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PALEOLITHIC MAN AND THE NILE VALLEY IN UPPER AND MIDDLE EGYPT

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PREHISTORIC SURVEY OF EGYPT AND WESTERN
ASIA—VOLUME III

PALEOLITHIC MAN AND THE NILE VALLEY IN UPPER AND MIDDLE EGYPT

A STUDY OF THE REGION DURING PLIOCENE
AND PLEISTOCENE TIMES

BY

K. S. SANDFORD

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LATE OR POST-MOUSTERIAN

LOWER AND MIDDLE SEBILIAN

TYPES FROM THE HILWAN SITES

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LIST OF ABBREVIATIONS

AJSL	American Journal of Semitic Languages and Literatures (Chicago etc., 1884——)
BIFAO	Bulletin de l'Institut français d'archéologie orientale (Le Caire, 1901——)
Blanckenhorn, *Hdb.*	M. Blanckenhorn, *Handbuch der regionalen Geologie,* VII. Bd., 9. Abt.: *Aegypten* (Heidelberg, 1921)
GJ	The Geographical Journal (London, 1893——)
GM	The Geological Magazine (London, 1864——)
OIP	Oriental Institute Publications (Chicago, 1924——)
OIP X	K. S. Sandford and W. J. Arkell, *Paleolithic Man and the Nile-Faiyum Divide* (1929)
OIP XVII	K. S. Sandford and W. J. Arkell, *Paleolithic Man and the Nile Valley in Nubia and Upper Egypt* (1933)
QJGS	The Quarterly Journal of the Geological Society (London, 1845——)
ZDGG	Zeitschrift der Deutschen geologischen Gesellschaft (Berlin, 1849——)

INTRODUCTION

The principal objects of this book are to examine Pliocene and Pleistocene strata in order to determine the age and order of the works of early Man in Upper and Middle Egypt, and to trace, as far as possible, their development and Man's environment toward the point at which purely archeological investigation can take up the story.

It is well to realize that there are still deficiencies of archeological material which hinder the linking together of the Paleolithic and Neolithic periods into a consecutive history of the human race. Certain evidence given in the following pages tends to provide a continuous record of events so far as the Nile is concerned. The "ever rolling stream" has set the time and preserved its record. Man has come and gone, sometimes to leave monuments of his passage, sometimes to fade away again, forgotten. In the harsh phraseology of the 20th century, there are barren strata in the series.

This volume serves also to bind together widely separated regions of research:

Nubia and Upper Egypt.
The Faiyum and the Nile-Faiyum divide.
The Cairo district, with which are associated the researches of Père Paul Bovier-Lapierre.
Lower Egypt, the Delta, and the coasts of Egypt.

Of these the first and second are already published.[1] The third and fourth will appear in the same series as soon as possible.

I do not propose to trespass upon the ground with which other volumes are intended to deal, but it is eminently desirable that there should be some overlap at the points of contact. Thus the volume that describes Paleolithic Man and the Nile Valley in Nubia and Upper Egypt sets its boundaries at Semnah in the south and at Luxor in the north (Fig. 1). In the present volume, therefore, the country south of Luxor will be referred to only for evidence and recapitulation essential to the argument.

The northern limits are rendered indefinite by the provision of a suitable overlap for work awaiting publication. The west bank, between Bahsamun, west of Beni Suef, and the step pyramid of Sakkarah, has already been described;[2] the country farther north will be left to the volume dealing with the Delta. On the east bank investigation was accomplished in fair detail to the latitude of Beni Suef and was continued in outline to Hilwan, the southern boundary of preliminary work carried out in 1929. In the winter of 1929/30 the Geological Survey of Egypt undertook the detailed mapping and study of an area embracing the greater part of the country adjacent to the Nile on both banks between Beni Suef and es-Saff, south of Hilwan. At the time of writing (1932/33) this work was still in progress. The fact that it was being carried out on a detailed basis such as only an official enterprise can achieve allowed me to economize time. North of Beni Suef, therefore, my work was reduced to a minimum; my time was devoted chiefly to inspecting localities previously made known by Blanckenhorn's studies.[3]

At a later date I had the pleasure of being shown parts of this sector of the east bank by two of the official surveyors, Messrs. R. E. Gubbins and M. I. Attia, in the company of the Director of the Geological Survey, Mr. O. H. Little. Co-operation was thus thoroughly estab-

[1] In *OIP* XVII and X respectively.

[2] In *OIP* X.

[3] *ZDGG* LIII (1901) 307–502; *Hdb.*

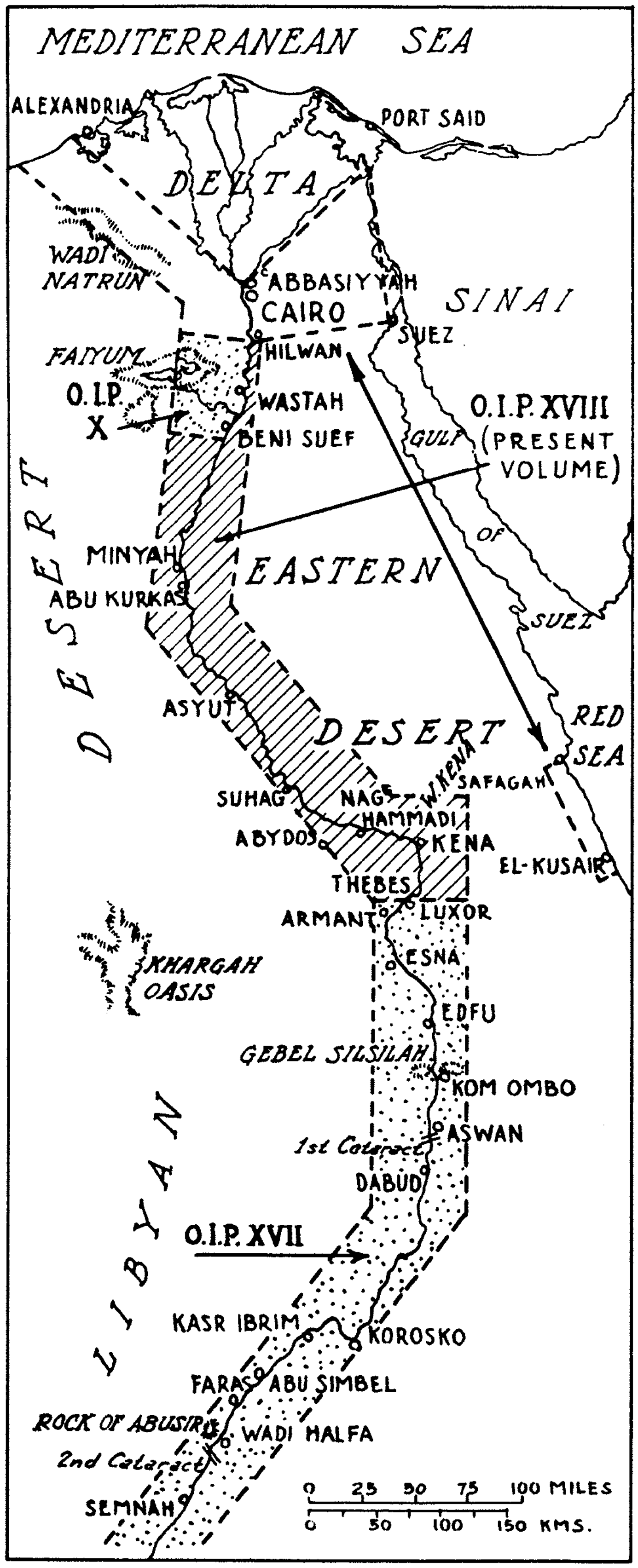


Fig. 1.—Sketch Map of the Nile Valley from Semnah to the Mediterranean, to Show the Areas Investigated by the Prehistoric Survey

lished, and on behalf of the Oriental Institute I was able in turn to provide information from work done north and south of the area. As it is a matter of fortune whether the official publication or this book will appear first, I wish, in expressing thanks to my friends, to make it clear that the authoritative account of the common area will be found in the official memoir, and that all direct reference to the ground which we visited jointly is omitted here. Brief comments will be made on country farther north, between es-Saff and Hilwan. Since the whole of the area west of the Nile now being surveyed falls within the map published in *OIP* Volume X, I shall draw freely on my own knowledge of the district in discussing the relation of the Faiyum to the Nile.

It is not to be supposed that the great length of the Nile Valley from Luxor to the southern approaches of Cairo, about four hundred miles, was investigated in a single season. The southern sector, Luxor to Kau, near Asyut, was covered on foot, with camel transport, in 1925/26 at the invitation of the British School of Archaeology in Egypt. The northern sector was not visited until 1930/31, in connection with the completion of the Oriental Institute's survey of the Nile Valley from the Second Cataract to the sea. The intervening four years had been spent on this survey in other parts of the valley. On the first occasion I was alone; on the second my wife accompanied me. Full details of the first season, of ground covered and of route followed, may be found in the published reports,[4] of which frequent use will be made in the present volume.

Of the concluding season perhaps the following summary will serve the needs of any who may wish to know the plan of work. Most of the places named will be found on the folding map at the end of the book.

1. Revisionary work in districts south and east of Luxor and west of Edfu.[5] Motor transport (one 7 h.-p. Jowett touring two-seater and one Model-T Ford truck), with Egyptian driver and cook. The same transport was used at the end of the season to finish earlier work along the Red Sea between el-Kusair and Safagah.
2. Revisionary work north of Luxor in Lakeitah–Wadi el-Hammamat district, Wadi Kena, Abydos district, and Kau district. Motor transport as above.
3. Edge of Western Desert from latitude of Shandawil to the Faiyum. Motor transport as above. Much of the ground is obscured by sand dunes; but the old Asyut–Faiyum camel road among the dunes was found practicable, with some detours.
4. Edge of Eastern Desert from Kau to Abnub (north of Asyut). Motor transport as above.
5. District of Tell el-ʿAmarna, from the house of the Egypt Exploration Society. By donkey and on foot. Most of the stretch southward to Abnub is marked by vertical cliffs.
6. From end of cliffs on east bank opposite Mallawi (i.e., Antinoupolis district) to Minyah. By camel (from Minyah to Antinoupolis and back).
7. North of Minyah the cliffs descend on the east side into the river for long distances. A native boat (*felucca*) was commissioned at Minyah and sailed to Wastah, camps being made on the mud flats. The Eastern Desert edge, where not cliff, was covered on foot. The special object of the work near the Nile north of Antinoupolis, apart from normal following of ancient gravels exposed in desert, was the study of the Nile bed in a period of low water.
8. The edge of the Eastern Desert north of Wastah to es-Saff was visited as already described. North of es-Saff the country was examined by means of daily journeys from Cairo and Hilwan.

The ground was covered not in the precise order given above, but in sectors as opportunity offered. Many of the critical areas were thus visited twice, at intervals of several weeks. In

[4] *QJGS* LXXXV (1929) 493–548 and *GJ* LXXII (1928) 144–58.

[5] See *OIP* XVII.

September, 1932, I traversed the edge of the Western Desert again from Sidmant el-Gebel to a point west of Minyah at the outset of an expedition into the Libyan Desert led by Major R. A. Bagnold.[6] Important additions were made to the previously mapped extent of the Nilotic Pliocene strata. With some other observations, these have been added to the text of this volume in the course of publication.

During the season 1925/26 the only available desert maps with any useful topographic detail were those on a scale of 1:500,000. By 1930/31 the work for the beautiful 1:100,000 series of maps by the Survey Department of Egypt had made considerable progress, and sheets showing the contour of the deserts adjacent to the Nile were available for the area as far south as Maghaghah. On my return to Cairo at the end of the season, proofs were ready for some of the country south of Maghaghah, where I had been working on the basis of a 1:250,000 desert map and a 1:100,000 map which lacked detail outside the limits of cultivation. I am greatly indebted to the officers of the Survey Department for allowing me to study these unpublished proofs and for much sympathetic help in providing me with the determinations of certain altitudes while I was in the field. Had these proofs been available four months earlier, much geological information could have been added which without them must remain for the present ill defined. In a few years, with the completion of this magnificent series of maps of the Nile Valley and adjoining deserts, there will be no reason why accurate maps of the Pliocene and Pleistocene deposits throughout the valley should not be produced. It is to be hoped that the Geological Survey will be able to continue its work southward along the Nile, as the new maps will revolutionize and simplify geological work in the valley.

Since discussions of relative altitude play a considerable part in determining the ages of ancient deposits, a scale of measurement must be chosen. This is not a simple matter. The Survey Department of Egypt employs the meter as the unit of vertical interval, with mean sea-level at Alexandria as datum. This serves well for some purposes, and it will be utilized here. For the measurement of sections, however, and in dealing with ancient fluviatile deposits for which the datum must be either the modern flood plain of the Nile or the floor of the tributary, as the case may be, the foot is a convenient unit. Terms in common use, such as 100-foot, 50-foot, and 30-foot terrace, are more familiar to the general reader than their metric equivalents. By this combination of suitable datum levels and scales, with constant inclusion of conversion figures, I hope to satisfy the requirements of the Survey Department and of European and Anglo-American readers.

Of previous work in the area more will be said in the following pages. In the southern part of the area we may carry our minds back to the pioneering days of the Survey of Egypt, to the early investigations of Dr. John Ball and Dr. W. F. Hume, and to H. J. L. Beadnell's long traverse of the edge of the Western Desert from end to end of the area. Archeologists in the Thebaid and at Abydos played a part, but there is some lack of cohesion among the many brief notes and publications. In the northern part we enter the ground which M. Blanckenhorn covered in his excursions south of Cairo along the eastern side of the Nile Valley. As to the west side, south of the Faiyum little recent work has been done since Beadnell's traverse at the end of the last century—not a surprising fact in view of the uninviting walls of sand and open gravel plains. There are many reports and publications which discuss the alluvium-filled bed of the Nile, and we owe to Sir William Willcocks and to M. R. Fourtau the marshaling of the facts chiefly for the needs of irrigation.

I am anxious to express my gratitude to those who have made the production of this work possible. I am indebted to many officials of the Egyptian Government, especially of the Survey of Egypt and of the Department of Antiquities, as acknowledgments in the text will show.

[6] *GJ* LXXXII (1933) 103–29, 211–35.

In the field I was given official support by the governors of provinces and by their senior officers of police. Archeologists were generous in their hospitality to my wife and myself when we were near their headquarters; and we desire to express our thanks to Dr. and Mrs. D. L. Askren in Medinet el-Faiyum, Mr. and Mrs. Guy Brunton at el-Matmar, Miss A. M. Calverley at Abydos, Dr. and Mrs. Harold H. Nelson at the Institute's Luxor headquarters, and Mr. and Mrs. J. D. S. Pendlebury at Tell el-ᶜAmarna. To those to whom our work was more of a mystery we owe a special debt of gratitude, above all to Mr. and Mrs. L. H. Dolman of Asyut, Colonel and Mrs. R. H. Haseldine of Mankabad Camp, and Mr. and Mrs. A. Welchman of Minyah. To these and many others we express our sincere thanks.

In the preparation of this volume I have been indebted to Mr. Henry Balfour for advice and helpful discussion of the flint implements, and to Professor and Mrs. F. Ll. Griffith[7] for the use of their magnificent library. Sir Flinders Petrie has generously given permission to figure certain flint implements and to publish data concerning discoveries at Kau el-Kabir.

The index and the editing of text and illustrations have been in the hands of Dr. T. George Allen and of Mrs. A. R. Hauser of his staff, who have given me most generous help, consideration, and advice. The volume has gained immeasurably from their skill and penetrating vision.

Lastly, I have been given the privilege of recording the part played by my wife, who accompanied me throughout every day of a somewhat arduous season, with many and unusual vicissitudes of weather, transport, and environment. At home the discussion and correction of the text and diagrams have been in her hands.

[7] It is with deep regret that the death of Professor Griffith is recorded.

I

GEOLOGICAL HISTORY OF THE REGION BEFORE THE PLIOCENE PERIOD

This chapter is not intended to be a geology of Egypt; for that the serious student can refer to Blanckenhorn's *Handbuch der regionalen Geologie* and to the volumes that Dr. Hume is publishing, also to official and other publications. There is only one object in view—to describe and account for (in language as simple and as free from technicalities as possible) the vast plains and plateaus of Egypt, suggesting the times and processes which governed the creation of those wide expanses and the cutting of the great gorge now occupied by the Nile.[1] A general physiographic description is given here; but the actual morphology of the sides of the Nile Valley is included in the survey of the Pliocene deposits (chap. iii), where it first becomes essential to the argument.

FORMATIONS REPRESENTED[2]

The oldest rocks bordering the Nile near Luxor belong to the Nubian sandstone series, here no doubt of Cretaceous age.[3] They are exposed on the right bank only, along the flanks of the great outliers of Upper Cretaceous or Esna shales and limestones, with Lower Eocene capping, which run northward from Gebel Nezzi to Gebel Abu Had in Wadi Kena. To the east of the outliers the sandstone forms extensive plains such as those of Lakeitah, Hammamah, and Fatirah, bordered by the more ancient massifs of the Red Sea Hills, from which a host of wadies debouch onto the sandstone plains. Probably Nubian sandstone forms the floor of part of Wadi Kena, hidden beneath a thick mantle of Pliocene and Pleistocene gravels; but it does not reappear in the Nile Valley north of Kena until it is brought to the surface in strongly disturbed beds at Abu Roash, north of Gizah, near Cairo.[4] Between these two distant outcrops its presence is shown by structural deformations which have exposed it in Khargah Oasis, where it is the vital water-bearing bed, and in Wadi Araba on the Red Sea coast.

The Upper Cretaceous shales and limestones are of great importance in the vicinity of Luxor, but sink from view beneath Lower Eocene limestones near Kena and, like the Nubian sandstone, are not seen again until they reappear suddenly at Abu Roash. Between Luxor and Kena, however, the soft shales have influenced out of proportion to their width of exposure the slipping of the superincumbent Eocene limestones along the margins of the main valley and its major tributaries. Similar slipping may be traced for a considerable distance north of the point where the shales disappear below the alluvium.

Throughout the rest of this region the Nile is bordered by Eocene rocks, chiefly limestones. These are elevated sediments of the ancient Mediterranean or Tethys Sea, which spread over a large part of Africa and southern Europe. When we see the great cliffs of the Thebaid towering above the Nile and follow the scarp as a faint blue barrier with regular plateau summit far to the southwest of Aswan, we realize that at one time these cliffs stretched yet farther southward, and that some distant shore line, probably in the Sudan, marked the southern margin of the sea in Lower Eocene times.

[1] Cf. analogous chapters of *OIP* X and XVII.

[2] See map at end of book.

[3] Blanckenhorn, *Hdb.* pp. 43–59.

[4] H. J. L. Beadnell, *The Cretaceous Region of Abu Roash, near the Pyramids of Giza* (Rep. Survey Dept. of Egypt, 1902).

Middle Eocene elevation led to some contraction of the sea, and it seems probable that a northward-draining river system may have come into being at this time as a natural drainage of land toward the retreating Tethys. Only by some such process does it seem possible to account for the penetration of the Lower Eocene south-facing scarp by the intrenched gorge of the Nile from Upper Egypt to the Mediterranean. Lower Eocene limestones flank the gorge to a line midway between Manfalut and Deirut, where they pass below Middle Eocene sediments, the whole series throughout the region dipping almost imperceptibly in a general northerly direction. Since the newer strata are essentially marine limestones, it is evident that they once extended much farther south than they now occur, and that the shore line of the Tethys still lay in that direction.

At first the passage from Lower to Middle Eocene limestones seems to be of no great consequence, but in the neighborhood of Samalut its full significance becomes apparent in the replacement of limestones by soft clays. The cliffs bounding the Nile disappear, giving place on the east to dusty plains that can be seen clearly by any traveler on the Egyptian State Railway. On the west the change is masked by gravels and sand dunes.

North of this area the topographic form bears a yet more marked relationship to the nature of the strata: varied series of sediments, normally overlying the clay, stand out like great islands upon it, as remnants of a once continuous cover now largely denuded. Of these great table-like masses, Gebel Kararah opposite Maghaghah is perhaps the most striking. It is matched by others farther north, between Beni Suef and Hilwan. Similar *mesetas*, such as Gebel Dishashah and the gravel-covered limestone hills which separate the Nile from the Faiyum, stand out on the west bank also. North of these, on the west bank, small and isolated patches of uppermost Middle Eocene rocks, at first noticeable in elevated positions, cover a considerable tract of the country. Their character can be studied north of the Faiyum.[5] They in turn are seen to sink beneath Upper Eocene beds, which form a marked plain, generally between 100 and 200 meters above sea-level. South of Cairo on the east side of the Nile the upper strata are limited to isolated patches at about 300–400 meters above sea-level (except where lowered by faults). There is, therefore, an appreciable difference in level between parts of the same strata on the east and west banks north of Wastah.

There arises that contrast between the low western desert plains, seen from the pyramids of Gizah, and the magnificent cliffs of the east bank, whence the pyramid builders obtained their best stone. They quarried, for example, the Mukattam Hills near Cairo and the cliffs at Turah, an ancient town where convicts still work the stone. It cannot even be said that the eastern heights owe their altitude to the preservation of later strata. The reverse is true; for a broad belt of Oligocene sands, gravels, and harder beds succeeds the Upper Eocene on the west bank south of the latitude of Hilwan, but those beds do not appear on the east bank until Cairo is reached. Therefore in the last section of the area with which we are dealing a marked contrast is the first feature noticed by a visitor on leaving Cairo for the south. For that reason early mention is made of it. Further references to it and to other contrasts, at first sight not so striking to a stranger, are made later. It is evident that the plateaus through which the Nile has cut its gorge are not so perfectly uniform as they appear, for the contrast of banks already mentioned indicates that some flexure or fracture must be present. It will become clear that this is but one of many such disturbances.

In the Upper Eocene and Oligocene strata the results of the contraction of the Tethys and the elevation of the country from which it had withdrawn are plainly seen. The Upper Eocene sea may have extended scarcely south of the Faiyum; for the surviving deposits are indeed the estuarine products of a northward-flowing river or rivers rather than of the sea. They repre-

[5] See *OIP* X.

sent the direct continuation of that shallow-water facies which was noted in the Middle Eocene. In the succeeding Oligocene period the shore was removed yet farther north, and the deposits in the vicinity of the Faiyum became purely estuarine. Finally river waters flowed over the plains to the retreating sea, rolling enormous quantities of large flint cobblestones derived from older beds in the south, as well as huge tree trunks. The latter have become silicified and survive in the "petrified forests" found over an extremely wide area.

The Oligocene river, or system of rivers, called by Blanckenhorn the Ur-Nil,[6] may be the ancestor of the Nile; at least the Nile is performing much the same function as far as Egypt is concerned. This volume is not directly concerned with the northern estuary, but it will deal in some detail with the cobble-strewn plains in the south.

Mid-Tertiary times were punctuated by a period of volcanic activity, perhaps accompanying crustal disturbances, and molten magma penetrated rocks of widely different ages, including the Oligocene, but excluding later rocks (i.e., Miocene and Pliocene). At intervals, sometimes hundreds of miles apart, over most of this corner of the continent, basaltic rock in the molten state found its way upward either in isolated dikes or in considerable sheets. In general any that reached the surface has long since disappeared, but the parts that cooled on their upward path through the rocks have survived. Strictly, then, they are dolerites, not basalts. It has often been suggested, probably with much truth, that associated thermal waters, charged with dissolved silica, caused the petrifaction and preservation of the tree trunks so abundant in the Oligocene flint gravels and quartz sands.

A broad belt of basaltic intrusions runs from the north side of the Faiyum toward the Nile at Cairo and continues eastward. Farther south a lonely outcrop makes its appearance east of Samalut, just at the point where the hard limestones of the lower part of the Middle Eocene sink beneath the clay plain. On the opposite side of the Nile, near el-Bahnasa, more extensive "black hills" stand somewhat grimly, half shrouded in sand, in a sea of white clay and white limestone knolls sparsely sprinkled with gravel. Remote on the western plateau Karat es-Sodaᵓ stands like a beacon on the routes from the Nile near Manfalut to the oases. Sulphureous springs still exist between Cairo and Hilwan and farther south.

An event of post-Oligocene (Miocene) times was the adoption of the present valley of the Nile and the cutting of the astonishing gorge through which it now flows from Upper Egypt near Esna to Cairo. It is difficult to discover what governed the selection of this particular course, although several probable causes suggest themselves. There is little doubt that crustal movements played a part, perhaps a dominant one; it is plain also that the uplift of the plateau was so rapid that the river was fully occupied with vertical erosion and had time to accomplish little else. This and the evidently heavy rainfall and run-off from south and east probably combined to keep the river on the course that it had taken, even if it was not the most advantageous one. Once the gorge was fairly started, all chance of readjustment was gone.

Middle Miocene deposits, which lie along an east-west line from Suez to the eastern edge of the Delta, and from the western side of the Delta stretch hundreds of miles westward, suggest a continuation of the Oligocene estuary entering a much reduced Tethys. Either the wide Oligocene delta or the newly shifted course which became the Nile would have fulfilled the condition demanded by the nature of the strata. No Miocene sediments are known in the Nile Valley.

Upper Miocene times saw revolutionary changes which would have caused the Nile to deepen its bed in its present or any other position. At this time general elevation carried the Middle

[6] It goes without saying that only the deposits survive; all traces of actual valleys are gone. In using the term Ur-Nil I wish to make it abundantly clear that I refer only to the Oligocene beds of the north and that I dissociate myself absolutely from the ideas recently published in the *Berliner illustrirte Zeitung*, 1934, p. 203, under the name of Leo Frobenius.

Miocene and older formations high above the reach of the sea, and a complex system of faults served also to break up their continuity.

By early Pliocene (Pontic) times the valley of the Nile in Egypt had been cut not only to its present level, but to a depth which has not yet been fathomed. Some of the tributary systems became similarly intrenched. Nearly all subsequent processes have tended to fill the greater depths of the valleys.

The first phase of the filling process is assignable to Pliocene times, when the gorge was flooded by the sea,[7] with accompanying marine and other strata, to a height of about two hundred meters above present sea-level. These and later events are described in detail in the following chapters.

FLEXURES AND FAULTS AND THEIR RELATIONSHIP TO THE NILE VALLEY

It is more than 20 years since the early belief that the Nile in Egypt lies in a rift valley was laid to rest, its epitaph written by Dr. John Ball and Dr. W. F. Hume in brief papers[8] which expressed not only their own views but also those of other eminent geologists such as Mr. H. J. L. Beadnell.

Six years ago Professor A. C. Lawson, while touring the Nile Valley, disinterred the rift theory, perhaps in modified form, and published his views.[9] These have not passed without shadows of doubt falling upon them;[10] and the authoritative pen of Dr. Hume has recently inscribed a second epitaph,[11] to which, from my comparatively brief though concentrated experience of the valley and adjoining deserts, I would add a respectful *requiescat in pace.* So hard does a theory with an easy name die, and so frequently do archeologists speak confidently, though they do not write, of the rift origin of the Nile in Egypt, that it may be well to devote a little space to the question.

Dr. Hume showed in his recent paper, as in earlier publications on the same subject, that the Eocene plateaus of Egypt have been affected by two sets of folds. The first, and perhaps the older, series may be termed rolls rather than folds, owing to their great amplitude and usually gentle dips. Their trend is almost north to south, or slightly west of north to east of south. Two anticlines are separated by a syncline, the anticlines marked by Khargah Oasis and Wadi Kena, the syncline being occupied by the Nile north of Luxor.

The second series, presumably of later Miocene age, is of more spectacular appearance, though less important so far as the Nile is concerned; the strata involved are folded and tilted to high angles. The trend is about northeast to southwest. The most northerly fold gives rise to the high ground of Gebel ʿAtakah (west of Suez), the Mukattam Hills above Cairo, and Abu Roash north of the pyramids of Gizah. This system Dr. Hume terms the "Tethyan fold." The second fold of the same nature appears to determine the presence of the northern and southern Kallalah limestone hills and, between them, the deep Wadi Araba on the Red Sea coast (Fig. 2).

[7] I.e., as explained in *OIP* X 10, the excavation may be presumed to have been accomplished in large measure in the interval between the Second and Third Mediterranean periods of Eduard Suess (*Das Antlitz der Erde* I [Wien, 1892] 406–29), i.e., between Upper Miocene and Lower Pliocene, generally known as the Pontic Pluvial period. The rising waters of the Third Mediterranean period, Middle Pliocene (Plaisancian–Astian), flooded the Pontic river valleys of the Mediterranean, among them the Nile Valley.

[8] *GM*, 1910, pp. 71–76 and 385–89.

[9] "The Valley of the Nile," *University of California Chronicle* XXIX (1927) 235–59.

[10] Sandford in *GJ* LXXII (1928) 154 and *QJGS* LXXXV (1929) 500–501.

[11] See *Bulletin de la Société royale de géographie d'Egypte* XVII (1929) 1–11, reprinted from the *Comptes rendus* of the International Geographical Congress, Cambridge, 1928, pp. 207–16.

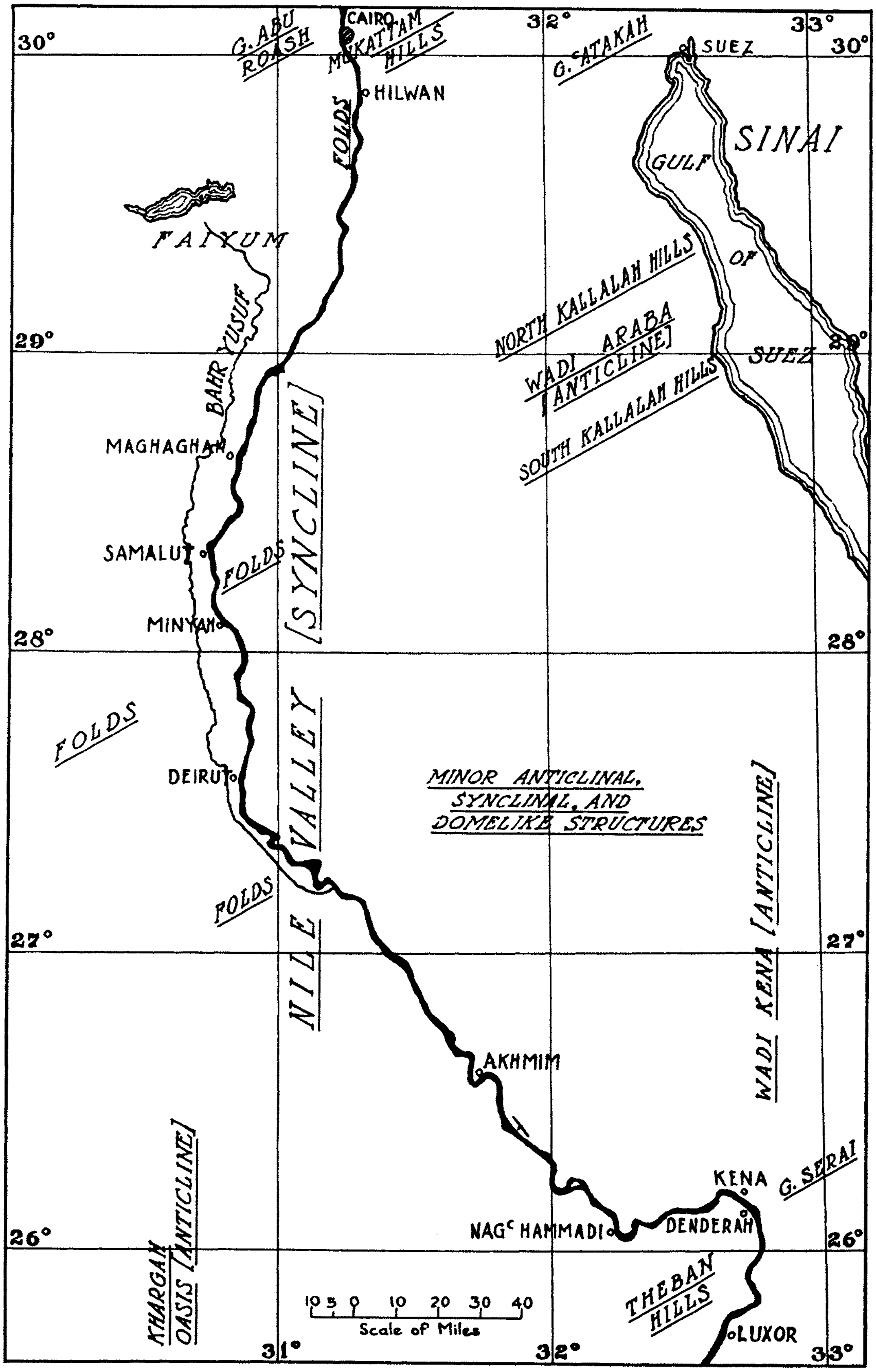


FIG. 2.—SKETCH MAP TO SHOW PRINCIPAL FOLDS AND FAULTS IN AND NEAR THE NILE VALLEY BETWEEN LUXOR AND HILWAN

The prolongation of this fold toward the Nile has yet to be traced; but, unless it dies out or is interrupted by faults, it should appear in the cliffs of the Samalut–Minyah region. At close quarters the bedding seems regular, save for a marked sag near the northern end of the cliffs, just south of the quarries of Gebel et-Teir and plainly visible from the State Railway. It was therefore somewhat of a surprise to me, when viewing these long cliffs from the tops of the great sand dunes at the edge of the Western Desert, to note below their even top a series of regular undulations of the bedding. Two distinct anticlinal crests separated by a syncline are plainly visible in section. The crests are approximately opposite el-Bayahu and el-Burgayah; the syncline is marked by the quarries between Gebel et-Teir and Tihna el-Gebel.[12] Whether or not these distinct undulations are the true continuation of the Kallalah fold cannot be proved until the intervening ground has been traversed and surveyed. Sand and cobble gravels on the opposite side of the valley allow the limestone to appear in small exposures only, except in certain localities, and I have no conclusive evidence of any folding here.[13]

Dr. Hume calls attention to a third fold of the same series, of primary importance to the Nile—that of the Thebaid, round which the Nile was forced to feel its way. It is probably continued across the river to the Gebel Serai outlier.

