

Archeology and Geology in Ancient Egypt

Geomorphological analysis permits reconstruction
of the geography of prehistoric settlement.

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Archeological sites of moderate or great antiquity generally present problems susceptible to investigation by geologists or geomorphologists, and often correct geological interpretation is essential to effective understanding of such sites (1). The physical environment of the immediate site and of the wider habitat of its occupants may require reconstruction for the period of settlement—at least if the archeologist aims at full interpretation of all categories of materials.

Interdisciplinary contact between prehistory and geology or geography (2) has a long, although often tenuous, history, dating back well into the 19th century. The most frequent occasion for such cooperation was provided by cave excavations, and the digging archeologist was as often as not a geologist himself. During the decades in which the Abbé Breuil dominated the field of Paleolithic prehistory, at least in France, such collaboration was fostered and developed. And in recent years earth scientists have frequently participated in archeological excavations and surveys on various continents.

However, the archeologists concerned with the younger, postglacial aspects of prehistory have often shown less appreciation of the need for a compre-

hension of the environment as a functioning whole. From the anthropologist's standpoint, R. J. Braidwood (3) has adequately emphasized the full interpretative potential of the evidence of natural history on the part of the earth scientist; however, there is inadequate awareness of this potential. Most geomorphologists involved in archeological work have little interest in post-Pleistocene events and often insist that nothing of note has happened during the Recent epoch. The basic difficulty is probably that a great deal of microstratigraphy and patient search for apparently insignificant pieces of evidence are necessary for this period.

Accordingly, I shall concentrate my present remarks upon the Neolithic and Chalcolithic (Predynastic) settlements of the Nile Valley, sites which date from the earlier part of the Recent, some 7000 to 5000 years ago (4). Although all Pleistocene investigations in Egypt have had paleolithic man well within their scope (5-7), the only Recent sites subjected to any detailed geological interpretation have been the Fayum Oasis (6) and Maadi, a few miles south of Cairo, examined by S. A. Huzayyin (8) in 1941. This should not be taken to imply that the archeologists in question have not paid attention to the physical settings. The great pioneer J. de Morgan (9) left proof of such

attention, and later reports on some sites, particularly those investigated after 1918, are not without comment on or appreciation for the geomorphological background.

Some problems related to the Nile Valley settlements of Neolithic and Predynastic times are widely recognized by prehistorians—chiefly, that many archeologic sites have been buried by Nile alluvium in the course of flood-plain aggradation. Another problem, ably presented by S. Passarge (10), has been the physical environment posed by the Nile flood plain in prehistoric time. Passarge indicated that a natural flood plain was no jungle swamp and was in no way comparable to the perennial Sudd marshes of the Upper Nile.

The problems discussed here are more specific:

1) What is the immediate geologic-geographic setting of the late prehistoric sites in the Nile Valley?

2) What are the relations of such settings to the surficial deposits of the valley margins? What situations are likely to have been deliberately selected by man or accidentally preserved from natural obliteration?

3) What regional generalizations can be made about the likelihood of occurrence of sites? Are some of the cultural gaps (see 11), in particular between the Lower and Upper Egyptian cultures in pre-Gerzean times (prior to about 3500 B.C.), related to unfavorable preservation over broad areas or to lack of former habitation in frontier marches?

4) What proportion of the late prehistoric sites is actually preserved, or, are the known sites representative of the density of actual settlement? And lastly,

5) What were the physical conditions dominant during the period of Neolithic-Chalcolithic settlement?

Geologic-Geographic Setting

The Nile Valley consists of three major land-form elements: the fertile alluvium of the seasonally inundated flood plain; the low-lying sand or gravel wastes bordering the flood plain; and,

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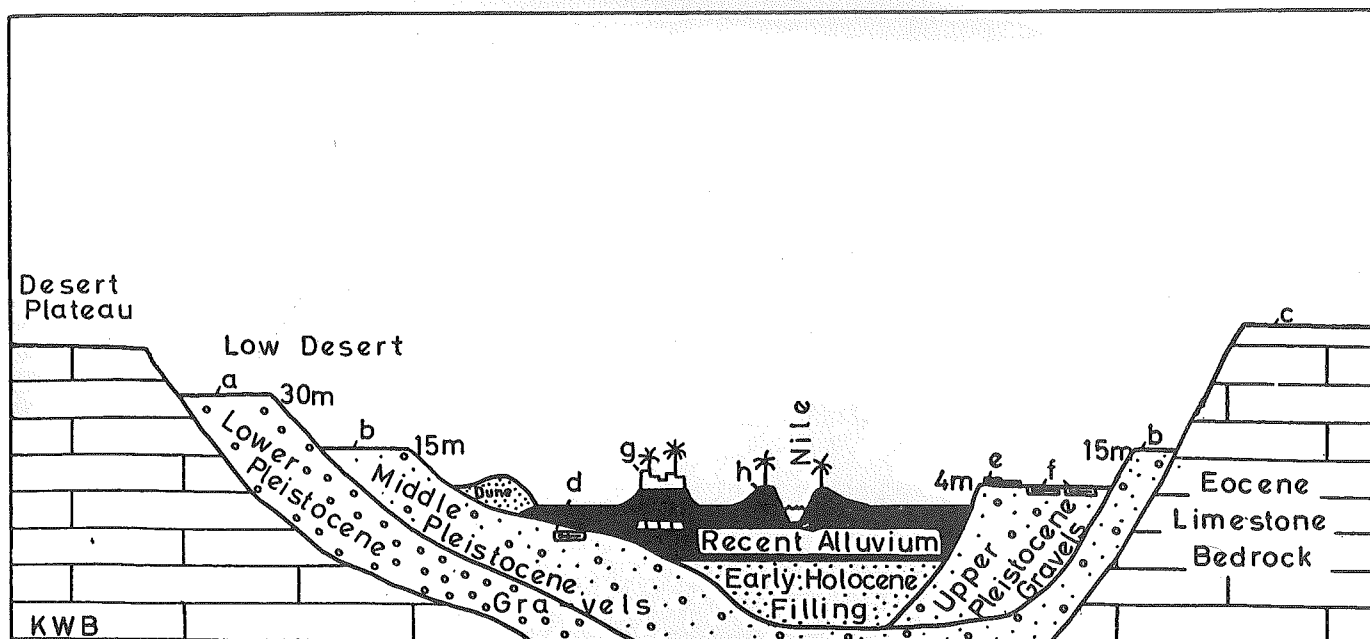


