in the light of historical and archaeological evidence relating to the delta area in the first millennium BC.

UNTIL THE early 1950s, it was generally accepted by archaeologists and geologists that the lower reaches of the Mesopotamian Delta had continued since remote antiquity to build out into the waters of the upper Arabian/Persian Gulf. According to de Morgan (1900), the enormous quantity of sedimentary material brought down by the Tigris and Euphrates rivers in Mesopotamia, and by the Karun in Khuzistan province of Iran, has caused the land area of the delta to extend some 200 km to the south of its northernmost limits during the seventh and fourth centuries BC. The shorelines of the Gulf proposed by de Morgan for these periods (Figs. 1 and 2) had been largely determined from a study of contemporary historical and geographical texts (de Morgan *op. cit.*). For the seventh century, Akkadian texts were used, the most significant of which described a military expedition led by the Assyrian king, Sennacherib, in c. 696 BC against the Elamites of south-west Iran (de Morgan, *op. cit.*). For the fourth century BC, de Morgan refers to passages in the geography of Strabo and to distances recorded by Nearchus, the admiral of Alexander the Great, who proceeded by ship from the mouth of the Euphrates into the mouth of the Pasitigris river (the present Karun in Khuzistan).

In 1952, Lees and Falcon (1952) demonstrated, by comparing various charts and maps, that the mud flats of the Mesopotamian Delta had grown very little during the previous 85 years. They further proposed, from the study of aerial photographs, that numerous old irrigation canals in the lower delta region were either cut across by tidal drainage or submerged under later alluvial deposits (Lees and Falcon, *op. cit.*). Using this evidence and that derived from a study of possible regional tectonic activity, Lees and Falcon (*op. cit.*) submitted what they believe to be a logical explanation for these features:

'The plains of Iraq and the Arabian/Persian Gulf occupy a zone in which gradual subsidence has been taking place during the concluding episode of mountain building movements of Mesopotamia and south-west Persia.

They postulated that:

'The Tigris, Euphrates and Karun rivers are not building forward a normal delta: they are discharging their load of sediment into a tectonic basin, which is the successor to a geosyncline in which many thousands of feet of sediment have been accumulated in the past.'

It was suggested that, in the delta, the 'balance between subsidence and sedimentation in the recent past seems to have been finely poised', but that 'in

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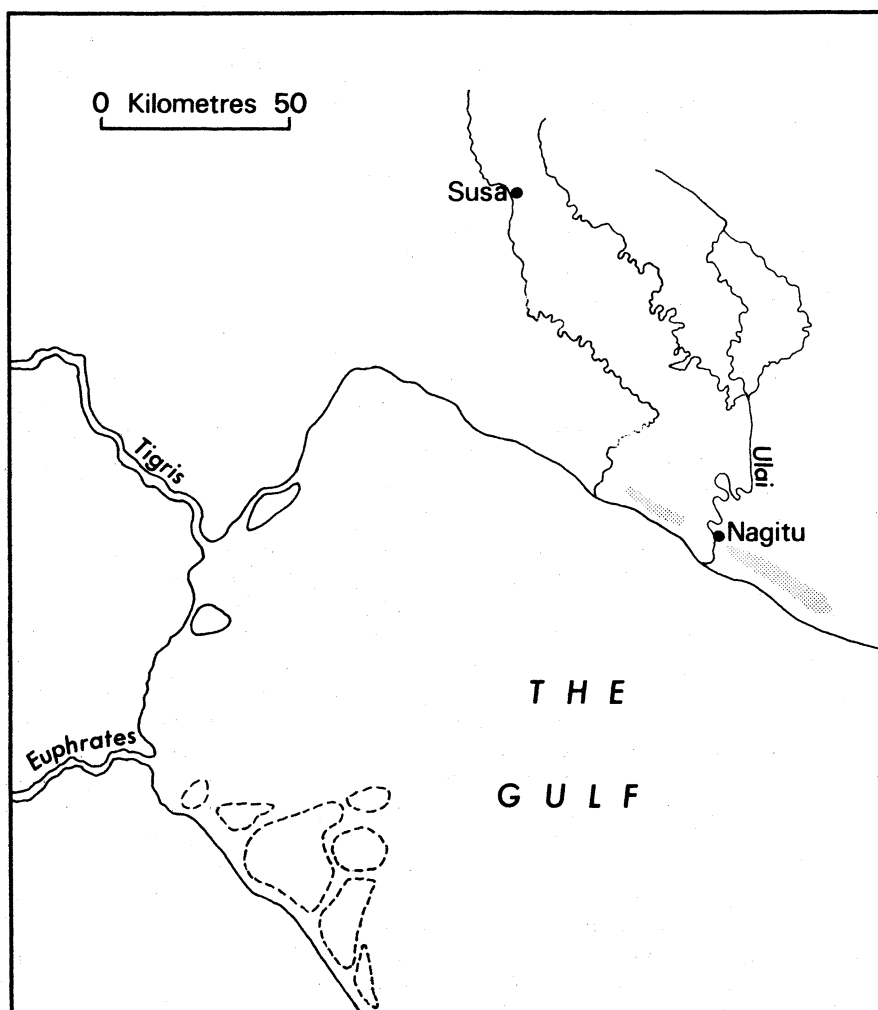


Fig. 1. The Mesopotamian Delta in the time of Sennacherib (c. 696 BC), according to de Morgan

general, subsidence has been dominant' (Lees and Falcon, 1952, p.38). In reference to historical indications, Lees and Falcon noted that none of the site locations of either Sennacherib or Nearchus was actually identified by de Morgan. In consequence, the authors held that the accuracy of the early shorelines, as represented by de Morgan, could not be substantiated and were untenable on geographical grounds. They concluded from this that there was

'no acceptable historical evidence that the head of the Gulf was ever very far up-country from its present position . . . the evidence which we have collected suggests, on the contrary, a complex pattern of advance and retreat by the sea.' (*op. cit.* p.39).