In addition to these marked folds, which are intimately associated with the development of the Nile, the Eastern Desert in particular is corrugated by gentle anticlines, synclines, and domal structures, but, as Dr. Hume says, "there is still much obscurity as to the reasons for these occurrences." They are seen in section where the Nile has cut through the formerly continuous limestone plateaus, and they have guided the courses of its tributaries at almost every turn.[14] The more we realize that the plateaus are thus corrugated, the easier it will be to understand the fretted edge which they oppose to the Nile Valley, here towering ramparts washed by the river, there enormous bays receding far into the desert.

The courses of the Nile and its tributaries are probably explained fully enough by a network of folds running north to south and northeast to southwest, besides others more sporadic, without mention of the word "fault." Yet each of the northern Tethyan folds is bounded and surrounded through some part of its course by faults, most of them parallel to it. A glance at any geological map of the region between Suez and Cairo, or of the northern Kallalah country, will impress the truth of this statement indelibly on the memory. Such of these faults as reach the Nile cross it diagonally, but they have nothing whatsoever in common with rift faults which might delineate the valley. In Upper Egypt, moreover, the cliffs bounding the Nile and its tributaries have been subjected to landslips on a grand scale, owing to the slipping of heavy masses of Eocene limestone on the soft Cretaceous Esna shales. Slip faults, essentially shallow features, often of gigantic size, thus bound almost the whole per-

[12] Marked by the word "Folds" on Fig. 2 between Samalut and Minyah. Where possible, examples are given which may be seen from a railway carriage on the main line, for the convenience of visitors who are tied to the ordinary means of travel. As far as possible also, exposures and other sites are described with reference to towns and villages which are on the maps.

[13] The Libyan Desert expedition led by Major Bagnold in the autumn of 1932 traversed these gravels in a southwesterly direction from Minyah and passed onto Middle Eocene limestones and clays about 65 km. (40 miles) from that town (see Fig. 8). For about the next 20 km. or 15 miles we ran between high, steep-sided ridges the strata of which displayed rapidly changing and locally very steep dips. The structures appeared to form a dome with anticlinal puckerings, including a strongly marked monoclinal flexure near the southwestern margin; they suggested severe lateral pressure along a northeast–southwest trend. Reference to Fig. 2, to which this new evidence has been added during publication, will show how closely the disturbed area conforms to the Tethyan line described above. The folds are entirely distinct from the corrugations of the Eastern Desert, with which I am familiar. It seems probable, therefore, that the Kallalah fold may be traced into the Libyan Desert, on the Nileward margin of which it is hidden by the gravels.

[14] Hume refers (*GM*, 1910, p. 387) to such relations, and a somewhat detailed study by the present writer may be found in *GJ* LXXII (1928) 144–58. Similar undulations, with marked down-folds, make their appearance on the west bank near Beni ʿAdi southwest of Manfalut (see pp. 27f.).

imeter of the Theban Hills, the slightly bowed or folded structure of which has further fostered a natural tendency. These are not trough or rift faults. Precisely similar structures are seen in any country where heavy masses of rock overlie soft and naturally unguent material such as clays and shales. How much more readily the slipping took place when the great gorges were being cut can be gauged by a study of the confusion that has resulted. In the Faiyum and its neighborhood, for instance, such detached, slip-faulted masses have not merely broken away from the cliffs, but have slipped considerable distances from them.[15]

Aided by shales of various horizons and by rolls and sags and gentle folds, the bounding cliffs of the Nile Valley and of its tributaries, for which a rift origin has never been suggested, have been reduced to varying degrees of ruin. From the detached outliers of Esna shale and higher rocks south of Luxor the slips may be traced with but few intervals to the Minyah district. The slips are seldom exposed better than they are on the flanks of Gebel Kararah,[16] on the east side of the Nile opposite Maghaghah; and again farther north they abound. Often the cliffs have receded long distances, leaving a succession of foundered masses in their wake. No more perfect examples of this could be found than the gigantic slips of Gebel Rakhmaniyyah and Gebelein (between Luxor and Esna)[17] or the edge of the western plateau near Denderah.

The recession of the sides of the Nile Valley and of the major wadies in the limestone, with or without subjacent slipped masses, and with retention of precipitous configuration, recalls Fenneman's description of the analogous Edwards Plateau "stratum plain." In this limestone district, much of it experiencing low rainfall, "the effect of the many springs . . . . is to sap the strong rocks of the canyon walls which thereupon retreat and separate. Thus results the somewhat anomalous form of canyons with almost vertical walls but several miles wide, having flat floors, often covered with fine deciduous forests."[18] Most of the springs have now disappeared from Egypt, with the lowering of the water table; but the results of their work remain.

So far it has been impossible to substantiate a single true fault which is even approximately parallel to the Nile Valley. Strata dipping gently toward it from both sides and accentuated in the close proximity of the cliffs themselves are common enough, but they are not faulted. The only faults approximately parallel to the valley that seem to suggest trough-faulting are those on the cliffs south of Akhmim, which have been proved by the boring of an irrigation tunnel through the cliff in connection with the new barrage of Nagᶜ Hammadi. That these are indeed faults, as in fact they appeared to be, and not slips, has been verified by the officers of the Geological Survey, to whom my thanks are due for the information.

One's mind may revert at this point to the marked difference in level of the Eocene beds on the west and east sides of the Nile south of Cairo. It is thus described by Beadnell in a paper now more than 30 years old in which he was, in fact, stressing the importance of faults:

> It is important to notice, however, that from Cairo for a considerable distance south of Helwan, on the east side, the Nile valley lies in a monoclinal fold, which has the effect of bringing the beds capping the high eastern

[15] Cf. *OIP* X 12, Fig. 2.

[16] A fault has been supposed to run along the southern side of Gebel Kararah where the slips are most marked, but on the ground evidence to prove its existence seemed to be lacking.

[17] Described in *OIP* XVII 21.

[18] N. M. Fenneman, *Physiography of Western United States* (New York, 1931) p. 53. The earlier vicissitudes through which the tributaries of the Nile passed may be studied at the present day along the course of the Little Colorado in Arizona. The course of this river, its canyons and open valleys, its aggraded or eroded floor, and the type of country through which it passes recall vividly characteristics of many of the wadies of Upper and Middle Egypt. During a period spent along its course in the summer of 1933 I became convinced that many of the problems of the Nile tributaries could be studied here at first hand with great advantage.

cliffs, from Helwan southward, to the level of cultivation. Although the area has not yet been mapped by the survey, this will probably be found to account for the absence of a cliff bounding the western side of the Nile valley in this neighbourhood. The difference in level of the Eocene beds on either side of the valley at Cairo is usually regarded as due to a valley fault, although it might equally well be due to this same fold.[19]

So far as I am aware, the foregoing quotation might be written verbatim today with as much accuracy.

On the whole, therefore, it seems best to take our leave of the rift theory and to regard the course of the Nile Valley north of Luxor as one of erosion guided by crossing series of gentle folds and by minor irregularities, but not by longitudinal faults. South of Luxor, in the area of Nubian sandstone that stretches to the First Cataract and beyond to the Sudan, the existence of a rift has never been suggested. Such faults as occur, for example the great fracture line of Gebel Silsilah, boldly cross the valley almost at right angles.[20] On the other hand, gentle folds, probably of the Tethyan system, continue. One or more of them may have induced the Nile to describe the great curve from Abu Hamed via Dongola to Wadi Halfa, which may, therefore, be a gigantic analogue of the Kena bend.

As is seen in the following chapter, the whole of the slipping and other differential movements had come to rest by the time the Pliocene sea flooded the great gorge and allowed detritus to accumulate in still water. Since that time virtually no movement of the kind has taken place.

[19] H. J. L. Beadnell, "Recent Geographical Discoveries in the Nile Valley and Libyan Desert," an English translation of a paper communicated to the International Geological Congress, Paris, 1900. I am indebted to the author for lending me a copy of this paper and for his generous help in discussing many problems of Egyptian geology.

[20] It may be said with truth that a fault line of major importance runs almost north and south along the center of Khargah Oasis, but it is not suggested that the oasis is a rift valley. The rift origin of the Red Sea coasts and ancillary gulfs is, of course, accepted without hesitation.

II

THE PLIOCENE PERIOD

HISTORY OF INVESTIGATIONS

In the preceding chapter it is stated that the Nile Valley in almost its present form was excavated in Pontic (Mio-Pliocene) times, ready for the invading waters of the Third Mediterranean period to flood it. The deposits that were laid down in the gulf have survived locally on a grand scale. They have, indeed, provided convenient camping grounds and habitation sites where Man could evolve his civilization, and they have been the retaining walls between which the Nile has worked out its history. Since our chances of tracing early Man's development depend almost entirely on the material that fell from his hand near his camps and on his hunting expeditions, it soon becomes clear in the field that a good knowledge of the Pliocene beds and their history is essential.[1] The marine and estuarine deposits of the Cairo district and southward along the east bank as far as el-Fashn were for some years the special study of Blanckenhorn, and their fauna has claimed the attention of that author and of a host of paleontologists who have visited Egypt. In Upper Egypt Hume gave analogous deposits early attention, and Beadnell traversed the country between the two regions on the west bank of the Nile. Laboring under the many difficulties of early official surveys, Beadnell was nevertheless able to give more than passing attention to the Pliocene in a desert geologically unmapped. Unfortunately his report was never adequately published. The east bank remained even more of an unknown quantity.

It was to be expected, therefore, that there might be useful results from a survey devoted entirely to the Pliocene and Pleistocene problems of both banks from Luxor northward. The results of the survey of the southern part have already been published,[2] and in that account the continuity of the Pliocene sea northward as far as Asyut was shown. In earlier times the Kena-Luxor region was considered to have been a lake, held by a barrier of cliffs across the present valley between Nagᶜ Hammadi and Kena.

In starting the final part of the work I had the advantage of many conversations with Messrs. Beadnell and Hume, of personal knowledge gained from long marches in the southern sector, and of four seasons spent north and south of this area.

EXPLANATION OF THE SEQUENCE

This chapter gives the gist of my conclusions resulting from the survey of the Pliocene beds. It will be found to differ in certain respects from the generally accepted twofold classification of marine Middle Pliocene and estuarine Upper Pliocene beds.[3] Both these divisions retain their former positions and designations, but a period of non-sequence is interposed between them. The Upper Pliocene estuarine conditions seem to have been followed by a second period of non-sequence and of erosion and by yet another period of gulf conditions before the Plio-Pleistocene terrace phase ended the long history of marine transgression.

[1] Cf. chap. iii.

[2] *QJGS* LXXXV (1929) 493–548.

[3] Blanckenhorn (*Hdb.* p. 151) refers the estuarine beds with *Melanopsis* fauna to the Quaternary, a decision which may be justifiable on paleontological evidence, but which does not in the least accord with the sequence of events, as will be shown later. They will be retained here as Upper Pliocene. He also (p. 130) refers the marine beds to the Upper Pliocene, though, as he notes, other authors regard them as Middle Pliocene—a consensus to which I adhere.

1. It is well known that the sea entered the mouth of the Nile Valley in Middle Pliocene times, that beds crowded with marine shells line the sides of the valley to a proved height of 100 meters above present sea-level (near Dahshur),[4] and that their most southerly occurrence yet known is at Dahaibah, opposite Biba, where they rise 1 meter above the modern alluvium and 30 meters above sea-level.[5] It has been shown also that the deep water within the lining of the *Pecten* bed deposited clays, sandy near the shore, sometimes containing a rich fauna of Middle or early Upper Pliocene age (the *Cardium* bed). We can assume that deposits to 100 meters, or to any greater height proved by the discovery of fossils in the northern part of the valley, may belong to the marine phase.

2. Estuarine and fresh-water shells, the *Melanopsis* fauna, followed in Upper Pliocene times and were covered by a great thickness of coarse gravel, evidently laid down in water of considerable depth. Ultimately the gulf was choked with sediments at a height of about 170 meters above present sea-level. This appears to represent approximately the total amount of submergence, that is, the height to which deposition was directly related to sea-level and not to river gradients.[6] I know of no record of the *Melanopsis* fauna that exceeds the level of 145 meters,[7] but most of the exposures are within little more than half that elevation. It transpires, moreover, that they frequently occur side by side with exposures of the *Pecten* (and *Ostrea cucullata*) shell bed at low levels, and more rarely are seen overlying it.[8] This suggests that a period of erosion separated the marine from the estuarine phase. In the resubmergence to the old level and above it, the body of fresh water flowing northward was sufficient to support an estuarine fauna, albeit somewhat stunted at times, virtually as far as Cairo, then as now the real mouth of the river valley. This is in marked contrast to a marine fauna living as far south as Biba.

3. It follows that, if this erosion took place, the earlier deposits of the gulf up to 100 meters or higher in more southerly localities may have been, and probably were, reduced by erosion, and that deposits of the second transgression may lie unconformably upon them. As Blanckenhorn has already shown, such deposits may also be of a different facies.

4. I attempt to show that these deductions are fulfilled in the south and that the Pliocene deposits throughout the gulf may be directly correlated.

For some years I have been impressed by the constant appearance of false-bedded quartz sandstones, false-bedded toward the north, in sequences of Pliocene marls in Upper Egypt. The sands cut sharply across the still-water marls, sometimes with marked signs of erosion, and are alien to this part of the valley, being derived from the Nubian sandstone. Their presence demands an active flow of water.

Further, large areas of fresh-water travertines have been traced as far north as Minyah on the west bank. I do not know of them north of this district. They have been shown to belong

[4] *OIP* X 11–16. Details of the *Pecten* and *Cardium* beds may also be found here.

[5] See Blanckenhorn, *op. cit.* p. 136 and Fig. 11 on his p. 23. I visited this small exposure in 1931 and found it in a ruinous state, as the fellahin have selected it for a number of interments, have dug ditches around and through it, and abandon all manner of undesirable rubbish on it. The palm trees still survive. In view of the condition to which it has been reduced and of the wild confusion that my visit caused among the people, it is not surprising that I found only unrecognizable shell fragments in the yellow, ocherous, marly to gritty clay exposed in the best of the tumultuous sections. I cannot subscribe to the fault that Blanckenhorn marks in his Fig. 11, but the flexure of the Eocene and the discordance of the Pliocene upon it are clearly seen.

[6] See *OIP* X 16–23.

[7] Blanckenhorn (*op. cit.* p. 159) records the beds to 117 meters above Nile cultivation in the vicinity of Gebel Umm Rakabah, between wadies Urab (i.e., Ghurab) and Sanur (i.e., Sanhur), about 7 miles south-southeast of Beni Suef: Nile flood plain there lies about 28 meters above sea-level. The beds are described more fully in Blanckenhorn's monumental papers in *ZDGG;* see in particular LIII (1901) 403 and Fig. 14 on p. 353.

[8] E.g. Blanckenhorn, *Hdb.* Fig. 22, p. 137, and Fig. 27, p. 158, with apposite text.

to the Pliocene sequence.[9] In every example known to me the travertine, if present, occurs above the quartz sands, not below. Travertine occurs in a few sections almost to the full height of the Pliocene deposits; but far more frequently it is replaced by torrent gravels and conglomerates of local origin, which form the plateau-like summit at about 170–180 meters throughout a large part of Upper Egypt (Pls. I–III).

Even where such gravels locally make up the major part of the gulf deposits a marked discordance may sometimes be noted. This in the first instance suggested to me a line of erosion and subsequent deposition[10] before the more striking evidence of the quartz gravels was complete.

I suggest, therefore, that all beds of the Pliocene series of Upper Egypt above the quartz sands, where present, are in all probability Upper Pliocene, those below, Middle Pliocene; the former certainly fresh-water, the latter perhaps deposited in more brackish water. It is worthy of notice that the salty *sebakhs* and marls usually occur in the lower parts of sections,[11] but this salt content may be due to subsequent infiltration and evaporation. Sometimes, however, marls occur unconformably above white limestones (not travertines) at the valley sides.[12]

5. So far there has been no sign throughout the Middle and Upper Pliocene deposits in Upper or Lower Egypt of detritus which could have been derived from the igneous and metamorphic rocks of the Red Sea Hills. So striking are the characteristics of these rocks that I was led, when working in Wadi Kena and other parts of Egypt in 1925/26, to adopt the absence or presence of material derived from them as a criterion of Pliocene or post-Pliocene (Plio-Pleistocene) age. Recent work in Wadi Matulah and Wadi Kena, the great valleys down which vast quantities of bowlders, gravel, and sand subsequently poured into the Nile Valley, supports the conclusion.[13] It is almost inconceivable that the treatment of a sufficient body of Pliocene sand should not yield at least some feldspar crystals, derived from one or more of many possible sources, for example the distant cataracts; but for the present the distinction seems to hold good. Its utility in the field will be seen in the following sections.

In the prominent group of hills immediately north of Kena[14] thick sands composed of quartz, feldspar, and other minerals, as well as small fragments of igneous rocks, overlie the usual Pliocene marls and clay. They were evidently deposited in water, for they are current-bedded to north and northwest. Again, the prominent hill and ridge of esh-Sheikh Abu Farwah near el-Matmar, on the east bank about 20 miles south of Asyut, shows similar relations; it is there the more evident that the Pliocene series was first severely reduced by erosion. "Plio-Pleistocene" sands, false-bedded to the north, have there accumulated to a height of about 106 meters above sea-level. Thirdly, between these two regions we may note a section in the bay on the east bank near the mouth of Wadi Abu Nafukh, southeast of el-Balyana, showing 80 feet of similar sand, false-bedded, on an eroded surface of Pliocene marl.[15]

These and similar sections show that we must take into account a third group of waterlaid[16]

[9] *QJGS* LXXXV (1929) 513 and 534. See also chap. iii, wherein their stratigraphic position is discussed.

[10] This may be traced near the base of the great cliffs of the North Valley of Wadiyein, Thebes, near the toadlike cliff profile (Pl. II, *A*) well known to archeologists.

[11] Beadnell (*op. cit.* p. 22, n.) suggests that they "may belong to the earlier marine series."

[12] As at Denderah; cf. *QJGS* LXXXV 507.

[13] See p. 22. For a full discussion of the problem see *QJGS* LXXXV 507–9 and 516–20.

[14] *Ibid.* pp. 508–9 and 519. The quartz sands (Pl. V, *B*) were found on reinvestigation in 1931 to contain feldspar and other minerals.

[15] *Ibid.* pp. 510–11. The full significance of earlier known sections has now been made clear by the esh-Sheikh Abu Farwah exposures (see p. 46 and Pl. V, *A*).

[16] Here and in later chapters the words "waterlaid" and "subaqueous" (cf. p. 43) are used as convenient terms for deposits laid down under a surface of water, to distinguish them from river gravels lying along a gradient.

deposits of the gulf—a group belonging to the latest stage of the gulf's existence and preceded, like the post-Middle Pliocene deposits, by a period of erosion. Such sands are well known in the Cairo district and in the Delta. It is interesting to find that there they are local representatives of a general feature, not merely deltaic sands of later age. We must add to our sequence, then, a final, Plio-Pleistocene term which has not previously been included in any general scheme.

6. The subaqueous Plio-Pleistocene deposits were accumulated to an unknown height, but there is no evidence that they overlapped the Upper Pliocene level of about 170–180 meters. They may be traced to a height of about 125 meters above sea-level at Kena Hill, and are covered by 10 meters of coarse sand and gravel.

The Third Mediterranean stage, which has almost carried us out of Pliocene times, may then be deemed to have ended. The history of the valley thereafter was one of fluviatile accumulation and erosion. There followed a series of high river terraces, the later and lower members of which contain human implements. For convenience the beginning of the Pleistocene period may be placed at that point in the series where artifacts appear. It is apparent that in Egypt Man was separated by a prolonged series of events from the latest strata recognizable as Pliocene. From the southern limits of the Pliocene gulf, southwest of Edfu, almost to the apex of the Delta the high terraces fall within the vertical range of the Pliocene deposits, 170–180 meters above sea-level. It will be seen that at the stage of the highest terrace the river chose for itself a course bounded on the east by the gulf deposits, and that it subsequently re-excavated its bed at their expense. The series from Pontic to Lower Paleolithic is thus in considerable measure rendered complete.

The following table may serve to correlate the movements discussed above and to show their relationship to events contemporary with Man. The term "Plio-Pleistocene" is retained for convenience for the final term of the Third Mediterranean period (Fig. 3).

Quarternary Period	12. Recent: continuation of recovery and deposition of alluvium in Egypt
	11. Pleistocene: later Paleolithic changes of river-level
	10. Pleistocene: Lower and Middle Paleolithic terraces
	9. Plio-Pleistocene river terraces cut in or beside gulf deposits
Third Mediterranean Period	8. Plio-Pleistocene sand and gravel deposits, perhaps to 180 meters but known only to 135 meters
	7. Unconformity: quartz-feldspar fresh-water sands of Upper and Middle Egypt* to about 125 meters
	6. Upper Pliocene estuarine and fresh-water beds: travertines etc. of Upper Egypt to about 180 meters, *Melanopsis* beds known to 145 meters
	5. Unconformity of fossiliferous strata: quartz sands of Upper Egypt
	4. Middle Pliocene marine stage to about 100 meters
	3. Lower Pliocene estuarine beds of Lower Egypt (cf. Wadi Natrun)
Pontic Period	2. Lower Pliocene: completion of excavation of valley Upper Miocene: uplift and faulting of Middle Miocene rocks
Second Mediterranean Period	1. Middle Miocene marine and deltaic deposits north of Cairo along east–west line

* There is some justification for assigning these beds to the Pliocene, and the Plio-Pleistocene terraces to the Pleistocene; but it does not seem desirable to do so at present. See p. 51.

PLIOCENE TRIBUTARIES OF THE NILE

In an earlier volume of this series[17] detritus-filled valleys of Pliocene tributaries flowing from the western plains into the Nile between Gebel Dishashah in the south and Dahshur in the

[17] *OIP* X.

north were mapped and described. Until the contoured maps of the 1:100,000 series are completed, it will not be feasible to continue detailed geological mapping south of Gebel Dishashah. Along a stretch of the Nile north of Luxor, however, several Pliocene tributaries have now been identified and may be depicted provisionally on a sketch map (Fig. 4).

In and near the Faiyum the material that choked the valleys proved to be more resistant than the soft Eocene and Oligocene rocks of which the country consists. Accordingly the fillings survive today as tortuous ridges (Pl. IV) running across a country the general level of which is scores or hundreds of feet below them.

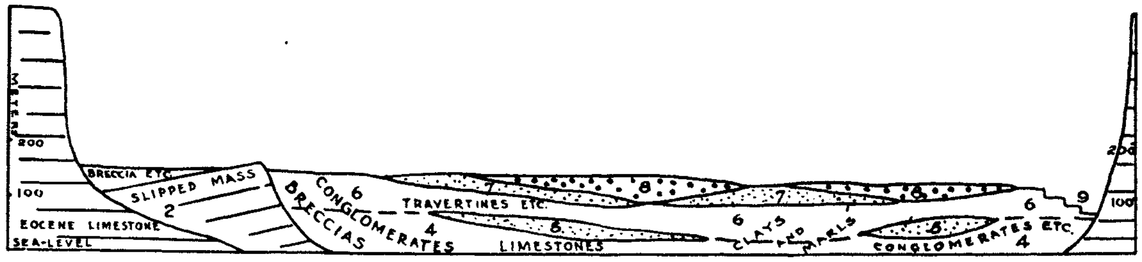


FIG. 3.—DIAGRAMMATIC SECTION ACROSS THE NILE VALLEY TO SHOW BEDS AT THE CLOSE OF THE THIRD MEDITERRANEAN PERIOD. NUMBERS ARE SAME AS THOSE IN TABLE ON PAGE 12

In the Luxor district, on the other hand, the greater elevation of the Lower Eocene plateau led to the cutting of deep and steep-sided gorges. The Pliocene fillings are therefore contained in the depths of the canyons, plastered against their sides and preserving their ancient contours. They have been trenched by later torrents and are torn at the present day by rare floods which sweep tempestuously down the valleys. The North Valley and the Valley of the Kings' Tombs at Thebes are examples of this type. It should be observed, however, that the Upper Egyptian valleys are with rare exceptions filled with débris that was swept into them when they were deeply flooded, and the deposits are accordingly subaqueous. The strata change fairly rapidly from angular rubble, cemented to form the beautiful red breccia, to coarse conglomerates and gravels, into which sands and white limestones of fine redeposited Eocene limestone and Esna shale are interdigitated. These in turn give place almost imperceptibly to clays and marls as the zone of deposition of still water is approached. Rarely, as at Kena, an exceedingly fine pottery clay, loesslike in appearance and probably partly aeolian in origin, is the final product of the sequence of lateral gradation. The finest beds have usually been destroyed by later erosion. It is thus common to see in any prominent section of the Pliocene deposits of Upper Egypt successions of gravels, sands, limestones, clays, and marls; they have no chronological value, but mark only vicissitudes in strength of current. The higher, unflooded headwaters of the tributaries which drained the remote parts of the high plateaus of Upper Egypt are no longer recognizable.

Between the northern and southern extremes of valley-fillings there are gradations which became apparent in the season of 1930/31. On the east the limestone plateau is continuous, except in the region of soft Middle Eocene clays, from Kena to the Mukattam Hills of the Cairo district, where it is trenched by impressive canyons such as Wadi Hof. Accordingly the waterlaid valley-fillings may survive in deep valleys, but the deposits of the upper parts of the tributaries are usually lost. On the west conditions are less simple. Since the valleys north of Asyut were not so deeply intrenched as those on the east bank, their former existence must be inferred from deposits rather than from deep gorges.

Another factor is important. In Oligocene times vast quantities of sand and coarse cobble

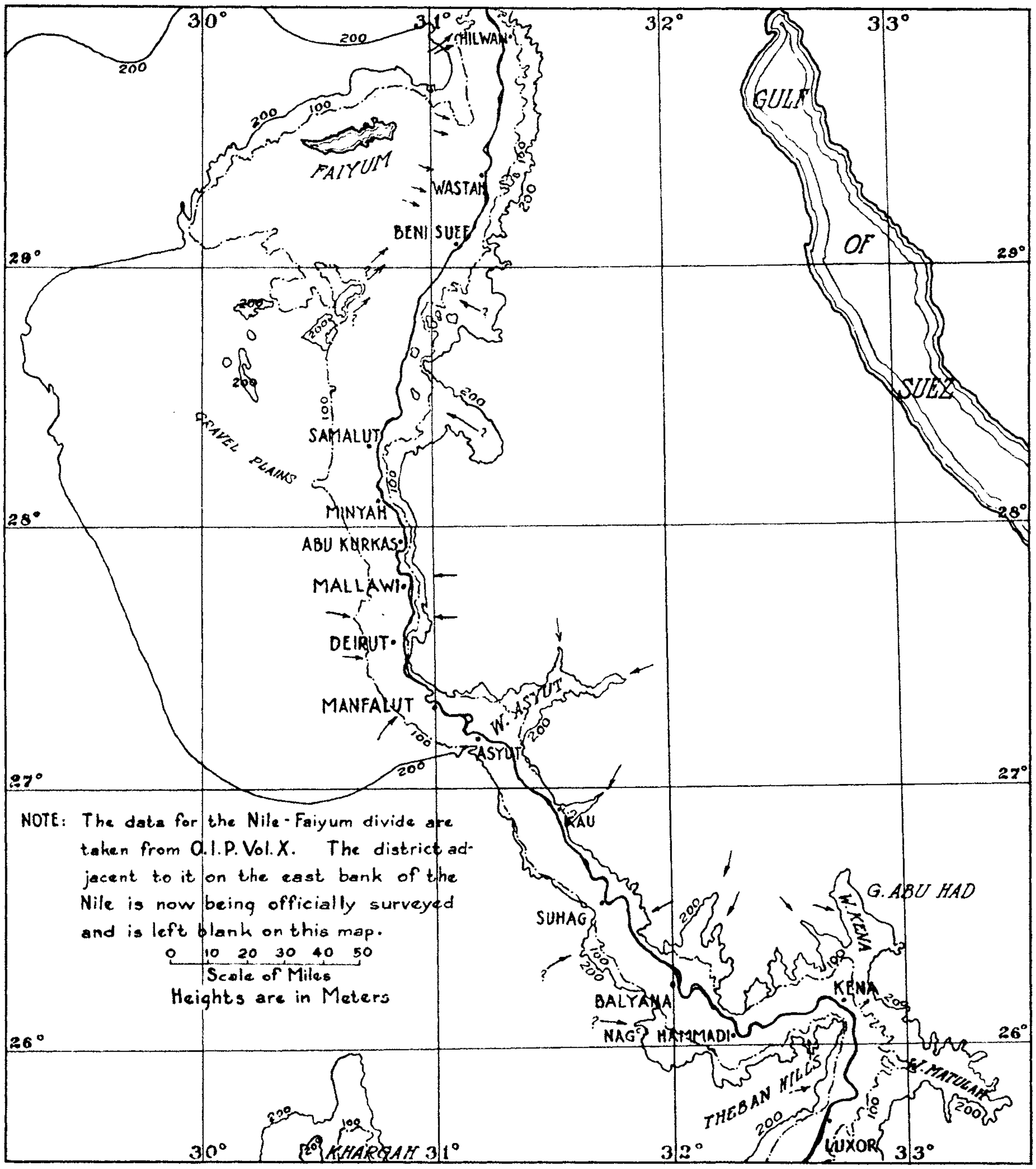


FIG. 4.—SKETCH MAP OF THE PLIOCENE TRIBUTARIES OF THE NILE IN UPPER AND MIDDLE EGYPT, SHOWING THEIR RELATIONS TO THE 100-METER AND 200-METER CONTOURS

gravel were rolled northward, apparently by a river or rivers flowing over what is now the western plateau; these were redeposited along Pliocene and Pleistocene channels. In the geological map 1:1,000,000 published by the Survey of Egypt in 1910, and in the revised map 1:2,000,000 published with Volume I of Dr. Hume's *Geology of Egypt* (Cairo, 1925), Oligocene strata were shown overlying the Eocene limestones almost as far south as Manfalut, whence they diverged northwestward from the Nile Valley. In the new *Atlas* of H. M. King Fuad, published in 1928 by the Survey of Egypt, this southerly protuberance of the main Oligocene outcrop is reduced to a line running approximately from Bahriyyah Oasis to the southern part of the Faiyum or to Wadi Rayyan. South of that line Middle Eocene is shown as the country rock, surcharged with the legends "Patches of gravel, age uncertain," and (farther south) "Flint gravels." None of the three maps delineates an eastern extension of the gravels toward the west bank of the Nile, though they are known to occur there and can, in fact, be seen plainly enough from the State Railway. In the map of 1928 they are no doubt included in part in the legend, "Gravels, probably Pliocene at base," that appears over a broad expanse of "Recent and Pleistocene" strata adjacent to the west bank of the Nile between Mallawi and Beni Suef.

I shall attempt to show that both legends of the map of 1928 are correct and, in particular, that the gravels are certainly "Pliocene at base." Furthermore, it will be found that at certain points broad streams of the coarse cobble gravel flowed eastward, and that at the Nile they became interbedded with the Pliocene series of the gulf.[18] It remains to be demonstrated that the cobble gravels are of Oligocene origin, that is, that they are the frayed eastern edge of the postulated river system, moved progressively eastward in successive redepositions until they gained the Nile border. In the absence of satisfactory fossils such as we find farther north, this demonstration turns on three factors:

1. Everywhere in these gravels are present quartz pebbles and quartz sand which are not locally derived but come from the Nubian sandstone.[19] Their presence indicates some means of transport from the south or southwest, presumably a river or rivers, before Nile-basin erosion picked out the overlap of the Eocene and Cretaceous onto the Nubian series in the Sudan, denuded them into outliers and a great south-and-east-facing scarp, and cut off the southern source of water supply from the Libyan Plateau. It is therefore certain that the cobble gravels are only in part locally derived, that is, local flint and chert, but in the main have traveled varying distances from southern and southwestern origins.

2. The presence of fossil wood is important, since it will be remembered that great silicified tree trunks, sometimes concentrated in "petrified forests," were characteristic of the Oligocene series in the Faiyum–Cairo region. Although such trunks are not to be expected in frayed-out gravels, smaller fragments serve the same purpose.[20] The most southerly position in which fossil wood was found was near ed-Deir el-Muharrak, on the Western Desert edge near Manfalut, in cobble gravels with quartz that debouch into the Pliocene series from the western plains.

3. Occasional pebbles of Oligocene quartzite or hard silicified quartz grit, a rock well known in northern Egypt, occur in the gravels of the Western Desert edge at least as far south as Balansurah near Abu Kurkas. I suggest that we may regard these gravels as of Oligocene derivation, and that a good case may be made for restoring at least part of the southern boundary credited to the Oligocene in the geological maps of 1910 and 1925.

Another point remains to be made clear. It has been said that the waters of the Pliocene

[18] See folding map at end of book.

[19] The outcrops in Khargah Oasis, being at low levels, seem to be inadmissible as sources of origin. See p. 17.

[20] Fossil wood occurs in the Nubian series also.

gulf of the marine stage reached a height of 100 meters above present sea-level. It is known that they stood a little higher than this; they may even have accumulated to the full height of 170–180 meters[21] attained by the gravels in which the estuarine phase culminated throughout the gulf. The nearest contour shown on the new 1:100,000 geological map (1928 ff.) is the 200-meter line. This leaves the Nile Valley near Asyut, runs a little south of west for 50 miles, and then turns north-northwest toward the eastern approaches of Bahriyyah Oasis. Finally it turns east-northeast and passes along the northern side of the Faiyum toward Cairo, where it turns sharply to the west again. Since the 100-meter contour keeps close to the Nile Valley nearly to Maghaghah before it turns northwest toward Wadi Rayyan, and since the two contours are 50–80 miles apart, it is a matter of some difficulty to interpolate between them with any reasonable accuracy. Even so, the criticism may be made, based on contours, that most of the gravels to which I have referred, especially on the Nileward side, were under still water in Pliocene times, and therefore incapable of movement. The answer is as follows:

1. Contours give little idea of the state of the surface in a previous geological epoch, when the surface has been exposed to denudation. The Western Desert suffers acutely from wind erosion, of which the great dunes and sand seas are tangible evidence. Gravels are at a serious disadvantage in these circumstances, since the interstitial sand is readily blown away, the larger fragments becoming concentrated but remaining loose. The 200-meter contour in this district probably gives an erroneous idea of the land surface in Pliocene times.[22]

2. Most of the exposures that show gravel interbedded in the Pliocene series are on, or a little above or below, the 100-meter line.

3. If much of the Western Desert between the 200- and 100-meter contours was under water at the height of the Pliocene transgression, there is the more reason to suppose that the tributaries to which I shall refer performed their function before that maximum was attained or between the first and second "peaks" of submergence discussed above.