Fig. 1. Schematic diagram of the relation of archeologic sites to geological features of the Nile valley. *a, b*, Nile gravels containing Lower Paleolithic implements with scattered Middle Paleolithic artifacts on the surface; *c*, Predynastic flints scattered over desert surface; *d*, possible "buried" Predynastic cemetery, under subsequent silt deposits; *e*, remains of Predynastic settlement; *f*, Predynastic burials; *g*, modern village on cultural mound (ancient site at base?); *h*, roads on levee embankments bordering low-water channel of the Nile. [Not to scale]

lastly, the mountainous escarpments along the margins of the valley. The latter represent the dissected edge of the horizontal sedimentary strata of the Libyan plateau. In the Younger Tertiary the predecessor of the modern Nile began to incise its present course (7) and so excavated a great channel averaging some 400 or 500 meters in depth, 10 to 15 kilometers in width. During a marine transgression of mid-Pliocene age this valley was submerged and filled with marine or lacustrine sediments, which were partially re-excavated at the beginning of the Pleistocene period some million years ago.

The subsequent evolution of the Nile Valley in the course of the Pleistocene is one of alternating gravel aggradation by the Nile and its now-defunct local tributaries and of vertical incision and downcutting. The sum total of semi- or nonconsolidated Pliocene sediments and Pleistocene terrace gravels exposed on the outer margins of the flood plain comprises what the archeologists designate as the "low desert." The youngest deposits are a relatively thin sheet of clayey silt, averaging some 6 to 11 meters in thickness—the alluvium (Fig. 1).

With the exception of the Neolithic settlements along the shores of the ancient Fayum Lake (10 meters above mean sea level) (6), all of the Late

Stone Age and Copper-Stone Age (Chalcolithic) village- or townsites are located on the low desert edge, immediately beside the flood plain (Fig. 2). The advantages of such locations in terms of water supply, proximity to the agricultural land, and flood-free elevations are obvious.

The oldest such low-desert site studied was that of Merimde, on the western margins of the Nile delta. One carbon-14 date, possibly some 300 years too young, is 3820 ± 350 B.C. (12). The townsite, thought to have been occupied for a few centuries, covered some 180,000 square meters and is characterized by cultural debris attaining an average depth of 2 meters (13). If the whole site was occupied at any one time, it would appear that a population estimate of some 16,000 would not be illogical (14); Merimde would thus have been the largest prehistoric settlement in Egypt and, at the same time, one of the oldest.

The geological setting of Merimde is relatively simple (Fig. 3). The basal sediments are sandy gravels of Lower Pleistocene (pre-Paleolithic?) age rising as low bluffs some 50 meters above the flood plain. Banked against these are Middle Paleolithic silts, at least 3 meters above the alluvium, dating from the late Pleistocene. The townsite is limited to these unconsolidated deposits and

may have extended farther northwards onto the flood plain; this area is now obscured by sand deposition, however. This edge of the townsite may also have been reduced by lateral planation of the Nile in the course of annual flooding and deposition during 60 cen-

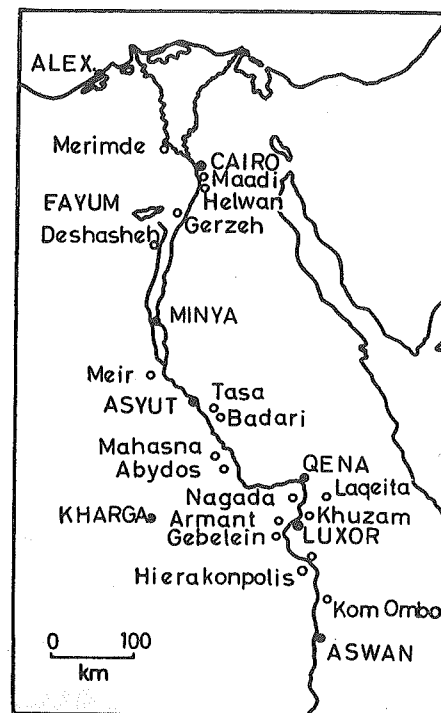


Fig. 2. Location of major late prehistoric settlement sites in the Nile valley.

turies. The surface eolian sediments on the alluvium are recent, but bores in the area indicate extensive sand lenses in the lower alluvium. These features are younger than the settlement.

Of interest within the site is the thin but fairly continuous gravel horizon above the lowest settlement stratum (13). The pebbles suggest a period of sheetflooding after appreciable rainfall. The trenches are unfortunately buried in sand and are no longer accessible. The wild fauna preserved—hippopotamus, crocodile, antelope, tortoise, fish—and the domestic animals—cattle, sheep, goat, pig, and dog (13, 15)—are fully compatible with the setting on the floodplain margins, probably during a phase of slightly moister local climate (14). During this wet spell the present semi-desert vegetation was probably replaced by moderate seasonal pastures on the Pleistocene gravels.

The next oldest sites of interest are the small Badarian villages on the low desert of the east bank, southeast of Asyut (Fig. 4). The "classical" Badarian village, "Hemamieh North Spur," was of very similar size. According to G. Caton-Thompson (16, p. 69), the cultural debris covered some 200 square meters to a depth of 150 to 180 centimeters, for which area a population estimate of 20 can be made (14). In the area considered here, quite analogous to the main site, the low desert is some 200 to 250 meters wide and consists of fluvial gravels and local detritus intercalated with scree, resting upon spurs of limestone bedrock. The edge of these coarse, semiconsolidated deposits to the alluvium is a 3-meter bank; the beds rise to 10 meters a little in the lee. Within the cultural deposits are two horizons of limestone scree; the older of these has been cemented to a tough breccia of up to 30 centimeters in thickness (16, pp. 73–76; profile delineated in 14). This indicates a period of greater moisture dating from the Badarian period; the carbon-14 date, probably at least 275 years too young, is 3155 ± 160 B.C. (12). The upper scree within the younger Gerzean horizon (about 3300 B.C.) is unconsolidated. The post-Badarian settlements preserved on the low desert are very few by comparison with the profusion of cemeteries, so it must be supposed that the major settlement location after the Badarian period was on the flood plain.