A paper published in 1975 favourably considers the theory that the positive oscillation of sea level during the first millennium BC could account for the

'internal' shorelines delineated by de Morgan (Larsen, 1975). Various data relating to tectonic activity, the question of sea level changes and the interpretation of sedimentary deposits were cited. The author of this paper concludes that 'the available evidence clearly does not disprove the views of de Morgan' (Larsen, *op. cit.*) expressed in Figures 1 and 2, but no attempt is made to assess the indications on which the findings of de Morgan are based.

It is the intention of the present writer to consider historical and archaeological evidence of the Alexandrian period, relating to the Mesopotamian Delta region in the context of how this material may accord with the shoreline delineations given by de Morgan. The Assyrian texts used by de Morgan in fixing the shoreline at the period of Sennacherib will be compared with the views of Lees and Falcon.

We begin with the account of the voyage of Nearchus, as told by Arrian (*Indica*, VIII. 42). Upon arriving at the head of the Gulf, after completing a voyage from India, Nearchus caused his ships to cast anchor at the mouth of the Euphrates.

'Here news is brought that Alexander was marching to Susa. They therefore sailed back from thence, in order to join him by sailing up the river Pasitigris. They sailed back having the land of Susis on their left. They sailed along the lake into which the river Tigris discharges itself . . . From the lake into the river is a voyage of 600 *stades*; here was a village of Susis which is called Aginis. This is 500 *stades* distant from Susa . . . Thence they sailed up the Pasitigris . . . After sailing 150 *stades* they anchored . . . When it was reported that Alexander was approaching they again sailed up the river and moored near the bridge of boats by which Alexander was going to convey his army at Susa.'

Now Arrian does not record the distance between the bridge of boats and Susa. But Strabo (XV. 3. 5) gives 60 *stades* as the relevant measure. De Morgan (*op. cit.*) follows earlier writers in suggesting that this figure is an error in manuscript transmission of the text, and that Strabo, or one of his sources or copyists, may have taken the Greek word of 600 as the Greek word for 60. De Morgan (*op. cit.*, p.11, note 1) further concludes that the bridge of boats is to be located on the Pasitigris/Karun at the shallow rapids which occur in the river near the present city of Ahwaz. De Morgan suggests this place, which would prove difficult for larger ships to pass, as a logical point to locate the bridge. He converts the 600 *stades* to 111 km and notes that this measure exactly equals the distance between Susa and the Ahwaz rapids. He then measures 27 km (the equivalent of 150 *stades*) downstream on the Karun to account for the distance of 150 *stades* which Nearchus sailed from the mouth of the Pasitigris until reaching the bridge of boats. It is at this point that de Morgan locates the shoreline of the lake into which the Pasitigris flowed. In considering the further extent of the lake in this region at the time of Nearchus, de Morgan runs his projected shore closely parallel to the southernmost line of a series of low anticlines of the southern Zagros mountain system, which rise out of the Khuzistan plain on an axis running in a north-west/south-east direction, as shown on Figure 2.

From the point on the modern Karun where de Morgan locates the outlet of the ancient Pasitigris, he has measured 111 km in a south-westerly direction to the nearest point where that measure joins the modern Tigris. This represents the distance of 600 *stades* which de Morgan calculates Nearchus sailed between the Tigris outlet and across the lake to the mouth of the Pasitigris/Karun. De Morgan does not show clearly how the western shore of the lake at the Mesopotamian plain was delineated.