4. Much of the eastern drift of cobble gravel was probably accomplished in Pontic Pluvial times, when the Nile Valley was first cut and its lateral drainage initiated. In Middle and Upper Pliocene gulf times those tributaries probably had an ample supply of material in their immediate vicinity, some of which they resorted until their valleys became choked. Outside the valleys the surface is still thickly draped with unassimilated gravel resting in confusion on Middle Eocene rocks.

5. Similar conditions may be seen on a small scale on the east bank of the Nile north of el-Fashn, where similar relics of cobble gravel have been partly absorbed in the valleys (see p. 40).

6. In most places the assimilated gravels occupy valley-like breaches in the high cliffs of Eocene limestone which flank the Nile Valley.

Finally, in discussing the desert west of the Nile it must not be forgotten that the oasis of Khargah lies little more than 100 miles away, and that it contains thick deposits of superficial strata, notably travertines and tufas.

Recent work[23] has shown that these calcareous deposits were formed during more than one epoch. To the oldest a Plio-Pleistocene age is provisionally assigned, but the evidence has not yet been fully published. At the time of writing there appears to be no reason why the great masses of travertine in the Nile Valley and the oldest or "plateau" type of Khargah should

[21] As a safe maximum the 200-meter contour line has sometimes been adopted in conversations about the Pliocene summit-level, and as such it serves well enough. I am indebted to Dr. Hume for a hand-colored map which he had drawn up on this basis for presentation at the International Geographical Congress, Paris, 1931.

[22] But see also pp. 33–35 and Fig. 4.

[23] Described by Miss G. Caton-Thompson in *Man* XXXI (1931) 77–84 and XXXII (1932) 129–35.

not prove to be of the same age, probably Upper Pliocene.[24] One might go farther and inquire whether the oasis may not have been flooded during the Third Mediterranean period. Khargah was evidently cut to great depth at an early date and contains not only travertine but other rocks that seem to have affinities with Pliocene deposits of the Nile Valley. According to existing maps the great depression is separated from the Nile Valley by a ridge that descends at its lowest point to 200 meters, with a width of about 25 miles, about 50 miles south of Aswan. The locality has not yet been mapped in detail, nor searched for Pliocene deposits that may rest on it or fill depressions in it. It is possible that ancient surfaces of Pliocene deposits may occur here below 200 meters. Until the question has been settled by detailed topographic and geological survey, carried out by a party familiar with the varied Pliocene deposits of the Nile, we cannot safely assume that the waters of the Pliocene Nile gulf either had or had not access to Khargah Oasis. Low levels also run from Khargah through Dakhlah and embrace both oases in the one depression. Two narrow strips of ground believed to be above 200 meters separate the northwest corner of the Dakhlah sector from Farafrah Oasis, and another lies between that oasis and the Mediterranean coastal lowlands and the Kattarah depression.[25] I know of no concrete evidence that suggests a marine flooding of Khargah from this direction, although there is now reason to believe that marine Pliocene deposits extend farther south than is generally supposed (see p. 34 and Fig. 4).

So far as the western tributaries of the Nile are concerned, Khargah may have set a limit to them in Pliocene times; in other words, a watershed existed then, as now, between the Nile Valley and the depression. Certain ancient gravels of the border of the oasis may thus prove to be analogous to those described in chapter iii. A broad plateau lies between the Nile and Khargah, ranging from more than 400 down to 300 meters above sea-level, from the latitude of Aswan to Asyut. North of that town the western tributaries of the Nile, of Pliocene age, become prominent. Here also the desert is of no great height (below 300 meters), and a belt at least 100 miles wide lies directly within the drainage basin of the Nile. Important Pliocene tributaries, draining a long ridge of high ground, have already been mapped across the Faiyum.[26]

Within broad limits, therefore, some limit of length may be fixed. The western tributaries were probably fairly short between Luxor and Asyut, long between Asyut and the Faiyum, short and steep between the Faiyum and Dahshur.

[24] Since this was written the question of the age and mutual relations of the travertines has become prominent as a result of the publication of Miss E. W. Gardner's valuable paper in *GM*, 1932, pp. 386–421, and of a long article by Miss Caton-Thompson and Miss Gardner in *GJ* LXXX (1932) 369–409. The latter has been severely criticized by Beadnell (*GJ* LXXXI [1933] 128–34), and at the moment the discussion appears to be unfinished. Throughout these recent contributions there seems to be a lack of familiarity with recent work on the deposits of the Nile Valley which are being used as a standard of reference. It is to be hoped that this volume will help to overcome the difficulty, and I submit that the evidence which it contains supports my original conclusion given above. Younger travertines also have been found in both regions; see *GJ* LXXXI (1933) 526–32.

[25] The positions of these places will be found in any good atlas.

[26] See *OIP* X, Fig. 5.

III

THE PLIOCENE DEPOSITS AND THE MARGINS OF THE NILE VALLEY

(See Pls. I–IV)

The following plan is adopted to condense a large volume of field notes and sections to serviceable form. The observations included here are simply those most illustrative of the general conditions both of the actual sides of the Nile Valley and of the Pliocene deposits which line them and form the walls of the inner valley, in which most of the Pleistocene deposits lie.

The region is divided into four districts (see Fig. 4):

1. Luxor–Wadi Kena–Nagʿ Hammadi
2. Nagʿ Hammadi–Asyut
3. Asyut–Samalut
4. Samalut–Beni Suef–Hilwan

Each is described under the following headings:

1. Margins of the Valley, also General Information[1]
2. Sections in the Valley
3. Sections of Tributary Valleys

To save duplication it is assumed that the following publications are available to any reader requiring more detailed information:

1. For the district Luxor–Asyut, the writer's paper in *QJGS* LXXXV (1929) 493–548; for that south of Luxor, *OIP* XVII.
2. For the west bank between Biba and Sakkarah, *OIP* X.
3. For the east bank, especially between el-Fashn and Cairo, Blanckenhorn, *Hdb.* and *ZDGG* LIII (1901) 307–502.

LUXOR–WADI KENA–NAGʿ HAMMADI

Margins of the Valley, also General Information

The western side of the valley is entirely governed by the Theban Hills, already described by Hume (see p. 4) as a gentle roll or flexure of the Tethyan system, crossing the generally synclinal disposition of the strata in the Nile Valley. The superposition of massive Lower Eocene limestones, here approximately 1,000 feet thick, on slippery Esna shales precipitated great landslips in the past. The movement was stimulated, no doubt, by the depth to which the valley had been cut and by the presence of the flexure. The fallen masses, often a mile or more long and tilted down toward the parent cliff, immediately attract the eye of an observant visitor. He should realize, however, that, although the slips here are on a grand scale, they are ubiquitous and their absence soon strikes a geologist's eye almost as much as their presence. They are less developed on the west bank between Denderah and Nagʿ Hammadi, that is, on the north side of the Thebaid, than between Denderah and Luxor. On the east bank their grand proportions south of Luxor at el-Mataʿnah and Gebelein have been noted in *OIP* Volume XVII. Thence they may be followed along the front of the triple peaks of Gebel Rakhmaniyyah (see Pl. I, *A*) which dominate Luxor. At the Wadi Madamud stumps of detached masses stand like half-sunken islands, separated by wide intervals from the parent cliff. They may be traced to the shattered little Gebel el-Kurn, at the mouth of Wadi Matulah,

[1] The physiographic descriptions under this head will suffice for the remaining chapters of the book.

and on through Gebel Serai to Gebel Abu Had and Gebel Arras, the sentinels at the mouth of Wadi Kena, which is similarly bounded. Here the northern face of Gebel Abu Had also is broken (cf. Gebel Nagᶜ et-Teir, its almost detached outlier). On the Nileward side the eastern limestone, or Maᶜzah, plateau is recessed by deep bays until the bold and precipitous cliffs of the approaches to Nagᶜ Hammadi seem to deny any possibility of landslips. Even so, an eroded remnant lies at their foot, and they owe their splendid profile to the fact that during Pleistocene times the Nile succeeded in breaking through the Pliocene lining of its valley and gnawing at the Eocene cliffs behind it. I am able to record only a single instance in which appreciable movement of the slipped masses has taken place since the Pliocene deposits accumulated round them.[2] The period of landslips seems therefore to be inseparable from the Pontic excavation of the valley and was already finished at the time of the Pliocene gulf.

Sections in the Valley

Full descriptions of the stratigraphic series of the Pliocene in this district may be found in the publications already mentioned. Since Wadi Kena was flooded almost to the northern end of Gebel Abu Had, it may be regarded as an essential part of the gulf. Its Pliocene deposits are identical with those of the neighboring part of the main valley, except for the notable absence of quartz sands. Everywhere the deposits grade from coarse at the valley sides to fine clays and marls toward the center. The coarse deposits extend farthest into the valley where tributaries were most active. These tongues of material, often cemented by lime to form a hard rock, for example the red breccia and red conglomerate, are enduring evidence of Pliocene submergence where softer deposits have disappeared.[3] In the Nile Valley they guided the river in the course that it should take in Plio-Pleistocene and later times. The enormous quantities of coarse detrital material that were poured into the valley are significant evidence of the severe denudation suffered by the plateaus in Pliocene times. Within the district the general height at which the deposits form a prominent table-land of varying width is approximately 165 meters above sea-level. This agrees reasonably well with readings up to 180 meters obtained elsewhere, and the 200-meter contour may be taken as a limit of altitude with a sufficient margin of safety.

No fauna is known in the strata, and published reports suggesting its presence and nature have not stood the test of time.[4]

The base of the series disappears below the level of the Nile alluvium and, like the floor of the valley itself, it has not yet been found in borings (cf. p. 100).

On the west side the deposits are continuous to Denderah, where, in the hills about 3 or 4 miles south-southwest of the temple, some old quarries containing Roman sherds (although the workings may be much older) expose the following section:

Section of Pliocene Beds near Denderah

Bed		Feet
4	Rolled rubble of flint and Eocene and Cretaceous limestone	40
3	Purple marl veined with gypsum, weathering brick red, with a 3-foot lenticle of rolled limestone rubble	5
2	Irregular band of rubble conglomerate, exceedingly hard	3
1	Hard white (Pliocene) limestone, base not seen	56+
	Total	104+

[2] The faulting of the 100-foot gravels near Bir Arras in Wadi Kena (*QJGS* LXXXV, Pl. XXIX 2).

[3] This lateral grading of breccia as a scree material at the foot of a cliff and conglomerate as a product of running water seem not to have been fully understood by Miss Gardner (*GM* LXIX [1932] 402–3). The presence of breccia does not necessarily imply an arid climate, as she supposes, and the conglomerates do not support such a belief.

[4] See detailed consideration of the evidence in *OIP* XVII 14.

Beds 1 and 2 were those desired by the masons. So hard is the conglomerate that it was worked in the same blocks as the limestone. Only 6 feet of the latter are exposed in the upper quarry; but it is found in another immediately below, and the thickness stated is probably a moderate estimate.

There are marked unconformities above and below the marl, which is seen near by to sweep down over the limestone toward the Nile, where in any event it would probably take its place. This is an indication[5] of time interval between lithological facies of the locally derived Pliocene series.[6]

Between Denderah and el-Marashdah (about 15 miles downstream) is a monotonous slope from the hills to the Nile. In places a brown marl, probably Pliocene, makes its appearance from beneath the surface gravel. Nearer Nagᶜ Hammadi, hard dark brown marl appears.

On the east side the normal series may be traced northward from Luxor to Wadi Madamud and along the flanks of Gebel Nezzi. In the wide valley of Lakeitah between the northern flanks of that great outlier and its northern companion, Gebel Serai (Fig. 5), I was able in 1931 to revise published views, thanks to the new contoured geological map (1928) and to excavations for the proposed railway from Kift in the Nile Valley to el-Kusair on the Red Sea.[7] Previous work had been hampered by lack of exposures and of known elevations. The valley and the great plains that extend to the distant Red Sea Hills indicate the exposure of Nubian sandstone. They were the site in post-Pliocene times of great tributaries which brought vast quantities of gravel and bowlders from the hills to the Nile Valley. The sandstone over large areas is thus hidden beneath a mantle of these foreign gravels, which have been redeposited in terraces of heights conforming to the Nile Valley series.

At the mouth of the valley the Pliocene beds are devoid of all foreign material which might have come from the Red Sea Hills. Previously I had attempted to account for this absence by supposing that Gebel Nezzi and Gebel Serai were joined in Pliocene times, as Barron and Hume have shown Gebel Abu Had was joined to the Maᶜzah Plateau at about Gebel Nagᶜ et-Teir in Wadi Kena.[8]

Further investigation has now shown that red breccia and Pliocene rocks extend along the northern slopes of Gebel Nezzi as far as Wadi Mushash (beyond which, although I had no opportunity to trace them, there is reason to believe they do not extend),[9] that is, well to the east of the supposed barrier.[10] Moreover, the recent excavations along the new desert railway have shown an abundance of typical Pliocene marl in the shallow Wadi Matulah as far as the northern extremity of Gebel el-Kurn. A natural exposure in a small wadi 15 kilometers west of Lakeitah Wells and about 1 kilometer south of the proposed line of the railway shows the

[5] Quite apart from the unconformities of the quartz sands, derived from elsewhere.

[6] Cf. *QJGS* LXXXV 506–7.

[7] The line is constructed for about 20 kilometers from Kift and ends blindly in the desert at present. The necessity for economy has led to the cessation of all work upon it. Some excavations exist beyond its present end, however, as far as Lakeitah Wells.

[8] Cf. *QJGS* LXXXV 508 and 516–18.

[9] I am indebted to Mr. G. W. Murray, Director of the Desert Surveys of Egypt, and to Mr. P. A. Clayton of the same Surveys for tracings of map proofs of this and other critical areas.

[10] The position of the 200-meter contour limits them. In Wadi Mushash, near its junction with Wadi Zaidun, red breccia abounded in the old terrace gravels of the west bank and on the floor, but it was absent from corresponding gravels of the east bank consisting of abundant materials from the Red Sea Hills, Nubian sandstone, and flint, in lime-cemented quartz sand.

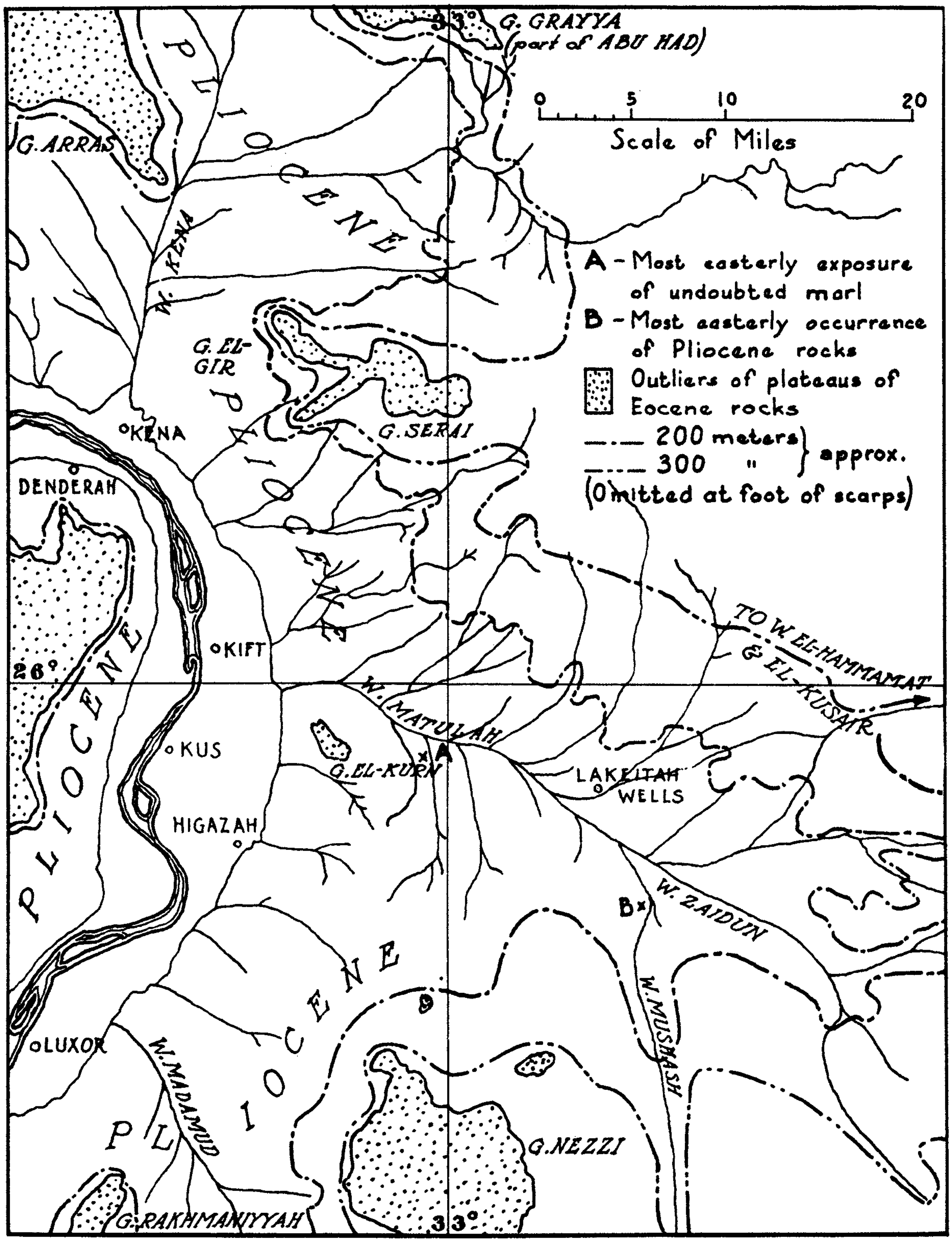


FIG. 5.—SKETCH MAP OF THE DISTRICT BETWEEN LUXOR AND WADI KENA. THIS FIGURE IS BASED ON MAP OF THE SURVEY DEPARTMENT OF EGYPT

following structure in a ridge which crosses that line diagonally about 7 kilometers west of the Wells (cf. p. 44):

Section 15 Kilometers West of Lakeitah Wells

Bed		Feet
4	Coarse igneous gravel (25- to 30-foot terrace, i.e., Pleistocene)...	10
3	False-bedded quartz sand with feldspar, subaqueous..........	5
2	Gravel containing pebbles from the Red Sea Hills and sand, false-bedded in part; lime-cemented, subaqueous, and indicating Nileward drift..........	10
1	Brown marl indistinguishable from, and essentially characteristic of, Pliocene type; base not seen, eroded upper surface covered by Bed 2..........	3–10+
	Total where measured..........	28+

Soft clays recently exposed at Lakeitah Wells may be Pliocene, or of later age, derived from the Nubian rocks. The "barrier" thus seems to fade away. Not far to the east the 200-meter contour sets a limit on the extent of the waters of the gulf, but it does not explain why great quantities of material did not reach the Nile by this route in Pliocene times.

The area shows the overlap of the Pliocene on the Nubian sandstone, but it affords no evidence of a tributary valley where such might be expected. It is closely paralleled by Wadi Kena, a gulf of still water between the main limestone plateau and what was in effect the northern end of the Serai outlier,[11] with Nubian sandstone as the floor. Here there seems no reason to dispute the theory that outlier and plateau were then joined. They are still coupled by the 200-meter contour, which has the same effect so far as a limit of the Pliocene gulf is concerned.

In both areas one seems to be driven inevitably to the conclusion that until the close of the Pliocene period the Red Sea Hills did not contribute material to the gulf, and that there was some substantial reason why they did not do so.

It may be suggested, as before, that all the outliers were joined together, the Serai–Nezzi sector being looped eastward of Lakeitah Wells in conformity with the new evidence. On the map this appears reasonable; but the question arises, whither did the western drainage of the hills go? There is no satisfactory answer. For the suggestion that it was carried southward into the Wadi ʿAbbad or Wadi Shait basins there is now no evidence whatsoever. Such a theory would be based on the fact, so obvious on the map, that the drainage basins from north to south increase markedly in importance—a measure, no doubt, of the retreat of the Eocene escarpment and of the trend of the Red Sea Hills. To appreciate this we have only to trace the wadies joining Wadi Kena, those that join near Lakeitah Wells, then the huge systems which join in wadies ʿAbbad, Shait, Kharit, and el-ʿAllaki.[12]

If we accept the amended theory of the barrier, we may attempt to answer the foregoing criticism by another line of inquiry. What evidence is there that the ancient massif of the Red Sea Hills was uncovered in Pliocene times? As far as I know there is none on the west side, although we know that on the east the hills were being extensively denuded in Miocene times, contributing vast quantities of débris to the coral and lagoon facies of the Red Sea coast. As far as I know there is nothing to prove the Pliocene position of the cover of Nubian, Upper Cretaceous, and Lower Eocene rocks which, it is believed, formerly continued over the now elevated massif to the distant in-faulted outliers of Gebel Duwi and others. Unlikely as the

[11] The outliers of Gebel Abu Had and Gebel Serai (or those parts of them known as Gebel Grayya and Gebel Gir) were probably joined until Paleolithic times (*QJGS* LXXXV 518). Even now they are separated only by a very narrow pass, which is dominated by Pliocene marginal deposits. The Nubian sandstone is hidden by deposits on the wadi floor.

[12] See folding map in *OIP* XVII.

suggestion may seem at first, it may be worth considering the possibility that the "barrier" not only existed, but that Nubian, and perhaps later, rocks still extended over a large part of the western side of the massif in Pliocene times, the watershed being governed in some degree by this cover, until the streams became adjusted in the rocks of the massif.[13]

North of the Lakeitah plains along the flanks of Gebel Serai the Pliocene sequence is fully established, and is normal, except for the presence of a thin band of quartz sand and indistinct bedding in the marls. The beds may be traced to Kena, where marl is exposed to a thickness of about 100 feet, covered by important sands of Plio-Pleistocene age.[14]

From Kena to Nagᶜ Hammadi the Pliocene, in its normal development, was traced in virtually unbroken exposures in 1925/26, the connection between the Wadi Kena–Luxor sector and the known Pliocene from Asyut to the Mediterranean thus being established. Traces of the red breccia survive even on the precipitous cliffs near Nagᶜ Hammadi. In the bays a succession of marls may be identified.[15]

Sections of Tributary Valleys

It has already been stated that in this district the original valleys of Pontic times are filled with Pliocene strata, below the summit of which their contours have been preserved in detail. They are therefore of great geological interest. On the plateau the upper parts of the valleys have been stripped of their gravels by later streams, and many have been so modified that their ancestry is not recognizable. In a general way, no doubt, most modern wadies of any length are descendants of the Pliocene streams.

NAGᶜ HAMMADI–ASYUT

Most of this district was investigated in 1925/26, and accordingly it is treated in the same way as the district immediately to its south. Certain generalities already explained with reference to that sector need not be repeated; and, to save space, valley sides and the Pliocene sequences are called "normal" when they conform to those descriptions.

Margins of the Valley, also General Information

From Nagᶜ Hammadi the valley is free of the Kena bend, and its course is set firmly along the northerly trend already described.

In view of the great height of the bounding cliffs there is no suggestion of the Pliocene water level overtopping them, as will be found in the next district to the north.

In the cliffs themselves slips are universal, with minor sags and down-warpings of the strata. Recessions of the cliffs to inclose great bays into which tributaries converge are notable features. They are filled with Pliocene gulf deposits and must therefore be considered to be as old as the valley itself. The deposits are occasionally found in some of the deep tributary valleys also, indicating that they too are very ancient. Such bays are Wadi Abu Nafukh, Wadi Kasab, Wadi Umm Dud (also known as Kau bay), and Wadi Asyut, all on the east side, and shallow indentations of the western plateau with less marked tributaries such as those south and north of Abydos. Of the latter, the southern bay is occupied by the Oases Railway to Khargah; the northern will be referred to as the Abydos bay.

[13] For further reference to these problems see p. 44.

[14] See pp. 45 f. Big quarries were open in 1931, and reinvestigation left no doubt as to the age of these sands, formerly considered to be Pliocene.

[15] See especially, for geological purposes, the data given in *QJGS* LXXXV 509–10.

Sections in the Valley

Between Nagᶜ Hammadi and Abydos on the west side no features call for attention in the present survey. The Pliocene deposits continue, often covered by long trails of later gravel and drifted sand, but good sections are rare. At the point where the Oases Railway begins its ascent by a wadi from the low desert to the plateau, a small cliff of travertine makes its appearance. The rock evidently belongs to the Pliocene sequence; it is developed on a grand scale in the bay to the north of Abydos, where it forms a wild desert of low rugged hills, in places several miles wide, which extends from north to south of the bay, a distance of about 20 miles, at the foot of the Eocene cliffs (Pl. III, *A*). The center of the bay is occupied by later gravels. Patches and loose bowlders of red breccia cap the travertine and bear witness to its Pliocene age; but more important, once that fact is appreciated, is a section such as the following, which was compiled from an exposure in the southern corner of the bay early in 1927:

Section of Pliocene Beds North of Abydos

Bed		Feet
5	Red breccia with quartz pebbles, Eocene chert, and limestone...	30
4	White conglomerate, on the whole of finer grain than Bed 5, cemented with travertine	
3	Marl, with laminated sands and fissile beds	30
2	Sand, with interlaminated clay, locally false-bedded, full of tubular markings at all angles, and some balls of brown mud	45
1	Coarse quartz sand or fine conglomerate of even texture; base not seen	10+
	Total	115+*

* Published in *QJGS* LXXXV 513.

Bed 4, when traced away from the cliffs, loses its pebbles and passes into travertine alone. The development of quartz sands below the travertine and the inclusion in them of balls of brown mud suggest that older deposits have been destroyed.

On crossing to the east side of the valley these features and the further occurrence of travertine[16] are emphasized. First, in the bay east of el-Balyana, into which the wadies Abu Nafukh and Kasab debouch, quartz sand plays a large part, forming the floor of the bay in certain areas, usually covered by recent gravels and wadi wash. Where seen, it is invariably false-bedded toward the north and occurs often only a little above the adjacent alluvium, below which it disappears. On the south side of the Wadi Abu Nafukh it is clearly visible and is contrasted in particular in the same section with the Plio-Pleistocene quartz-feldspar sands (Fig. 6):

*Section at the Mouth of Wadi Abu Nafukh**

Bed		Feet
5	Pleistocene gravels with rolled pebbles of red breccia, cemented to form a hard conglomerate, resting on eroded surface of Bed 4	15
4	Quartz-feldspar sandstone and conglomerate false-bedded toward the north, resting on eroded surface of Bed 3	0– 80
3	Brown marl	15– 20
2	Hard white quartz sandstone (white on fresh surface)	15
1	Buff loam with brown specks	5+
	Total	135+

* Published in *QJGS* LXXXV 510.

[16] For general discussion of the occurrence of travertine on about the same latitude in Khargah Oasis, see p. 17, n. 24. Its occurrence in typical Pliocene gulf deposits on the east side of the Nile from el-Balyana to Akhmim should be noted in this connection; i.e., it is by no means an unusual member of that series. Recognizable fossils are lacking, though pseudomorphs of reed- and sticklike form are abundant. Fossiliferous patches have been reported from time to time, but the collections have not been published. They belong to later formations.

Everywhere in the bay and round its edge normal Pliocene rocks are in evidence; but on the north side of Wadi Kasab, about 15 miles from the edge of the Nile cultivation, the travertine reappears in a number of buttresses, each about 250 feet high, plastered against the Eocene cliff (see Pl. II, *B*).[17] They appear to belong to the Pliocene succession and to be the product of streams flowing from the limestone plateau by niches which are still visible above them. Sticklike casts and impressions are common, but I found no recognizable fossils. At the foot

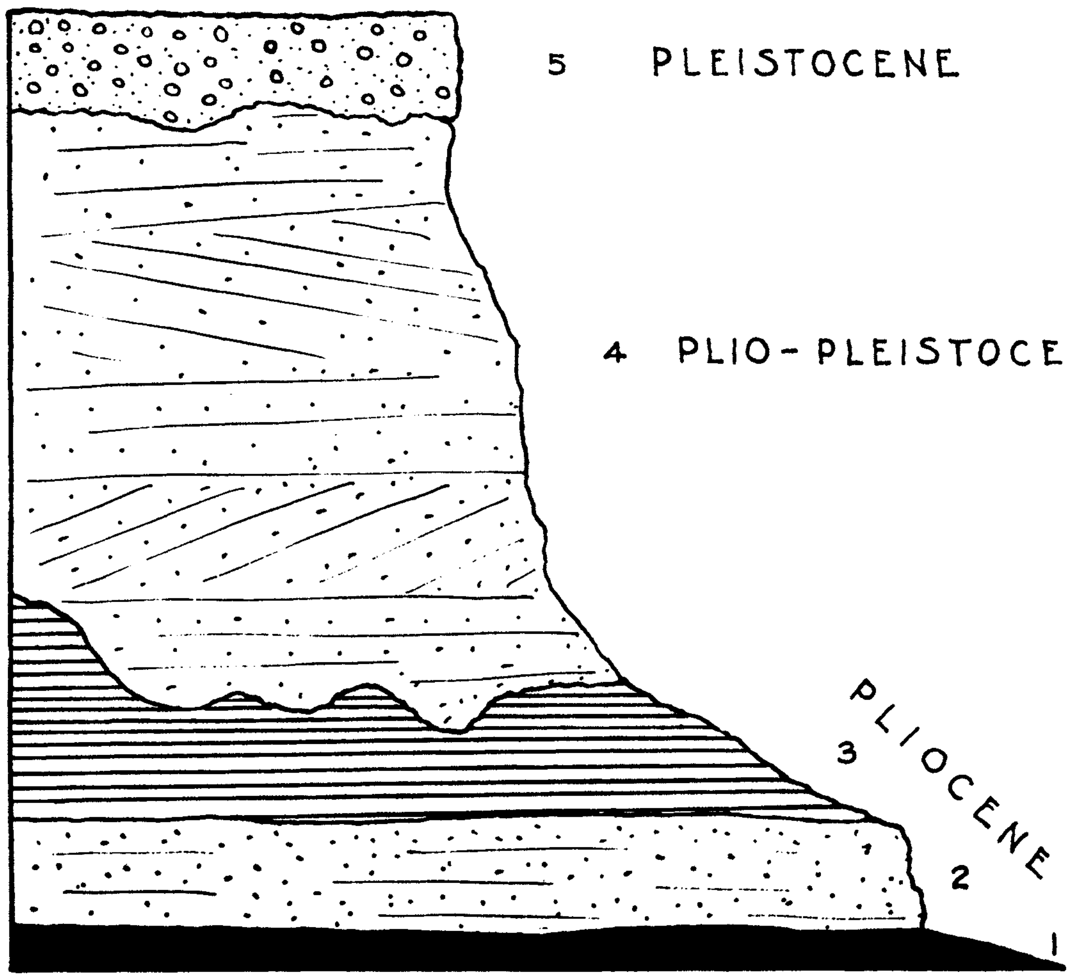


Fig. 6.—Section of Pliocene and Plio-Pleistocene Strata near the Mouth of Wadi Abu Nafukh, East of el-Balyana

of the cliffs is a beautifully waterworn surface of Eocene limestone covered with large rounded bowlders cemented by calcite and travertine. Similar bowlders occur sporadically at higher levels in the great mass of porous travertine. The tops of all the buttresses are horizontal and conform to the general upper limit of the Pliocene platform.

In the next embayment, northeast of the northern part of the cliffs which flank the Nile from Wadi Kasab to ʿIsawiyyah, and southeast of Akhmim, the travertine is found *in situ* in a recognizably Pliocene sequence:

[17] They are described in some detail in *QJGS* LXXXV 512.

Section of Pliocene Beds between ʿIsawiyyah and Akhmim

Bed		Feet
5	Red breccia	10
4	Conglomerate interbedded with travertine, the conglomerate containing bowlders of travertine	10
3	Alternating pebble beds and white limestone[18]	50
2	Calcareous sand	5
1	Red marl, seen in small exposures over vertical range of about	225
	Total	300

North of Suhag the Pliocene may be described as normal on both sides of the valley, with interesting successions of clays and marls in secluded spots, comparable with those south of Nagʿ Hammadi. The top of the platform of deposition remains clearly marked; but north of this point, and more especially north of Asyut, the Pliocene deposits have suffered more and more severely from denudation, until the almost continuous platforms of Upper Egypt give place to the isolated exposures of Middle Egypt. As the strata remain lithologically much the same, there seems justification for suggesting that the reason for this change lies in the persistence of rainfall in the north, while desiccation approached from the south.

Other interesting features of the Pliocene between Suhag and Asyut may be reduced to a summarized form:

On the east bank not only do the gulf series occupy the bays of Kau and Wadi Asyut, but the valleys beyond were evidently flooded to such an extent that incoming débris was deposited in them under water. The gulf series remain at the same level at the heads of the bays.

Quartz sands appear in thin seams in the marls near the mouth of Kau bay.

On the west bank no features call for special attention between Suhag and Guhainah.[19] North of that town the cliffs approach the modern alluvium, and the usual series is to be found only in small embayments. Travertine occurs as a cementing material of the cliff débris, recalling the cement of the red breccia.

In the cliffs between Durunkah and Asyut red marl takes the place of travertine or other cementing material between the fallen blocks and fragments.

The Pliocene is nowhere lost to sight for more than a few miles. The marls are actively worked by the fellahin for fertilizer (*sebakh*) in countless places on both banks, the surface of the low desert near the fields being thereby reduced to a wild confusion of desolate unclean delvings and rubbish heaps.

The accumulation of well rounded pebble conglomerate in Wadi Asyut is particularly impressive and gives some indication of the profound denudation of the Eocene plateau in Pliocene times. The conglomerate, especially near the cliffs, has maintained a height of about 155 meters.

We must thus summarily dismiss scores of miles of exposure.

Sections of Tributary Valleys

On the east bank Wadi Abu Nafukh is probably an ancient tributary. Its neighbor on the north, Wadi Kasab, contains breccia and conglomerate of Pliocene type for about 30 miles from the edge of the Nile alluvium. At that distance a buttress of travertine, identical to that (already described) in the bay 15 miles nearer the Nile, is plastered onto the cliff of the narrow gorge to a height of 70–100 feet. It seems probable, therefore, that the wadi was already

[18] "At Isawia the limestones of this series are of considerable economic importance, supplying .... material .... for building the large dam .... at Assiut" (Beadnell, "Recent Geographical Discoveries in the Nile Valley and Libyan Desert" [1900] p. 22).