Of the great number of Gerzean sites (about 3500 to 3000 B.C.) I will discuss

only two here—namely, Hierakonpolis, a little north of Edfu, and Nagada, northwest of Luxor in the Thebaid. Both sites are on the western bank in Upper Egypt. The former was a town of religious and political distinction, probably representing the capital of the Predynastic kingdom of Upper Egypt (17). Kaiser believes the "painted tomb" may represent a royal grave.

Settlement remains, probably of one central town and many subsidiary villages cover a total area of a million square meters. In my opinion this large area may be misleading, as the debris is often very thin. Figure 5, showing the final results of the 1958 site survey (18), permits an assessment of the denser remains, seldom more than a superficial horizon of pottery sherds, as 50,800

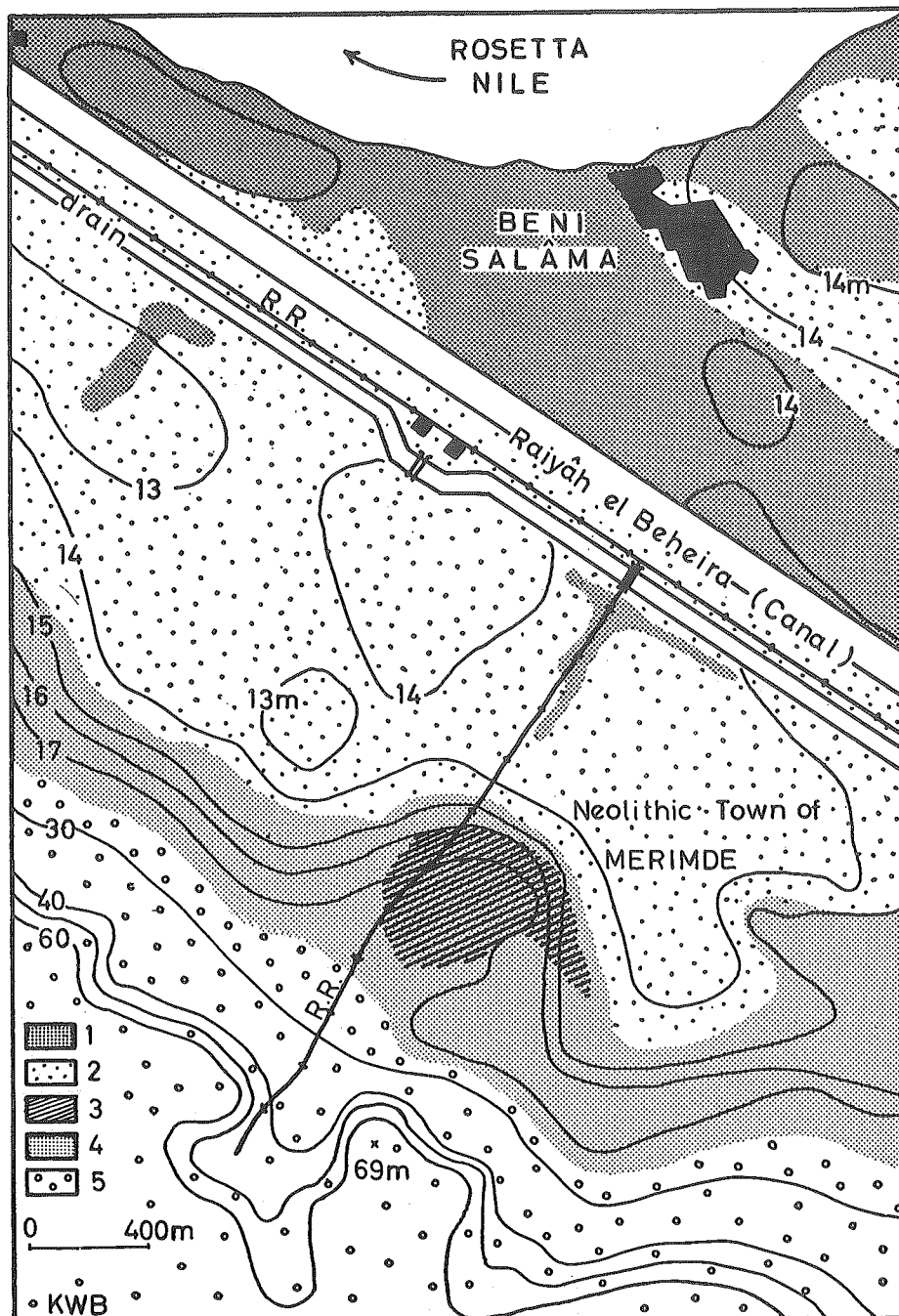


Fig. 3. Topographic geologic map of Merimde-Beni Salama, Md. el Giza, Mz. Imbaba (Delta) (29). (Md., *mudiriyyet*; Mz., *markaz*; administrative units) The Neolithic townsite is situated on the Upper Pleistocene Nile silts, the Nileward portions being obscured by drifting sand. The paved highway is located near the 30-meter contour. 1, Recent alluvium; 2, eolian sand and downwash on Pleistocene silts and modern alluvium; 3, approximate extent of townsite; 4, Upper Pleistocene Nile silts; 5, Lower Pleistocene gravels. Both 4 and 5 are superficially veneered by fine downwash.