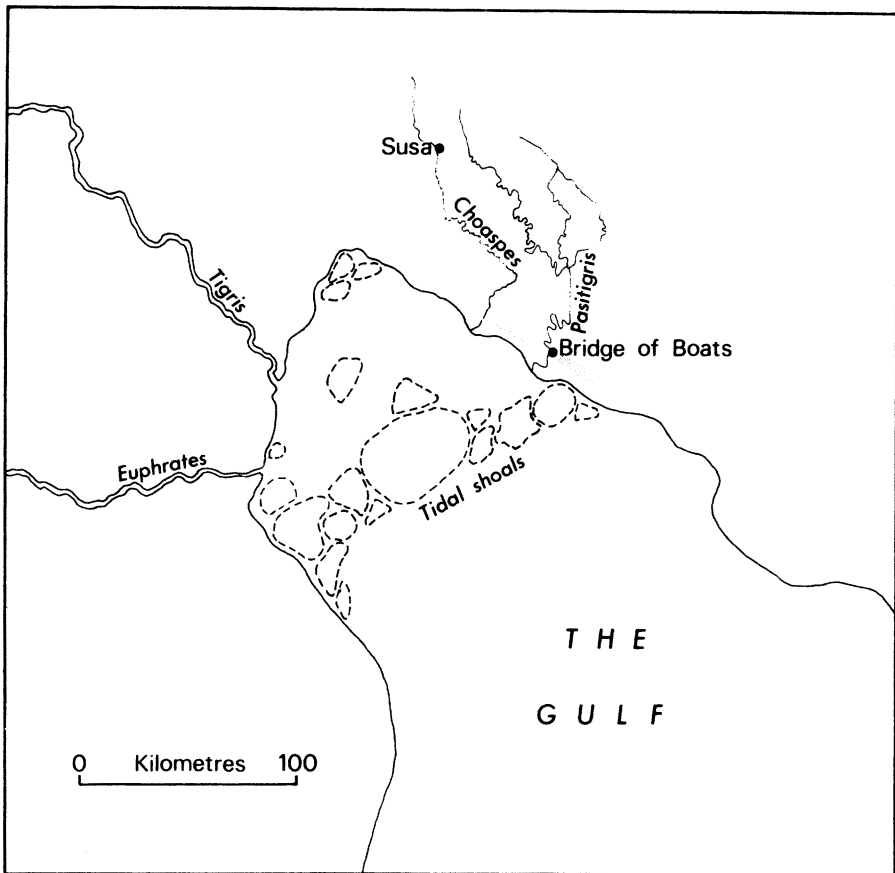


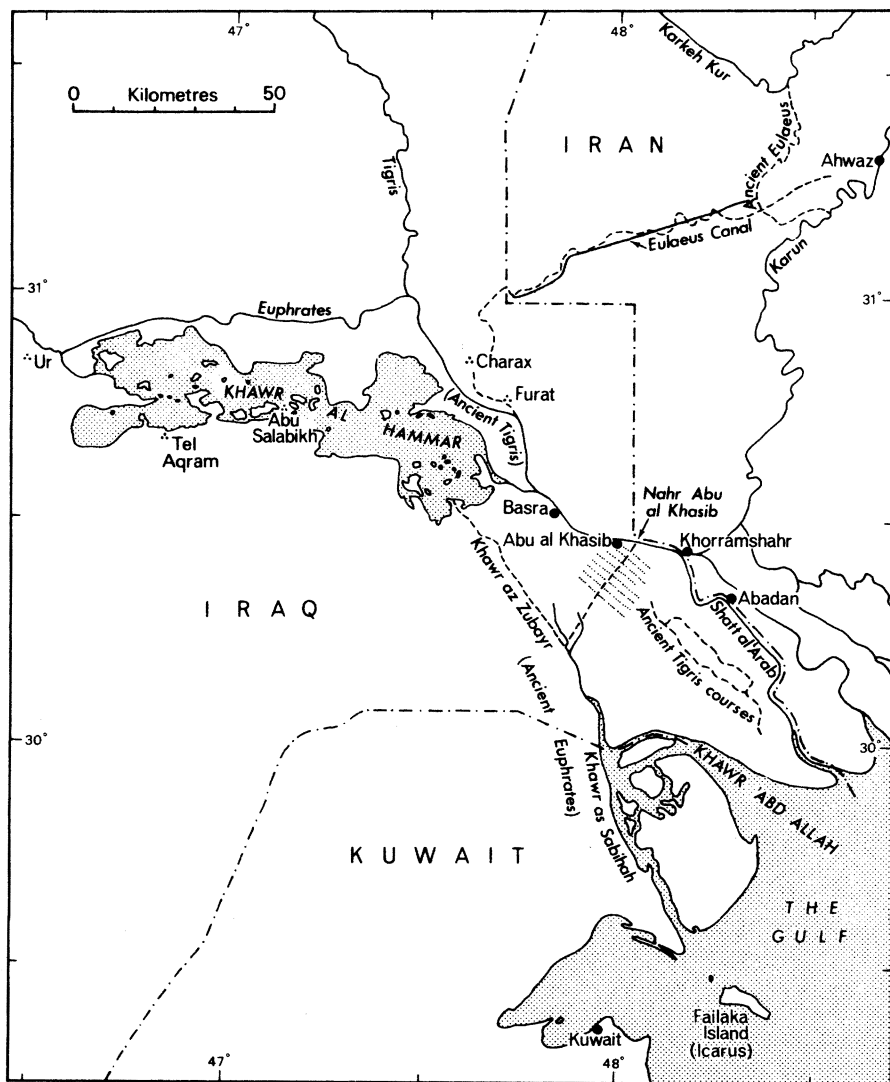
Fig. 2. The Mesopotamian Delta in the fourth century BC, according to de Morgan