[19] About 25 miles above ez-Zarabi on the west bank. Ez-Zarabi and Durunkah are marked on Fig. 8.

cut and shaped to its present, or a greater, depth and flooded for this distance in Pliocene times.[20]

Into Kau bay, farther north, the two wadies Umm Dud and Abu Halafi enter at the extreme eastern end. In the latter, as far as Bir Abu Halafi, there are ancient accumulations of lime-cemented conglomerate and fragments of red breccia. These indicate that the drainage basin of the Kau bay was similarly flooded to the height of the Pliocene waters, that is, that these tributaries were already in existence.

As far as I know, the head of Wadi Asyut may be added to the list. My knowledge of it extends only for about 20 miles. The Wadi Umm Dud–Wadi Kasab area I know from the watershed of the Maᶜzah Plateau to the Nile.

On the west bank only one locality attracts attention—that of the ascent of the Oases Railway from the Nile Valley. Here is a sharply defined tongue of cobble gravel, with some quartz pebbles, which evidently descended from the plateau. It is not seen interbedded in the Pliocene series, and the reason for associating it with the period rests chiefly on its close analogy to the gravel spreads entering the Nile Valley north of Asyut. Once those have been seen in the field, the present example seems to be inseparably associated with them. On a small scale, cobble gravel and quartz pebbles also entered the Abydos bay to the north, and specimens of red breccia containing rare quartz pebbles may be found there on the travertine. Concentrations of similar pebbles in a quartz sand occur on the south side of the Oases Railway at the foot of an isolated Eocene limestone hill, but their stratigraphic position is not clear.

This southern indication of a feature which dominates the west bank 100 miles farther north is quite isolated.

ASYUT–SAMALUT[21]

So far as I know the greater part of this district has not previously been searched for Pliocene deposits.[22] It is important since it leads us to the threshold of the marine and estuarine facies which have been the subject of so many researches and excursions from Cairo.

Margins of the Valley, also General Information

North of Asyut the great cliffs continue for many miles, broken and warped by slips and sagging strata just as they are farther south. On the east bank in fact they continue throughout the district, and, although we pass from Lower to Middle Eocene strata near Manfalut, the nummulitic limestones of the later beds behave in much the same manner so far as physiographic features are concerned. They provide bold cliffs with the Nile at or near their base for many miles between Manfalut and Deirut, and from Minyah nearly to Samalut. Even in the narrow embayments between Deirut and Minyah the cliff scenery is very similar to that south of Asyut. It is true that their heights are less; in fact, the 200-meter contour passes to their summit near Deirut, and the 100-meter line does so near Samalut. The Pliocene beds do not appear on top of the cliffs. Unfortunately the long cliffs, with little low desert below them, or with the Nile flood plain at their very feet, severely reduce the area in which useful Pliocene strata may be expected. North of Manfalut we shall find them limited to three main outcrops: near Tell el-ᶜAmarna, at Antinoupolis, and at Beni Hasan.[23]

On the west side of the valley conditions are different. The high cliffs, with their slips and sags marked by small wadies, and displaying normal Upper Egyptian Pliocene rocks in

[20] The buttress shows no features which would tend to distinguish it from exposures already described, and there is thus no evidence to separate it in age from them.

[21] Places mentioned in this section will be found in Fig. 8.

[22] Except by Beadnell's traverse of the west bank.

[23] See Fig. 8. There is also a small patch about 7 miles south of Deirut.

abundance, continue from Asyut for about 10 miles. Then comes a marked change in topography. The cliffs fall sharply away with synclinal down-warp and for nearly 20 miles do not reappear on the Nile margin. In the interval the Eocene limestone is seen in low bluffs near the river, and farther west it appears here and there in white patches in a great sea of brown or black cobble gravels of Oligocene aspect and derivation. With these the Pliocene series is closely connected. The high Eocene cliffs can be seen about 10–15 miles to the west.

Farther north, toward Minyah, there are many alternations of cliff and cobble gravel. North of Minyah the Eocene undergoes a change from nummulitic limestones to clays, and open, wind-swept, sand-incumbered, featureless plains border the Nile on the west side.

It has been shown that the 200-meter contour, the Pliocene limit, passes onto the western plateau near Asyut (see Figs. 4 and 8). North of that point it was necessary to search the tops of the cliffs for the expected overlap. This was first seen with sufficiently definite evidence near the small village of Bawit, on the latitude of Deirut (see Fig. 8), at an altitude of 160 meters.

A further change lies in the new source of quartz sand, which became locally available in the Pliocene gulf with the advent of the derived Oligocene gravels on the west bank. Owing to the association of the Pliocene of the west bank with incoming streams of gravel from the west, most of its expanse is described in connection with those tributaries, and the Pliocene of the east bank is taken as the standard of the gulf deposits.

Sections in the Valley

On the east bank Pliocene rocks are fairly prominent from the mouth of Wadi Asyut to Maᶜabdah, not far from Manfalut, where vertical cliffs descend to the fields near the Nile. A typical section seen in a hillock a little to the south of Deir el-Gabrawi (about 5 miles east of Maᶜabdah) near the cliffs is:

Section near Deir el-Gabrawi

Bed		Feet
3	Conglomerate of local Eocene limestone pebbles and "melon" (chert) concretions	10
2	Hard quartz sand	1
1	Marl, brown-gray, ocherous where weathered	50
	Total	61

The next exposure along the line of cliffs is found in some spurs not far from el-Kusair, whence cliffs showing marked rolls and fractures continue to the southern end of the Tell el-ᶜAmarna bay. Here the Pliocene rocks have been sadly reduced by denudation. The central and northern parts of the bay are much confused and partly hidden by the remains of Ikhnaton's ruined city. Continuity is maintained, however, in the center of the bay by a prominent spur of Pliocene rocks which continues up the cliff face on the east to a height of about 140 meters above sea-level, the main spur being 70–90 meters. Ten feet of local conglomerate overlie a great thickness of the normal brick-red marl, of which only about 20 feet can be seen. Pebbles and bowlders of red breccia here and elsewhere testify to the former presence of Pliocene rocks. The intensive erosion of Pliocene beds already noted as characteristic of the country north of Asyut is well illustrated here.

Farther north, near el-Barsha (see Fig. 8), screes and red marl may be seen. They serve to maintain continuity until the next prominent Pliocene exposures are encountered in the center of the bay of Antinoupolis, between Mallawi and Abu Kurkas, but on the east bank. The main ridge rises about 100 meters above sea-level, but, as in the Tell el-ᶜAmarna ridge, a long and characteristically gentle slope leads from it to the top of the Eocene plateau. The section is of the Upper Egyptian type, a great body of local conglomerate, cemented by lime, with bands of marl. This is the most northerly appearance of the Pliocene series which has become so familiar. North of this point the Middle Eocene succession also changes rapidly, the prominent "melon" beds of its southerly exposures[24] sinking at a rather steep angle below nummulitic beds, with softer clayey limestones between. The strata are somewhat tilted toward the north and broken. Near esh-Sheikh Timai, south of Abu Kurkas, hollows in the porous limestone are filled with marly clay which recalls the Pliocene rock, with thin dusty and rubbly deposits upon the surface.

From esh-Sheikh Timai to a point about 3 miles north of Beni Hasan the incoming nummulitic limestones of the Middle Eocene have a profound effect on the Pliocene rocks, which are here seen free of the cobble gravel which confuses them on the west bank. Large unbroken nummulites[25] have weathered out of the Eocene rocks in enormous numbers; the resulting Pliocene beds consist almost exclusively of them, bedded horizontally, without cement, and with only a fine clay residue to bind them together. A unique Pliocene rock results, beautifully bedded, evidently deposited in still water, disturbed only at the mouths of small wadies. At the tombs of Beni Hasan a deep wadi has cut through the deposit, exposing a section of about 50 feet and laying bare the smooth Eocene floor on which it lies.[26] The Pliocene age can be adduced only from the regular, obviously subaqueous bedding, which is in sharp contrast to the redeposited, post-Pliocene wadi wash, in which the foraminifers lie at all angles in entire disorder, mixed with loose chips and fragments.

North of the tombs the Pliocene beds form a regular and broadening platform which becomes almost horizontal, in contradistinction to stream beds which cut it in channels deepening toward the recent alluvium. The platform ends in a steep cliff usually about 30 feet high, with the alluvium at its foot.

In the broad bay farther north the deposit has been destroyed or covered with fine wadi wash and is not seen again. Then the cliffs of Minyah–Samalut close in to the Nile. When we next meet Pliocene strata, at their northern end, they are of the marine and estuarine types, and within a few miles become fossiliferous.

The travertines of the west bank serve to bridge part of the gap.

Sections of Tributary Valleys

On the west bank, north of Asyut, the Pliocene is normal and well developed for about 10 miles. Throughout that distance its marls show indistinct bedding-dip toward the east. They are extensively dug along two parallel lines diverging from half a mile to a mile and a half from the desert edge—the only excavations of the sort in Egypt known to me to show any such system. Usually the entire surface for miles around is rendered precarious to all forms of transport by haphazard digging, the abandoned holes remaining empty or becoming masked by drifting sand and rubbish.

At the point where the Eocene cliff recedes, with a marked synclinal down-fold, a fan of the cobble gravels spreads out toward the Nile on a front of about 12 miles, with Beni ᶜAdi at its center. From this point northward we may divide the west bank, south of Samalut, as follows (see Fig. 8):

1. Beni ᶜAdi tributary, about 12 miles wide, travertine at base.
2. Travertines of ed-Deir el-Muharrak and Meir, under Eocene cliffs.
3. Sanabu tributary, about 5 miles wide.

[24] "Melon" beds are prominent also in the Lower Eocene limestones.

[25] I.e., *Nummulites gizehensis*.

[26] Contrast with districts farther south, where the floor beneath the Pliocene is rarely seen.

4. Bawit cliffs, red breccia first found on top of plateau.
5. Dashlut–Dalga tributary, about 10 miles wide, Pliocene limestone at base.
6. Middle Eocene cliffs opposite Mallawi, capped with cobble gravel.
7. Embayment of the Western Desert, covered with cobble gravel resting on Eocene beds and on Pliocene travertine at about 100 meters from Mallawi to Minyah,[27] continuous on the west with No. 5.
8. Region of soft Middle Eocene clays, traces of Pliocene beds scanty.

From end to end the cobble gravels or their finer elements are interbedded in the travertine and Pliocene marls, as the sections will show. The rolling gravel country is everywhere much the same and needs no special description; we are chiefly concerned with its behavior at its eastern margin.

1. Near Beni ʿAdi the Eocene limestone, concealed under the gravels, advances close to the Nile. The Pliocene sediments are limited to a narrow fringe with tongues running up inequalities in the old surface, reminiscent of the Nile-Faiyum divide. The following section (Fig. 7) will serve as an example. The base of the pit here shown is 100 meters above sea-level (measured from bench mark). The section changes laterally, but the top bed is maintained for about 7 miles. Marl especially tends to replace other beds. The interbedded pebble bands thicken locally to about a yard. The travertine is capped by varying thicknesses of loose cobbles and quartz sand of Oligocene derivation. The locality is shown in Plate III, *B*.

Section of Pliocene Beds Half a Mile West of Beni ʿAdi

Bed		Feet
9	Travertine with horizontal layers and vertical tube marks (reeds?) about 1 inch wide; alternate beds of very hard and massive rock (cf. limestone) and soft mealy or tufaceous materials; color, gray to buff	30
8	Battered flint and fine quartz pebbles in calcareous marl	0½
7	Travertine, as above	2
6	Green marl with white specks	4
5	Hard gray lime rock or travertine	2
4	Hard light gray marl, mealy at top	10
3	Marl, gray at top, chocolate below	13
2	Pebble bed in marl, rolled flint (mostly with the battered surface typical of the Oligocene pebbles and bowlders), quartz pebbles, and waterworn pebbles and small bowlders of Eocene limestone	1
1	Chocolate marl, base not seen	10 +
	Total	72½+

2. As the Beni ʿAdi fan dies away, it is replaced on the north by long, unbroken slopes of fine quartz gravel. Pliocene beds are not noticeable under the Eocene cliffs, which here return to the desert edge, until a point southwest of ed-Deir el-Muharrak is reached where a prominent low table-land of hard travertine projects from the cliffs for 2 or 3 miles. The presence of red breccia[28] on top of the travertine and covering the surface of the underlying Eocene limestone where exposed beneath the section is important. The table-land recalls in many respects that of the Abydos bay. Bed 6 of the following section contains the fresh-water, estuarine, or brackish-water gastropod *Melanoides tuberculata*.

[27] It is of interest that the camel roads to Bahriyyah from Sanabu, Dashlut, Mallawi, Minyah, and other points mark the gravel slopes from the Nile.

[28] The lower breccia here was formed no doubt by the cementing of loose fragments of Eocene limestone more or less *in situ*. The upper layer is of the normal type, which commonly passes laterally into a conglomerate cemented by a similar red limy matrix.

Section of Pliocene Beds in Travertine Plateau about 3 Miles West of ed-Deir el-Muharrak

Bed		Feet
7	Patches of red breccia resting on Bed 6	
6	Very hard gray or brown travertine, limestone where massive, with porous patches	3
5	Travertine and gray marl	2
4	Hard travertine rock, as above, with quartz grains	7
3	Gray-white marl with quartz grains, varying to gray marly grit	3
2	Gray-white marly travertine rock with quartz grains, uppermost 2 feet massive	6
1	Porous travertine with reed impressions, uppermost 3 feet and junction with Bed 2 obscured, resting on uneven surface of Eocene limestone with intervening layer of red breccia	14+
	Total	35+

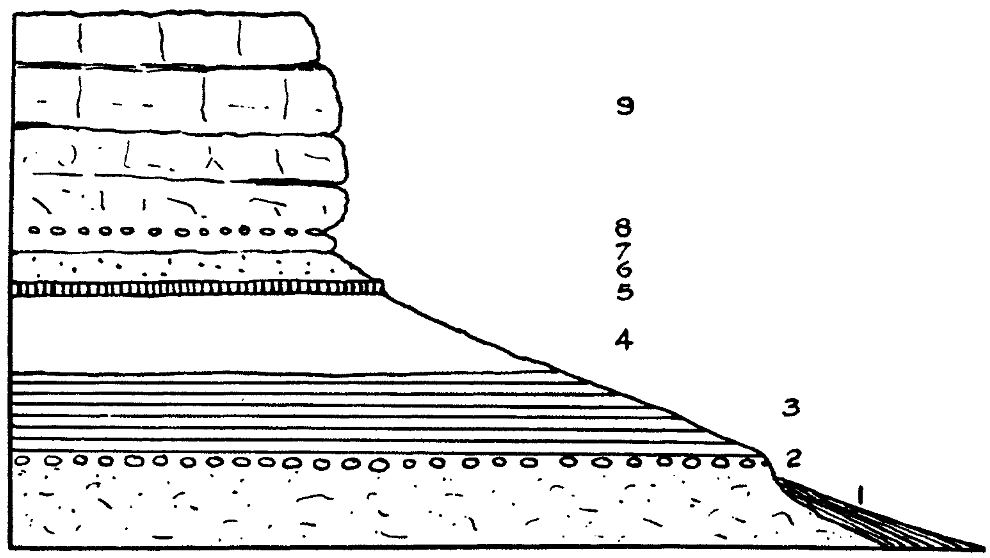


FIG. 7.—SECTION OF PLIOCENE BEDS HALF A MILE WEST OF BENI ʿADI, SOUTHWEST OF MANFALUT

A few miles farther north, under the cliffs of Meir, an isolated hill of travertine attracts attention. The neighboring ground is obscured by rubble, but marl probably occurs at a greater depth between Meir and ed-Deir el-Muharrak. The section is as follows:

Section of Pliocene Beds about Half a Mile North of the Rock Tombs at Meir

Bed		Feet
7	Hard gray travertine rock, with vertical tubular cavities (reed impressions?) and earthy partings	3
6	Pebble bed in brown marl, pebbles as in Bed 2	1
5	Mealy travertine	2
4	Bedded gray travertine rock	3
3	Porous gray travertine	6
2	Quartz sand with flint, quartz, and Eocene limestone pebbles, as at Beni ʿAdi	2
1	Porous gray limestone (cf. massive travertine)	4
	Scree	30
	Total	51

Loose fragments of red breccia at Meir contain abundant quartz pebbles, as, on a small scale, at Abydos and Bawit.

3. About 2 miles north of the section given above, the cliffs fall away once more, and a great fan of cobble gravel stretches out toward the Nile. No sections were observed.

4. The cliffs reappear from beneath the invading mass of gravel about 5 or 6 miles farther north. Around the headland of Bawit familiar conditions are re-established, though heavy sand obscures most of the ground.[29] At the top of the cliffs here red breccia was found. At Meir no trace of it could be seen on the plateau. It contains small quartz pebbles and passes under thick gravel banks at a short distance west of the cliffs. There seems to be no reason or evidence for dissociating gravels from breccia-with-quartz pebbles. That they are of one series is already evident, and the next section confirms the belief.

5. In the Bawit cliffs the Lower Eocene limestone is visible for the last time. The next exposure, the great cliff west of Mallawi near the tomb of Petosiris, shows the Middle Eocene *Nummulites gizehensis* beds fully established. On the western plateau the change takes place considerably farther south, and the cliffs of Bawit disappear westward under an enormous spread of gravel. This dominates the desert scenery within a wide range of vision in that direction and reaches the Nile between the Lower and Middle Eocene limestone cliffs on a front of 7–10 miles. That the intervening Eocene beds have been eroded near the Nile in this interval is shown by their replacement with Pliocene rocks. The latter are seen only in rare exposures of a few feet, which have usually been quarried. The most important section is about 4–5 miles west of Dalga. About 30 feet of pinkish gray Pliocene limestones are seen under about 10 feet of cobble gravel. The limestone, a remarkably beautiful rock, is studded with quartz grains, quartz pebbles, and flint pebbles; that is, it contains the elements of the gravels themselves. Its height is about 100 meters above sea-level. The gravels, then, are evidently "Pliocene at base." From Dalga northward the gravels become an almost continuous sheet of varying thickness (Pl. VI, *A*), filling all hollows in the underlying Eocene surface and stretching far to the north, west, and southwest.

6. The outcrops of hard *N. gizehensis* limestones along the Nile border on the latitude of Mallawi and northward to Balansurah call for no special attention here. Cobble gravels everywhere form the western background of the picture. In the foreground recognizable Pliocene beds have probably been destroyed by the Plio-Pleistocene courses of the Nile (see p. 50).

7. The Pliocene returns to its former rôle on the northern flanks of the Eocene plateau above Balansurah, and is first seen there as distinctive sand rock and quartz sand cemented by gray travertine of such solidity as to merit the title of limestone. It is seen beneath the thick gravels and may be exposed in decomposed form by scratching their surfaces; that is, there is reason to suppose that over wide areas the cobble gravels are loose only by reason of the decomposition of the binding material.

The first good section is exposed among the great sand dunes not far away, about 5 miles west of Beni Khiyar, in an isolated hillock about 25 feet high standing in a broad and shallow depression, surrounded by the gravel mantle. It is at 115 meters, levels of about 100 meters being remarkably constant on the west side.

From this point precisely similar sections can be found almost continuously along the western line of dunes, not those that incumber the edge of the Nile alluvium, but a parallel line a few miles to their west. Here and there surfaces of red breccia are seen on the Eocene floor.

[29] The sand along the front of this headland forms the most serious obstacle between Asyut and the Faiyum across the desert. The great dunes north of Tunah el-Gebel can be negotiated by turning westward for a few miles and then moving between two parallel sand belts to the latitude of Minyah. Thereafter the desert is fairly open.

Section of Pliocene Beds about 5 Miles West of Beni Khiyar

Bed		Feet
7	Hard travertine rock with pebbles of quartz and flint	3
6	Gray limy marl with pebbles, as in Bed 7	3
5	(Scree)	10
4	Quartz sandstone	1
3	Reddish brown marl	3
2	(Scree covering marl)	6
1	Red breccia, resting on eroded surface of Eocene limestone; variable thickness, in measured section about	1
	Total	27

The Pliocene is last seen immediately south of the Minyah–Bahriyyah camel road, where it forms a prominent little plateau, like that of ed-Deir el-Muharrak on a small scale, with Eocene rocks rising behind it, the whole shrouded with gravel. The height remains as above, 115 meters.[30]

North of this line there is a change to a monotonous, wind-swept slope with hard Eocene rocks at a distance of several miles to the west. The cobble gravels continue, but are not such a marked feature of the landscape. The Pliocene seems to fade from sight; it was not found even under the Eocene scarp at the point where the track of the military railway from el-Bahnasa toward Bahriyyah turns into the sand-incumbered wadi.[31] The reason no doubt lies in the lithological change in the Eocene rocks from limestone to predominant clays, but to this must be added the fact that in Plio-Pleistocene times this neighborhood, from the cliffs near Mallawi northward, was washed by the Nile. Detailed search (when the sand is not blowing) north of the last exposure seen on the Minyah–Bahriyyah road and at a distance of some few miles west of the Faiyum–Asyut camel road might be expected to produce further exposures, if by good chance they were not temporarily hidden under the deep sand which settles on the lee side of any rise in the ground.

Postscript.—Valuable corroboration of some of the views put forward in the foregoing sections and in chapter ii was made possible by the Libyan Desert expedition of which I was a member in the autumn of 1932 (see also p. 6, n. 13). In running over the gravel surfaces southwest of Minyah we paused near an isolated group of bushes and small trees, indicated in Figure 8, to inspect a deep hole dug probably in the hope of finding water. The following section was recorded:

	Feet
Loose cobble gravel and quartz sand	3
Quartz, flint, and Eocene limestone pebbles with small bowlders of hard white quartz sand, in ocherous cement; base not seen	6+
Total	9+

Near the bushes, masses of gravel were still cemented by lime to form a hard red conglomerate containing small bowlders of another conglomerate with dark gray or black cement. The pebbles of this yet older bed were the same: quartz and flint and hard quartz sand. This rederivation of quartz sand and other elements of the Pliocene series strongly suggests, in my opinion, an intra-Pliocene period of erosion such as that discussed in chapter ii.

The fact that all the gravels over a wide area were originally cemented by red ocherous and limy material was borne out here and for many miles of the gravels along our route: rills

[30] In the absence of a contoured map of the desert these levels were taken by Abney level from the nearest available datum. For this particular area I was able to verify my measurements subsequently from a proof of the new 1:100,000 map.

[31] I am indebted to Dr. John Ball, until recently Director of the Desert Surveys, for the levels along this line.

and runnels almost invariably exposed the pebbles still held in such a matrix, mixed with fine white limy sand. The cobbles gave place to finer pebble beds along the traverse to the southwest, and the margin of the gravels as a whole was very clear: within a few yards we passed from dull brown gravels, restful to the eyes, onto Middle Eocene rocks of blinding whiteness.

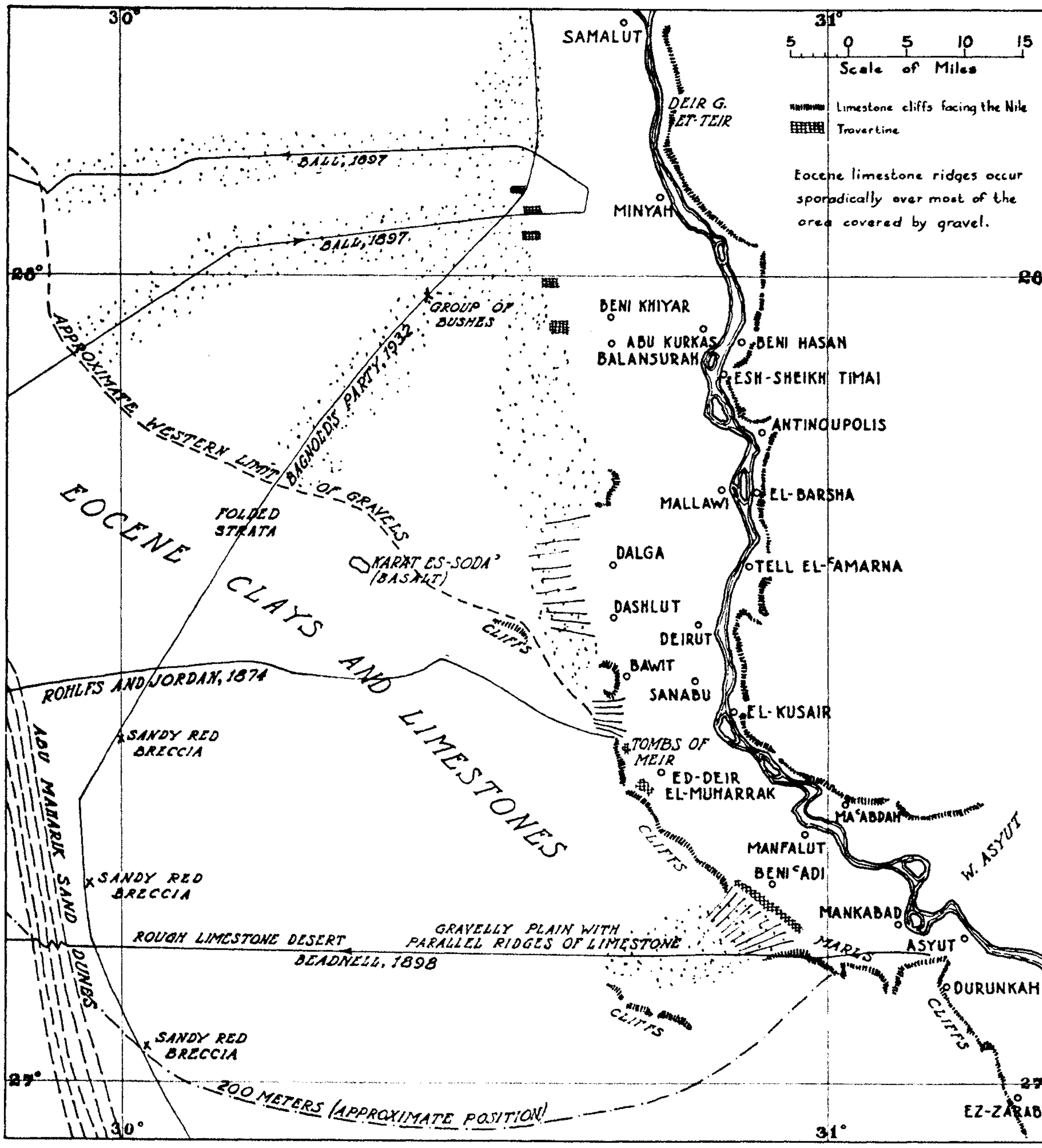


FIG. 8.—SKETCH MAP OF THE DESERT WEST OF THE NILE BETWEEN ASYUT AND MINYAH

At this point I supposed that the Pliocene rocks had been left behind. It was a surprise, therefore, to find the familiar red breccia, mixed with quartz sand (which is not present in the local Eocene rocks), at distant points along our route. There was no means of distinguishing it from the normal Pliocene type. The identification becomes the more satisfactory, therefore, when it is found that these patches fall within the 200-meter contour, as will be seen in Figure 8, which has been prepared to link together the observations made in this section. The relation of the isolated patches of rock presumably of Pliocene age to the 200-meter contour suggests, moreover, that a considerable part of the bay which it incloses on the Western Desert was already in existence in Pliocene times. It should be expressly stated that the breccia here described is on no account to be confused with the veins and capillaries of percolated ocherous and limy material which mark joints and fracture surfaces, often on a minute scale, especially of Lower Eocene limestones, at any altitude.

SAMALUT-BENI SUEF-HILWAN

Only the southern part of this district receives close attention here (Fig. 9[32]). The remainder falls within the boundaries of Blanckenhorn's studies, of *OIP* Volume X, and of the present field work of the Geological Survey of Egypt.

Margins of the Valley, also General Information

The topography of the region is governed by the resistance or decay of the Eocene rocks. The hard limestones of the lower part of the Middle Eocene give place to softer limy and clayey beds at the latitude of Samalut. On their outcrop nothing has survived, but where harder beds intervene the Pliocene rocks also have been preserved.

Standing out on these variable plains of hard and soft beds are great flat-topped outliers of rocks higher in the Middle Eocene sequence.[33] Such are the magnificent Gebel Kararah, opposite Maghaghah, and its northern prolongations on the east bank, through Gebel Latif and Gebel el-Abyad to the hills about el-Fashn. A succession of similar hills leads to Gebel Tarbul opposite Wastah, second only to Kararah in its bold contour and magnificent slip-faulted sides,[34] and so northward to the more massive limestone cliffs of Hilwan.

On the west bank a similar line of detached masses may be followed, broken in the south by the low ground of Wadi el-Muweilih and the Nileward end of the Bahr bi-la Maʾ. Neither of these depressions shows on the ground adjacent to the Nile evidence of fluviatile origin. Both appear today as simple erosion hollows in the soft beds, excavated by subaërial denudation; and such no doubt they are. Since enormous quantities of gravel have been brought in from their direction, support may be found for the belief that at one time tributaries of the Nile existed over their sites. Farther north the outliers continue into the area covered by *OIP* Volume X, appearing at Gebel Dishashah, Naʿlun, and el-Lahun, beyond which the outcrop becomes a continuous east-west belt, overtopped within a few miles by the Upper Eocene Kasr es-Saghah beds. The latter are preserved only in a few high and isolated patches on the east bank. On the west they are covered in turn by the estuarine Oligocene beds of Dahshur.

Sections in the Valley

On the west side no sections of the gulf facies could be found between the travertine of the Minyah-Bahriyyah camel road and those recorded along the Nile-Faiyum divide in *OIP* Volume X. As some such exposures were particularly to be desired in this interval, great care

[32] Sketch of main topographic features and location of places.

[33] Cf. Ravine beds and Birkat Karun series of Beadnell's classification in the Faiyum, used in *OIP* X 5–6, or Lower and Upper Mukattam beds, which may include Upper Eocene elements according to M. Jean Cuvillier. For recent classifications see his *Revision du Nummulitique égyptien* ("Mémoires présentés à l'Institut d'Egypte" XVI [1930]).

[34] Gebel Kararah is bounded on the west and south by slipped masses which have "run" on gypseous shales interbedded in the Middle Eocene succession. Their size and profusion are unrivaled north of the Thebaid. An important fault has been recorded near the south side and parallel to it, and is shown in the geological map of 1928. Even so the evidence for its existence might be worth critical reinvestigation. It is omitted from the map at the end of this book.

was taken in searching for them. The reasons for their non-appearance are probably as follows:

1. The soft nature of the Eocene deposits.[35]
2. The thorough scouring of the ground adjacent to the Nile in Plio-Pleistocene times.

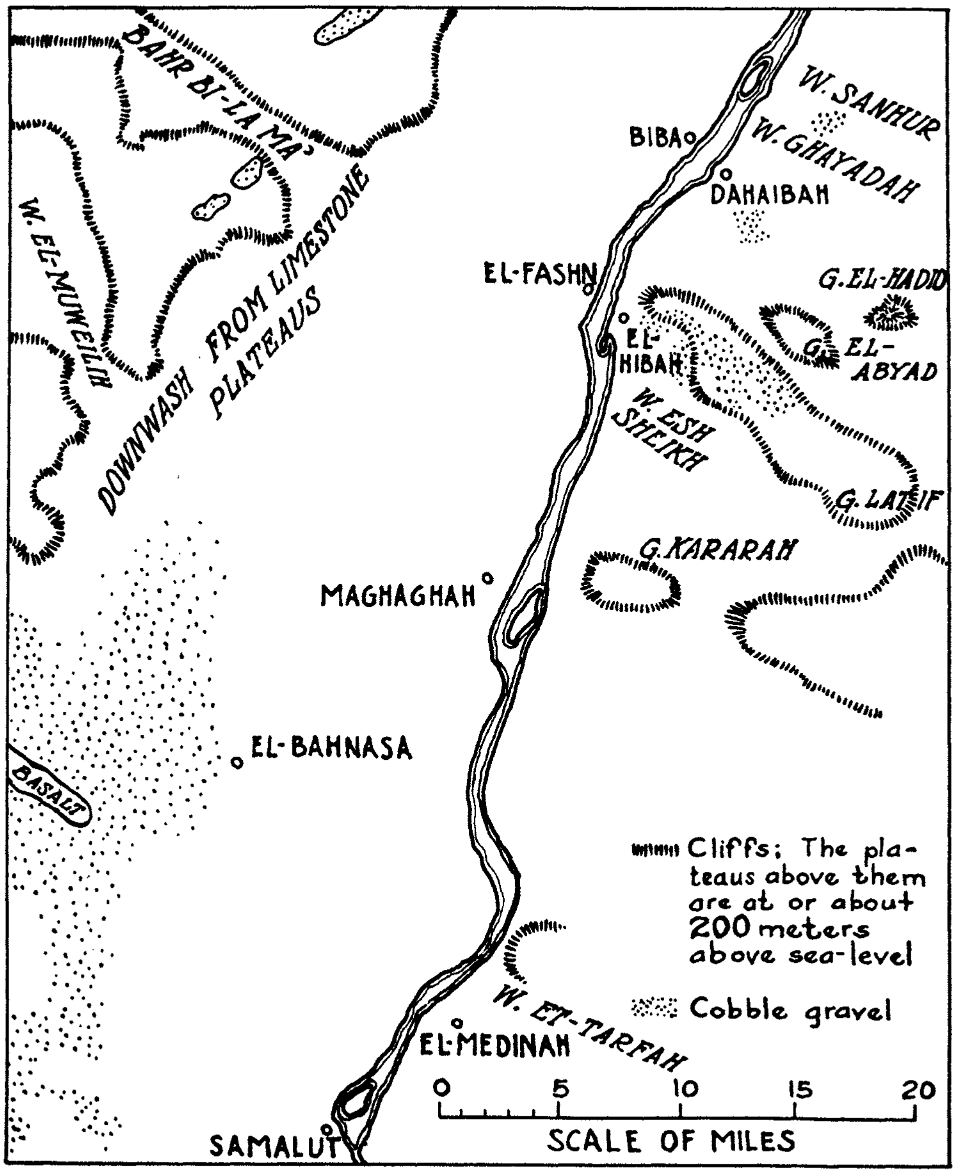


FIG. 9.—SKETCH MAP OF THE COUNTRY BETWEEN SAMALUT AND BIBA

3. The subsequent washing down from the western slopes of a mixed detritus of Oligocene cobble gravels and Eocene débris.

