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Review paper

Water storage (Lake Moeris) in the Fayum Depression, legend or reality?

GÜNTHER GARBRECHT[1]

[1] *Leichweiss-Institute for Water Research, Technical University Braunschweig, P.O. Box 3329, D-3300 Braunschweig, Fed. Rep. of Germany*

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Abstract. Historical references and archaeological evidence indicate that a man-made lake existed in the Fayum in historical times. There are few historical structures in the field of water resources development which are discussed as controversily as this storage lake. The various theories are described, a certain assessment is attempted and planned investigations are mentioned.

1. General

The Fayum is a depression some 1800 km^2 in size, west of the Nile valley and about 75 km south of Cairo (Fig. 1). At the time of the Middle Empire, it was developed for settlement and agriculture use and has since then been one of the most fertile provinces of Egypt. Comprehensive literature is available on the water management measures taken and hydraulic structures built in the Fayum. The records also mention an artificial lake named after Pharaoh Amenemhet III (whom the Greeks named King Moeris). Few historical hydraulic engineering structures are the centre of such controversy as Lake Moeris. The central issues of these discussions are (Garbrecht, 1977): Is the present-day evaporation Lake Birket-el-Qarun the shrunken remains of Lake Moeris and how large was this lake during the various historical epochs? Or was the legendary Lake Moeris a second artificial lake in the Fayum and if so, where was it situated and how large was it? Finally, some views contend that the statements of the ancient writers are misleading and that a man-made lake for irrigation purposes has never existed in the Fayum.

The literature available can be roughly subdivided into three groups:
(a) written records of ancient writers
(b) reports and interpretations from the 19th century
(c) more recent research results and interpretations.

The statements contained in these writings are contradictory and in part diametrically opposed. In the following, the present-day state of research will

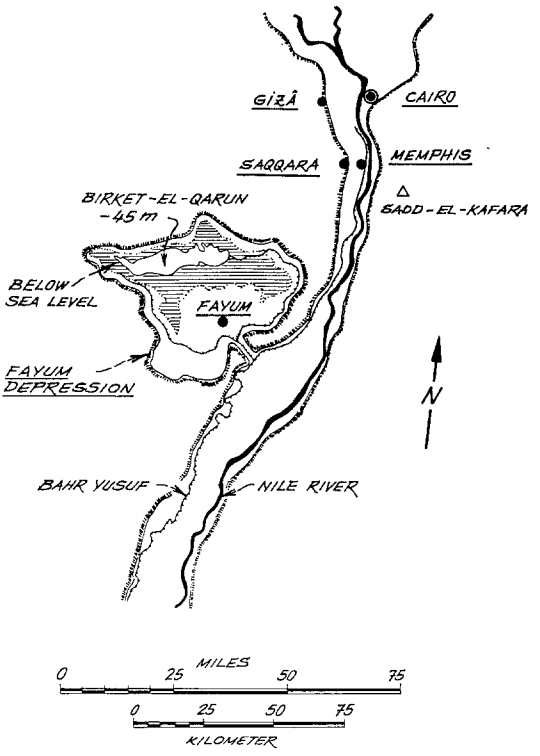

Fig. 1. Location of the Fayum Depression in Egypt.

be explained. A certain assessment will be attemped and the current and proposed investigations described.

In order to avoid a confusion of names of the lakes (which to some extent already exists), in the following, Lake Moeris will not be referred to. Reference is made to (a) a natural evaporation lake in the deepest region of the depression (which has always existed and is today called Birket-el-Qarun) and (b) an artificial storage lake (whose existence is disputed).

2. The Fayum depression

The Fayum is connected with the Nile valley via a break-through 1.0 to 1.5 km wide through the mountains bordering the Libyan Desert (Fig. 2). The surface of the basin slopes down from the east to the west, three terraces being distinguished (Erbkam, 1865):

(I) a more or less sector-shaped upper step between Hawara and Medinet-el-Fayum. Its greatest length from north to south is about 15 km and from

Fig. 2. Area of the Fayum Depression.

east to west about 10 km. As for its level, it is situated today 1 to 2 m above the low water levels of the Nile and 3 to 4 below its high water levels (about 100 km^2 area).