In assessing the above summary, we may see that de Morgan had made a number of suggestions based on supposition. It was assumed that the distance of 60 *stades* given by Strabo was intended as 600 *stades*; that the bridge of boats across the Pasitigris/Karun is to be located at Ahwaz; that the shoreline of the lake into which the Pasitigris emptied ran parallel to the anticlinal system noted above; and that the ancient outlets of the Tigris and Pasitigris into the lake were located at the points proposed. We may further note that de Morgan shows both the Tigris and the Euphrates emptying into the lake located at the Tigris estuary. But Nearchus does not imply this. He says his ships anchored at the mouth of the Euphrates and then sailed back from thence. They sailed along the lake into which the river Tigris discharges itself, and that from the lake into the Pasitigris is a distance of 600 *stades*. Now it is not the Euphrates but the Tigris which discharges into the lake. The Euphrates has an entirely separate outlet into the Gulf. Pliny (*Nat. Hist.*, VI. 31. 129–30) states that, from the lake, the Tigris waters flowed by a broad estuary out into the Gulf beyond. To sum up the immediate point, it would seem that, in stating the distance from the lake to the mouth of the Pasitigris, Nearchus intended the distance from the outlet of the joint Tigris/Pasitigris discharge channel leading from the lake into the Gulf,

and not from the outlet of the Tigris into the lake, as indicated by de Morgan's map.

We turn now to the Assyrian text which chronicles Sennacherib's campaign against the people of Nagitu, a city belonging to Elam in south Iran. It is largely from this source that de Morgan proposed to show the extent of the upper limits of the Gulf in c. 696 BC. The text relates that Sennacherib advanced with an army of ships down the Euphrates until

\*The ships of my warriors reached the swamps at the mouth of the river where the Euphrates carries its waters into the fearful sea (the Gulf) . . . My ships I speedily brought over to Nagitu. On the shore of the fearful sea, which for landing and loading of horses, and for men to walk upon, was unsuitable . . . By the Ulai, a river whose bank was good, the battle line was drawn up' (Luckenbill. 1927, pp. 45-46).



*Fig. 3. The Mesopotamian Delta in the present century, showing ancient geographical features*

From this description, de Morgan has postulated a shoreline for the upper limit of the Gulf, as shown on Figure 1. The delineation is almost exactly that given for this region over 350 years later at the time of Nearchus, except that the area of the lake indicated in the latter period has, on the map of the time of Sennacherib, become an open part of the Gulf. The river Ulai is identified by de Morgan as the modern Karun, but the Ulai has since been equated with the classical Eulaeus river, the modern Karkheh (Hansman, 1967).

In assessing the evidence of the first part of our study, the present writer would agree with Lees and Falcon that no fixed geographical point mentioned by the ancient sources has been identified by de Morgan in his delineation of the limit of the Mesopotamian Delta during the seventh and fourth centuries BC. It is moreover suggested that certain interpretations of the sources, as given by de Morgan, are based on incorrect assumptions.

In the following section, we shall examine further references of classical writers, which concern the area of our enquiry, to determine if any of the ancient locations which these attest can be related to existing topographical features of this region.

Arrian (*Anabasis*, VII. 7. 1–2) states that Alexander spent the winter of 325–24 BC at Susa and, in the spring, he sailed down the Eulaeus river to the sea. Whereas, with a few of his faster ships, Alexander coasted by sea from the Eulaeus toward the mouth of the Tigris, the rest of his flotilla 'sailed up the Eulaeus as far as the canal cut between the Tigris and Eulaeus, and in this way they sailed into the Tigris'. Now near the point of confluence of the Tigris and the Eulaeus (canal), Pliny (*Nat. Hist.*, VI. 31. 138–9) says that Alexander ordered a city to be built. During the subsequent Seleucid period, the city was refounded by Antiochus IV as an Antiochia. Later, Hyspaosines, who seized southern Mesopotamia from the Seleucids and who became the first king of a local dynasty, caused new embankments to be raised around the city, which was then called Charax Spasines after Hyspaosines. Pliny (*Nat. Hist.*, VI. 31. 138) states that these embankments extended a distance of nearly 2 miles or 3·2 km. During some 350 years of the existence of this kingdom, known to the Greeks as Characene, the region remained under varying degrees of political control by the Parthians, who succeeded the Seleucids as the major power in Mesopotamia. Over much of this period, the main emporium of Characene was the city of Forat, which, according to Pliny (*Nat. Hist.*, VI. 31. 145) was situated 11 miles, or 17·7 km, south of Charax.

In the context of the above source evidence, we should expect to find at some point a former channel of the Eulaeus/Karkheh river, from which a canal led westward to the Tigris. Near this point of confluence, there should be located an archaeological site to be identified as ancient Charax, having embankment walls measuring approximately 3·2 km in length. Approximately 17·7 km below the embankment site, there should be another large site, which would indicate the location of the great emporium of Forat. The search undertaken to locate the Eulaeus canal, Charax and Forat has been published in detail elsewhere (Hansman, *op. cit.*). It is sufficient to note here that an ancient canal was found, which at one time joined the Eulaeus/Karkheh with the ancient Tigris, and that near the confluence of the canal with the Tigris, an enormous site was located, having embankment walls which measured the length given by Pliny. Moreover, at approximately 17·7 km below this site, there was found a second site, which measured 1·8 by 1·3 km in area. Both sites contained surface pottery of the Parthian period, the time of the major flourishing of Characene and



its two chief cities. A careful study of aerial photographs of this region, both in Iraq and Iran, has not revealed a second ancient canal which may at one time have joined the Eulaeus/Karkheh river with the lower Tigris; nor have archaeological surveys on the ground in the relevant areas, nor a close study of the aerial photographs, identified other sites which might correspond to the location and measurement of the ancient cities of Charax and Forat. Bearing the geographical and archaeological evidence in mind, as it would seem to relate to the indications of ancient sources, the canal and two sites noted above were proposed in 1967 to be those attested in antiquity. (Hansman, *op. cit.*).