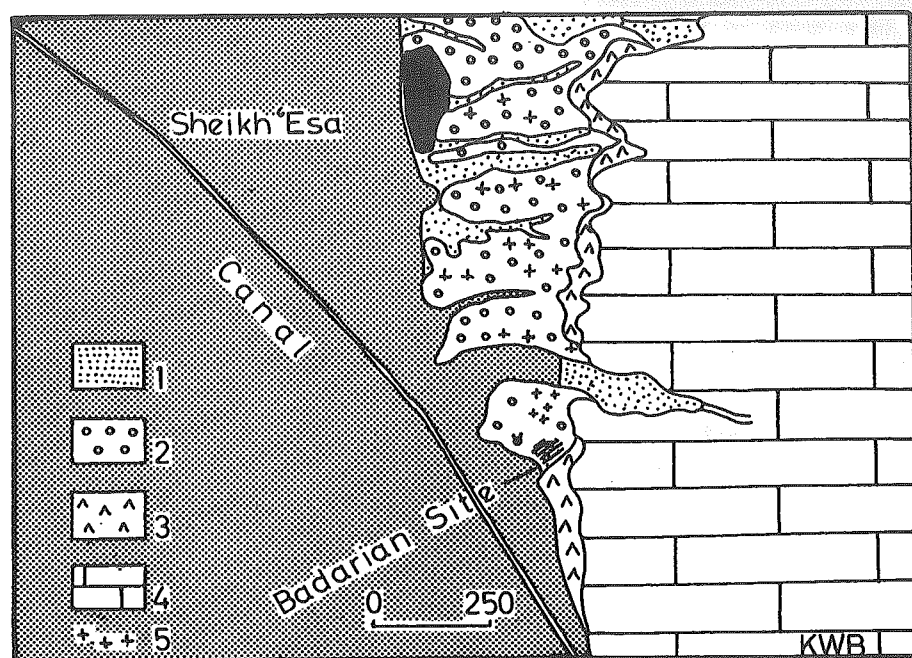


Fig. 4. Geologic sketch of some of the Chalcolithic sites in the Badari area, Md. Asyut, Mz. Badari. Indicated are numerous prehistoric cemeteries and one Badarian village near Sheikh Esa (30). 1, Recent wadi wash; 2, fluvatile gravels to 10 meters above flood-plain level on limestone base (Middle Pleistocene?); 3, Recent scree on limestone bedrock; 4, Eocene (Upper Libyan) limestone; 5, prehistoric cemeteries.

square meters. The former population may have been of the order of 4700, at most 10,000 (14).

Figure 6 illustrates the broader geographic and geologic setting of Hierakonpolis: the maturely dissected Nubian sandstone, bordered by flats, 1 to 2 kilometers wide, of Upper Pleistocene Nile silts (containing Lower Sebilian—that is, Late Paleolithic—artifacts). These Sebilian silts average some 5 to 7 meters in depth; they rest unconformably on the sandstone and pose a steep embankment of several meters to the alluvium. The major Gerzean settlement was located on the semi- or nonconsolidated silts between two shallow wadis dissecting these. Obviously apart from a perennially "dry" location the site enabled easy excavation of the pits used as sunken dwellings.

Of particular interest at Hierakonpolis is the evidence of wind deflation and deposition on the southeastern margins of the settlement. A Gerzean cemetery (11) was denuded, and parts of the settlement were eroded or buried, so the eolian activity responsible must have occurred after 3000 B.C. It very probably was contemporaneous with dune invasions of the Nile Valley further north, dating from about 2350 to 500 B.C. (19).

Before the 1st Dynasty and the historical unification of Egypt (about 2850

B.C.), the settlement site had been transferred to the alluvium (Fig. 6). The new site was occupied until at least the close of the VIth Dynasty (about 2150 B.C.). Cemeteries were still laid out on the Sebilian silts, however (Fig. 5); these accompany the great structure of sun-dried brick, the so-called fort of Chaschmui (IInd Dynasty, about 2675 B.C.). The Kula pyramid, consisting of quarried rock and dating from between the IIIrd and VIth dynasties, is similarly located some 6 kilometers to the northwest. Even in later Dynastic times the area remained important, to judge by the temples of Amenophis III (1410–1372 B.C.) and Ramses II (1301–1234 B.C.) situated in a broad wadi incised in the Nubian series to the northeast. Lastly, the site of El Kab (the later town of Nikhab or Eileithyiaspolis) can be seen in the flood plain on the east bank.

Although the flood plain widens to 4 kilometers at this point, J. A. Wilson (20) has pointed out that the general economic potential of the whole area is low. The early importance of the region, therefore, must have been based partly on cultural factors.

The last site to be considered is Nagada-Tukh, *locus typicus* for the Predynastic cultures of Egypt. Figure 7 indicates the relation of the Gerzean and Dynastic townsites in relation to

the Pleistocene deposits of the area. The low desert, some 3 kilometers wide, consists of Pleistocene wadi gravels on greyish yellow marls, presumably of Pliocene age. Whereas Nubt extends from the flood plain onto a 4-meter terrace, part of it being submerged under alluvium, Nagada-South Town is located on a fan 1.5 to 2 meters above wadi sole at the embouchure of the Wadi Ibeidalla. To judge from samples collected for me by W. Kaiser, the settlement remains overlie a thin and incomplete veneer of gravels, below which yellowish marls are exposed. The locality is above the wadi floor and the flood plain, and it provided a fine-textured sediment for ready excavation. Although a few contemporary burials were located on the wadi floor, the greater part are concentrated on the low terrace. Only the latter graves were not exposed to subsequent fluvatile activity.

Like Hierakonpolis, the Nagada area was long a focal point of settlement. Remains found here of the Middle Paleolithic industries of the Pleistocene terraces are the richest of the Luxor area *in situ*; surface finds of Epi-Levallois II flakes are common, and it is apparent that even after the Gerzean settlement the location was quite important, as evidenced by the Old Kingdom townsites nearby, a IVth Dynasty pyramid, and an XVIIIth Dynasty temple.

The fauna of the Gerzean sites at Nagada is again quite compatible with the situation: isabella gazelle, a buffalo, tortoise, and various fish (19), as well as the usual array of domestic species (15). It is the almost typical combination of steppe and gallery woodland-flood-plain biotopes found at Nile Valley sites from the Upper Pleistocene on.