(II) a middle step which constitutes the largest part of the agricultural area. It drops flatly from Medinet-el-Fayum to the Birket-el-Qarun and is situated between +20 m and -20 m (about 1200 km^2 area).

(III) the saline Birket-el-Qarun ('Lake of the Horns') and its largely marshy and saline bank plains. Its water level today is 45 m below sea level (about 500 km^2 area).

In prehistoric times the Fayum was connected with the Nile River by a branch 340 km long along the hills bordering the Libyan Desert. The depression formed a large lake whose water levels communicated with those of the Nile. This connection was lost about 7500 B.C., probably due to sedimentation in the Nile branch and in the connection to the Fayum. Owing to the high evaporation rates in this desert region which are of the order of 1.5 m and 2.0 m per year, the lake area was reduced in the periods following.

At the time of the Old Empire (about 3000 to 2200 B.C.), the Fayum was not populated. Permanent settlements were to be found only in the marginal areas of the evaporation lake. As the only settlement in the actual Fayum area,

Shedet is known from a pyramid inscription dating from the 5th dynasty. In the Arab language this name means 'the raised' or 'the sheltered'. Shedet was probably situated on a cleared, elevated place in marshy land, drained by a network of canals and protected from floods by a dyke system. Later this settlement at the western border of the upper step became the capital of the 'Lake Province', with the name Crocodilopolis, Arsinoe or Medinet-el-Fayum (Fig. 2).

At the time of the Middle Empire (about 2000 to 1730 B.C.), the marshy depression of the Fayum was transformed by large-scale water management measures into one of the most fertile Egyptian provinces. The culminating point and completion of the works took place in the time of Amenemhet III (1830 to 1793 B.C.).

The project of the development of the Fayum depression comprised:

(1) the cleaning and reactivation of the old Nile arm which once connected the depression with the river (named Bahr Yusuf, as according to the legends, this work dates back to the biblical Joseph)
(2) the closing of the connection between the Nile valley and the Fayum by dams in order to regulate the water supply by the Bahr Yusuf and to prevent uncontrolled flooding of the depression
(3) the clearing and draining of the marshy and reedy plateau between the low-lying evaporation lake in the west and the eastern mountains
(4) the construction of a permanent irrigation and drainage system in the newly developed regions.

At the time of the Middle Empire a new province with an additional irrigable agricultural area of about 1,000 km^2 was developed. In the literature it is often referred to as the 'Garden of the Pharaohs', as it was a favourite place of residence of the kings because of its fertility as well as its luxuriant gardens and fields. With good reason, this peaceful conquest of wide areas by technicians and engineers is held to be one of the greatest cultural achievements of the Middle Empire.

3. Classical records

About 445 B.C., i.e. about 1400 years after the development of the province, Herodotus visited Egypt for four months in autumn, i.e. at the time of the receding floods. He stayed for some time in Memphis and also visited the Fayum.

The parts of his descriptions which are of interest here are the following (Herodotus, II. 148/150):

– There existed a man-made lake in the Fayum. In its immediate vicinity, the labyrinth and a pyramid were located (Hawara).

– The lake was filled via a canal from the Nile.

Diodorus Siculus, too, mentions extensive hydraulic engineering structures in connection with the Fayum. He lived 400 years after Herodotus and visited Egypt from 60 to 56 B.C. As he does not describe the lake but chiefly the connecting canal to the Nile, his chronicles are certainly not just a copy of Herodotus's writings. Furthermore, it is of importance that in his times, the Ptolemaic structures for the extension of the agricultural area in the Fayum already existed. According to Diodorus's statements,

– an artificial lake received excessive Nile water
– the lake was connected with the river via a canal 14 km long and about 100 m wide
– the opening and closing of the locks was achieved only with great effort and high costs. It cost 50 talents (one Attic talent = about 26 kg of silver).