[35] The impression should not be gained that north of Samalut uniformly massive *Nummulites gizehensis* limestones give place to clays alone. Such do indeed tend to predominate, and are the more apparent for the slight dip of the beds and the drastic change they produce in topography. They alternate with white limestones, which are quarried on a considerable scale. Thus on the west bank the surface is at its softest at and near el-Bahnasa, but even so limestones appear above and below the clay, the upper band, reduced to scattered flat-topped hillocks, being about 20 feet thick.

4. The devastating effect of blown sand in reducing surfaces, destroying all but the hardest elements; the piling up of sand round projections and its massing in a great line of dunes at the edge of the Nile alluvium, effectively hiding any exposures.

The resultant of the above is a long and featureless slope toward the Nile, bounded on the west by the Oligocene gravel plains and farther north by the Eocene outliers.[36] Partial continuity is maintained by greatly reduced spreads of tributary gravel streams at high levels.

East of the Nile the deficiencies of the west bank in the critical area north of Samalut are in some measure made good. It will be recalled that in the preceding section the subaqueous Pliocene deposits were traced to the Beni Hasan–Minyah bay on the east side, and to the Minyah–Bahriyyah camel road on the west, and that the eastern limestone cliffs then interrupted the succession of outcrops. We now know that the Western Desert in the sector from Minyah to the southern limit of the area mapped in *OIP* Volume X affords no help.

A wadi enters at the northern end of the eastern cliffs near Deir Gebel et-Teir, exposing a basalt dyke on its south side and soft Eocene clays on its north side. Locally the clays simulate Pliocene sediments, especially in their erosion, but their nature is beyond dispute since they pass under interbedded fossiliferous limestone of Eocene age.[37] A deposit even more suggestive of Pliocene rocks is provided by the blowing of the dry clay onto slopes and into hollows, where it is added to dusty material which consists largely of foraminifers derived from the limestone. Accumulations, exceedingly friable, to a thickness of a few feet occur in undisturbed situations in this neighborhood, but there is no evidence that they are relics of a Pliocene covering. Locally modern Nile silt, loaded with flakes of mica, is blown into this mixture.[38]

Immediately north of the district of el-Medinah the broad Wadi et-Tarfah enters the main valley. It takes its origin in the Nubian sandstone of the northern part of Wadi Kena, south of the Kallalah Plateau and in close proximity to the exposed massif of the Red Sea Hills. No evidence was found, however, that detrital material had been brought into the Nile by this route from these hills or from the Nubian sandstone in Pliocene or Pleistocene times. The wadi and its broad expanses of Eocene clays and low limestone ridges seem to be destitute of Pliocene deposits. At its mouth, on the Nile bank half a mile north of the coast guard station, about 10 feet of ocherous or bright yellow soft marly and sandy clay are exposed, well bedded like a subaqueous deposit, but unfossiliferous. Nothing similar to these beds has been seen in the south, and to one passing northward they are inexplicable except as a local variation of the Pliocene series. Approached from the north they would be so familiar that they would arouse no comment. They are, in my opinion, indubitably of Pliocene age and of the northern type, comparable in appearance and in composition with the most southerly outliers of the estuarine deposits reported by Blanckenhorn. Their upper limit is about 38 meters above sea-level.

Between the mouth of Wadi et-Tarfah and Gebel Kararah no more satisfactory evidence of Pliocene rocks was found within walking distance of the Nile. Ocherous clays of somewhat similar appearance are to be seen here and there, specially on the floor of the bay in its northern sector near the foot of Kararah; but no fossils were found.[39]

[36] Between el-Bahnasa and Sidmant el-Gebel Pliocene rocks were sought in the broken country from the head of this slope at about the 100-meter contour to the Eocene scarps. Here the country is broken mostly by the erosion of the soft clays, and no indubitably Pliocene beds could be recognized.

[37] Cf. el-Babein, Girishan, and the extensive ruins and workings of el-Medinah.

[38] Mica is characteristic of all Nile silts, ancient and modern, and indicative of their southern origin. The Pliocene clays and marls contain mica only in abnormal circumstances. The distinction is of value in the field.

[39] A thorough survey, as for official purposes, might disclose recognizable Pliocene deposits in the long terrace-like ridges farther from the Nile, especially in the northern sector. The dissected slopes of waste material washed from Kararah in the northern corner seem unprofitable ground.

In the amphitheater of soft Eocene clays and thin limestones between Kararah and the hills above el-Fashn sections in hummocks near the desert edge, between Zawiyat el-Gidami and the mouth of Wadi esh-Sheikh, disclose Middle Eocene rubble and redeposited clay. This is an ocherous marly material, certainly deposited under water, and recalls the beds exposed near the mouth of Wadi et-Tarfah. It lies on white limestone which, north of the hummocks, forms a prominent cliff of interbedded white limestones and gypseous marls rising 40 feet above the alluvium or 65 meters above sea-level.

On the north side of Wadi esh-Sheikh the beds suggest accumulation in still or fresh water rather than active marine deposition. The presence in them of locally abundant quartz grains should be noted. There is also a marked line of small wadies between the low plateau which the beds form and the Middle Eocene strata, near the palm trees in Wadi esh-Sheikh, about 2½ miles from the Nile. Examination of the uppermost bed of limestone revealed an external cast of a gastropod which I identified as *Melanoides tuberculata.* No means were available for taking an impression, and an attempt to extract the cast caused the soft limestone to disintegrate. Small calcareous organisms were abundant in a part of the same bed and have been compared to *Serpula* (*Rotularia*) *spirulaea* Lamarck, an annelid.[40]

At the time of my visit I formed the opinion, to which I adhere, that the limestones were Pliocene, but I was unable to revisit them for further investigation at a later date, as had been my intention. Some weeks later Messrs. Gubbins and Attia showed me some exposures of white limestones interbedded in fossiliferous strata of undoubted Pliocene age northeast of Wastah. I was unable to distinguish these in the field from the thicker limestones of Wadi esh-Sheikh. Farther north, in the vicinity of Gebel Umm Rakabah (see p. 10, n. 7),[41] Blanckenhorn has proved the estuarine beds to a far greater height, no less than 145 meters above sea-level or 117 meters above Nile alluvium. The Wadi esh-Sheikh limestones may prove the marine fauna to have lived farther south than has previously been recorded.

To the east great thicknesses of locally derived gravels of torrential character form broken country. These Blanckenhorn attributes to the same age as the estuarine *Melanopsis* beds. Their surface slopes are steeper than the gradient of the present wadi, and their general appearance suggests a dumping of rubble from the Eocene hills by short streams which flowed into standing water. The gravel that remains is clearly only a relic of an extensive sheet, and altitudes are therefore unreliable. The twin hills above the palms of Wadi esh-Sheikh show 30 feet or more of this torrent-bedded rubble, with a summit level of 109 meters. High ridges of the same type occur farther up the wadi, and at el-Hibah opposite el-Fashn (Pl. IV, *B*).

From el-Hibah northward bare Eocene limestone flanks the Nile as far as Biba, opposite which, at Dahaibah, Blanckenhorn found his most southerly marine Pliocene fossils (see p. 10). On the east the Eocene plateau is dominated by the gravels of a Pliocene tributary.

From Dahaibah northward we are traversing ground that has been described in detail by Blanckenhorn. The localities mentioned by him between Biba and Wastah were investigated with some care to gain familiarity with them, and attention may be drawn to the following points:

[40] This is a Middle Eocene species that occurs with *Nummulites gizehensis* in Egypt. My thanks are due to Dr. J. A. Douglas of Oxford and Mr. T. H. Withers of the British Museum for identifying the new fossils. Mr. Withers points out that he considers them not to belong to the Eocene species but only to be closely allied to it, that *Rotularia* specimens occur also in the Pliocene of Bordighera, Italy, and that the Wadi esh-Sheikh species seems to be a littoral form. He notes also that the specimens show not the slightest trace of being derived from an older bed, and in his opinion such derivation of so fragile a fossil is improbable.

[41] I.e., the Umm Rakabah about 7 miles south-southeast of Beni Suef, not another of the same name east of el-Fashn and about 2½ miles northeast of el-Hibah.

1. The recognition of Pliocene tributaries and their surviving gravels modifies but little Blanckenhorn's conception of the older diluvial deposits, some of which he considered to be of *Melanopsis* age.[42]

2. The *Melanopsis* stage is an integral part of the Pliocene facies and antecedes the introduction of detrital material from the Red Sea Hills.

3. To judge by sections in Wadi Sanhur, the superposition of the *Melanopsis* beds upon the marine facies is certain, and the contact is essentially unconformable; that is, there was a period of erosion between the depositions of the beds. This fact is more clearly displayed in Blanckenhorn's section in Wadi Tabbin.[43]

4. From Beni Suef to Wadi Lishyab, a little south of Wastah, the east bank consists of bare Eocene rocks, flanked by high mantles of redeposited Oligocene gravels for a distance of several miles.

5. North of Wadi Lishyab lies the area now being officially surveyed. There is reason to believe that the conclusions I have drawn will find confirmatory evidence here, rather than the reverse.

6. The Pliocene beds northward to Hilwan are analogous to those on the west bank which have been fully described in *OIP* Volume X.

7. I am indebted to Dr. Hume for the information that two fossil teeth set in a fragment of lower jaw which he identified as *Hippopotamus hipponensis*[44] were recently found between Turah and Hilwan. This is a species of Lower and Middle Pliocene age. Nothing precise is known of its field relationships, but it suggests an estuarine or fresh-water origin. If, therefore, it was derived from the *Melanopsis* beds, it would tend to support the belief that they are of greater age than Blanckenhorn supposes. On the other hand the specimen might have been washed into the older marine series from one of the fresh-water wadies. Little reliance can be placed on a single specimen of uncertain provenience, although its presence here is significant.

8. In the northern part of the area the periods of erosion, marked also by changes of fauna, are strikingly displayed. They seem to indicate an intra-Pliocene period of non-sequence, erosion, and deposition at least as important as that which followed in Plio-Pleistocene times.

Sections of Tributary Valleys

In the southern and central parts of the district the evidence found in tributary valleys is of some interest. In the northern sector those on the west bank have already received attention in *OIP* Volume X, and we may anticipate that the official survey of the east bank will produce a complementary series at least as interesting.

On the west bank is the prolongation of the great southern bay of cobble gravels adjacent to the Nileward slope. As it continues northward it swings a little west, and near the Nile and the Faiyum it breaks up where higher ground has stood and in some measure still stands. Thus survivals of tributaries flowing from the elevated ground are encountered high on the Eocene ridges north of Wadi Muweilih, the cobble gravel (Pl. IV, *A*) often black from exposure and standing out in sharp contrast to the dazzling yellow and white Eocene rocks. They rise to 216 and 225 meters;[45] that is, they extend above the known height of the gulf series. They are in every way analogous to the larger tributary streams of Dishashah and Naᶜlun.[46] A few miles

[42] *ZDGG* LIII 403. [43] *Hdb.* p. 137.

[44] The same species has been reported from Wadi Natrun. See C. W. Andrews in *GM*, 1902, p. 434.

[45] Levels taken from maps of the new 1:100,000 series of the Survey of Egypt.

[46] *OIP* X 22.

farther north, at 251 and 237 meters (summit),[45] similar remnants cap the Eocene in prominent conical hills, from which enormous quantities of material have been washed down in great slopes that spread out on the plain toward the Nile. The marked discordance in height between these high levels and the Pliocene gulf level calls for further explanation, but the evidence for it has been destroyed by denudation. The facts remain that the gravels of Oligocene origin are resting with obvious unconformity on the upper beds of the Middle Eocene and that they reached that position in Oligocene or later times. On the whole they seem to be most readily explained by identifying them with the known Pliocene outcrops and by assuming that their river bed flowed northward for some distance before entering the gulf or its bay over the southeast corner of the Faiyum. Since the gravels may be at least 50 feet thick, and locally twice as much, the gradient of the river floor was not as steep as it would at first appear. Since it is unlikely that such gravels, if of greater age, would have survived Pontic denudation in so critical a situation, they may be included provisionally in the Pliocene series.

On the east side of the Nile, north of Samalut, it seems reasonable to suppose that some predecessor of the great Wadi et-Tarfah was in existence in Pliocene times, although I know of no concrete evidence within the wadi.

North of Wadi esh-Sheikh occur cobble gravels of Oligocene derivation, marking an eastern sector of the Oligocene delta, which may be traced across the country east of Hilwan and Cairo to the widespread gravel uplands of the Cairo–Suez road. These have probably been redeposited over most of the area, and there occur patches that suggest, as might be expected, that they had been denuded by streams flowing into the Nile. A trend of this nature has already been noted at the mouth of Wadi esh-Sheikh. Its character is better displayed at el-Hibah opposite el-Fashn in hills of black cobble gravel which are plainly visible from the State Railway. In sections above el-Hibah the hills are seen to consist of great thicknesses of local Eocene rubble mixed with Oligocene débris (flint cobbles, quartz pebbles, fossil wood). No trace can be found of material derived from the Nile that might suggest a Plio-Pleistocene age, that is, far-traveled pebbles of igneous and metamorphic rocks; the gravels are obviously of vastly greater age than the adjoining Pleistocene terrace gravels. Sections show at least 50 feet of bowlder beds, with a basal conglomerate, indistinguishable from those of any of the Pliocene tributaries of the Nile-Faiyum divide.[47] The conglomerate consists of well rounded bowlders and pebbles of local Eocene rubble, with indestructible Oligocene elements which became concentrated in the upper layers. This coarse deposit covers the dissected hills as a thick mantle, which may be traced away from the Nile at el-Hibah, where it attains a height of 182 meters above sea-level, to a point south of Gebel el-Abyad, where it seems to be thickest and most extensive at and about the 200-meter contour. It continues thence to Gebel el-Hadid (223 meters).

North of el-Hibah the elevated ground at a distance of a few miles from the Nile is covered sporadically with similar thick mantles and with gravels washed down from them and from other patches now destroyed. In strong contrast to the underlying Eocene rocks, a few thick groups stand out at about 90 meters above sea-level 5 miles southeast of Biba. Another marks the higher parts of Gebel en-Nur, near the Nile about 5 miles north-northeast of Biba, and may be traced eastward at about 80 meters. Similar masses occur 7 miles southeast of Beni Suef, others farther north between Beni Suef and Wastah, whence they may be traced into the particularly wide expanses of Pliocene deposits occurring from high to low levels in the area now being mapped by the Geological Survey.

At Gebel en-Nur yellow ocherous grit and marly material, for the greater part fine Eocene detritus, was found to a thickness of 10 feet beneath the cobble gravels. It is indistinguishable

[47] *OIP* X 21–22.

from the local facies of the Pliocene gulf deposits and, although here unfossiliferous, it reappears close by in Wadi Ghayadah, with Gebel en-Nur flanking the northern side, in sections from which Blanckenhorn has already recorded *Melanopsis*, *Melania*, and *Neritina*.

In view of their relations to the *Ostrea cucullata* beds of the Nile-Faiyum divide, to the travertine found between Abydos and Minyah, and to the *Melanopsis* beds of the Nile between el-Fashn and Hilwan, I am strongly of the opinion that the redeposited Oligocene gravels containing Eocene rubble can be regarded only as relics of Pliocene tributaries which poured their detritus into the gulf in Middle and Upper Pliocene times.

IV

THE PLIO-PLEISTOCENE SERIES

(See Pls. V–VI)

The earlier chapters of this volume are devoted to a study of the events that brought the Nile Valley into existence. Its subsequent submersion has been considered more thoroughly; and the stages by which it passed from a gulf, some 500 miles long, once more to a river valley remain to be described.

THE CHANGE FROM GULF TO RIVER

At the outset two questions present themselves:

1. Was the gulf completely filled with subaqueous deposits in Pliocene times?
2. Was the change brought about by variation of sea-level or by rise of land? If by rise of land, was the uplift uniform or accompanied by differential movements of warp, tilt, or fault?

The answer to the first question, based on the study of the Pliocene deposits, seems to be found in the fact that the lateral strata of the gulf preserve a uniform level over long distances. If they alone had survived, it would appear probable that the gulf had become so choked that the sea was virtually excluded. The survival of beds laid down at some distance from the banks shows that deposition decreased rapidly as incoming currents lost their momentum, gravel and shingle being rapidly replaced by clays and marls of a texture so fine that aeolian dust played an appreciable part in some beds of Upper Egypt.[1] There were, then, areas of deficiency, or non-deposition, probably along the median line of the valley and of its larger bays. The same fact is revealed in northern Egypt by the ecological change of the fauna from *Pecten* and *Cardium* to *Ostrea* at the margins, and later in the gravels of the Nile border to the gritty clays and sandstones containing *Melanopsis* fauna.

It may be contended, then, that since the soft beds, the most easily removed, lay in the tract most affected by subsequent fluviatile erosion, they have small value as evidence that the gulf was filled. Probably the first function of the abundant Plio-Pleistocene subaqueous deposits was to fill these hollows. The records of borings suggest that by a combination of scouring and deposition the greater depths of the Pontic valley were filled (see p. 101). The deposits thus form a late or transitional part of the Pliocene series. Moreover, the water level of the gulf probably was not constant, as is shown in the following pages. In the intervals of erosion the higher parts of the Pliocene beds were denuded, the irregularities subsequently being filled with false-bedded sands when the water level again rose. Recently I was fortunate enough to find fresh-water and land shells in these sands at ʿAbbasiyyah near Cairo. The officers of the Geological Survey of Egypt later visited the site with me, and from our combined collection Mr. M. I. Attia of the Survey identified *Zooticus insularis, Melanoides tuberculata, Planorbis* (*Tropidiscus*) *Philippii*, and *Helix* sp.

It is evident that the waters of the Nile which poured into the southern end of the gulf, as well as the run-off of surface water from the adjacent plains and plateaus, had to be accommodated and allowed to pass northward to the Mediterranean. For a part of the Plio-Pleistocene interval these functions were thus performed within the gulf. Later the waters seem to

[1] Cf. *QJGS* LXXXV 503.

have sought a new course over dry land throughout an increasing length of the valley, and the adjacent parts of the gulf may be presumed to have become choked.

We come therefore to the second question, which can be answered summarily. The researches of many French and Italian geologists have established beyond all reasonable doubt that in post-Pliocene times there were marked regressions of the Tertiary Tethys, approximately to the area occupied by the Mediterranean of today.[2] Whether the contraction was governed by reduction in amount of sea water, by elevation *en masse* of the continental borders, or by both is beyond the scope of this volume. The result was the same: the level of the sea and of its gulf became seriously reduced with relation to the land by stages which can be recognized at similar altitudes around a large part of the Mediterranean littoral.

The second part of the question finds its answer in the present uniformity of ascertainable elevation attained by Pliocene submergence. So far as is known, it is constant from Upper Egypt to the sea. If it was tilted at any time, that tilt or warp was subsequently readjusted within the limits of measurements applicable to the deposits. The summit level of submergence, 180 meters, is found over a wide area; higher records are not common. A covering figure seems to be 200 meters, though even this may prove to be exceeded by a narrow margin. The discrepancies of level may be apparent rather than real and may depend upon the fortunes of post-Pliocene denudation; precise and satisfactory determination must await the completion of the new 1:100,000 maps by the Survey Department of Egypt, but it is clear that no major folding or faulting has taken place.

In the records which will be given it will be shown that the deposits of the *Melanopsis* stage are far removed in time from the earliest recognizable traces of Man's handiwork. The *Melanopsis* fauna is manifestly of Upper rather than Middle Pliocene age, and on paleontological grounds Blanckenhorn included it in the Quaternary or Pleistocene. Yet it is older than both the subaqueous Plio-Pleistocene strata and the whole series of associated gravel terraces that antedate Paleolithic Man's entrance into the sequence. Moreover, some of the terraces may justifiably be correlated with those of the Sicilian stage of the Mediterranean, which in Sicily are known to lie unconformably upon beds of Upper Pliocene age.[3]

It is the necessity of reconciling the facts of paleontology with those of geology that has called into being the dual terminology of "Plio-Pleistocene." One of the most vivid impressions of a few years' work in the Nile Valley is the realization of the immeasurable time involved between the Pliocene and Pleistocene periods. In many parts of the world a few feet of deposit seem to bridge the interval between the Pliocene and the Ice Age.[4]

The distinction between Pliocene and Plio-Pleistocene deposits in many parts of the Nile Valley is clear enough: the former are subaqueous, the latter are river gravels.[5] In the field the contrast is rendered striking by the nature of their constituent pebbles: the Pliocene, of local origin, usually white or light in color by reason of the Tertiary limestones from which they are chiefly derived; the young gravels brown or yellow, since they consist almost entirely of far-

[2] The classical studies by Chaput, Depéret, Gignoux, Gortani, and De Lamothe are well known. Most of them are conveniently recorded in Sollas, *Ancient Hunters*, 3d ed. (New York, 1924) esp. pp. 28–35. Since 1924 the question has been studied by a commission of the International Geographical Union which includes some of those mentioned above. Three reports have been issued (in 1928, 1930, and 1933). Summaries of recent views, based on these reports, will be found in *Geographical Review* XXII (1932) 345–47, and in *GJ* LXXII (1928) 461 f.; LXXVIII (1931) 317 f. See also an important paper by R. Vaufrey: "La question des isthmes méditerranéens pléistocènes," *Revue de géographie physique et de géologie dynamique* II (1929) 323–42.

[3] So Depéret and others; see Sollas, *loc. cit.*

[4] As in the eastern counties of England.

[5] I.e., the gravels, sands, and silts dropped by the river in its passage along its valley. On the term "subaqueous" see p. 11, n. 16.

traveled pebbles of quartz, rocks from the Red Sea Hills, and cherty flint. In the south the quartz pebbles are derived from outcrops of the Nubian sandstone; in the north they may also have come from the redeposited Oligocene cobble gravels. The cherty flint is everywhere abundant as the insoluble residue of Upper Cretaceous and Eocene beds. It has been incorporated in residual deposits since Oligocene times, the cobbles providing some indication of the destruction of early strata that had already taken place. The rocks from the Red Sea Hills make their first appearance in the Nile Valley at this time. They are entirely unknown in the Oligocene and Miocene rocks bordering the Nile Valley and in the Pliocene series of the gulf, including the *Melanopsis* beds. The Pliocene quartz sands appear to lack even minute fragments of feldspar or other igneous or metamorphic minerals. If in the future such should be found, their origin will almost certainly prove to be in the rocks of the cataracts,[6] or in Nubian sandstone which lies unconformably on the ancient complex. Even so there will remain an essential dissimilarity between the Pliocene quartz sands and the Plio-Pleistocene deposits, in which detritus derived from the Red Sea Hills is readily visible to the naked eye or, if fine, with a hand lens. In the field the change of composition of coarse and fine beds alike has proved so constant, so widespread, and so striking, that the distinction between Pliocene and Plio-Pleistocene beds has been based upon it. In the area with which this volume deals the Plio-Pleistocene sands continue the facies of the Pliocene gulf and bring it to an end; but even so, as already explained on page 11, they are separated from the subaqueous Pliocene deposits by a strongly marked unconformity.

I have described elsewhere,[7] in some detail, how two broad streams of coarse gravels and bowlders were brought from the Red Sea Hills to the Nile Valley across the Lakeitah plains and down Wadi Kena, and how the rocks of the two streams may be traced to their sources by simple petrological classification. In the present volume it is the problem of their absence in the Pliocene rather than their subsequent appearance that causes difficulty. Their irruption into the Nile Valley was so sudden, and their volume so overwhelming, that some rapid disintegration of obstructions seems to have taken place with approximate contemporaneity in both Wadi Kena and Lakeitah. Certain suggestions have already been put foward (pp. 22 f.) to which nothing need be added here. The magnitude of the change that had taken place becomes evident in the following records of the subaqueous deposits and in the terrace gravels. The material, once introduced, was redeposited repeatedly as the Nile excavated its bed, destroyed its older gravels, and again laid them down in Plio-Pleistocene and Pleistocene times. From this point the term "Nile gravel" will be used to define gravels of the above described composition in contradistinction to the detritus of tributary streams or "local gravels." It follows that Nile gravels abandoned by the river and subsequently incorporated and redeposited by lateral streams flowing into the Nile will become intimately mixed with material of local origin and will be playing the part of local gravels.

These considerations may be illustrated by four sections:

1. In the section recorded about 15 kilometers west of Lakeitah Wells (see p. 22) the essential facts are that subaqueous false-bedded sands and gravels derived from the Red Sea Hills lie unconformably on Pliocene marl, which lacks these constituents. The exposure is situated most advantageously for the incorporation of such material if available in beds of Pliocene age, and their absence suggests that the conditions of isolation were maintained, followed somewhat precipitately by the irruption of material from the hills. The Plio-Pleistocene sands and gravel lie unconformably on the Pliocene marl at about 94 meters above sea-level.

[6] In what measure the rocks of the cataracts were exposed is discussed in *OIP* XVII.

[7] *QJGS* LXXXV 516–20.

2. The deposits at the mouth of Wadi Kena are even more striking; in the wadi itself the Plio-Pleistocene gravels seem to have been destroyed and redeposited in Pleistocene times. A little north of the town lies a prominent group of gravel ridges which I have called Kena Hill.[8] Their section is variable, but the following is typical and may be verified by a walk of a few miles along the southern and western flanks:

Section at Kena Hill (Fig. 10)

Bed		Feet
4	Gravels derived from Red Sea Hills via Wadi Kena, with large pebbles of quartz* from Nubian sandstone and rolled fragments of red breccia (from Pliocene); sandy, particularly in the lower part	40
3	Loose white sand (hardening and becoming brown on exposure) false-bedded toward the north, of subaqueous origin, of quartz sand and grit mixed with feldspar crystals and with fragments and small pebbles of rocks from the Red Sea Hills. General thickness about 30 feet, but thickening from west to east, in central part of hills sweeping down to level of floor of Wadi Kena; probable maximum thickness 100 feet	30–100
2	Brown marl (Pliocene) covered unconformably by Bed 3 and locally almost entirely destroyed and replaced by it	100–
1	Gray marl (Pliocene) seen in pits below level of Nile alluvium; base not seen	10+
	Total	180+

* Probably derived from farther south and brought northward by the Nile to the mouth of Wadi Kena.

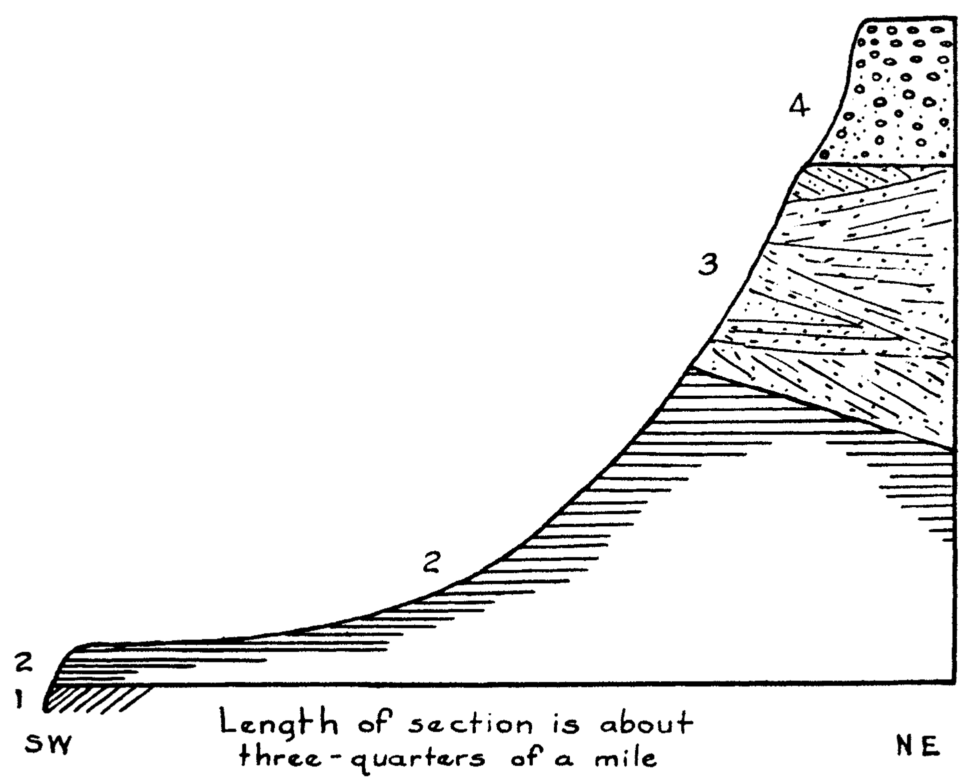


FIG. 10.—SECTION OF PLIO-PLEISTOCENE BEDS RESTING ON PLIOCENE DEPOSITS AT KENA HILL

[8] *Ibid.* pp. 508, 519, 526. On revisiting the ridges in 1931 I found a large sand pit (Pl. V, *B*) had been opened on the south side. Here, in fresh material, feldspars and fragments of granite and other rocks abounded and could be seen *in situ*. In 1926 I was not satisfied, from a study of surface exposures and an old quarry covered with gravel washed down from above, that the quartz sand contained the extraneous minerals and rocks.

The summit is 135 meters[9] above sea-level. The Plio-Pleistocene beds thus descend to about 85 or 90 meters. The subaqueous origin of Bed 3, quartz-feldspar sand, is abundantly shown in the beautiful false bedding and in the conditions of deposition. The marls were previously scoured out to less than 100 meters above sea-level, either by exceptionally strong currents of underwater type or by exposure to fluviatile erosion during a fall in water level.

3. The section at the mouth of Wadi Abu Nafukh (see pp. 24 f.) is almost identical with that of Kena Hill. The top is about 110 meters[10] above sea-level (less local gravels of Pleistocene age, 105 meters.)

4. Gebel esh-Sheikh Abu Farwah is a prominent group of hills less than two miles north-northeast of the village of el-Matmar, on the east bank of the Nile about 20 miles south of Asyut. Their distinctive appearance and smooth outlines on the west side attract attention even when seen at a distance from the State Railway. On the south and east sides a wadi and gullies coming from the limestone plateau have cut a line of cliffs from which the essential part of the following section was recorded. The Pliocene deposits are seen in an irrigation canal that traverses the edge of the desert distant about half a mile; higher members of the same series appear at the foot of the main exposure, separated from the lower beds by washes of the wadi and by scree (see Pl. V, *A*).

Section at Gebel esh-Sheikh Abu Farwah (Fig. 11)

Bed		Feet
7	Conglomerate of well rolled local material with some quartz and other pebbles of southern origin (i.e., from Lakeitah–Kena streams), especially on the western side of the hills; entirely of local origin on eastern side. The whole well stratified	50
6	Quartz-feldspar sand with bowlders and pebbles of local origin; sand of local origin replaces far-traveled sand toward the east. The whole passes gradually into Bed 7	6–15
5	Quartz-feldspar sand rock, passing laterally (to east) into local lime sand and gritty clay, strongly false-bedded toward the north; subaqueous deposit. Pebbles (up to 1.5 cm. in diameter) derived from the Red Sea Hills are fairly common	16
4	Quartz-feldspar sand conglomerate with local pebbles, thickening to south and west, well bedded and of subaqueous origin. Bowlders of Pliocene red breccia and rolled masses of an older conglomerate occur	1–10
	Scree, dusty and friable below surface, for the greater part certainly obscuring Bed 3*	} 24
3	Fine-bedded friable lime clay (cf. Bed 2) deemed to be of the Pliocene series. Top and bottom masked by scree: seen to thickness of 4 feet, but certainly much thicker	
	Foot of main section	
	Scree and wadi-wash	50
	Beds 1 and 2 are seen in canal at edge of desert; the others appear in a continuous exposure about ¼–½ mile long on south and east of hills.	
2	Lime sand of local origin, interbedded with marl (Pliocene)	10
1	Brown marl, base not seen below alluvium	10+
	Actual thickness of beds about	185+

* After scraping deeply into this scree from top to bottom, I was convinced that Pliocene beds extended to its upper limit; and I feel fully justified in so marking them in Fig. 11.

The summit of the hills is approximately 108 meters above sea-level.[11] The Plio-Pleistocene beds thus descend to 85 meters. The similarity that exists between this section and the beds of Kena Hill (see Pl. V, *B*) is evident, though here the upper beds are elaborated. The height of

9 I am indebted to the officers of the Desert Surveys for this altitude, which replaces my own measurement.

10 I made this measurement in 1926, and it seems to be confirmed in the Geological Map of Egypt, 1928. The exposure is on the south side of the wadi, southeast of the detached hill of Lower Eocene limestone on the north side of the wadi; the 100-meter contour passes over its position.

11 I am indebted to Mr. H. Rowntree of the Survey Department, Gizah, for sending me this record while I was at el-Matmar and for allowing me to inspect proofs of map sheets subsequently in Cairo, with the permission of the Surveyor-General.

the gravels at the summit above alluvium is almost the same at both places, 180 feet (55 meters).[12] From the hills of el-Matmar the quartz sands may be traced northward for a few miles over prominent pebble-strewn surfaces. A hard conglomerate which may have supplied the rederived bowlders of local material may be seen a little inside the mouth of the wadi, where it debouches from the limestone plateau by a deep gorge. It is probably of Pliocene age.

North of Asyut exposures such as those described above are rare; their place is taken, as far as the Plio-Pleistocene deposits are concerned, by the great development of high terraces of gravel. Here and there, however, the finer deposits of the quartz-feldspar sand type may be seen, as on the west end of the spur of Pliocene rocks a little south of Tell el-ᶜAmarna at 79 meters. Such incidental exposures need not be recorded here in detail.