Geomorphic Situations Typical for Predynastic Settlements

With the exception of the somewhat stony surface at Badari, each Predynastic settlement was located on soft or fine-textured, semi- or nonconsolidated deposits: Merimde, Hierakonpolis, Armant (11, 21), and Maadi (8) on silts; Nagada on marl; Mahasna (11, 22) and Abydos (11, 23) on sandy Nile gravels. Nowhere was coarse gravel or bedrock used. The reason for this apparently deliberate choice was the type of house construction in use—namely, daub-and-wattle structures set up around shallow

pits, the huts being left half below ground level (24).

The second general feature of all sites is a location immediately beside the present flood plain, invariably above embankments or scarps standing several meters over the alluvium. Such location is the result of accident; it was only sites at these heights that escaped the annual inundations of recent centuries and the lateral expansion of cultivation. There has been a rise in the flood-plain level by at least 2 to 3 meters since the Predynastic era (19) and a lateral extension of the flood plain, through alluviation and human activity varying from several meters to 1 or 2 kilometers during the same period. Consequently, sites at lower elevations, and especially those on gentle slopes, have been buried or destroyed. So, for example, the Predynastic cemetery of Gerzeh, excavated some 70 years ago, has disappeared, and at many localities ancient pottery sherds in cultivated fields give evidence of recent encroachment at the expense of the desert (11).

It is possible to state generally that all prehistoric settlements and cemeteries today preserved are located on (i) wadi terraces embanked against the alluvium; (ii) differentiated Nile deposits

immediately in contact with the flood plain; and (iii) Upper Pleistocene silts also forming terrace-like steps to the cultivated fields. Virtually no remains were located where (i) small, formerly active wadis have dissected ancient Nile deposits into broad fans; (ii) slow horizontal shifts of the Nile have left undifferentiated deposits with very gentle slopes (5 percent and less); and (iii) the low desert is limited to a narrow, talus-strewn belt between the flood plain and the escarpment of the limestone plateau. The principles involved are illustrated in Fig. 1.

Lastly there are the complications relating to the alluvium—marginal gravel complex—namely, the third variable, eolian activity. At Hierakonpolis, deflation and redeposition at one end of the site affected an area of 250,000 square meters. Such features are more local, however, than the evidence of eolian activity in western Middle Egypt, where dunes border the alluvium over a 175-kilometer stretch from north of Asyut to near the Fayum (7, 11, 19). Here any possible archeologic sites of older date would have been located on a gently sloping low desert, now buried by many meters of alternating dunes and beds of Nile alluvium.

Regional Land Forms and

Distribution of Archeologic Sites

Bearing in mind the deliberate choice of location on fine-textured, unconsolidated sediments and the accidental factor of preservation strongly limited to specific geomorphic situations, what can we say about the over-all relations of regional land forms to archeology in the Nile Valley? To begin with, prehistoric settlements and cemeteries are rather unevenly distributed in Egypt. One complex of sites is located between the Fayum region and the Delta, the Lower Egyptian cultural province *sensu lato*. The other complex occupies the Nile Valley from about Asyut southward—namely, Upper Egypt. With one exception, the intervening section of 175 kilometers has not preserved any prehistoric sites (11).

On the basis of the principles discussed above, a map was compiled, indicating the distribution of geomorphic features having archeological significance in the intervening zone—namely, Middle Egypt (Badari-Asyut to the Fayum margins) (11). The salient points can be summarized briefly. On the west bank of the Nile the low desert from Asyut to about Meir consists of Nile