The historian and geographer Strabon lived from 63 B.C. to 23 A.D. In the 17th volume of his 'Geography' (Strabon, 1829/1835), he also describes Egypt which he had visited in 26 and 25 B.C. Like Diodorus, his description refers less to the lake than to the canal and its operating installations:

– The lake is suitable for taking up the excessive flood waters and for retaining the water necessary for irrigation.
– Both mouths of the canal are provided with locks.

In about 43/44 A.D., the South Spaniard Pomponius Mela, in the first volume of his three-volume 'Geography' indicates that '... Lake Moeris is situated where once there were fields ... Its circumference was 20 millia ...'. Finally, Pliny (1855), in his 'Natural History' which he wrote from 50 to 70 A.D., twice mentions an artificial lake in the Fayum (5th and 36th volume).

According to these ancient historians and geographers, between 450 B.C. and 50 A.D., there was a lake in the Fayum in which water from the Nile was stored for irrigation purposes. The discharge in the connecting canal between the Nile and the depression could be regulated. Herodotus and Diodorus speak of an artificial lake. whereas Strabon states that is was a 'natural phenomenon'. The fact that Pomponius describes a lake 'where once there were fields' is indicative of a man-made lake.

An Arab manuscript should also be mentioned which is cited by Whitehouse (1887). It ascribes the development of the Fayum depression to the legendary Joseph (Yusuf). Although the technical principle of land development is correctly described, a storage lake is not mentioned. However, two lakes appear in a map 'Aegyptus Hodierna' which was drawn up by the geographer Baptist Homann, Nuremberg, on the basis of a travel book by Paul Lucas (who had visited Egypt in 1719): 'Moeris Lacus' in the north and 'Gara Lacus' in the south of the depression (Fig. 3).

Fig. 3. Two lakes in the Fayum Depression according to a description of Paul Lucas (1719).

4. Descriptions from the 19th century

Linant de Bellefonds was in Egypt for many years and was Chief Engineer to the Viceroy of Egypt in the mid 19th century. In his memoires (Linant, 1872-73), he also dealt in detail with the storage lake in the Fayum men-

tioned in the ancient writings. On the basis of the literature available to him and his visits to the Fayum, he held the view that the lake was situated on the uppermost terrace in the east of the depression. It was an artificial lake enclosed by man-made embankments which had nothing to do with the Birket-el-Qarun (Fig. 4). Linant repeatedly cited the ancient writers and also referred to the long stretches of a masonry wall near Itsa-Shidmuh in the south-east and the 'dams' near Idwa (north-east of Medinet-el-Fayum).

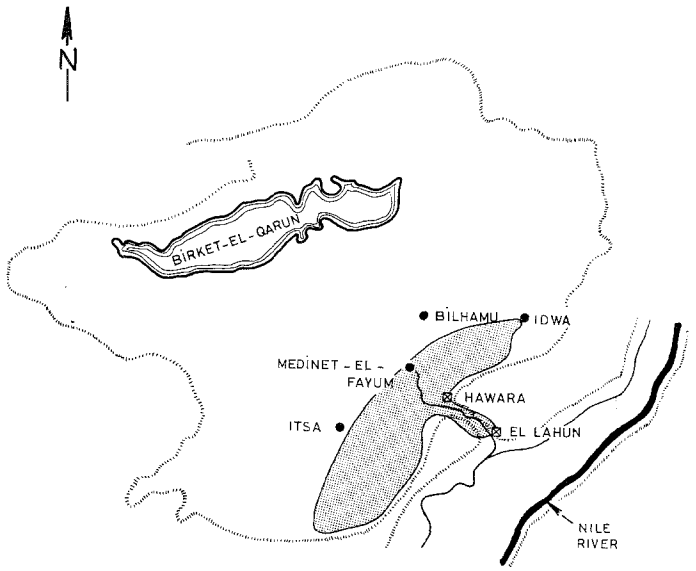

Fig. 4. Lake Moeris according to Linant de Bellefonds (1872-1873).

R.H. Brown (1892) who was the Chief of Staff for irrigation in Egypt at the end of the 19th century was of the opinion that the whole Fayum depression had served as a storage reservoir for the Nile and that only parts of the uppermost terrace had been protected by dykes (Fig. 5). The present-day evaporation lake of Birket-el-Qarun is thus the remains of the former lake. Brown supports his opinion chiefly by arguments from the point of view of irrigation engineering and frequently refers to Herodotus. W.M. Flinders-Petrie (1889), egyptologist and archaeologist, basically comes to the same conclusions as Brown.