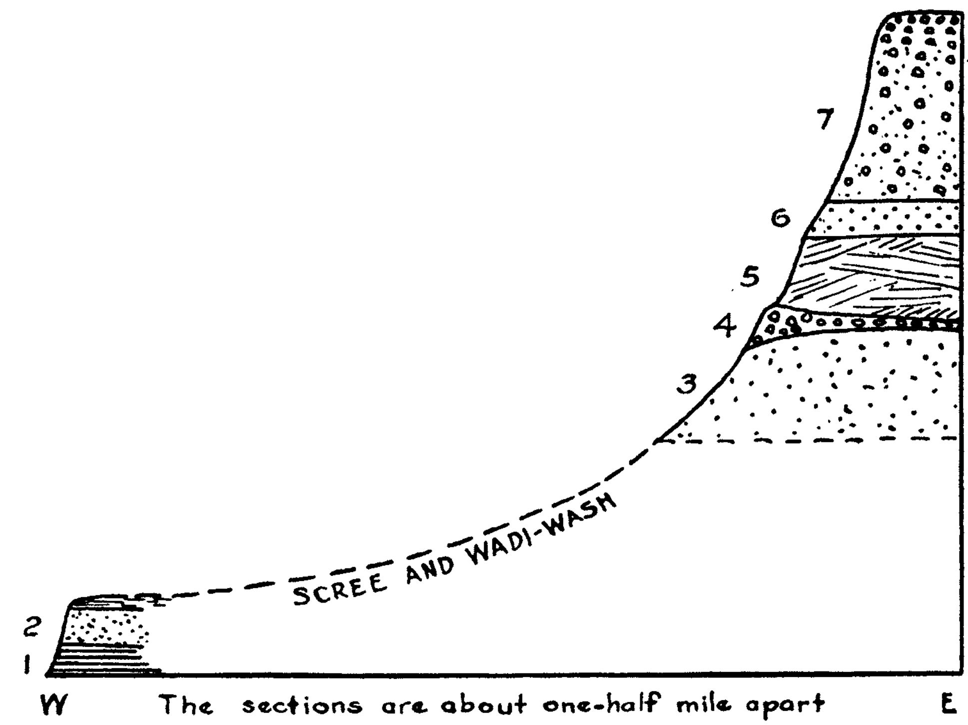


Fig. 11.—Section of Plio-Pleistocene Beds Resting on Pliocene Deposits at Gebel esh-Sheikh Abu Farwah, near el-Matmar, on the East Bank of the Nile about 20 Miles South of Asyut

The sands reappear on a grand scale in the region between Wastah and Hilwan now being officially surveyed. There, on the east bank, they form hills of considerable size, strikingly similar in surface form to the hills near el-Matmar, rising well above the 100-meter contour. Their detailed description will, I believe, indicate conditions similar to those given above.

Farther north the great accumulation of conglomerate at the mouth of Wadi Hof, near Hilwan, may belong to this period.

The irregularity of the eroded surface upon which the Plio-Pleistocene subaqueous sands were deposited is well shown by the base levels of the sections given above:

	Meters		Meters
Near Lakeitah Wells	94	Gebel esh-Sheikh Abu Farwah	85
Kena Hill	85–90	Tell el-ᶜAmarna	79
Wadi Abu Nafukh	80		

[12] The upper part of the gravels may be attributed to fluviatile origin, but the lower seems to belong to the underlying subaqueous series.

The sections at Kena Hill and Wadi Abu Nafukh show clearly defined channels with sides of Pliocene rocks. There is a slight fall, exaggerated in the record at Wadi Abu Nafukh, toward the north. Although the exposures are too few for a conclusion to be drawn from them, I am of the opinion that the erosive agent was running water, that is, rivers and streams, and that resubmergence followed. The summit levels have suffered some reduction in Pleistocene or Recent times, but at about 125 meters above sea-level, from Kena to Hilwan, the undoubtedly subaqueous deposits are replaced by coarser ones, probably of fluviatile aggradation. These changes are represented diagrammatically by Beds 7–9 in Figure 3.

THE PLIO-PLEISTOCENE TERRACES

After the first arrival in the Nile Valley of material from the Red Sea Hills via the two great tributary basins north of Luxor, considerable erosion of the Pliocene gulf series took place, the new form of detritus then being redeposited. Subaqueous deposits of the new series can be traced well above the 100-meter contour, and, as we have seen, they are followed by gravels at Kena about 180 feet above the modern Nile alluvium subjacent to them. There is no conclusive proof that the latter were laid down as subaqueous deposits; their appearance suggests rather the ending of the gulf series and a transition to fluviatile conditions. But there is nothing to show that the older series may not have risen to greater heights and been reduced by fluviatile erosion to the level at which the gravels now cap it.

In the central part of the area terraces of coarse gravel, of Plio-Pleistocene composition, stretch over and along the edge of the Western Desert at 200–250 feet (61–76 meters) above the alluvium. This implies that the valley of the Nile was filled with detritus in that latitude at least to 120 meters above sea-level; otherwise the Plio-Pleistocene river could not have been maintained at that height on one side of the valley.

Farther north, on the Nile-Faiyum divide higher terraces of similar composition are preserved, which indicate that the valley was then filled to 164 meters above sea-level.[13]

Again, in the south, quartz pebbles about the size of pigeons' eggs are found on, or within a few feet of the top of, the Pliocene deposits near Ballas, that is, at about 300 feet above alluvium. They also occupy considerable areas on the surface at Denderah. These examples suggest that river activity was restarted in the latitude of the Thebaid almost at the summit of the Pliocene platform, and that whatever scouring had taken place had been made good in the last Pliocene (Plio-Pleistocene) subaqueous stage of deposition to the height of the Pliocene platform.

From this point, in Upper and Middle Egypt, except in the extreme north, fluviatile degradation set in, and we see no more of subaqueous deposition. With certain exceptions in the extreme north (see pp. 50 f.), the whole of the degradation by the Nile took place within the altitude of the Pliocene range of submergence. I know of no evidence, with the exception to be noted below, of the burdening of the valley with rubble above the 200-meter line. This may be made clear by a diagram (Fig. 12).

The enormous accumulation of Pliocene and Plio-Pleistocene detritus, with the heavy contribution which was now poured in from the Red Sea Hills, was transported northward as the sea-level sank, and the river deepened its course. For a time, therefore, material was probably shot into standing water farther north, to be forwarded again as relative sea-level sank.[14] Perhaps it is not surprising, therefore, that higher terraces are preserved near the apex of the Delta than are to be found farther south, where denudation was rapid and continuous. On

[13] *OIP* X 24–27.

[14] By relative sea-level sinking I mean that the level of the sea was lowered, or that the land rose with relation to it, the absolute difference between the two increasing, whichever was the variable element.

the whole, however, the Nile maintained a marked degree of uniformity in its grade. Rock platforms, generally stripped of their gravels, have been recognized at 300, 200, and 150 feet (91, 61, and 46 meters) above the modern alluvium, northward from the Second Cataract throughout Nubia,[15] and the 200- and 150-foot levels may be traced throughout Upper and Middle Egypt.

Before any classification of these levels is attempted, field observations are needed to draw the remote southern and northern provinces together.

Of the high-level gravels of the Luxor–Kena district sufficient has been said. Here I need add only the statement that the great delta of coarse bowlders and gravel discharged from the drainage of Lakeitah and Wadi Kena in Plio-Pleistocene times drove the Nile to its west bank. A sharp distinction survives to the present day between the varied rocks of the gravels on the east bank near Kena and the essentially southern constituents[16] of corresponding gravels of the west bank near Denderah. North of this point the two streams of detritus mingled to form the general "Nile gravel." Here as elsewhere are gravels of local origin and probably of Plio-Pleistocene age, but they have no great chronological value and will not be recorded in detail.

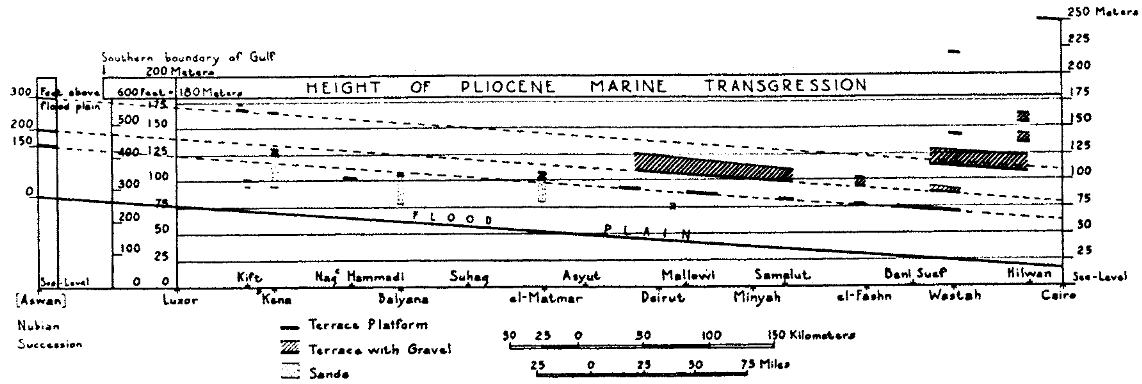


FIG. 12.—SCALE DIAGRAM TO SHOW RELATION OF PLIO-PLEISTOCENE SANDS AND RIVER TERRACES TO THE LEVEL OF PLIOCENE SUBMERGENCE (HERE TAKEN AT THE 200-METER CONTOUR AS SAFE LEVEL, WITH THE 180-METER LEVEL ALSO SHOWN)

North of Denderah the Plio-Pleistocene gravels of the Nile seem to have been destroyed in Pleistocene times. They are not well exposed on the west bank until the neighborhood of Deirut is reached, when gravels appear that can be traced northward almost continuously to the Faiyum. So far as I know the Nile terraces of this age are not represented at all on the east bank between Nagᶜ Hammadi and Beni Suef. At Nagᶜ Hammadi I found gravel to a height of about 120 feet above alluvium on the flank of Gebel et-Tarif.[17] The eastward shift of the Nile is marked, and at the present day the river is close against the eastern cliffs for long distances; it never approaches the west bank north of Nagᶜ Hammadi. Throughout the post-Pliocene history of the Nile there is much evidence of the present tendency, which has been attributed to the effect of the rotation of the earth upon a notably "longitudinal" river.

The first indication of a Plio-Pleistocene river course on the west bank is seen near Dashlut, northwest of Deirut, where the edge of the redeposited Oligocene cobble gravels is sharply marked by a semicircular bay of gravel, rewashed and graded, on a remarkably regular slope

[15] See *OIP* XVII.

[16] Quartz pebbles from the Nubian sandstone, brown flint of local origin, and some rocks derived from Wadi Matulah (Lakeitah). For details see *QJGS* LXXXV 516–20.

[17] *Ibid.* p. 533. Since the 150-foot terrace occurs both north and south of the area, isolated occurrences such as this are probably part of it.

toward the Nile (Pl. VI, *A*). The edge of this smooth terrain is about 150 feet above alluvium; above and beyond it the cobble gravels are dissected into ridges and are confused. On the slope Nile gravel could not be found; probably the remains of the meander that passed along it are buried under washed-down gravels from the higher ridges on the west. The observation by itself would be useless; but a few miles farther north, near Tunah el-Gebel, the cobble gravels were washed by the Nile and the desert is planed for a distance of a few miles from the edge of the alluvium. Nile gravel is everywhere in evidence, mixed with redeposited cobbles, and forms a plain 250 feet above alluvium. The gravels are 50 feet in thickness. At Balansurah a headland of Eocene limestone covered with cobble gravel forced the Nile eastward again. The western margin of this country, across which passes the camel road to the Faiyum, was carefully searched for traces of yet higher Nile gravels, but none was forthcoming. The eastern edge of the 200- to 250-foot gravels is sharply defined, and at its foot is a slope, starting at 150 feet along the cliffed edge of the higher terrace (Pl. VI, *B*). This seems to mark the beginning of the lateral shift of the Nile. It is burdened with local downwash. In the hollow thus formed between the cliffs and the slope wind-blown sand has found a place of rest, and a forbidding line of sand dunes arises.

North of the headland of Balansurah the gravels turn westward again, at the same height, covering some of the exposures of Pliocene travertine already described, and extend northward with a width of about 6 miles from the edge of the alluvium. North of the Minyah–Bahriyyah camel road, owing to the incoming of soft Eocene beds, the terrace ceases to be a prominent feature. Nevertheless gravels control the long Nileward slope and occur in patches upon it, dissected by a later meander of the Nile at a lower level. Between the latitudes of Maghaghah and el-Fashn the terrace continues, but its gravel seems to be deeply covered or replaced by downwash from the dreary slopes and denuded Eocene country on its west. The terrace-like feature is marked and dissociated from local detail: no similar platform occurs in the broken country on the west, and similar features on the east are covered with Nile gravel of 100-foot and later stages (Pleistocene). The patches are closely delineated by the 90-meter contour, that is, about 250 feet above alluvium, from which must be deducted the covering of local washed-down débris. I have no hesitation in regarding these platforms as the northern continuation of the 200- to 250-foot terrace. A little farther north, west-northwest of el-Fashn, and under identically similar local conditions, Nile gravel was found by digging into a terrace at the same altitude, covered by local débris. A few miles to the north lies the southern boundary of the country described in *OIP* Volume X. The 200- to 250-foot terrace may thus be traced on the west bank over about 150 miles from south to north, from Deirut to Dahshur.

In the region of the Nile-Faiyum divide and on the low and open country north of it the Plio-Pleistocene terraces had an opportunity to spread out. Accordingly they achieve a remarkable development, and higher stages appear, of which in the south there is no evidence.[18] They also make rare appearances on the east bank. I am indebted to Mr. G. W. Murray of the Desert Surveys for the information that he found patches of Nile gravel and a block of granite (for which I can offer no explanation) at 140 meters in Wadi Garrariyyah and at 220 meters in Wadi Hamrai, rather less than 10 miles from the Nile, east of Wastah. Their levels are approximately 380 and 650 feet, or 116 and 198 meters, above Nile flood plain. The latter is higher than any terrace recorded on the opposite bank of the Nile. It is also the only record of Nile gravel, within the area dealt with in this volume, that exceeds the maximum level attributed to the Pliocene gulf (200 meters).

Both these high records lie in the area now being officially surveyed, and the conclusions

[18] Many flat-topped cliffs farther south, e.g. those opposite Minyah, suggest higher terrace levels when seen from the State Railway. They prove uniformly unprofitable when walked over.

that may be based upon them are awaited with interest. The higher level recalls a footnote which was appended to *OIP* Volume X, page 26, to the effect that Nile gravel, as fresh as in any Plio-Pleistocene exposure, occurs on the summits of Gebel el-Khashab and Gebel el-Haddadin, west of the Gizah pyramids and north of Abu Roash respectively. These, the highest hills in that part of the Western Desert adjoining the Nile and the Delta, rise 250 meters above sea-level, or 233 meters above the Nile.

How far can the records of Nubia, Upper Egypt, and Middle Egypt be brought into a comprehensive account? Of the Pliocene Nile in Nubia we know that its base level was the height of water at the southern end of the gulf, near Edfu or Kom Ombo, a maximum of 200 meters, probably about 180 meters. The flood-plain level there now is 85 meters, giving a difference of 115 or 95 meters (377 or 312 feet). In other words, levels only a little more than 300 feet above flood plain had probably been attained in Nubia by the Nile in Pliocene times, and the 300-foot terrace may be but little younger. The high levels found near the apex of the Delta may indicate the maximum height of water in Plio-Pleistocene times, plus such piling up as took place above that level due to excessive degradation in the south causing excessive aggradation in the north. If this be so, the amount of subsequent denudation in the north has been enormous. We may accept the remainder of the series below the 200-meter contour as post-Pliocene; the evidence is conclusive, yet the subsequent alteration of the face of the country implies, for example, the nonexistence of the Faiyum depression. It is only in the terraces uncontrolled by the 200-meter contour that doubt of their age arises; in every other respect they are inseparable from the rest of the series. Outside Egypt (e.g. in Algeria)[19] levels as high are a matter of common experience. Though there is no evidence within the country of actual submergence to such a depth in post-Miocene times, it is conceivable that the high gravels are relics of the landward portion of an aggradation plain built up by the Nile, or that some of the more northerly relics of terraces were in fact formed at lower levels during an interval of depression in the vicinity of the great post-Pliocene delta, which, with the relief of load by denudation or from other cause, subsequently recovered.

The problems of the Delta will be considered in a later volume of this series, but in the present issue we are concerned with the more ancient delta. Having its origin farther south than its modern successor, it has left records of successive levels at heights not generally found in Egypt. Why it did so is as yet entirely unknown. A table (Fig. 13) will serve to summarize the altitudes above Nile alluvium. This in itself is not an ideal datum, but it is the inevitable standard of comparison when dealing with a river. For comparison the levels determined by De Lamothe and summarized by Depéret are included, and it becomes obvious that there is a common factor.

In view of the similarity between the Nile terrace levels and those of the general Mediterranean classification, it seems justifiable to adopt the terms "Sicilian" and "Milazzian" in Egypt. In the succeeding period Chellean man is generally supposed to have entered the succession. Since his implements first appear in the 100-foot terrace of Egypt, we may be justified in adopting the term "Tyrrhenian" also. At this point in a descending series of terraces I have for convenience hitherto considered the Pleistocene period to have begun, but in terms of the Mediterranean sequence the 100-foot terrace falls well within it.

A choice is therefore open to any who may wish to reassign the whole of the Plio-Pleistocene beds, the subaqueous deposits to the Pliocene and the terrace gravels to the Pleistocene. If every bed throughout the entire sequence were fossiliferous, it might be possible to dispense with the intermediate series; but for the present at least it serves its purpose, and I propose to retain it. As already pointed out by Blanckenhorn, the fauna of the younger Pliocene beds has

[19] De Lamothe, Depéret, and others; see references on p. 43, n. 2.

Pleistocene affinities; and to the latter period he has assigned the *Melanopsis* beds. From chapters ii and iii it is fairly clear that the travertines and associated strata of Middle and Upper Egypt are not far removed in time from those beds. But even if the nature of their

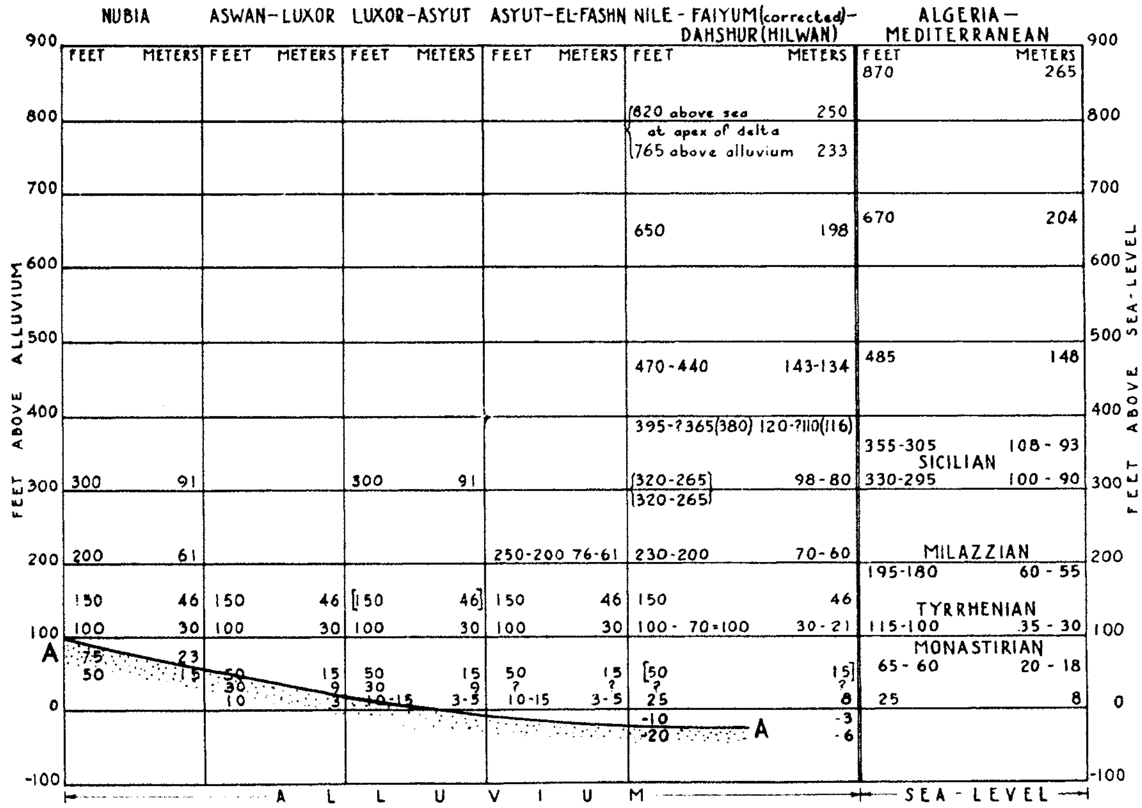


FIG. 13.—TABLE TO SHOW HEIGHTS OF NILE TERRACES ABOVE ALLUVIUM AND THEIR RELATION TO LEVELS OF THE MEDITERRANEAN. CURVE *A–A* REPRESENTS THE SURFACE OF SEBILIAN SILT AND GRAVEL

fauna justified their transference to the Pleistocene, I am of the opinion that the geological changes and breaks of sequence, which occurred during and after their deposition, point to their logically correct position in the time scale being at the close of the Tertiary era. The real change, and the beginning of Quaternary history, came with the return to fluviatile conditions in the Nile Valley, with the Sicilian stage in the Mediterranean.

V

THE LOWER PALEOLITHIC STAGE OF THE PLEISTOCENE

INTRODUCTION

From a chronological point of view the Pleistocene period is already introduced by the events of Plio-Pleistocene times, and during the period of time occupied by Lower and part of Middle Paleolithic evolution of culture the development of the river continued along those lines. There followed changes of climate, of the behavior of the river, and of human industry, with which later chapters will be particularly concerned.

An endeavor has been made in chapter iii to give an adequate account of local detail, and the same sequence of districts will be followed from south to north. The detail of the southern sectors may be reduced to a minimum;[1] for the extreme north reference should be made to Blanckenhorn's detailed accounts of the Quaternary gravels.[2]

The Selection of a Level of Reference

On passing from the high Plio-Pleistocene terraces to the Pleistocene gravels we find increasing need for a satisfactory datum from which they can be measured. For the Pliocene gulf present sea-level serves the purpose. For the platforms and gravels of a river that descends to the sea with a varying grade clearly reference to sea-level is of use only for cartographic purposes: altitudes so given are without meaning unless the height above sea-level of the existing river near the site is known. It becomes natural, therefore, to refer all traces of former river action directly to adjacent river-level. But certain difficulties have to be overcome: the level of a river is ever changing, and in the Nile the variations are great even when modified by irrigation. If the annual height of flood is taken, we find that it varies from year to year. Reference to water level is difficult unless some mean or maximum is chosen—a question that exposes itself to potential disagreement among irrigation engineers.

In this work, therefore, the ultimate and tangible resultant of the river's changing moods, that is, the height of the modern alluvium, has been taken as the datum. This in itself is imperfect, since the height of alluvium varies naturally from river bank to valley side, tending here to bank up, there to leave unfilled hollows. Artificial modifications also have arisen from thousands of years of irrigation, by the construction of basins and of smaller inclosed areas within them (Arabic, *ḥôḍ* < *ḥauḍ*). On the other hand, the alluvium provides an indispensable datum for leveling in the field in the present state of the surveying of the adjoining deserts. In practice, therefore, the level of alluvium near the edge of the desert has been the term of reference from force of circumstances, and it serves well to interpret the heights of ancient deposits. Any surveyor knows that marginal heights of alluvium are erratic; and it follows that the depths of a *ḥôḍ*, or the heights of drifted desert sand, waterlogged by the annual inundation, have been avoided. Where they have occurred the chains of levels have been continued, usually to some permanent bench mark on a bridge or canal bank which can be located on the map. With the appearance of the maps of the new 1:100,000 series, in which the desert will be

[1] Fuller data have been given in *QJGS* LXXXV 520–43.

[2] E.g. in his *Hdb.* pp. 155 ff. Certain modifications of classification may suggest themselves, but these do not affect the actual field observations and need not be discussed.

included, later investigators of the Nile Valley will be saved the endless labor of these chains of level. The irregularity of the alluvium remains, however, and in general we cannot expect, nor do we need for the purposes in view, accuracy within a foot.[3]

There is another factor in the use of alluvium as a datum, or of the river itself, namely the known accumulation of silt and the raising of the river bed in historic times. This was computed many years ago, and the problem has since been reviewed by almost every archeologist, geologist, and irrigation engineer who has worked in the country. The broad facts remain, that great thicknesses of alluvium have accumulated, and that approximately 4 inches in a century have been added (cf. p. 99, n. 3a). The principle itself is of the utmost importance, since it implies among other things the growth of the Delta and the concealment beneath the alluvium of an increasing body of material. Thus in the northern part of the region it will be found that all but Lower and Middle Paleolithic levels are submerged.

In view of the inconstant level of the alluvium, faith may be lost in it as a datum; that is, the 100-foot terrace of Upper Egypt might be twice or half as high in Lower Egypt. On the contrary, the 100-foot terrace, within the limits of accuracy which its state of dissection permits, remains constant at that height. It so happens, then, that the alluvium and the 100-foot terrace have about the same gradient in the 20th century. At the beginning of the Christian era, if we accept the figure already given, the 100-foot terrace would have approached 107 feet above alluvium, and in another 2,000 years may appear to be but 93 feet above datum. This applies also to the later of the two Lower Paleolithic terraces. On passing to the Middle Paleolithic stage, however, we shall find that the gradient of the river was not that of Lower Paleolithic or of modern times.

Pleistocene Tributaries of the Nile

Although the tributaries are now dry except on rare occasions, when they become fierce torrents for an hour or so, they attracted Paleolithic man, and throughout a large part of the Nile Valley his implements and workshops lie abundantly in and near them. Moreover, as the Nile lowered its bed, the tributaries adjusted themselves to it, so that a sequence of local terraces analogous to those of the Nile resulted. In measuring these the datum must be the wadi floor, not the alluvium of the Nile. In the smaller torrent beds accurate measurement is often impracticable, but in the tributaries of any size the measurements are in accord with those obtained in the main valley, provided the position of the Nile in its valley has remained more or less constant. If the Nile meandered from one side of its valley to the other, the tributaries on the one side were forced to flow perhaps 7 miles farther, while those on the other side were truncated by a similar amount. Readjustments of tributary gradients are therefore to be expected, and the appearance of terraces in them discordant to the gradients of earlier or later levels indicates the period of a meander of the Nile. The survival and incorporation in later deposits of Nile gravel in and near the mouths of tributaries is additional evidence, commonly seen, of such changes. In Upper Egypt the valley between the Pliocene bastions is fairly narrow, and in the part that falls within the boundaries of this volume it has been possible to mark the Nile's lateral movements in Lower and Middle Paleolithic times.

North of Asyut, however, the uniformly eastward drift of the Plio-Pleistocene excavation of the valley was continued in a striking manner in the Paleolithic stages. Scarcely any Nile gravel is to be found on the east bank above the present height of the alluvium, while on the west one bench occurs below another, sometimes in marked steps, sometimes in a continuous

[3] For problems in which the precise height of a former water level is required, the whole of the work has been carried out in the field on leveling reduced to sea-level and attached throughout to official bench marks. Cf. the relationships of the lakes of the Faiyum to one another and to the Nile.

slope of lateral shift. The effect on the eastern tributaries has been great, and the levels of the surviving fragments of the more ancient wadi terraces are correspondingly difficult to interpret; that is, a terrace now 50 feet above the shortened and steepened valley floor may have been half that height above the floor at its full length. The projection of profiles to the approximate position of the Nile at the time (if known) serves as a guide, but the fact remains that the local terraces on the east bank north of Asyut are unfortunately of little real use in the general history of the valley. The almost complete absence of incorporated implements adds to their present lack of value and to the difficulty of embodying them in the general scheme.

THE LOWER PALEOLITHIC GROUP

At the conclusion of the preceding chapter certain analogies were drawn between the high gravel terraces of the Nile and a general scheme that has been employed in other parts of the Mediterranean basin. If, as seems probable, comparisons are reliable, some at least of the high terraces may be included in the Pleistocene period; but since there is no positive evidence from fossils or human implements, I prefer to leave them in their present position in the chronological series.

In the gravels of the 100-foot terrace occur the oldest human implements yet known in Egypt; and mammalian remains have been found in the gravels near Cairo, thanks to the researches of Père Paul Bovier-Lapierre and others. At the present juncture I am at liberty to state that these represent a markedly early Pleistocene fauna.[4] The terrace thus forms a good starting-point for studying the human series; and, if altitude is taken as the standard of age, no more regular feature is to be found. The same types of implements occur in it throughout its length. It covers, as might be expected, a long period of time, during which primitive Lower Paleolithic man evolved his implements from crude to highly developed forms. In other words, during the period of the 100-foot terrace Man gained a considerable tradition of experience and technique in the working of stone. So constant is the level, and so long is the period of time implied, that it seems certain that sea-level was maintained without noticeable change throughout the phase. This in terms of Mediterranean chronology is the Tyrrhenian stage, a term which, as I have already suggested, may be employed in Egypt.

Below the 100-foot terrace a lower terrace of 50 feet has been recognized. It was already known between Luxor and Asyut and was traced through Nubia to Luxor, but it could not be found in the neighborhood of the Nile-Faiyum divide. The recent investigation between Asyut and the Faiyum has now filled the gap, but has proved the deposits of this stage to be extremely fragmentary. Later denudation in the north has left only small patches.

The implements of the 50-foot terrace in Upper Egypt include the higher development of Lower Paleolithic skill, that is, the later forms of Acheulean industry in Egypt. The earlier Acheulean types also occur in the 50-foot terrace, but they are usually rolled and waterworn to some extent, indicating a previous source of origin. That source was verified in the Lower Paleolithic channel of the Nile-Faiyum divide and again in Bovier-Lapierre's sections at ʿAbbasiyyah near Cairo, where succeeding horizons of primitive Chellean,[5] Chellean, and Acheulean cultures have been identified in thick strata. Here, as elsewhere in the gravels of the 100-foot terrace, coarse flakes also have been found. Of recent years attention has been given to flakes that occur in Chelleo-Acheulean beds, and in England and France the term

[4] At the moment of writing I am the only person, so far as I know, who has been privileged to study the whole of this material.

[5] Bovier-Lapierre in *L'Anthropologie* XXXV (1925) 37–46 and *Bull. de l'Inst. d'Egypte* VIII (1926) 257–75.

"Clactonian"[6] has been applied to them. There seems (see p. 111) to be sufficient in common between the Clactonian flakes of Europe and the Lower Paleolithic flakes of Egypt to warrant a comparison. The fact remains, however, that in Egypt the flakes have not been found in beds separate and distinct from those which contain Chellean or Acheulean implements.

With whatever caution or boldness European terminology is withheld or applied, the fact remains that the 100-foot and 50-foot terraces are to be regarded as a Lower Paleolithic group. The periods of deposition, of bed erosion, and of renewed deposition at lower level record the physical factors operating at the time; the human record is as complete as we can expect it to be in the circumstances:

100-foot terrace.... Primitive Chellean, Chellean, older Acheulean, and primitive core-and-flake industry
50-foot terrace.... Evolution of Acheulean to its highest development in Egypt

Throughout the whole region there is evidence of nothing but river action, of the Nile and tributaries alike—of a generous run-off of water from a country consisting for the most part of limestones, which are known also to have had a subterranean drainage.[7] The deposits do not suggest torrential rains and periods of drought, but rather the more evenly distributed rainfall of temperate latitudes. At the same time we must note that the deposits of the Nile were predominantly coarse,[8] in contrast to the modern alluvium which is borne on a similar gradient. The run-off of water was therefore considerable. Of the existence of deserts within the area there appears to be no sign.

It may be argued that we are studying the results of water action, and that other evidence is overlooked or not available. On the contrary, the incorporation of wind-borne sand and of split or faceted pebbles with or without *vernis du désert*, the presence of vermiform markings of proved antiquity on incorporated material, torrential deposit, and lacunae of non-deposition in an alluvial deposit serve to demonstrate a desert climate. Moreover, in a country of deserts there is a natural inclination to regard everything that suggests aridity in antiquity as a proof of the former existence of deserts. Limestone plateaus tend to be arid in the most temperate and humid of climates; sand is carried on the wind and etches surfaces in a multitude of circumstances. The region in Lower Paleolithic times may be defined, I believe, as well watered, the plateaus open to man and beast, with a vegetation sparse or prolific according to the nature of the rocks.

The full significance of the considerable degradation of 50 feet in Acheulean times is difficult to appreciate; the removal of a great burden of detritus demands virile rivers, and these in turn suggest an ample rainfall. On the other hand, diminution of volume or of load or increase of slope usually causes a river to concentrate on bed erosion[9] at the expense of lateral corrasion and deposition of gravel on the wide platforms. This is a principle that may be applied to the

[6] From Clacton-on-Sea at the mouth of Thames. The name was first suggested by Mr. S. Hazzledine Warren (South-Eastern Union of Scientific Societies, *Transactions*, 1926, pp. 38–51) to define certain implements hitherto grouped with the Mesvinian. The term came into general use upon the publication of Professor Breuil's *Exposé de titres et bibliographie* (1929); see also the same author in *Bull. Soc. préhist. française*, 1930, No. 4. A description of the industry from one of its type localities will be found in a paper by Mr. R. H. Chandler in *Proc. Prehist. Soc. East Anglia* VI (1929) 79–116 and a summary in *Proc. Geol. Assoc.* XLII (1931) 175–77. Professor Breuil has recently published a detailed work on the subject in *Préhistoire* I (1932) 125–90.

[7] *GJ* LXXII (1928) 152 and 155.

[8] Silt was found in the central parts of the 100-foot channels of Kom Ombo (*OIP* XVII 32) and Rus (*OIP* X 33), interbedded with contemporary gravels; only gravels occur nearer the sides.

[9] For a discussion of factors involved in river-terrace construction, see W. M. Davis, "River Terraces in New England," *Bull. of the Museum of Comparative Zoölogy at Harvard College* XXXVIII (1902) 281–346, or the same author's *Geographical Essays*, ed. Douglas Johnson (Boston, 1909) 516–86, esp. pp. 520–27 and 530.

Nile. It is probable also that the relative level of the Mediterranean fell in Acheulean times. Either or both of these changes may be held responsible, but in neither does there seem any reason to suppose that there was a *greater* run-off than in Chellean or later Acheulean times. The conclusion may prove unpalatable at first to those who associate glacial phases of Europe with pluvial climates elsewhere, since in the generally accepted European chronology a glacial phase had certainly been experienced before the close of Lower Paleolithic times.

On the whole, diminution of rainfall seems likely to accompany the removal of vast bodies of water from general circulation to form ice; and this is in accord with the Egyptian evidence. In view of the close similarities between European and Egyptian Lower Paleolithic implements, their homotaxial succession, and the enormous periods demonstrated by the physical achievements of uniform grade in the two Lower Paleolithic terraces of the Nile, it seems reasonable to suppose that a common time factor may be found. I feel confident that it exists in the changing relative levels of the Mediterranean, washing the shores of Europe and Egypt alike, rather than in typology or the long-range correlation of pluvial, interpluvial, glacial, and interglacial periods.