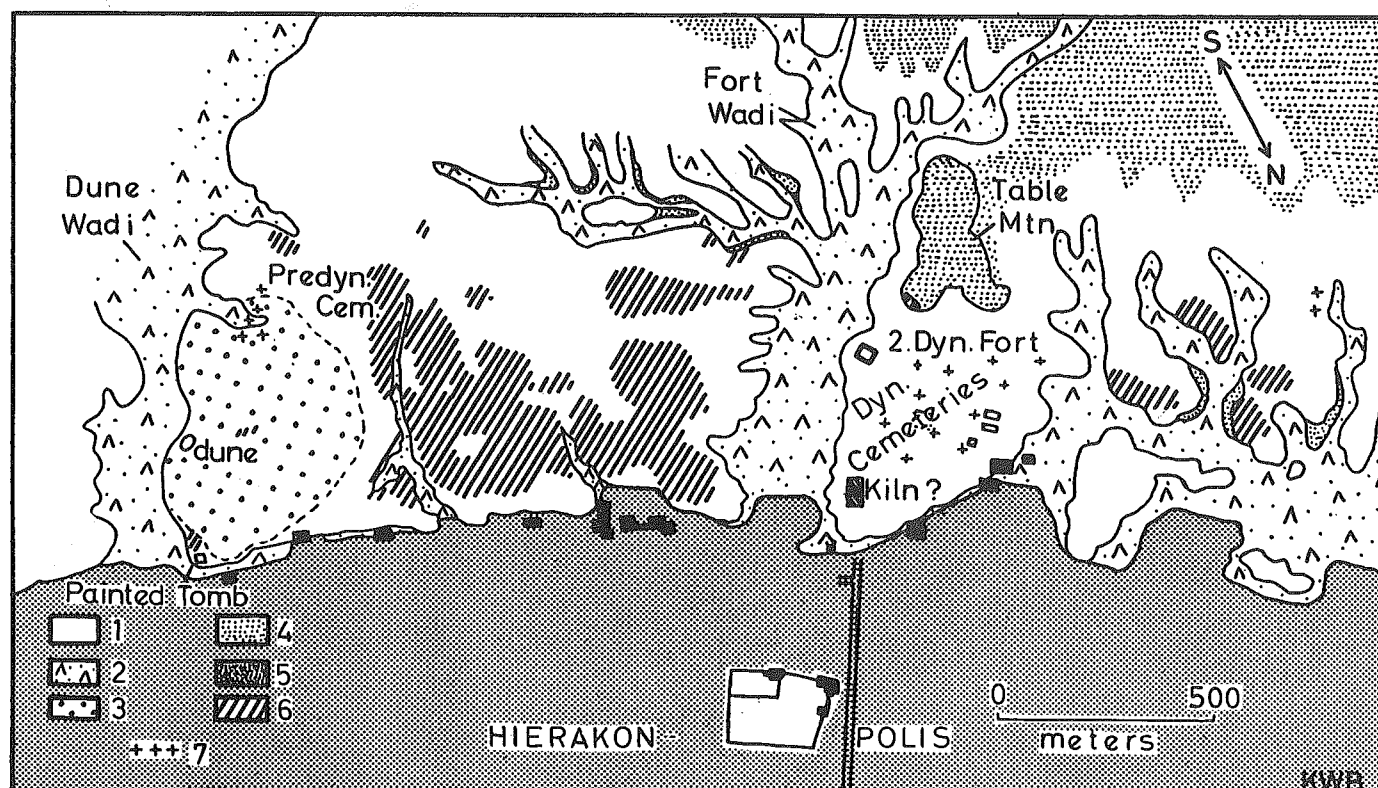


Fig. 5. Topographic-geologic map of the Predynastic and Early Dynastic townsites of Hierakonpolis, Md. Aswan, Mz. Edfu (18). 1, Upper Pleistocene (Sebilian) Nile silts; 2, wadi wash and detritus; 3, unconsolidated eolian sand; 4, Nubian sandstone outcrops, locally obscured by wash and detritus; 5, Recent alluvium; 6, approximate extent of major cultural debris of Gerzean settlement on the Sebilian silts; 7, cemeteries and burials.

gravels sloping very gently to the alluvium. Here the cultivated fields have advanced at least 50 to 100 meters in the course of the present century alone. Northwards from Meir to Deshasheh a belt of dunes overlies the alluvium at the edge of the Pleistocene gravels, often merging with dune fields on the open desert. Any existing prehistoric sites on this western margin of the valley would be long buried under several meters of sand or mud, and in fact no settlement or cemetery can be found here antedating the 4th century B.C. A profusion of Ptolemaic and Roman materials stands in contrast to the archeologic sterility

of the preceding periods. This, again, can be explained readily in terms of physical features: between about 500 B.C. and A.D. 300 the Nile arm known as the Bahr Jusef shifted westwards, removed the valley dunes by lateral planation, and deposited some 2 meters of Nile silt to the edge of the Pleistocene gravels, burying older eolian deposits (19, 25). During this time, settlement of the area was intense, as manifested by the archeological provenance (11).

The eastern margins of the valley are more complex in character, but only very locally are the physiographic fea-

tures conducive to good preservation. The greater part of the area is characterized by a narrow belt of alluvium bordering almost immediately the escarpment of the limestone plateau, often obscured by talus fans. Other stretches are occupied by recently eroded soft bedrock or wadi fans sloping imperceptibly towards the encroaching flood plain. Most of the few favorable locations are occupied by modern villages or cemeteries. The stretch in question is almost sterile in terms of Predynastic remains (11).