In the works of Schweinfurth (1880, 1886) Willcocks (1904, 1913) and Beadnell (1905), the lake in the Fayum is discussed but in comparison with Linant, Brown and Petrie, the statements do not contribute any essential new aspects.

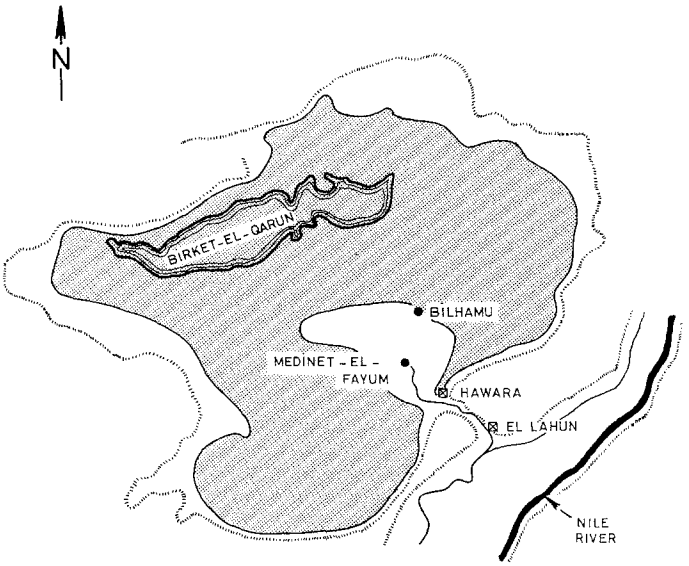

Fig. 5. Lake Moeris according to R.H. Brown (1892) and W.M. Flinders-Petrie (1889).

5. Investigations in the 20th century

A solution of the Moeris problem was attempted by the geologist Miss Gardner and the archaeologist Miss Caton-Thompson (1929) who carried out investigations from 1924 to 1928 in the relatively undisturbed northern region of the depression to which only scant attention has hitherto been paid. As one result of the thorough investigations, the following lake levels existed (Fig. 6):

- 7500 B.C. The connection between the Nile and the depression is interrupted.
- 5500 B.C. The water level of the lake lowers to about +10.00 m. First eolithic settlements at the border of the depression.
- 5000 B.C. The water level lowers to about −2.20 m.
- 5000 to 2000 B.C. The water level remains more or less unchanged.
- later than 2000 B.C. Water levels at −2.20 m or lower (indications of intermediate levels between −2.20 m and −44.90 m do not exist).

On the basis of these results, the scientists concluded that the water level of the Birket-el-Qarun (which they considered to be Lake Moeris) was −2.00 m to −3.00 m (Fig. 7) at the time of the development measures taken by Amenemhet III and did not change during the following 1500 years. As intermediate levels are not perceptible, the lowering by about 42 m to the present-