THE 100-FOOT TERRACE

In this and the next chapter the terraces will be followed with a view to showing their main distribution and behavior, and attention will be given to tracing, as far as circumstances allow, the course of the Nile itself at each stage (Figs. 14–15). Local terraces will receive attention where necessary, but for the main argument they may be regarded as a secondary, though important, consideration.[10]

Luxor–Wadi Kena–Nag᾿ Hammadi

Between Luxor and Kena the Nile seems to have maintained its course at the 100-foot stage along a median line drawn between the present limits of the alluvium; that is, it does not appear to have meandered into the zone of local wadies to any appreciable extent. Its gravels are therefore absent over the greater part of the distance, and the terrace is represented by local deposits 100 feet above the wadies. They are seen at intervals, for example under the cliffs of the Thebaid and on the Pliocene strata in the wide expanses of the east side northward from Wadi Madamud. The river swung across to the point of the bend at Gebel el-Kurn to meet the inflow from the Lakeitah plains. Subsequently it shifted to the west side, where local terraces of later phases indicate in some instances progressive shortening of the tributaries as the Nile encroached upon their territory.

In the Lakeitah plains gravels of the 100-foot terrace are seen especially on the north side of Wadi Matulah, but over most of the area they were destroyed during the succeeding period of the 50-foot terrace. Near the Nile they are in evidence, sweeping down from the southern flanks of Gebel Serai both toward the wadi and to the Nile, where they were subsequently truncated.

The combined flow from Wadi Matulah and from the slopes on its north side seems to have forced the Nile toward the Thebaid after its approach to Gebel el-Kurn, and its gravels are well displayed in a prominent conical hill of Nile gravel, deeply patinated on the surface, near Ballas, and on an open slope behind Denderah. Here Chellean implements are abundant, loose on and among the gravel, from which presumably they have been weathered. On the opposite side of the valley I found similar implements *in situ* in gravels of the same age on the south

[10] For the conditions that govern local terraces see also an explanation of processes in *QJGS* LXXXV 528–30.

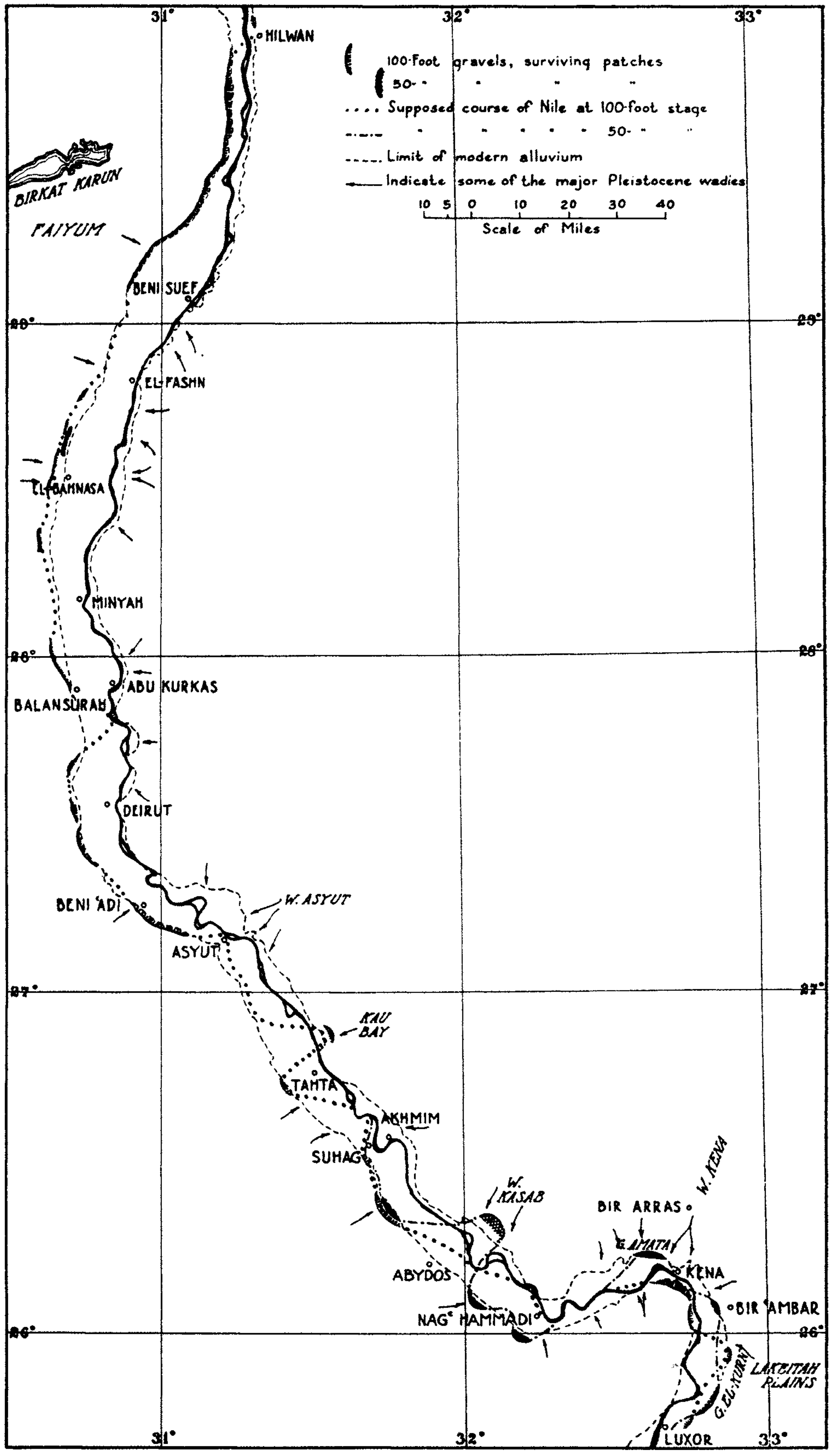


FIG. 14.—SKETCH MAP TO SHOW THE COURSES OF THE NILE AT THE STAGES OF THE 100-FOOT AND 50-FOOT TERRACES

side of Kena Hill, waterworn and lacking the patina of the material exposed on the desert surface.

Within Wadi Kena terraces are preserved on a magnificent scale over a distance of 50 miles or more from the Nile toward the Red Sea Hills. The contrast of local terraces in juxtaposition to those of the great stream of igneous and metamorphic rocks from the hills is nowhere better displayed than in this interesting tributary of the Nile. Chellean and primitive Acheulean implements are not rare in the local gravels of the 100-foot terrace, and they occur in the far-traveled gravels in two localities known to me: at the Roman fort of el-Haita, crowning the 100-foot gravels about 30 miles from the Nile, and at Bir Arras (see Pl. VII, *A*), about 15 miles from Kena. At the latter point may be seen the only fault of which I am aware in the Paleolithic terraces of Egypt; it is situated in front of a prominent pre-Pliocene slip at the edge of the limestone plateau.[11]

Although primitive Acheulean and Chelleo-Acheulean implements occur in the gravels, unrolled and patinated Acheulean implements of more usual and more advanced types lie on the surface; they are certainly later than the gravels of the 100-foot stage.

At its mouth Wadi Kena bifurcates north and south of Kena Hill. In the northern branch isolated hills and ridges of the 100-foot gravels stand out from a sea of 50-foot gravels choking the channel, and the water thereafter was concentrated in the southern or main wadi, which is still open.

As already stated, local trains of gravel from Wadi Matulah and Gebel Serai tended to force the Nile toward the west bank. The process was completed by the great fans that were projected into the valley from Wadi Kena, and the remains of the Nile's course may be found behind Denderah. On the east side, however, the interosculation of the two currents is seen in the percentage of quartz pebbles, virtually lacking in the Wadi Kena gravels, that becomes apparent at their Nileward margin.

The river does not seem to have encroached on the east side again until Nagᶜ Hammadi is approached; until this point it was evidently warded off by local streams of detritus. On the west bank is a long and dreary slope from the alluvium toward the distant Eocene cliffs, from Denderah almost to Nagᶜ Hammadi; this probably represents the combined results of the staving off of the river by local drainage and of the river's sideslipping on the outside of the sharp curve round the north side of the Thebaid. The river finally stripped off the Pliocene strata from the east shore and impinged on the great cliffs of the eastern plateau at Gebel et-Tarif, the northernmost of the magnificent bastion cliffs of Nagᶜ Hammadi.

Nagᶜ Hammadi-Asyut

The great Kena bend accomplished, the river had before it an easier course, and it probably flowed within the present limits of alluvium, while from both sides a multitude of large and small tributaries flowed off the plateaus to reinforce it and to keep it within its bounds. Their remains are especially well seen in the bay between Wadi Abu Nafukh and Wadi Kasab, on the east bank, and survive in a great mass at the mouth of the former (see pp. 25, 46). In about the center of the bay between Abydos and Suhag, however, the Nile invaded the region of the tributaries on the west bank and left a well preserved sweep of gravel at 100 feet to the northern cliffs that hemmed it in (see Pl. VII, *B*). In this sector it transgressed across the Pliocene travertine already described, and Chellean and early Acheulean implements are found resting on the cliff face of the travertine as well as in the gravel itself.

[11] *Ibid.* Pl. XXIX. This remarkable stability is in strong contrast to the severe folding of Lower to Middle Paleolithic beds in Tunis, recorded by R. Vaufrey, "Les plissements acheuléo-moustériens des alluvions de Gafsa," *Revue de géographie physique et de géologie dynamique* V (1932) 299–321.

Immediately north of the headland west of Suhag the margin of the 100-foot Nile gravel is well displayed, with implements *in situ*, and we see how it trended away in a new meander eastward, followed by the slopes of local streams from the western plateau.

On the east bank the local gravels are intrenched in the Pliocene rocks south of Akhmim. They have been protected from the Nile by cliffs that run to the mouth of Wadi Kasab; gravels survive at their northern corner, but they may be of Plio-Pleistocene age. Farther north the Pliocene deposits have been stripped from the walls of the valley except in secluded corners, and the Nile or its alluvium is almost at their feet. It may be assumed that the destruction began in 100-foot times when the Nile swung across from the west bank at Suhag; but, although the river meandered into the mouth of Kau bay for a mile or two and turned sharply back again, it had been deflected into yet another meander a little farther south. This is represented by gravels 10 feet thick that traverse the desert in a well marked bend at 110 feet above alluvium and are distant 2–3 miles from it near Nazlat ᶜAli, opposite Tahta, to the northern cliffs near Nazlat el-Kadi. The river swept away an enormous body of Pliocene deposits in this region, and its meander is particularly well displayed. Thence to Asyut the alluvium now approaches almost to the foot of the western cliffs, which are protected only by a narrow belt of confused scree and by relics of Pliocene rocks; at its 100-foot stage the Nile north of Kau probably occupied this position. On the east bank, north of Kau, the alluvium abuts the cliffs for several miles; then, near el-Matmar, broad expanses of Pliocene, Plio-Pleistocene, and Pleistocene deposits jut into the fields. The 100-foot terrace, where recognized (cf. Wadi el-Matmar), is of local origin, stretching out to join the Nile on its westerly meander. Similarly, immediately to the north, the huge fans of local detritus poured out of Wadi Asyut, and the Nile does not seem to have invaded the district, except perhaps near the projecting cliffs of Maᶜabdah, where about 3 miles north of Nagᶜ Husain Hasan a few pebbles of Nile gravel were found up to 100 feet. They may be of Plio-Pleistocene origin, since they are unusually small for Nile-terrace pebbles of southern origin.

Asyut–Samalut

The Nile seems to have turned the hills that dominate Asyut on the west side and to have continued on a straight course from Mankabad near Asyut almost to Beni ᶜAdi. Between these two places wide plains and isolated knolls of Nile gravel, resting on Pliocene marl, are a distinctive feature, in strong contrast to the coarse glittering white gravels of local origin that flank them on a well marked line.[12] I know of no instance here of Nile gravels exceeding the 100-foot level, and they slope fairly gently to the edge of the alluvium. Near Beni ᶜAdi partial redeposition of the great fan of cobble gravel from the western plateau, Pliocene deposits, deflected the Nile, and it evaded the obstruction, gravels becoming prominent again, once the fan is passed or its edge overridden, between el-ᶜAtamnah and et-Tataliyyah. They are then lost for a space in the sand-swept country near ed-Deir el-Muharrak and Meir;[13] pebbles are still present, but the height and feature are indefinite.

On the east bank, north of Maᶜabdah, cliffs intervene for a considerable distance. Nile gravel of the 100-foot terrace does not seem to have entered the Tell el-ᶜAmarna bay; the river appears to have kept a straight course on the line of the present alluvium. It is next seen on the east side on the cliffs above Geziret Shaibah, south of Abu Kurkas; but only scattered pebbles survive. Similarly contacts of the river with the west bank are seen at 100 feet on the cliffs near Bawit. North of this the river seems to have shifted eastward before local tributaries of redeposited cobble gravel, leaving curved meander-like belts, as at Dalga

[12] Clearly visible from the State Railway.

[13] For situations of most of the places here named see Fig. 8.

and Dashlut, in which Nile gravel is not now preserved on the surface. North of Balansurah, however, the river followed closely the east side of the gravel plain that it had deposited in Plio-Pleistocene times. A Nileward slope, incumbered with great sand dunes, may be traced for many miles northward, Nile gravel being abundant upon it. On the east side north of Abu Kurkas for about 125 miles the river was conspicuous by its absence. Local gravels of the 100-foot stage occur in the deeper bays between Beni Hasan and Minyah and in the center of Wadi et-Tarfah. It is evident here that an enormous amount of denudation has since taken place, and that a late transfer of the river's course from the west bank has disorganized the succession.

Samalut–Beni Suef–Hilwan

The straight course of the river along the margin of the Western Desert in 100-foot times is in striking contrast to its total absence on the east, where there are only local terraces, as in the bays south and north of Gebel Kararah. On the west sand and denudation have obscured or destroyed the gravels over wide areas west of Minyah, but they are well exposed at the point at which the old military railway line from el-Bahnasa turns into the sand hills at a distance of about 3 miles from the edge of the alluvium.

From el-Bahnasa northward for many miles the gravels stand out as prominent ridges, sometimes covered by local detritus beneath which they may be found by a little digging. They are situated often on low ridges of white Eocene limestone, to which they owe their preservation in a region of soft underlying clays. Their height is remarkably constant and independent of the dip of the Eocene beds. A chain of such survivors of the 100-foot terrace may be traced southwest of el-Bahnasa, north of the military line, west of esh-Sheikh Mas῾ud, then in scattered ridges sometimes continuous for a mile or more almost to the latitude of el-Fashn.

West of the smooth line of gravel lies a confused region of local cobble gravel and Eocene detritus washed from the gravel plains and Eocene hills in the background.

In the desert a few miles farther north the full development of the 100-foot stage of the Nile is visible in cross-section.[14] From Sidmant el-Gebel the old river bed, containing Chellean and Acheulean implements, may be traced in its original form northward across the mouth of the Faiyum, through the remarkably preserved Rus Channel, until it finally leaves the Western Desert and turns toward the present alluvium near the Pyramid of Lisht, about 12 miles south of Dahshur.

Throughout the whole of this region contemporary Nile gravels are entirely lacking, so far as I know, from the east bank. Local wadi terraces are developed on a grand scale when the cobble gravel country is reached north of el-Fashn; sheet gravels of redeposited cobbles of indefinite age, though in part certainly Pliocene, have been cut by definite wadies and again deposited in orderly succession of terraces in Wadi Ghayadah and particularly in Wadi Sanhur, where the 100-foot terrace is well developed. Its gravels are about 10 feet thick and rest on the Pliocene subaqueous deposits and old accumulations of cobbles. Careful search revealed no implements here.

In the neighborhood of Hilwan the channel of the Nile, which was finally forced eastward at Lisht, reappears on the east bank. The gravels have been severely denuded at a later stage on the south side of Hilwan; but on the north between the town and the mouth of Wadi Hof I have traced a full cross-section of the channel, and Chelleo-Acheulean implements occur in its gravels. The river traversed the eastern side of the valley to Cairo.

[14] This has been sufficiently described and mapped in detail in *OIP* X.

THE 50-FOOT TERRACE

Luxor–Wadi Kena–Nagʿ Hammadi

The Nile seems to have kept much the same course between Luxor and Kena as it had occupied in the 100-foot stage (see Fig. 14). Its gravels are not seen on the west side, and the local terraces are accordingly fairly well developed along the foot of the Theban scarp as far as Ballas. The right bank seems to have skirted the Wadi Madamud–Higazah bay, where it was joined by strong tributaries. These flowed from a wide area of deeply incised Pliocene beds that run many miles in a southeasterly direction on the east side of Gebel Rakhmaniyyah and flank Gebel Nezzi from its southward corner along its west side to its northern slopes in the Lakeitah plains. The drainage from the Red Sea Hills across the plains joined the streams from the north flank of Gebel Nezzi at about Wadi Mushash, since the 50-foot gravels of its west bank consist almost entirely of Cretaceous, Eocene, and Pliocene débris, those of its east bank of Nubian sandstone, quartz, and rocks of the Red Sea Hills. The entire area of Nubian beds that constitutes the Lakeitah plains seems to have taken its present form at the 50-foot stage, and terraces and gravels dominate it from the edge of the hills to the Nile. Subsequent erosion has served to strip off the gravels and to break up the terrace into "islands" of all sizes, which stand out from a featureless plain.

Lakeitah Wells seems to have been the point of junction of the chief lines of drainage; but the combined waters, or braided streams, with many local tributaries, had to negotiate a narrow barrier to reach the Nile. The outlier of Gebel el-Kurn lay directly in the path, and Pliocene foothills extended toward it from Gebel Serai, on the north. A considerable amount of erosion seems to have been effected here at the 50-foot stage. One stream of markedly coarse gravel crossed the southern part of Gebel el-Kurn and entered the Nile by Wadi Kurn, near Kus. The main stream passed north of the outlier and probably cut away the Pliocene northern bank until the broad and shallow depression of Wadi Matulah was formed. Here many square miles of the 50-foot gravels survive, of finer texture than those of the southern course (Wadi Kurn), which was permanently abandoned by the end of this stage.

The Nile, hemmed between the Theban cliffs and their Pliocene undercliff on one side and the advancing delta of Wadi Matulah on the other, executed a sharp bend and cut deeply into the local gravels of the 100-foot stage at Bir ʿAmbar on the east bank about 10 miles north of Gebel el-Kurn.[15] It then skirted the line of the present desert edge until it encountered the great body of water and gravel that was pouring out of Wadi Kena. Within that wadi the 50-foot terrace and its gravels have largely been swept away by erosion,[16] but any such deficiency is compensated by the great delta which spreads out into the Nile from its mouth. As at Gebel el-Kurn, the delta was split by a central hill, here consisting of Pliocene and Plio-Pleistocene beds (Kena Hill; see pp. 45–48). The narrow southern stream entering the Nile near the town of Kena is still open. The northern branch, several miles wide, was choked with gravel of the 50-foot stage and remains as an elevated gravel plain, giving some indication of the destruction wrought at this time by the headwaters in the Red Sea Hills and in Wadi Kena itself.

The Nile was driven to the west bank; but the mixture of its gravels with those of the Wadi Kena delta may be traced near the edge of the alluvium almost as far as es-Samata, about 12 miles downstream from Kena, where a strong local flow still marked by a prominent tongue of gravel finally forced the Nile westward. The river seems to have kept a fairly straight course

[15] For situations of places here named see Fig. 5.

[16] A number of isolated mounds survive, and there is a considerable area of these gravels on the west side about midway between Bir Arras and el-Haita.

as far as Nagᶜ Hammadi, and its gravels of 50-foot stage are not seen on either bank. Local terraces are ubiquitous on the east bank.[17]

Flint implements of well defined Acheulean type have been found *in situ* in the gravels throughout the region described above, in both Nile and local deposits (see Pl. VIII, *B*). They are markedly abundant in the gravels between Kena and Dishna on the east bank. The type collection, obtained in 1925/26 from pits dug in the gravel at the southern corner of Kena Hill, is described in chapter ix.

Nagᶜ Hammadi–Asyut

The Nile entered upon a meandering course again at its 50-foot level as it turned the sharp bend in its valley near Nagᶜ Hammadi. It encroached upon the west bank about 10 miles west-southwest of the town, but was diverted again by an Eocene limestone ridge, now broken into detached hills separated by many miles from the western scarp. The second lobe of the meander carried the river farther west, to a prominent hill of Eocene limestone about 5 miles from the point at which the Oases Railway enters the desert. Here are considerable banks of Nile gravel containing Acheulean implements. Cobble gravels streaming down from the western wadies limit the meander north of this point.

Evidently the river swung across its valley again, for a meander, incised into local 100-foot gravels, may be traced across the northern part of the bay between the wadies Abu Nafukh and Kasab (Pl. VIII, *A*). In the southern part of the bay 50-foot terraces of local gravel are prominent, and it will be realized that they stretched out to the west to join the Nile on its meandering course. At the northern corner of the bay the Nile was turned back by the cliffs; it reappears on the west bank, and gravels sweep along the face of the travertine foothills north of Abydos until at the great cliffs above Suhag they enter the valley once more. Some beautiful examples of Acheulean implements were found in the 50-foot gravels of this neighborhood.

The return of the river to the east side caused the gradients of the wadies in the Pliocene-filled bay southeast of Akhmim to be steepened at this and later stages, and the usual uniformity of the local terraces is interrupted. North of Akhmim bare cliffs of Eocene rock, draped with fragments of Pliocene beds, present themselves to the Nile, and no reliable levels are available until the bay at Kau el-Kabir is reached. This the Nile entered at many stages; but a 50-foot meander is not clearly marked, nor does the river seem to have followed its old course along the Western Desert edge opposite Tahta. No trace of it has been found at the 50-foot level on either bank between Kau and Asyut. Local gravels are seen in a wadi at ez-Zarabi on the west side, but at the mouth of the great Wadi Asyut on the east bank, and within the wadi, the 50-foot stage is poorly preserved. The succeeding 30-foot terrace is much in evidence.

Asyut–Samalut

North of Asyut the disappearance of the 50-foot Nile gravels, already noted farther south, is complete. Throughout the region they are not seen as a distinct feature. This does not mean that the stage is entirely absent, but that the meandering habit of the river was replaced by lateral migration, a tendency to sideslip—always toward the east. Thus from Asyut to Samalut the east bank is an alternation of small bays and almost vertical cliffs, with the river at their feet for miles at a stretch. The west bank, on the other hand, displays a continuous Nileward slope throughout the region. Below 150 or 100 feet it is frequently covered with Nile gravel, but usually the terrace feature is not recognizable. Above 100 feet the slope may be continued

[17] Details of the whole region will be found in *QJGS* LXXXV 528–30.

by Pliocene cobble gravels, sweeping in from the west, or by Plio-Pleistocene levels of 150 feet, generally the upper margin of the slope, or by the higher 200-foot platform.

On the east side no trace of the 50-foot terrace can be expected, except in the bays. On the west any opportunity of identifying a 50-foot platform in the general slope is vitiated by the presence of high sand dunes, which incumber the edge of the desert from the latitude of Deirut northward.

In the bays on the east side the prolonged encroachment of the Nile has caused the wadi gradients to steepen, and the level of reference for local terraces, the wadi floor, is thus rendered unreliable. Due allowance having been made for this, however, local terraces of the 50-foot stage seem to be present in the Tell el-ᶜAmarna bay; but implements could not be found *in situ* to prove it. In the bay between Beni Hasan and the cliffs of Minyah the changes due to the shift of the Nile's bed have left no trace of a 50-foot terrace; and in this and in Wadi et-Tarfah, east of Samalut, no observer can fail to be impressed by the enormous areas of water-eroded slopes of soft Eocene clays that have been graded approximately to the level of the modern alluvium.

Of local terraces on the west side the most prominent is the reduction of a vast area of cobble gravels at and about Beni ᶜAdi to a level 50 feet above the modern wadies which traverse them. Here also Acheulean implements were found *in situ* in the gravels.

Farther north 50-foot local gravels are uncommon except perhaps in the cobble gravels between Sanabu and Minyah. Most of the country is wind-swept and sand-covered, and levels lose their value.

Samalut–Beni Suef–Hilwan

On the west bank Nile gravel is seen once more opposite Maghaghah at a height of 50 feet in a well marked terrace stretching for a few miles and broken by more recent watercourses. Its westward edge, capped with a few feet of fine gravel, is a prominent feature. The terrace itself is a few hundred yards wide or less, and toward the Nile it is followed by a slope of fine sands and grit that suggest deposition under water. This is the last exposure of the 50-foot Nile terrace known on the west bank within the area.[18] On the south lie miles of open plains; on the north, opposite el-Fashn, gentle slopes of local material are cut to a depth of 50 feet by broad wadies. Loose gravels everywhere mask the banks of the wadies; but the floors, except the modern run-off channels, are evidently of great antiquity, since deeply patinated Mousterian implements lie upon them and upon the higher slopes. North of Gebel Dishashah the area dealt with in *OIP* Volume X is entered, in which a 50-foot terrace, local or of Nilotic origin, was not recognized.

On the east bank Nile gravels of the stage are entirely absent, as might be expected, but wadi terraces are locally prominent and serve to show that the level was maintained throughout the area. Thus between Wadi et-Tarfah and Gebel Kararah the 50-foot level may be recognized, but since the district is one of soft clays no great reliance should be placed upon it.

In the Wadi esh-Sheikh, between Maghaghah and el-Fashn, a terrace is widespread at 50 feet, capped with local gravel, near the Pliocene foothills. When traced toward the Nile it falls gently to about 30 feet, and the gravel is almost entirely stripped from it. Again, it is not reliable. In Wadi Ghayadah and Wadi Sanhur near Biba 50-foot terraces are prominent and appear to be above suspicion. Unfortunately no flint implements were found in their gravels, which are about 10 feet thick.

For many miles the terrace seems to have been entirely destroyed, although the 100-foot terrace has survived; but it reappears in Wadi ᶜUrak, opposite es-Saff, where it is well developed. It remains to be seen whether it will be found in the intermediate area now being investigated

[18] Along the Nile-Faiyum divide it probably is merged in the lower part of the Rus Channel (*OIP* X 33).

by the Geological Survey. Lastly it reappears, with other terraces, after a considerable gap, at the mouth of Wadi Hof, north of Hilwan.

The absence of the Nile at the 50-foot level east of the present margin of alluvium, north of Kau el-Kabir, is a particularly interesting feature. The straightness of the river's course north of Asyut throughout Lower Paleolithic times contrasts sharply with the meanders to be observed in the southern part of the area. There is sufficient evidence to infer the former presence of platforms and gravels at this altitude in the north, and the fragmentary remains are a plain indication of the great amount of subsequent denudation, which is scarcely paralleled in the south.

VI

THE MIDDLE PALEOLITHIC STAGE

INTRODUCTION

It is 50 years since Pitt-Rivers found implements *in situ* at Thebes[1] in gravels that we now recognize to be of Mousterian age. Further discoveries of Stone Age Man, made toward the end of the 19th century, were reviewed by J. de Morgan,[2] who was the first to realize their true nature and significance. Some years later Petrie published a general discussion.[3] Existing information was brought up to date and reviewed with special reference to Mousterian culture by Seligman in 1921 in a paper that can be regarded as the starting-point of modern work on the subject.[4] Two years later Vignard published his monograph on the Sebilian industry of the Kom Ombo plain,[5] in which he made an inconspicuous announcement of his important discovery of Mousterian implements beneath the great thickness of the Kom Ombo alluvial plain. In 1926 I suggested that the previous discoveries around the Thebaid could be incorporated in a more general and widespread sequence of Paleolithic terraces.[6] Full publication of the geological evidence was delayed until 1929. The recently published volume[7] of this series indicates that the stratigraphy of Mousterian deposits becomes more complex from the Thebaid southward. In the present volume it will be shown how in five years the conception of the 10-foot Mousterian terrace has become elaborated with reference to the country between the Thebaid and Hilwan.

THE MIDDLE PALEOLITHIC GROUP

In an initial and acutely summarized preliminary note[8] some years ago I described two horizons below the 50-foot or Acheulean terrace:

A 25- to 30-foot terrace with Mousterian and later working-floors on the surface, and at its foot

A 10-foot terrace containing rolled and unpatinated implements of Mousterian age (especially of early type). There is evidence that gravels of this age are continued below the Nile alluvium.

In the summary submitted in the same year (1926) to the Oxford meeting of the British Association it was made clear that rolled Acheulean implements occurred in the 25- to 30-foot terrace, as might be expected, the earlier omission of the fact being an oversight. In these reports no mention was made of a limited number of coarse flakes and cores that were found in the same terrace, as there had been no time to supplement field notes by further study of the collection. In the field I had formed the opinion that the terrace was partly built in

[1] *Journal of the Royal Anthropological Institute* XI (1882) 382–400.

[2] *Recherches sur les origines de l'Egypte* I–II (Paris, 1896–97); see also H. R. Hall in *Man* V (1905) 33–37.

[3] *Ancient Egypt*, 1915, pp. 59–77 and 122–35.

[4] *Journal of the Royal Anthropological Institute* LI (1921) 115–53.

[5] *Bull. Inst. français d'arch. orientale* XXII (1923) 1–76, with 2 maps and 24 plates.

[6] *Report of the British Association for the Advancement of Science, Oxford—1926* (London, 1926) p. 358.

[7] *OIP* XVII.

[8] *Catalogue of Prehistoric Antiquities:* Exhibition of the British School of Archaeology in Egypt, University College, London, 1926.

Mousterian times, on account of these implements, but Professor Breuil's opinion was sought before the term "Early Mousterian" was finally adopted to describe it.[9]

The 25- to 30-foot terrace (Pl. IX) in Upper Egypt therefore contains rolled Chellean, Acheulean, and Early Mousterian implements, and flaking-sites on its surface belong to the Mousterian industry of the type found in the 10-foot terrace. On account of irregularities of level I have described the lower stage as the 10- to 15-foot terrace.

The 10- to 15-foot terrace in the Thebaid contains Mousterian implements of simple and rather coarse technique along with others, more skilfully made and with delicate retouch, comparable with some of those from the Nile-Faiyum region figured in *OIP* Volume X. The Nile-Faiyum gravels contain types unknown in the 10- to 15-foot terrace of Upper Egypt, whereas the forms of the 25- to 30-foot terrace of Upper Egypt are lacking. So marked is the contrast in the northern part of Middle Egypt that it has been suggested that the deposits which might contain them have been either destroyed or hidden from view. If they had existed at higher levels there is no reason why some of their implements should not appear as derived material in the later deposits. It is so invariable a rule that earlier deposits do not entirely disappear, but contribute something to later beds of the same series, and that implements of higher and earlier gravels are found mixed in the later beds when they are intensively searched, that negative evidence becomes almost positive in its strength. If the missing beds were below the exposed Mousterian gravels, they would contribute nothing to the later deposits and would be concealed beneath the modern alluvium which hides the basal part of the later series. I believe the older gravels to be represented on the east side of the valley opposite Beni Suef (see p. 91). Moreover, the visible Mousterian beds of the same district were evidently the products of aggradation, not of erosion. They were built up from a level now hidden, although locally they may rest, due to overlap, on visible edges of older rock, until they attained their summit level about 25 feet above the modern alluvium. If they were the products of a pause in degradation, it is probable that they would not be so thick, that a floor with eroded surface would be visible somewhere, that the type of deposit would indicate the fact, and that, in particular, they would have invaded the lower parts of the exposed and abandoned floor of the Lower Paleolithic river course. This they have not done; they are banked against its truncated edge, although levels exist within it that are low enough to receive them if they had overcome the marginal cliff by further accumulation, or if they were part of a descending series.[10]

Yet more convincing evidence has been found in the approaches to the Delta, in accumulations of silt of this stage and altitude interbedded with comparable Mousterian implements. This must necessarily be left for the volume to which it belongs, but I submit that the evidence is strong enough to show that thick accumulation from below upward is the only means by which the gravels of Nile origin could be built. Further details are given when the deposits are described (pp. 76 f. and 79), and confirmatory evidence is found also in the adjoining depression of the Faiyum.

[9] *QJGS* LXXXV (1929) 524; i.e., Early Mousterian of Egypt. More recently, however, Professor Breuil has classified the Egyptian Mousterian as Levalloisian (cf. *Afrique* [Editions "Cahiers d'art" (Paris, 1931)]), a term which I had ventured to use in the first draft of these chapters but, on advice, had abandoned. It should be understood, then, that with reference to the 30-foot and 10- to 15-foot terraces the word "Mousterian" is used to indicate core-and-flake industries both with unprepared and with faceted striking-platforms. To avoid confusion with the Mousterian of the European caves etc., it may be termed "Egyptian Mousterian"; it is synonymous with the Levalloisian and, in part, with the Aterian of Breuil. See also chap. ix.

[10] Cf. the Rus Channel, *OIP* X 33. Contrast this with the invasion of an abandoned meander of the 100-foot terrace at es-Siba'iyyah, between Esna and Edfu, by silts at about the same height above alluvium and of about the same age; see *OIP* XVII 47. The relationship here described is shown in Fig. 17, p. 79.

Since this volume is primarily concerned with the Nile Valley, I propose to take up the history of the Faiyum only in so far as it is associated with the river. Although there is some discussion as to the origin of the depression, this at least is agreed: that in Mousterian times the Hawarah Channel, which joins the Nile and the Faiyum, was already open, with lower ground on the west than on the east, and that the Nile flooded it and built up a delta in the depression. Along the eastern shores of the lake so formed prevailing winds threw up great storm beaches. There is evidence that the level of the lake rose, that shore deposits accumulated, and that at the end of the period the lake was still 5 feet or more below the level of the Nile, which fed it. Mousterian implements similar to those of the neighboring part of the Nile Valley occur *in situ* from the bottom to the top of these beach gravels. The indications of Mousterian accumulation are thus verified by external evidence.[11]

The 25-foot "terrace" of the Nile, in the vicinity of the Faiyum and north of it, is therefore only the summit level of an accumulation of gravel of which we can see 25 feet. It is also of undoubted Mousterian age; the older Mousterian levels and implements are so completely lacking that they may indeed lie below the visible levels of accumulation.