It is to be noted on Figure 3 that the canal of our present concern joined the Shatt al 'Arab extension of the Tigris some 55 km south of the point where de Morgan has proposed to locate the mouth of the Tigris, which emptied into the lake at the head of the Gulf at the time of Alexander. Moreover, the canal runs 67 km south of the overall northernmost limit of the lake area proposed by de Morgan. Since the Eulaeus/Tigris canal presumably would have passed across normally dry land, it may be suggested that the actual shore of the lake in the fourth century BC was located somewhere south of this canal. Given the above findings, we may perhaps, with reason, suggest that the shoreline of the lake into which the Tigris and Pasitigris/Karun rivers emptied in the fourth century BC was located some considerable distance to the south of the limits proposed by de Morgan.

We turn next to the question of the location of the Euphrates estuary at the period of Alexander. We shall also consider the location of the Tigris estuary, which carried the combined waters of the Tigris and the Pasitigris/Karun from the lake (into which these rivers initially flowed), out through a broad channel and into the Gulf at the limit of the Mesopotamian Delta. We begin with the Euphrates.

It will be remembered that the Assyrian text, quoted above, states that the ships of Sennacherib reached the swamps at the mouth of the Euphrates, where that river carried its waters into the Gulf. Arrian, (*Anabasis*, VII. 7. 5), quoting the contemporary historians of Alexander, confirms that at that period, the 'Euphrates finishes with a diminished stream, and that spread over 'marshy land'. Jacobsen (1960) has suggested that the Euphrates of the early sources discharged into an ancient extent of the shallow body of water now called Khawr al Hammar. This swamp-like feature, measuring some 110 km from east to west, lies approximately 115 km north of the present limit of the Mesopotamian Delta (Fig. 3). Part of the Euphrates empties at present into Khawr al Hammar, and from there the waters drain into the Shatt al 'Arab near Ma'qil, some 12 km north of Basra. Approximately 20 km due west of Ma'qil aerial photographs show a broad, now abandoned, water course, Khawr az Zubayr, which runs south-east out of the southern limit of Khawr al Hammar. This leads directly into Khawr as Sabihah, a tidal channel which ends at the Gulf (Fig. 3). It would seem clear that Khawr az Zubayr/Khawr as Sabihah at one time formed a single channel by which water from Khawr al Hammar drained into the Gulf. That this was also a former course of the Euphrates is indicated from aerial photographs, in which a dark line, extending from a point near to where the modern Euphrates enters the Khawr in the west, runs to the point of the exit of the Khawr az Zubayr channel. This feature could well represent a submerged section of an old length of the Euphrates, a length which may have been submerged in the Khawr even when the az Zubayr channel was in use. **But if Khawr az Zubayr is to be identified as a former estuary of the Euphrates, is it**



possible to determine when the channel was actually carrying water?

To consider the question posed above, we turn again to Arrian (*Anabasis*, VII. 20. 3), who states that a small island, located in the Gulf 120 *stades* from the mouth of the Euphrates, had been named Icarus by Alexander. Now, in 1960, Danish archaeologists excavated a small temple on the island of Failaka, which is located some 19 km south of the outlet of Khawr az Zubayr. Two Greek inscriptions recovered from the temple confirm the identification of Failaka as Icarus (Jeppesen, 1960). Moreover, although the length of the Greek *stade* may vary, by measuring the distance given by classical authors between geographical points in the Middle East which are now known, the *stade* in these parts has been reckoned to equal 0.165 km (Hansman, 1968). Using this equation, 120 *stades* would become 19.56 km, a figure which matches very closely the distance between Failaka/Icarus and the mouth of Khawr az Zubayr (Fig. 3). As there is no other point on the Mesopotamian coast to which this short measure would reach, it would seem reasonably to follow that we have established two fixed points of ancient geography, and that from this we may determine that Khawr az Zubayr/Khawr as Sabihah was the outlet of the Euphrates at the time of Alexander in the fourth century BC. We turn now to consider evidence for the location of the Tigris estuary at this same period.

Pliny (*Nat. Hist.*, VI. 31. 131), who lived in the first century AD, states that the mouths of the Tigris and Euphrates

'used to be 25*p.* apart, or as others record 7*p.* and both were navigable, but a long time ago the Euphrates was dammed by the Orcheni and other neighbouring tribes, in order to irrigate their lands, and its water is only discharged into the sea by way of the Tigris.