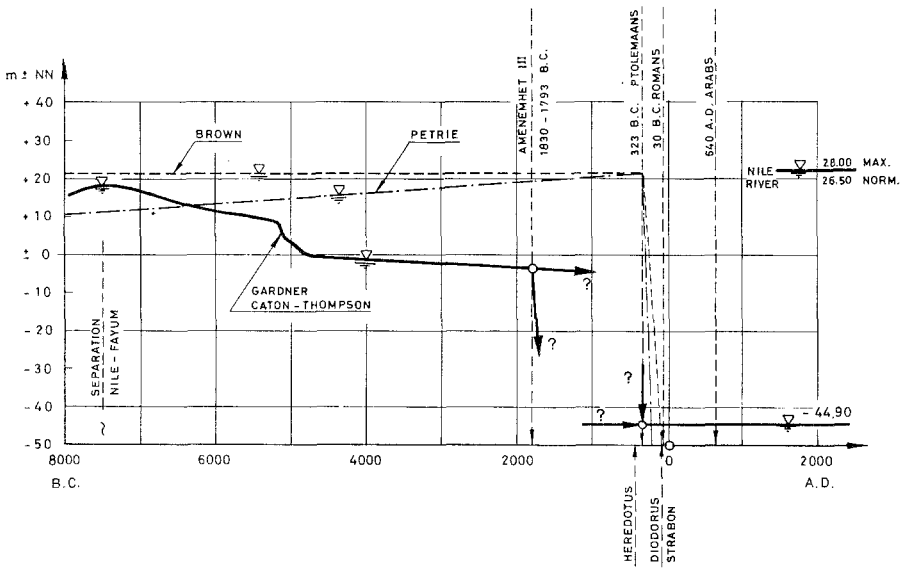

Fig. 6. Historical lake levels in the Fayum Depression.

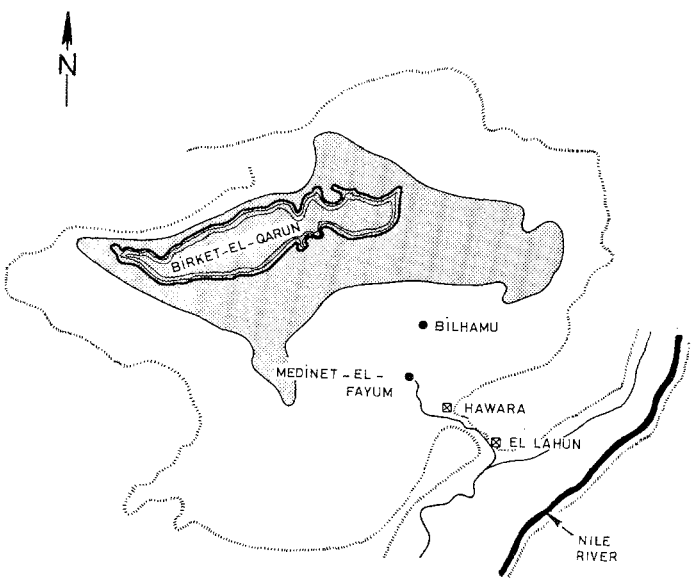

Fig. 7. Lake Moeris (about 1800 B.C.) according to Caton-Thompson/Gardner.

day level of about −45 m must have taken place within a relatively short time. According to the geological and geographical findings, this drawdown can have occurred at any time between 2000 B.C. and 300 B.C. Caton-Thompson/ Gardner assume that it took place at the beginning of the Ptolemaic period (300

to 250 B.C.) when new land had to be procured for the settlement of the Macedonian soldiers.

Another essential result of the investigations consists in the finding that the 'dams' east of Bilhamu which Linant, Brown and Petrie considered to be artificial dams are of natural origin and are not man-made.

These investigation results rule out the theories of Brown and Petrie who assumed that until the time of the Ptolemies, the water level of the lake was about +23.00 m (Brown) or was rising to +23.00 m (Petrie). The possibility that a second lake (in addition to the evaporation lake) existed in the east or the south of the depression is, however, not in principlt excluded.

Strub-Roesler (1941) assumes that apart from the evaporation lake, a second lake existed which in his opinion could have been situated only in the Gharak Basin in the south-east of the Fayum (Fig. 8). In the region of the basin no historical monuments exist, and the area is thinly populated even today. In 1829, in its western part, Linant de Bellefonds still saw a lake which was drying up. The dam separating the basin from the Fayum Depression would have to be sought on the watershed between the Gharak Basin and the Fayum. Here in fact long stretches of masonry walls exist which Linant included in his concept and which were also mentioned by Brown and Schweinfurth.