In the light of these considerations, older hypotheses that the cultural gap

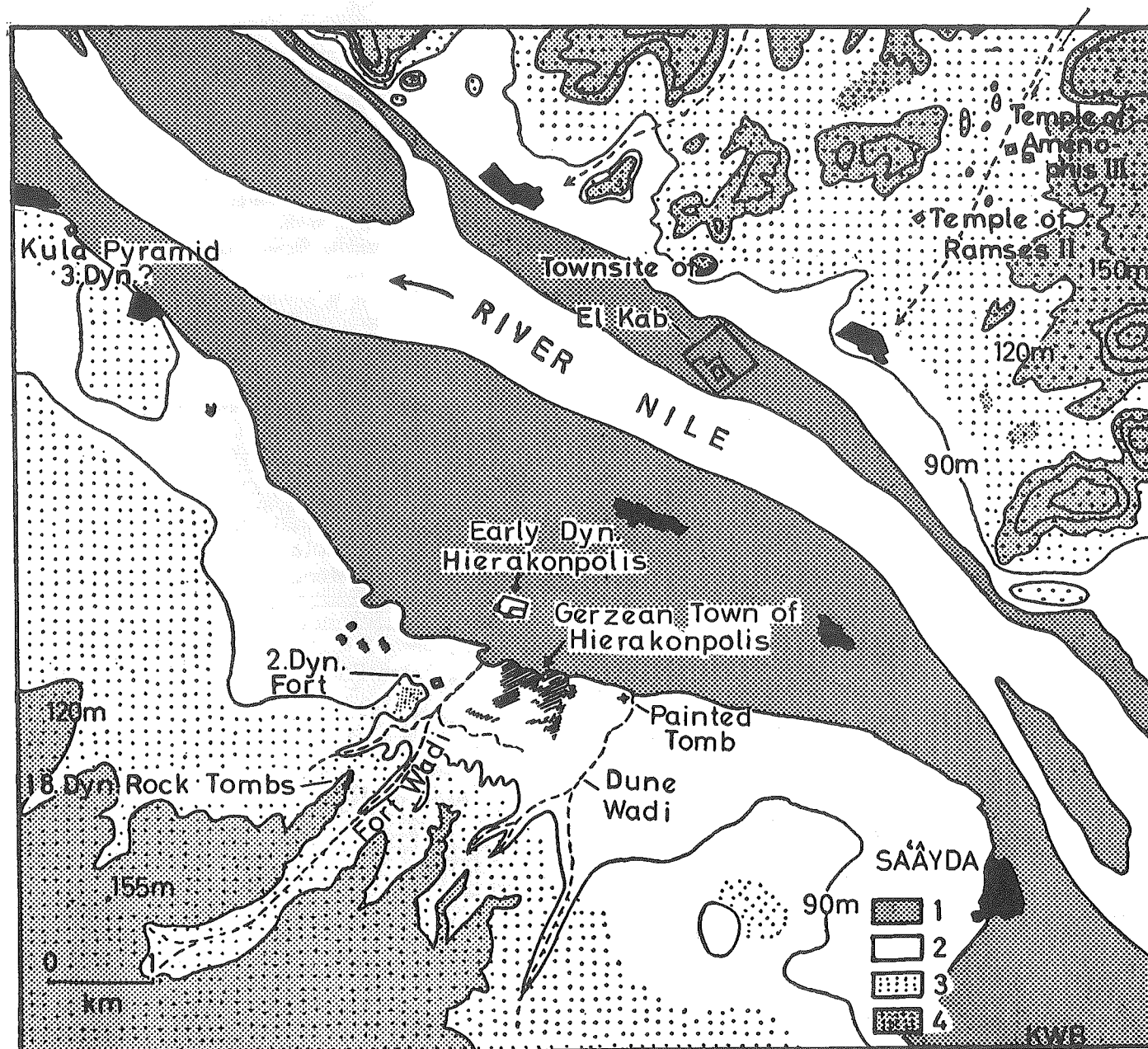


Fig. 6. Geographic and geologic setting of the Hierakonpolis-El Kab area (31). 1, Recent alluvium; 2, Sebilian silts; 3, Nubian sandstone with wadi wash and surficial detritus; 4, Nubian sandstone (Mesozoic) outcrops. Flood plain, 82 to 83 meters above mean sea level; contour interval, beginning at 90 meters, is 30 meters.

in Middle Egypt indicated a lack of prehistoric inhabitation seem to lack support. It would be a little surprising if Predynastic remains *could* be found here, at least at the surface, today. The geomorphic conditions are simply inimical to preservation of older archaeological sites. This anthropologically important example demonstrates the applicability of regional land-form analyses in archeological surveys. After detailed study of a representative number of individual sites, the geomorphologist can assess the significance of various physiographic features in terms of local conditions relevant for a larger region. Such generalizations may even permit a direct conversion of surficial geology maps into archeologically significant units.

Predynastic Sites and Predynastic Population

From the foregoing discussion one can already conclude that only a small proportion of the late prehistoric sites once situated on the desert margins have survived to this day. But the next question is, were all settlements originally located on the desert margins and not in the alluvium, on, for example, the levees (10, 19)?

Two lines of argument can be presented in favor of dense Predynastic settlement right in the flood plain. Firstly, the archeological evidence indicates many hundreds of Predynastic cemeteries on the low desert but no corresponding settlement sites. The corresponding villages must have been located on the flood plain. Merimde, on

the other hand, indicates a similar phenomenon: here, a single, short-lived, but very large town is preserved from a whole cultural epoch of a larger cultural province. It must have had countless predecessors, if not successors, and, above all, there must have been countless complementary village farming communities. Yet not a trace of these is preserved; they must exist under the Delta alluvium (14, 19, 26).

The second line of argument is theoretical: simply that the sites preserved, even if they were all contemporaneous, would indicate a total Egyptian population of no more than 30,000 inhabitants (14). Actually these sites are spread out over a whole millennium in time. Moreover, one must allow for 16,500 square kilometers of relatively drained, fertile land in the valley at the time in ques-