For these measures of distance Pliny used the Roman *milia passuum*\*, which equals approximately 1.5 km. Since we have a fixed point for the outlet of the Euphrates at the time of Alexander, we may determine the equivalent of 25 *milia passuum* in kilometres and then measure this distance eastward from the limit of the Mesopotamian Delta toward the present Tigris estuary. The resulting figure is 37.5 km. But, in applying the measure to our map, we find that this ends some 8 km short of the present estuary of the Tigris/Shatt al 'Arab. However, on the location of the mouth of this river, we may note the observation of Lees and Falcon (*op. cit.*, pp. 29–30):

'On comparing the coastline at the mouth of the Shatt al 'Arab as shown on an old Admiralty chart of 1825 (corrected up to 1857) with the current chart . . . it will be seen that the main change is a shift of the channel of the Shatt al 'Arab to the north-east.'

They also note:

'It is interesting to find clear evidence in air photographs of older courses of the Shatt al 'Arab on the alluvium of the south bank below Abadan, some of them several miles from the present river, and it is clear that the river has for a long period, historically, had a tendency to migrate to the north-east.'

Our determination that the distance from the mouth of the ancient Euphrates to that of the ancient Tigris is 8 km short of the distance from the old outlet of the Euphrates to the present mouth of the Tigris/Shatt al 'Arab would seem consistent with the above findings. For it may be considered that the mouths of the abandoned channels of the Shatt al 'Arab/Tigris noted by Lees and Falcon,

\*For the Roman *milia passuum* see *Oxford Classical Dictionary* s.v. Mile.

and which aerial photographs show to run to the west of the present outlet channel of that river (Fig. 3), would relate more closely to the ancient measure.

The second measure given by Pliny's sources for the distance between the mouths of the Tigris and Euphrates is *7 milia passuum*, or 10.5 km. If we measure 10.5 km westward from the present Tigris estuary along the delta limit and toward Khawr as Sabihah, we arrive at a point about one-third of the way across the mouth of the very wide Khawr 'Abd Allah (Fig. 3). Now Khawr 'Abd Allah is, in fact, an eastern arm of Khawr az Zubayr, which has cut across the channel leading from Khawr az Zubayr, south of Khawr as Sabihah. As we have established that Khawr az Zubayr/Khawr as Sabihah is an ancient outlet of the Euphrates, we may further suggest that Khawr 'Abd Allah represents an alternative or later channel of the Euphrates estuary. Even if the measurement west from the Tigris/Shatt al 'Arab were taken 8 km west of the present course, to accord with a former more westerly outlet of the Tigris at the period of Pliny, this measure would still reach within the limit of the mouth of the Khawr 'Abd Allah channel, which measures 30 km across. All this would explain why the sources of Pliny variously placed the distance of the Euphrates outlet from that of the Tigris as 37.5 and 10.5 km. Arrian does, indeed, state that the Euphrates emptied into the sea by many mouths. Alternatively, it may be that the Euphrates abandoned the Khawr as Sabihah outlet for that of Khawr 'Abd Allah in the classical period, and the distances given by Pliny relate to sources of different date within that period, the earliest of which would attest the older Khawr as Sabihah channel and the latest, that of Khawr 'Abd Allah.

We have now determined that distances quoted by Pliny equal the approximate measure of distance between the established ancient outlet of the Euphrates and a possible alternative ancient outlet, and the mouth of the modern Tigris estuary, when we allow for gradual migration of the latter channel to the north-east, which is indicated. The measure from Khawr as Sabihah to the Shatt al 'Arab is already directed sharply to the north-east, so it would seem doubtful, when using the measures allowed, that the ancient outlet of the Tigris could have been further inland than at present. We may, therefore, deduce with some reason that the mouth of the Tigris to the Gulf, as it exists today, is located very close to the point of its outlet in the fourth century BC, when the Tigris/Karun and the Euphrates flowed to the Gulf in separate channels. Taking also into account the relatively unchanging position of the shoreline of the Gulf at the ancient outlet of the Euphrates, we may suggest from this evidence that the limit of the Mesopotamian Delta itself has remained approximately at the same place over the past 2400 years.

In the following section, we shall consider a further point of historical reference. Larsen (1975) states that cuneiform sources, edited by Jacobsen and Falkenstein, have 'consistently related the third millennium cities of Ur and Eridu with the sea', and it is suggested that these 'appear to have more validity than previously thought' (Larsen *op. cit.*, pp. 25, 57). The inscriptions published by Jacobsen (1960) tell of a registry place for ships on the shore of the sea in the vicinity of Ur; that edited by Falkenstein (1951) makes reference to the shadow of Eridu, which spreads over the sea. Jacobsen (*op. cit.*) himself suggests that mention of the sea in his texts may relate to a possible ancient, western extension of the shallow Khawr al Hammar, which would bring the Khawr to the vicinity of Ur. We do, of course, know that, from at least the time of Sennacherib, the Euphrates, which once passed near Ur, entered a swamp before flowing into the Gulf.