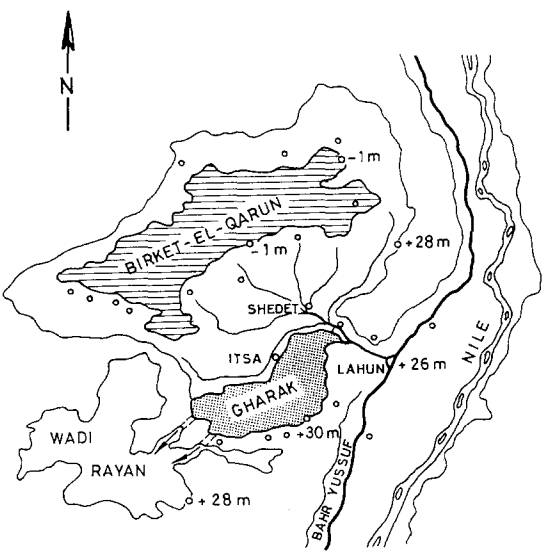

Fig. 8. Water storage in the Gharak Basin according to Strub-Roesler [1941].

6. Present state of research

If the investigation results obtained by Caton-Thompson and Gardner are correct – and there are no sound reasons for believing that they are not –, the following can be stated:

(a) A natural evaporation lake existed in the Fayum. In historical times, until the period of the 12th dynasty, its water level was situated slightly below sea-level (Fig. 6).

(b) In Ptolemaic and Roman times, the lake area corresponded already more or less to its present-day size (Birket-el-Qarun).

(c) As intermediate levels are not perceptible from the geological point of view, the lowering by about 42 m must have taken place very rapidly. In view of the short period and the extent of the fall, only human interference can be held responsible. According to historical records, it could be attributed either to measures taken at the time of the 12th dynasty (about 1800 B.C.) or to the land development measures under Ptolemy I (305-283 B.C.) and Ptolemy II (283-246 B.C.).

(d) The Birket-el-Qarun was and is a deep-lying lake in the north-west of the depression. It cannot have had the characteristics that ancient writers attribute to the Lake Moeris. Either Herodotus was mistaken (i.e. he saw only the irrigation basins which were flooded at the time of the visit) and later writers wrongly took over from him the existence of this lake, or there indeed existed a second lake in the east of the depression which Herodotus actually saw.

(e) Remains of the lake and of other structures of Amenemhet III have not been found. As Herodotus describes only the labyrinth and the lake but not the connecting canal and the appurtenant dams and locks (like Diodorus and Strabon), the regulating structures dating from the Middle Empire cannot have been very impressive.

(f) Diodorus and Strabon visited the Fayum more than 200 years after the development measures taken by the Ptolemies, i.e. they did not know the structures from the Middle Empire. Both deal in more detail with the canal and the dam than with the lake. Of the dam between the Nile valley and the Fayum near Lahun (Fig. 9), several kilometres are still preserved. According to its construction details the dam could be of Ptolemaic origin. Even today it is very impressive, and it is understandable that it was referred to by both writers together with the canal.

(g) Both Diodorus and Strabon mention a storage lake for irrigation purposes which they call Lake Moeris. They cannot have been referring to the Birket-el-Qarun whose water level at that time was already more than 40 m below sea-level (Fig. 6). In the south-east of the Fayum, in the vicinity of the village of Itsa, however, several kilometres of well-preserved remains of a

Fig. 9. Dam at Lahun separating the Fayum Depression from the Nile Valley

masonry dam (Fig. 10, 11) are to be found which are situated on the watershed between the Gharak Basin and the Fayum (Fig. 8). According to the type of construction, they can be dated back to the Ptolemaic-Roman period. These walls could have surrounded an artificial lake situated in the Gharak Basin. Such a lake would fit the descriptions given by Diodorus and Strabon. It apparently still existed in the 18th century (Fig. 3).

7. Attempts at an interpretation

The ancient records after the Ptolemaic period (Diodorus, Strabon, Pliny) and more recent investigations (particularly Caton-Thompson and Gardner) permit the following interpretation in context with an artificial lake: In Ptolemaic times, new irrigation land was developed in the Fayum. At that time, the dam in the vicinity of Lahun, which still exists today, was constructed; the Birket-el-Qarun shrank to its present-day size. In the region of the Gharak Basin an artificial storage lake was laid out which was filled during the Nile floods from August to October. These installations, repeatedly repaired and reconstructed, were in operation until the 17th or 18th century. Here there are no serious contradictions.