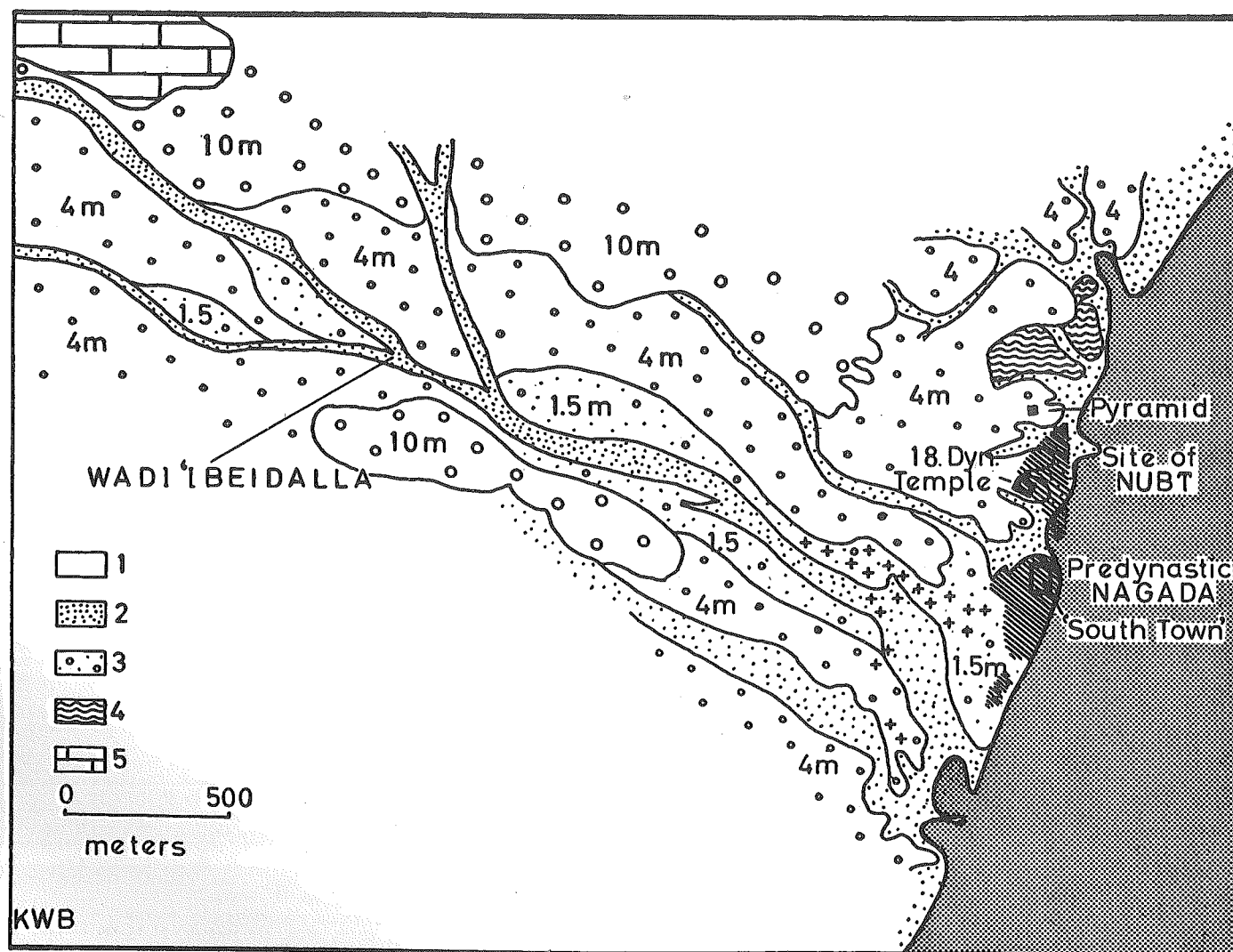


Fig. 7. Geologic sketch of the Nagada-Wadi Ibeidalla area, Md. Qena, Mz. Luxor (32). 1, Recent alluvium of the flood plain; 2, Recent wadi wash; 3, various Pleistocene gravels (on marl): terrace, 10 meters above wadi sole, with scarce Acheulio-Levallois industry, Middle Pleistocene; 4- and 1.5-meter terraces with Levallois and Epi-Levallois II, respectively, Upper Pleistocene; 4, yellow Pliocene (?) marls; 5, Eocene limestone. [Old Kingdom townsite of Nubt and Gerzean townsite of Nagada after Kaiser; "South Town" after Petrie and Quibell (32)]

tion. So, with an advanced primary village farming economy, the Egyptian population in later Predynastic times must be thought of in terms of 100,000 to 200,000 inhabitants (14, 27). In other words, most of these people must always have lived in the flood plain, on natural elevations offering ideal location for early settlement (10, 14, 19). These innumerable villages and towns are no longer readily accessible today. Many probably lie at the base of existing larger townsites, some of which have remained in use for many millennia.

Physical Conditions in Egypt during the Neolithic and Chalcolithic

The macrosetting of Predynastic Egypt in its paleo-environment has been discussed in considerable detail already (14, 19, 28). Briefly, the period 5000 to 2350 B.C. was a time of variable climate, but, in general, there were heavier or more frequent winter rains than there are today. A savanna fauna including the giraffe, elephant, and rhinoceros was not uncommon in large parts of the more elevated Egyptian deserts. From this more humid period, which is geologically verified, there is historical and archeological evidence of tree growth, of an open park-land character, on large parts of the low desert. This probably indicates that the desert hinterland of the marginal desert sites had economic significance, specifically for a pastoral subsistence of some proportions. A reflection of this favorable paleo-environment was the expansion of Neolithic populations into the desert hills and wadis of Egypt after 5000 B.C., areas which have been largely uninhabited since the close of the 3rd millennium B.C.

This brief sketch of the methods and potentialities of geomorphologic analysis of archeological sites and settings will serve its purpose if it illustrates a means of effective cooperation between the earth scientist and the digging archeologist. Depending upon physical and human factors, the problems involved will vary from country to country; the ones discussed here are peculiar to the lower valley of the Nile. To recognize these problems the geomorphologist must have some familiarity with archeology and must actively exchange ideas and notions with the anthropologist. In other words, the "straight" geologist

with little direct interest in the cultural aspects cannot fully apply himself to problems which can only be formulated in interdisciplinary discussion. For example, regional studies of Pleistocene tectonics or climate will be of only limited use to an archeologist excavating a Bronze Age site. Whatever the area, the basic work should be directed to an intensive and comprehensive study of the immediate location, applied to as large a number of representative sites as possible. When the typical geomorphic situation is known, regional land forms can be evaluated as to their possible significance for contemporary settlement. And into this picture should be introduced any detail bearing upon differences in the physical environment—climate, vegetation, and fauna. Only on this foundation can the geography of prehistoric settlement be effectively understood or analyzed.

References and Notes

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2. Methods of work would involve surficial deposits, microstratigraphy, general geomorphology and land-form analysis, and sediment and soil examinations. So, depending upon where the division between geography and geology is drawn from country to country, or university to university, the investigator may be "labeled" differently. On account of this difficulty in departmentalizing research in Quaternary geology and geography, the terms *geology* and *geomorphology* as employed here are not intended to specify what category of earth scientist may be involved.
3. R. J. Braidwood, *Natl. Acad. Sci.-Nat. Research Council, Publ. No. 565* (1957), pp. 14, 26.
4. The material presented here is derived from a geomorphological and pedological field survey carried out under the auspices of the Deutsche Forschungsgemeinschaft (Godesberg) in 1958. The primary purpose was the study of Pleistocene stratigraphy, although I spent 6 weeks in informal association with an archeological survey then in progress. The sites described were all examined in collaboration with Dr. W. Kaiser, an Egyptologist, although the evaluation of the evidence and publication of my geological and geographical investigations proceeded independently. The archeological results of the survey (by Kaiser) and descriptions of the geological settings (by me) are now in press (*Mitt. deut. Archäol. Inst., Abt. Kairo*), but I have not yet had an opportunity to see the manuscript on the archeological materials. Some of the data may be referred to in greater detail in the aforementioned paper by me in that publication, and in K. W. Butzer, *Abhandl. Akad. Wiss. Liter. (Mainz), Math.-naturw. Kl. 1959*, No. 2 (1959). I am grateful for the financial support rendered by the Deutsche Forschungsgemeinschaft, the German Academy (Mainz), and the Canada Council, as well as for certain field facilities provided by the German Archaeological Institute.
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31. Map based on survey of Egypt map No. 24/72-78 (1928, revised 1940) (1:100,000), on personal observations, and on geological map (1:1,000,000) in K. S. Sandford and W. J. Arkell, *Univ. Chicago Oriental Inst. Publ. No. 17* (1933).
32. Part of the topography marginal to the flood plain after the sketch (1:15,000) (greatly modified) by W. F. M. Petrie and J. E. Quibell in *Nagada and Ballas* (British School of Archaeology in Egypt, London, 1896): wadi topography and surficial deposits mapped by Butzer. Compare K. W. Butzer, *Erdkunde* 13, 46, Fig. 3 (1959).