On the other hand, using evidence given by the early Islamic geographer Baladhuri, it has been suggested that Khawr al Hammar was formed in comparatively recent times. Baladhuri (I: 453–6) states that, during the reigns of several of the late Sasanian kings, many levees in southern Mesopotamia were breached by high flood waters from the Tigris and Euphrates rivers. Repairs were undertaken at various times, but it was found impossible to plug all the breaks and extensive areas of bottom land remained under water. These swamps, called al Batiha by the Arab geographers, are probably to be identified with the series of lakes and marshes which Arrian (*Anabasis*, VII. 21) and Pliny (*Nat. Hist.*, VI. 31. 130) report to have existed in the same parts of southern Mesopotamia at an earlier period.\* For it is reasonable to suggest that, without the levees, built presumably through the considerable resources of the Sasanian state, there would not have been any bottom land in the first instance. The levees would have enabled former marshy areas to be drained and protected from further flooding, for levees are not built without a primary need. It would appear, therefore, that, in breaching the levees, water from the various rivers had, in a sense, returned to areas formerly flooded and known from Assyrian inscriptions and from the writings of classical writers. We may, therefore, consider with Jacobsen that Khawr al Hammar may have extended to the vicinity of Ur in pre-Sasanian Mesopotamia, and that, over the centuries, the effect of upstream deposition from the river had reduced its size. Alternatively, it has been suggested that a registry for ships near Ur, in Ur III times, would probably have been on the main Euphrates river channel, which was then located a short distance north-east of that town. §

It is of relevance to the present enquiry to note that archaeological surveys (Roux, 1960) have located at least two ancient settlements at the southern limit of Khawr al Hammar. The first of these, called Tel Aqram, lies approximately 70 km due west of the Shatt al 'Arab, near the shore of the Khawr (Fig. 3). This site, which rises to a maximum height of 3 m and is 100 m in diameter, has produced tall, conical-shaped, pottery jars with outstretched bases, and also large beakers with flat bases. Both of these forms are characteristic of the Kassite period in Mesopotamia, i.e., of the last half of the second millennium BC. A second site, Abu Salabikh, is located on a high point of land near the southern edge of Khawr al Hammar, some 50 km east from the Shatt al 'Arab (Fig. 3). Here, pottery fragments, datable to the Neo-Babylonian period, were recovered together with a cuneiform inscription in Neo-Babylonian, which had been incised on a pottery vessel before this object was fired. The inscription has been read as Bit Iakin (Roux, *op. cit.*) and seems to relate to the land of that name, which Assyrian texts (Luckenbill, 1927), II. p. 242) describe as being a region of swamps and canebrakes near the Bitter Sea (the Gulf). Now, at present, numerous patches of canebrake grow in shallow water at the southern shore of Khawr al Hammar. The cane is the species *Phragmites communis*, called in Arabic *qasab*, and used extensively by the marsh Arab of southern Iran to build shelters. Rushes of the genus *Typha*, called *bardi* in Arabic, and used to make woven mats, also grow in Khawr al Hammar. Both of these species, and other locally-attested canes and rushes, are freshwater plants, which thrive in the

\*These upper lakes or marshes are not to be confused with the estuarine body of water, into which the Tigris once flowed, and which Ptolemy called Pelodes, meaning swampy. See Ptolemy VI.3 and the relevant map.

§A personal communication from Dr. H. Wright, who had recorded several possible sites for this mooring, which have not as yet been published.

river-fed waters of the Khawr. On the other hand, no species of cane or rush grows in the salt water estuary of the Shatt al 'Arab, or in the tidal areas at the edge of the Mesopotamian Delta; nor have we evidence for such species in the Gulf. These indications, then, seem to suggest that the reference to Bit Iakin, attesting a region of swamps and canebrakes, identifies an area of freshwater swamps, as is Khawr al Hammar, and not a tidal extension of the Gulf. Moreover, finds from the archaeological sites, located at the southern limit of Khawr al Hammar, suggest that this was the region of Bit Iakin, and that at least part of the corresponding area was **dry land which had supported a settlement (Tel Aqram) as early as the second half of the second millennium BC**. Furthermore, although both marine and freshwater fauna have been recovered from a sedimentary formation at the southern limit of Khawr al Hammar, which test borings show to be 21 feet (c. 6.5 m) thick (al Naguib, 1963), the finding of a site of the second millennium BC in this area would indicate that the underlying deposit relates to geological periods earlier than that of the Tel Aqram settlement and, therefore, also earlier than the historical periods with which the present paper is concerned.

Turning now to a further point of interest, we note that Lees and Falcon (*op. cit.*) mention Khawr az Zubayr, considered above, and also refer to another, now dry, canal, leading south-west from the Shatt al 'Arab 19 km below Basra, and which joins Khawr az Zubayr 24 km south-east of the present town of Zubayr (Fig. 3). It is pointed out that 'the tidal drainage of the Khawr az Zubayr cuts right across these old canals'. Lees and Falcon also refer to a wide area of now abandoned, irrigated land, which extends west and south below Basra and which the authors relate to the Abbasid period (AD 758–1258). It is noted that, to the south, these works gradually disappear beneath the alluvium. Lees and Falcon (*op. cit.*) believe that tidal scour, unaided, could not have caused the erosion in the tidal drainage area, or the drowning of parts of this irrigation system. They suggest that, to understand these features, 'it is necessary to assume that a slight subsidence has taken place in the tidal embayment area'.