The question of the period of time between 1800 B.C. and 300 B.C. still remains to be answered. The position of the water level of the Birket-el-Qarun is

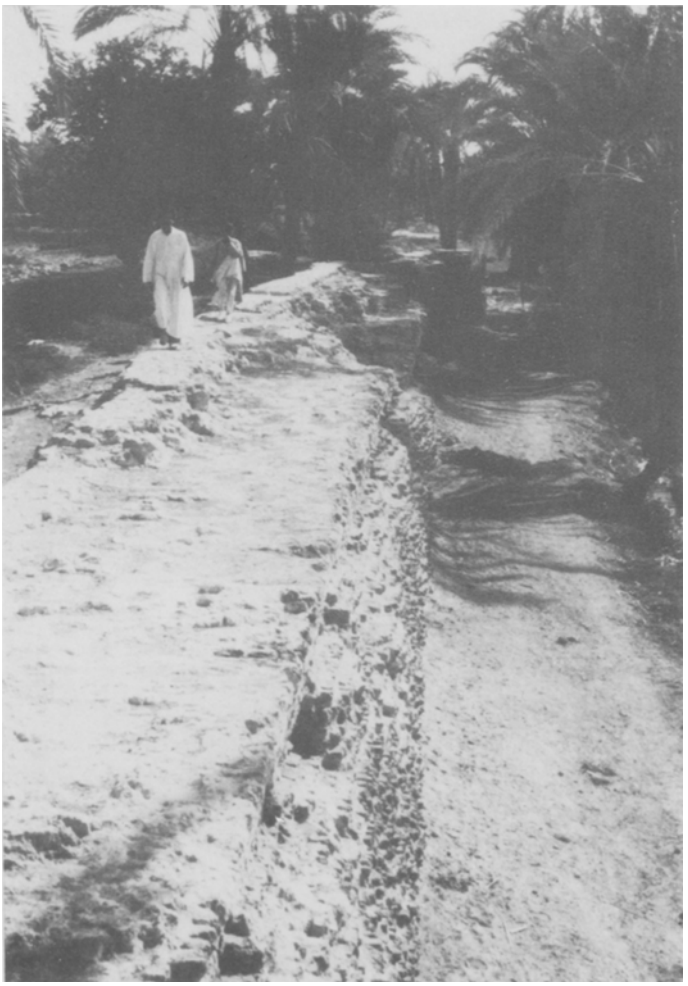

Fig. 10. Masonry Dam near Itsa (Fig. 8).

unknown (Fig. 6). In any case, in the Middle Empire, wide regions of the Fayum were developed for settlement by water management measures, particularly by a regulation of the water supply from the Nile. Remains of the dam structures have not survived. Herodotus who visited the Fayum before the Ptolemaic constructions were undertaken describes an artificial lake 'a little below which', 'near which' or 'on whose bank' the labyrinth and the appurtenant pyramid (Hawara) were located.

Linant de Bellefonds took the indication 'on whose bank' literally. He interpreted the natural dams north of Idwa to be artificial structures and concluded that the lake described by Herodotus had covered the whole upper terrace of the Fayum (Fig. 4).

Fig. 11. Masonry Dam (downstream face) near Itsa.

If the natural formations near Idwa are disregarded and the statement that the labyrinth was situated 'a little above Lake Moeris' is accepted, a lake in the Gharak Basin, too, would fit Herodotus's description. This location would also be supported by the fact that the Gharak region constitutes a natural basin which can easily be transformed into an artificial lake. If this idea is correct, the old lake dams from the Middle Empire would have to be sought underneath the Ptolemaic walls.

The key to the solution of the question of whether or not Herodotus's 'Lake Moeris' existed thus appears to lie in the region of the watershed between the Fayum Depression and the Gharak region. At present, a thorough investigation of the walls which have survived in this region is being prepared. Should the research unveil older foundations or fills below these masonry walls which are probably of Ptolemaic origin, the existence of an artificial storage lake in more ancient times is evident. If such traces are not found, the suspicion that Herodotus incorrectly interpreted his observations and the descriptions of his Egyptian hosts (priests) gains ground.

The above interpretation of what is known and the records available still leaves some questions open. Of all views held, however, it appears to contain the fewest contradictions.

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