Larsen believes that the partial drowning of the irrigation system noted above, and also the breaching of the channel of Khawr az Zubayr/Khawr as Sabihah by the sea, could be explained by 'possible fluctuations in sea level of 1 or 2 m above the present [level] . . . without recourse to tectonic mechanisms' (Larsen, *op. cit.*). In posing this theory, he suggests that the relevant irrigation system, considered by Lees and Falcon to be Abbasid, 'could also be Sasanian' (Larsen, *op. cit.*). This would then accord with the eustatic sea level curve proposed by Lund (1969), which shows a sea level in the late Sasanian period reaching a height of approximately 1.5 m above the current level.

In reference to the abandoned irrigation system of present interest, it was pointed out in 1962 that most of this area is covered by a network of parallel ridges of soil, which have been built up in short lengths. A series of abandoned irrigation canals and ditches connect to the strips of flat land, which lie between the ridges. Nelson (1962) has proposed to identify these ridges with the soil scraping operation undertaken by the Zanj, who, beginning in the seventh century, were brought to the Basra area from Africa, to serve as agricultural labour. Their main task was to render parts of this region cultivable by removing from the ground the heavily salt-impregnated top soil or *sabakh*, thereby exposing the sweet soil below for agricultural planting (Noldeke, 1892).\*

\*Tabari is the main source for the Zanj in Mesopotamia. A summary of this account is given by T. Noldeke (1892).

In tests carried out on the soil from three typical ridges, by Nelson, it was found that the salt content of these ridges was about twice that found in the basin soils.

In 869, the Zanj revolted against the Abbasid and established a stronghold at al Makhtara at a point where the canal called Nahr Abu Khasib diverged from the west bank of the Shatt al 'Arab below the port of Basra. This canal, beginning just below the present settlement of Abu al Khasib, has elsewhere been identified with the abandoned channel noted by Lees and Falcon, which joins Khawr az Zubayr below Basra, and which aerial photographs show to have been the primary feeder canal for the irrigation system described above (Hansman, 1970). The Nahr Abu al Khasib was still functioning in the tenth century, when it is mentioned in the geography of Ibn Serapion (1895). Given the available evidence then, it would seem reasonable to accept that the abandoned irrigation system below Basra, which features extensive ridges of salt-impregnated soil, are to be identified with the salt scraping and agricultural operations of the Zanj, and that these works date from the Abbasid, rather than from the Sasanian, period. It would therefore follow that the suggested drowning of a part of this system, and the erosion of the Khawr az Zubayr/Khawr as Sabihah tidal embayment area, would not relate to a high sea level of the Sasanian period, as suggested by Larsen.

It will be remembered that, in their assessment of the geomorphic process to which the Mesopotamian Delta has been subjected, Lees and Falcon suggest that tidal scour, unaided, could not have caused the extensive erosion of the Khawr az Zubayr/Khawr as Sabihah embayment area. They believe that tectonic subsidence had substantially contributed to the down-cutting. On this point, Mr. Alan Craig, a hydrological engineer with many years' personal knowledge of the region, suggests that wind-induced tides from the Gulf and upland flood flows could have played significant roles (personal communication). On the point of the possible effect of higher sea levels, if these are to be related to the Khawr az Zubayr/Khawr as Sabihah scouring, evidence considered above suggests that the rise would correspond to that shown on the curve published by Lund as post-dating the Abbasid period, and not to a rise occurring in the late Sasanian or the Abbasid period. However, a curve prepared by Scholl and others (1969) indicates no rise in sea level at this late period, and, in this case, the scouring would probably have resulted more from a combination of the effects of subsidence, upland flood and tidal scouring.

In conclusion, the present writer would agree with Lees and Falcon that the shorelines of the upper limit of the Arabian/Persian Gulf in the seventh century BC, and of the Gulf and the estuarine lake, into which the Tigris and Karun rivers discharged in the fourth century BC, as projected by de Morgan, cannot be substantiated from the historical sources. It has been noted that archaeological sites of the second and first millennia BC exist at the southern limit of Khawr al Hammar. Moreover, a comparison of geographical descriptions given by classical writers appears to relate to archaeological sites and other features, as do those referenced above to areas considered by de Morgan to have formed part of the Gulf in the seventh century BC, and of either the Gulf or the estuarine lake in the fourth century BC. Furthermore, it is suggested that geological positions, determined from comparing ancient measures of distance with existing geological features, indicate that the limit of the Mesopotamian Delta has changed very little over the past 2400 years. This finding may support the proposal of Lees and Falcon that in the delta a finely poised balance between



subsidence and sedimentation is taking place. We also note the statement of Lees and Falcon that there is no acceptable historical evidence to suggest that the head of the Gulf was ever far up-country from its present location. Given the historical and geographical indications which we have considered, the present writer suggests that the above proposal would seem reasonably established in respect to the delta over the past two and a half millennia. However, in attempting any final assessment of the geological factors which have contributed to the formation and eventual disappearance of the lake at the head of the Gulf, and to the apparent stability of the limit of the Mesopotamian Delta since the first millennium BC, we should need to give further careful attention to the possibly variable influences exercised by the interaction of different geomorphic forces at work in the delta area. As an essential part of this process, it would be necessary to look at the entire Shatt Al 'Arab tributary system, in order to attempt a reconstruction of past flow patterns. This would be a considerable task, but one worthy of serious attention, because of the light which might be shed on regional hydrology, long term water resources, soil formation and agricultural land classification.

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