What, then, is the condition at the southern end of the region? In Nubia it is clear that such Mousterian as occurs *in situ* is not of early type, that it is at low levels and usually submerged beneath the silts of subsequent aggradation in such a way that it is difficult stratigraphically and typologically to draw a line between them. The evidence shows that in post-Acheulean (50-ft.) times the Nile descended approximately to its present level and then built up silt. Of the Early Mousterian 25- to 30-foot terrace nothing is seen; either it is hidden, or it has been destroyed, or it was never formed. In Upper Egypt, especially the Thebaid, the 25- to 30-foot terrace is widely represented in the wadies. The 10- to 15-foot gravels follow, completing an oscillation of erosion and degradation with a cap of implementiferous gravel (Pl. X, *A*). When the wadi terrace is followed toward the Nile there usually comes a point where the underlying abraded surface, the true terrace or platform, disappears, the gravels occupy the full thickness of 15 feet, and the modern wadi rubble is at their foot. Where a section is exposed at the point of contact with the modern alluvium, frequently only gravel, with its contained implements, can be seen (see Pls. X, *B*–XI, *A* and Fig. 16), although the visible section above and below alluvium may exceed 15 feet. In other words, the terrace is in every way a normal platform of erosion so far as the wadi is concerned; but, as recorded in my first note of 1926, "there is evidence that gravels of this age are continued below the Nile alluvium."[12]

In the Kom Ombo plain M. Vignard found Mousterian implements at a depth of 13 meters (43 ft.) below the surface. From what he has been kind enough to tell me, and from studying the ground, it is clear that the surface at that point was at—or a trifle above—the level of the local alluvium, 89 meters above sea-level; hence the implements were at 76 meters. M. Vignard collected at the foot of a cliff cut in the old silts by the Nile, and he worked actually in the

[11] East of Medinet el-Faiyum, through the Hawarah Channel, there is a grave deficiency of knowledge of the contour of the solid rock beneath the alluvium. Sir R. Hanbury Brown's record (*The Fayûm and Lake Moeris* [London, 1892] p. 92) of a rock barrier across the channel at about 18 meters (59 ft.) above sea-level remains to be verified, but it may be presumed that the channel descends at least to this level. In a figure on his p. 98 Sir Hanbury Brown seems to indicate that Nile deposit continues below 15.80 meters (51 ft.). The supposed level of the barrier leaves an open passage for the Nile by which it could supply the Paleolithic lakes of the Faiyum. If the sill recorded by Sir Hanbury Brown proves to be other than solid rock, the channel will prove to be so much the deeper. The Mousterian gravels on the west bank of the Nile adjacent to the Faiyum survive to a height of 36–37 meters (118–121 ft.) above sea-level. During the winter of 1933/34 boring operations were undertaken by the Geological Survey of Egypt, in connection with the official survey started in 1929, to determine the profile of the channel. No report is yet available. Delays enforced by national economy are inevitable.

[12] See pp. 76–78 for the field observations on which this discussion is based.

water during the summer period of low water. The usual low-water mark here is about 78 meters, I understand, so the figures agree reasonably well. It is fair, therefore, to place the Mousterian layer at present low-water level or a little below it. This level, it should be noted, is not that of the bottom of the Mousterian river bed, which was deeper and lay near by,[13] but of its lateral alluvial surface.

It follows, then, that the depth of Mousterian erosion was greater near Kom Ombo than in Nubia; and this northward deepening is indicated also at Luxor, to be exceeded by the depths attained in the Delta and elsewhere. The probable depth of the river bed is discussed in chapter viii (see especially pp. 102–4 and Fig. 25).

I am of the opinion, therefore, that erosion followed the 25- to 30-foot stage of Upper Egypt to some level near present low water, that the tributaries conformed to it in some measure, with terraces of erosion, and that subsequent rise in level, no less than continued supply of material from the headwaters, tended to thicken the local gravels in the parts of the wadies adjacent to the Nile. The considerable mixture of types among the Mousterian implements of the 10- to 15-foot terrace may thus be explained. It will be shown that the aggradation of the Nile finally led to deposition of overlapping silt upon the lower ends of the tributary gravels.

Little is known of the fate of the Early Mousterian 25- to 30-foot terrace in Middle Egypt. A gravel is seen at that height at intervals; but few implements have been found *in situ*, and without them it is difficult to discriminate between gravels of the 25- to 30-foot Early Mousterian *terrace* and those of the 25-foot Mousterian *aggradation* phase.

To summarize the general survey of Mousterian stratigraphy before passing to the question of climate, we may draw up the following table, based on type sections (i.e., Kom Ombo, Edfu, etc.):

		Kom Ombo and Edfu	Thebaid	Beni Suef
5		Thick silt (Sebilian)	Slight overlap of silt	Degradation
4	Mousterian........	Present low-water level;* 10 feet†	10–15 feet	25 feet
3		Degradation to present low-water level of river	Degradation to present low-water level, but probably not much deeper‡	Degradation below alluvium; deep, but depth unknown
2	Early Mousterian...	?	25- to 30-foot terrace	?
1	Acheulean.........	50-foot terrace	50-foot terrace	Probable 50-foot terrace

* As recorded by Vignard at Kom Ombo.
† Under silts at this height on the west bank about 7 miles south of Edfu. See *OIP* XVII 45.
‡ Based on measured tributary gradients. See Fig. 16.

In Stage 4 grades of Mousterian technique have not been distinguished for purposes of this summary; they are described in chapter ix. Stage 5 is discussed in the next chapter.

If the table is read from right to left, by columns, one gains an impression that the changes were not completed throughout the length of the valley, that is, that they started from the seaward end and may have been the result of an oscillation of relative sea-level. It will be shown in another volume that deltas of the same general plan as that of the present day existed throughout Pleistocene times. The gradients of the terraces may therefore be continued beyond the apex of the modern Delta, Cairo, to grade to sea-level on subparallel curves. The terraces record variations in level below the 50-foot stage in a river which seems to have achieved some degree of accordance with marine conditions; that is, the changes probably correspond with sea-level oscillations from 50 feet to an unknown depth, rising again to about 25 feet from Acheulean to late Mousterian times. It may be not without significance that the Monastirian stage of the Mediterranean is at 18–20 meters (59–66 ft.), and Depéret and other authors

[13] As is shown in *OIP* XVII.

have laid special stress on the late or post-Monastirian level of 8 meters (26 ft.). The growing body of evidence points unmistakably to such an association. It will be shown, moreover, that the recovery to 25 feet was but temporary, and that further degradation followed. In the south drastic changes came about in the invasion of the valley by a flood of silt borne from the remote south, accompanied by an unmistakable change of climate.

CLIMATE (see Pls. XIII–XIV)

In introducing the subject of climate we are entering upon difficult ground. In the Nubian sector of the Nile Valley it has been shown that rainfall was failing in post-Acheulean times, but that it continued in some measure in the later Mousterian–earlier Sebilian phase. During the succeeding invasion of the valley by silt it certainly failed. In Upper Egypt the wadies were still in use in the period of the 10- to 15-foot terrace, but their deposits are notably irregular as compared with those of the earlier stages: they suggest torrents rather than a regular flow. No wind-etched pebbles have been found indubitably *in situ* in them. M. Vignard has shown conclusively that in the succeeding silts the local rainfall had failed, and I have called attention to the occurrence of a sand dune in the silts themselves near Armant.[14]

The signs of intense water erosion of Eocene, Pliocene, and Plio-Pleistocene rocks become more marked from south to north. Everywhere, especially on the soft ground of the east bank, curves of surface-water erosion and deposition are displayed, and almost everywhere on the west bank the cobble gravels may be seen melting down in great alluvial fans. The Mousterian beaches of the Faiyum are similarly dissected by water. In these more northerly latitudes one has only to be caught in a winter rainstorm on a newly emerged mud bank of the Nile to realize that erosion and deposition by running surface water are still important factors.[15] Yet the country beyond the reach of irrigation is desert; and of the power of sand storms to abrade, and of sand to advance in irresistible dunes, there is no question. Here, then, is the northeast corner of one of the worst deserts of the world, and its slopes are controlled by wind, rain, and running water. How is its climate in Middle Paleolithic times to be determined? The evidence is admittedly conflicting, and opinions tend to suffer from environment. If the observer is living in an atmosphere of cold winds and driving sand, with occasional rainstorms and periods of intense heat, he tends to think that these things must always have been in such a land and to see evidence of them in all studies of the past. I am convinced that the limestone plateaus and cobble-strewn plains of Egypt can under no circumstances have borne a luxuriant vegetation[16] except in favored hollows. Work in the Nile Valley north of Luxor and on the ancient beaches of the eastern Faiyum impresses upon an observer the conviction that running water still persisted at this time. It becomes necessary, therefore, to comment upon the reasons for a belief that conflicts with this conclusion—a belief that the Faiyum had already become dry before Middle Paleolithic times.[17] A Lower Paleolithic dry period has been postulated, followed by a Middle Paleolithic (Mousterian) rainy interval, then by another dry period in Upper Paleolithic (Mousterio-Capsian) times. I suggest that the earlier dry episode lacks confirmatory evidence.

[14] *AJSL* XLVIII (1932) 178–79.

[15] See an account and sketch of a cone of sand carried over the fields from the desert edge by running water during a heavy shower of rain in J. de Morgan, *Recherches sur les origines de l'Egypte: L'Age de la pierre et les métaux* (Paris, 1896) p. 25 and Fig. 7.

[16] See Seligman in *Journal of the Royal Anthropological Institute* LI (1921) 141.

[17] Miss E. W. Gardner in *GJ* LXXIV (1929) 371–83 and plate; cf. Sandford and Arkell in *GJ* LXXIV 578–83.

1. Since in the Faiyum no Lower Paleolithic beds are definitely known and the only strata suspected of being of that age are coarse gravels,[18] I am unable to find any evidence for a dry period; nor does any seem to be forthcoming beyond the fact that somehow a large depression had been provided to receive the Mousterian lake. But there is insufficient reason to suppose that this had been accomplished by wind erosion. In view of the evidence of the Lower Paleolithic terraces of the Nile and its tributaries, at any rate north of the First Cataract, that the whole system was well supplied with water, I can see neither necessity nor evidence to suppose that the climate of the Faiyum was dry.

2. Stress has been laid, however, on some remarkable diatomaceous clays, which are considered to be part of the series of deposits belonging to the 35-meter (112-ft.) or Mousterian lake of the Faiyum.[19] Some obscurity seems to exist as to the association of Mousterian implements with these lake deposits on the northern side of the Faiyum,[20] but there is no doubt about it on the east side.[21]

These beds are believed to indicate dryness in, it will be noted, not Lower but Middle Paleolithic times. As this view is at variance with that stated above, we may review the evidence on which it was based. The beds were certainly laid down in water and have no bearing on the climate before the lake was formed. The clays certainly suggest a lack of a considerable run-off of water; they are covered by 40 feet of coarser detrital material, which indicates greater rainfall. They appear to have been deposited close to the water's edge, yet they are virtually free from ordinary detrital material. It has been stated, moreover, that "on the south side [of the depression] coarser material is found overlying the Tertiary, and in this wind-cut and thermally fractured pebbles occur, confirming the evidence obtained in the north."[22] One suspects that desert-like conditions are intimated; but there is no definite statement that the beds are of the same age, and from what I know of the south side of the Faiyum I should require most convincing evidence of the age of the deposit. If, then, coarser material was being wind-cut on the south side, why do not wind-borne sand and other material appear in the diatomaceous clays deposited close to the water's edge on the north side? There is a varying proportion of detrital matter, mostly quartz grains; and an analysis gives: SiO_2, 60.77 [parts in 100] = quartz 10 per cent approximately, diatoms 50 per cent approximately.[23]

3. Attention is also called to the absence of land shells from the fresh-water lake faunas throughout the series. This seems a strong point; but why are there no land shells of desert-inhabiting species present, to say nothing of the resistant chitinous elytra of beetles or other traces of kindred fauna? Winds will blow such things over water when streams may not carry them into it. The absence of land fauna, desert or otherwise, is remarkable, but it is doubtfully admissible as evidence of desert.

4. The lake beds were laid on an uneven floor, and it has been stated that channels had been eroded before the beds were deposited. How? The situation does not seem to be covered by the statement that the surface had just such irregularities as would be expected if it were the product of desert erosion.[24]

5. Moreover, if fluviatile erosion and drainage into the Nile is denied, what has happened to the "blocks of limestone, fossil wood and basalt [of the Pliocene deposits] . . . . [which]

[18] *OIP* X 34.

[19] Miss Gardner, *op. cit.* pp. 376–78 and *GM* LXIV (1927) 386–410.

[20] Misses Caton-Thompson and Gardner in *GJ* LXXIII (1929) 37; but (p. 52) it is stated to be "obvious" that it was in communication with the Middle Paleolithic gravels in the Nile Valley.

[21] *OIP* X 37–45. [22] *GJ* LXXIV 376. [23] *GM* LXIV 390. [24] *GJ* LXXIV 377.

occur below the present rim of the depression, and were considered by Beadnell to have once formed a continuous terrace,"[25] to say nothing of cobbles and the massive siliceous concretions of the Eocene known as "melons"? These are virtually indestructible. They do not seem to be fully accounted for in the lake beaches and storm beaches, and they have not been found in concentrations in the deeper parts of the basin, whither they might have rolled. Their reduction and removal by wind is not consistent with their survival outside the depression in far more exposed positions. It seems more probable that they were removed little by little by water, as in Pliocene times.

6. Beadnell, dealing with this problem in his splendid monograph, remarks: "Whether there was ever complete disconnection between the Nile and the originally formed lake in Pleistocene times is uncertain, but even so it was probably only during a comparatively short period."[26] Elsewhere in the same work he calls attention to the drainage area far to the southwest of the Birkat Karun (the surviving lake in the Faiyum) and notes the occurrence of thick silts in depressions, one of them 80 meters above sea-level, and superficial gravel receiving drainage from the southwest under the Gar el-Gahannam and west-southwest of it. Of drainage there is no lack; and, as already explained,[27] it is supposed not that a single river many times wider and deeper than the Nile flowed along the depression, but simply that the area was analogous to other tributary drainage basins of the Nile.

There is, then, some confusion of opinion as to the Lower or Middle Paleolithic age of the supposed dry period. With Miss Gardner's later view, namely that rain fell and streams flowed into the Faiyum in Mousterian times, one is in full agreement; but I can find no evidence whatever of a Lower Paleolithic desert. The diatomaceous clays of the oldest (Mousterian) lake are, nevertheless, an outstanding difficulty in the way of the acceptance of our joint view that the contemporary climate was not that of a desert. They fail to give conclusive evidence, I suggest, of the existence of a desert; they seem to point to lack of running water, although they pass into coarser strata and form a part of a succession of sand rocks, sands, and clays.

In spite of this difficulty, then, there seems to be agreement that rain was falling in the Faiyum in Mousterian times. The Nile and its tributaries certainly point to the same conclusion. So, I take it, do the tufas and gravels of Khargah.[28] It is evident too that Man could wander at will far from the Nile up Wadi Kena and over the adjoining Hammamah plain into the Red Sea Hills, as at Wasif and Wadi Dib.[29] To conclude, the most probable explanation seems to be a compromise: that, although the climate was changing radically in the south and the change was creeping northward, the north as a whole was not yet a desert, but was beginning to enter a stage of deficient run-off of surface water. This became more marked as the Nile's aggradation progressed.

THE 30-FOOT TERRACE

In the following account of the Middle Paleolithic deposits it will be shown that the older, or 30-foot, terrace remains virtually at a constant level, and that its Nile gravels are frequently seen in meandering belts across the low desert, as shown in Figure 15. The younger stage is

[25] *Ibid.* p. 373.

[26] *Topography and Geology of the Fayum Province of Egypt* (Cairo, 1905) p. 80.

[27] *GJ* LXXIV (1929) 581.

[28] Cf. Miss Caton-Thompson in *Man* XXXI (1931) 77–84 and XXXII (1932) 129–35. See also more recent papers referred to on p. 17.

[29] Where Mr. G. W. Murray made important collections; see Seligman in *Journal of the Royal Anthropological Institute* LI (1921) 115–53. The recent explorations of the more westerly parts of the Libyan Desert also tend to demonstrate the wide area over which Mousterian implements are to be found; see *GJ* LXXXII (1933) 219–22.

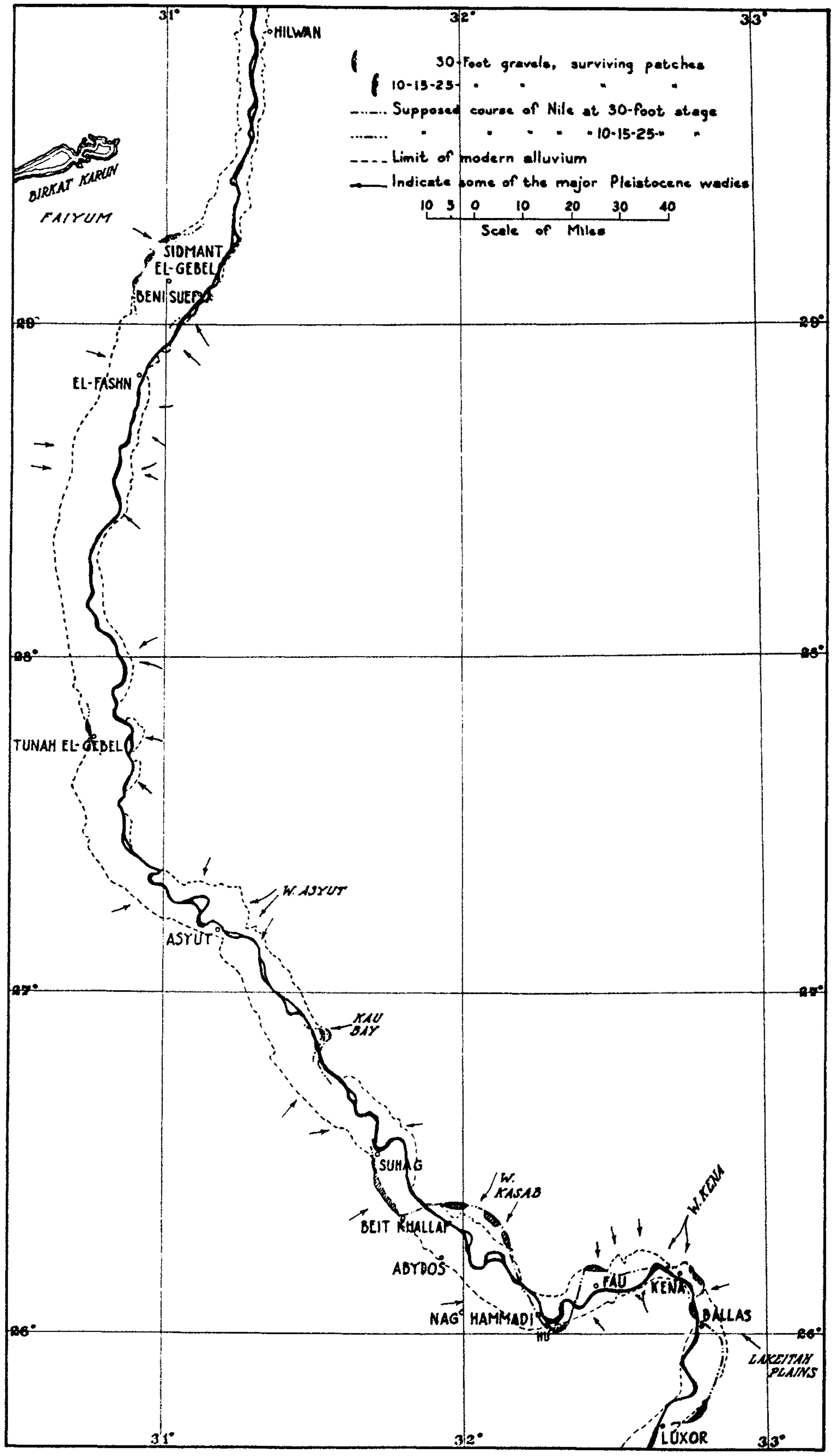


FIG. 15.—SKETCH MAP TO SHOW THE COURSES OF THE NILE AT THE STAGES OF THE 30-FOOT TERRACE AND OF THE 10- TO 15- AND 25-FOOT NILE GRAVELS

known almost entirely from local gravels in the south, where their upper surface forms a prominent terrace-like feature, but the rock surface, the true platform or terrace, dips below the recent alluvium and is lost to sight. In the north the Nile gravels are exposed to a thickness of 25 feet, their base being hidden below the alluvium; that is, as stated above, there is a rock platform only where the gravels overlap older surfaces. The terrace-like upper surface of the gravels is due to deposition; no true terrace of abrasion is visible. The 25-foot gravels contain Mousterian implements that seem to be further developed, and therefore probably later, than those of the lower terrace in Upper Egypt.

Luxor-Wadi Kena-Nagᶜ Hammadi

In earlier publications on Upper Egypt the older Mousterian horizon has been called the 25- to 30-foot terrace, to embrace the usual vertical range of platform and gravels. Confusion with the 25-foot level of the later gravels of aggradation in the northern part of Egypt is thus likely to arise,[30] and accordingly the 25- to 30-foot stage will here be described as the 30-foot terrace.

Nile gravels at this height are not seen between Luxor and Kus, except for certain patches in the Higazah bay, which may have been redeposited by local streams that destroyed the older gravels. On the Theban side local terraces are clearly marked, and rolled Acheulean implements occur in their gravels.

At Gebel el-Kurn the gravels that blocked the southern channel at the 50-foot level were partially redeposited on the Nileward side of the outlier, and a wadi terrace of about 20 feet was developed, probably belonging to this stage. The Lakeitah plains have already been described (pp. 57 and 62): the 50-foot terrace is dominant, but considerable areas of 30-foot terrace occur, usually between the 50-foot "islands" and the main wadies. They call for no further attention here. The outflow from the plains, by Wadi Matulah, made itself felt, however, on the west bank of the Nile a few miles north of Ballas, where a coarse conglomerate of rocks derived from the Red Sea Hills is banked against the truncated end of a 50-foot[31] local terrace.

The terrace is next seen at the mouth of Wadi Kena, where it occupies prominent positions on both sides of the southern channel, the northern being already blocked. It may be traced for about 10 miles along the east side, broken only by one large wadi. The composition of the gravel changes laterally from igneous and metamorphic rocks, brought from the headwaters of Wadi Kena, to local rubble. In 1925 implements were found *in situ* at depths of a few feet; they comprised rolled Chellean coups-de-poing, derived from the 100-foot terrace, and large cores of Early Mousterian type (see p. 114). No flakes were found here, but they occurred *in situ* in similar gravels on the west side of the wadi about midway between Bir Arras and el-Haita. In common with the higher terraces, in Wadi Kena and throughout Upper and Middle Egypt the 30-foot gravels and platform are littered with Mousterian cores and flakes, sometimes assembled in flaking-sites. These surface implements have never been incorporated in the gravels and are not waterworn, but are heavily patinated. They do not occur in this way on the surface of the lower 10- to 15-foot terrace, but are contained in its gravels.

The 30-foot terrace is scarcely seen between Kena and Nagᶜ Hammadi. On the right bank the 50-foot terrace is dominant, until at Fau Nile gravel is banked against the foot of a local 50-foot spur. On the left bank is the featureless slope from Denderah to el-Marashdah. Then at Hu, about 5 miles south of Nagᶜ Hammadi, the Nile gravel encroaches on the desert for 2 miles from the cultivated land.

[30] Especially as the later gravels mount a little above 25 feet farther north, near Cairo.

[31] In *QJGS* LXXXV 531 figures were erroneously transposed.

Nagᶜ Hammadi–Asyut

The Nile's meander from Fau across the valley was turned back to the east side again to enter the desert south of Wadi Abu Nafukh. A terrace may be traced for several miles in a gentle curve, banked against the local 50-foot gravels, until the mouth of Wadi Kasab is reached (see Pl. IX). A great delta of gravel of the 30-foot stage, now forming prominent foothills, debouched from the wadi and diverted the Nile at the northern corner of the bay. The river then followed the course of its 50-foot meander across the valley to the west side and skirted the bay north of Abydos from Beit Khallaf almost to Suhag.

From Suhag the 30-foot stage is lost, except for occasional local gravels, as in the bay south of Akhmim, until traces of a meander of the Nile are seen at the mouth of the bay at Kau el-Kabir. Thereafter the course of the Nile is lost again. Local terraces occur at intervals under the cliffs along the east bank as far as el-Matmar, where a prominent tongue of local material, resting on Pliocene marls, projects about 3 miles from the general line of the desert edge. The surface is about 35 feet above alluvium, 30 feet above Wadi el-Matmar, which has cut a cliff-sided trench between the tongue and Gebel esh-Sheikh Abu Farwah. Probably this expansion of the local wadi rubble marks the attempt of the Wadi el-Matmar and similar streams to reach the meandering Nile close under the western cliffs. The tongue is continued northward and passes into the great fan of sand and gravel that was shot out of Wadi Asyut at this and other stages. Terraces of 30 feet, with gravels, are widely developed on a considerable scale in Wadi Asyut, but lack incorporated implements, in common with most of the gravels of the district.

On the west side of the Nile, almost opposite Kau el-Kabir, local terraces of 30 feet are strongly marked near Nazlat el-Kadi. They appear at the mouths of a number of wadies north of this place for about 15 miles to ez-Zarabi. Here a steep-sided wadi cuts the Eocene cliffs and in the past has laid down a cone of detritus in which terraces are developed. The highest is at 50 feet above the wadi floor; the normal 30-foot terrace is divided into two platforms, at 35 and 25 feet respectively. At their foot is a 10-foot gravel deposit containing Mousterian implements. The splitting of the 30-foot terrace at the mouth of the wadi probably indicates an attempt to conform to a change of course in the Nile; that is, the river was near at hand at the 35-foot stage and then swung to the east, necessitating a lower slope of the detrital cone. The 25-foot bench is clearly cut into the higher gravel and recalls the similar cutting of Wadi el-Matmar, farther north on the opposite side of the river.

Asyut–Samalut

Nile gravels of the 30-foot stage are not known between Asyut and Samalut, the terrace being represented only at intervals by local deposits. The destruction of gravels in the region has already been discussed with reference to the 50-foot terrace. A straight river course, cutting always into its right bank and abandoning continuous slopes on its west side, does not tend to leave many useful relics from which its history may be read. Sand and cobbles on the west bank, soft strata on both sides, steep cliffs along the greater part of the east bank, give small chance for terraces to be formed. Subsequent denudation has obviously completed the destruction.

In the south, local terraces may be traced on both banks, at the mouths of wadies, as far as Manfalut. The combination of unfavorable elements then becomes apparent, and no further trace of a 30-foot terrace is seen on the west bank, although it may survive under the great sand dunes which are piled high on the desert edge. On the east bank local gravels conform to a general height of 25 feet above the floor of a deep wadi that enters the Nile Valley near the ruins of Antinoupolis. They are of considerable thickness and cannot be accepted as undoubted portions of a 30-foot Early Mousterian terrace. The country north of this point is described in an earlier chapter (see pp. 61 and 64).

Samalut–Beni Suef–Hilwan

The scarcity of remains of the 30-foot terrace, already noted north of Asyut, continues almost as far as Beni Suef. The reasons are the same. A few miles south of Beni Suef, however, local gravels appear at the approximate height on the east bank, and near Kom el-Asfar Nile gravel reappears at 30 feet. It forms a bed a few feet thick, resting on Pliocene beds with a markedly flat upper surface; but it has been severely eroded and is partly hidden under local wash.

As far as I know the Nile deposits do not reappear between Beni Suef and Hilwan. Local gravels may be noted at about 30 feet at the mouth of Wadi Lishyab near Wastah, and they are strongly marked in Wadi Gibbu a little south of Hilwan, where they lie unconformably upon deposits laid on the bed of the Nile at the 100-foot stage (see p. 61). Of the district between these two wadies we shall await with interest the results of the official survey. Similar gravels appear at the mouth of Wadi Hof, but in none of these exposures were late Acheulean or Early Mousterian implements found *in situ*. The terrace was not identified on the west bank.

It will be realized that in the northern part of the region the distinction between the Early Mousterian 30-foot terrace and the upper levels of the Mousterian gravels of the aggradation phase is a delicate matter. It cannot be stated positively that the Early Mousterian terrace is known north of Beni Suef or, if the severest tests are applied, north of Asyut (see p. 69).

THE 10- TO 15-FOOT AND 25-FOOT GRAVELS

At the close of the 30-foot stage the Nile seems to have withdrawn to the limits of the modern alluvium. Few clearly defined meanders of 10- to 15-foot level are seen in the adjoining deserts. Their rarity suggests that a considerable period of time intervened between the two stages, a hypothesis which is confirmed by the contrast of the flint implements, and that in the interval the Nile lowered its bed. In view of the virtual absence of visible Nile gravel, the second deduction needs confirmation, and the evidence must lie in the gravels of tributary streams.

With this in view, in 1930/31 I reinvestigated much of the ground between Luxor and Asyut that was already familiar to me, with the following results, which happily served to confirm earlier observations (see Fig. 16 and cf. Pls. X–XI, *A*):

1. The wadies show rock platforms at varying distances from the Nile. The platforms conform to normal river gradients; that is, they rise along gentle or steep curves according to the length of the tributary and its height of origin. They are covered by 5–10 feet of locally derived gravel and rubble, sometimes well bedded, sometimes tumultuous, but invariably stream-laid. Mousterian implements, some of them barely waterworn, abound in these beds, along with Early Mousterian and Lower Paleolithic material derived from older surfaces or gravels. No doubt exists as to age. All older surfaces are littered with similar Mousterian implements, which have never been incorporated in a water-borne deposit.

2. Near the Nile the rock platform invariably sinks, and the total exposed section of 10–15 feet consists of gravel identical with that described above.

3. In shallow excavations in the fields adjacent to the desert edge the platform is rarely exposed; the gravels frequently continue, but in many instances their surface has been abraded, sometimes highly polished, by the river in later times, when the alluvium was deposited. Implements may be found in them. Frequently the lower limit of Mousterian gravel is diffi-

cult to identify in these exposures, since Pliocene conglomerates of similar appearance underlie it. In some localities, for example Kena, the gravels lie unconformably on Pliocene marls at a depth of about 10 feet below alluvium.

4. By plotting the exposed gradients of rock platform and projecting that curve, it is found that the local base level—the Nile—may not have been more than about 10 feet below the modern low-water level.[32]

5. The continued supply of material by tributaries, and the importation by the Nile of its load already gained farther south, seem to have caused the channel to fill up again. Thus the wadi gravels thickened at their Nileward ends, while the courses in their upper parts remained virtually unaffected. The process was continued until the gravels, so accumulated, conformed over a wide area to a general level of 10–15 feet above the Nile alluvium of the present day.

6. The upper surface of the 10- to 15-foot wadi gravel had a normal river gradient; the lower end conformed to the gradient of the Nile. In the gravel are local concentrations of pebbles introduced by the Nile.[33] It seems impossible, therefore, to escape the conclusion that the

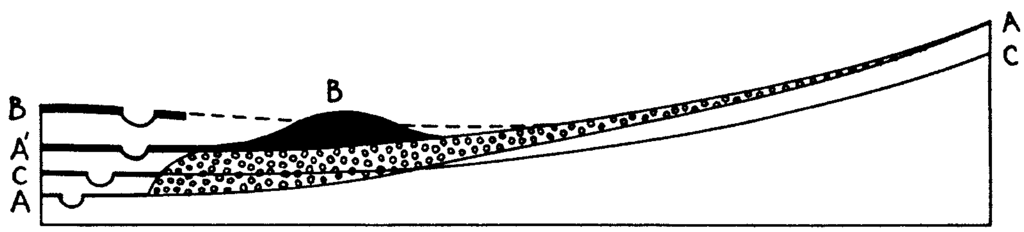


FIG. 16.—PROFILE SECTION OF THE 10- TO 15-FOOT GRAVELS OF UPPER EGYPT NEAR LUXOR

A–A Profile of earliest stage of 10- to 15-foot terrace, grading to the Nile at some depth below its present position (*C*)
A′–A Profile at end of 10- to 15-foot terrace period; Nile then above its present position
B–B Further rise of Nile, with deposition of Nile silt on gravels of local origin (in late Mousterian–early Sebilian times)
C–C Present position of Nile, its alluvium, and wadi floor
Silts *B* are reduced to residual patches.

erosion of the river bed after the 30-foot stage to a level below the modern river bed was made good in Mousterian times by aggradation to 10–15 feet above the present flood plain.

So far as I know, this applies to the Nile from Luxor to Asyut at any rate. Farther south we know that the river cut at least to its present low-water level in Mousterian times, then aggraded its bed to a far greater height.[34] There is ample confirmation of the double movement outside the area, but it had not previously been established within it.

LUXOR–WADI KENA–NAGᶜ HAMMADI

Local exposures of the 10- to 15-foot terrace are seen along the Thebaid cliffs in almost every wadi from Luxor to Denderah, and flint implements are commonly found in the gravels. They occur in superabundance on old surfaces above and below the cliffs, and the Thebaid has been called the Mousterian metropolis (see Pls. X, *B*–XI, *A*). On the east bank implements are fewer, especially on the Nubian sandstone. On the Lakeitah plains the 10- to 15-foot level is seen at intervals, bordering the main wadies, but it calls for no special comment. So also in Wadi Kena, where Mousterian implements were found *in situ* in the gravels.

Between Kena and Nagᶜ Hammadi the terrace occurs locally, and Mousterian implements abound on the desert surface, particularly on the east bank. On the west side wadies cut in

[32] For suballuvial gravels see further chaps. vii and viii.

[33] The gravel in some instances is no doubt derived from remains of old meanders at higher levels; elsewhere the concentration is such that a direct derivation from the Nile at the time seems certain.

[34] See p. 69, Figs. 18–19 on pp. 82 f., and *OIP* XVII 35–52.

the long open slope between Denderah and el-Marashdah show that it was probably completed in Mousterian times (see Pl. *X, A*). It seems to have been formed by streams, choked with débris, dropping their load on the way to the Nile. From a purely geographical point of view it suggests deficiency of run-off.

Nagʿ Hammadi–Asyut

Mousterian gravels at 10–15 feet are seen at frequent intervals; they conform to the general description given above (pp. 76 f.). With the exception of the Kau bay, where Nile gravels skirt the desert edge at a height of 10 feet, the exposures are of local origin. Implements have been found *in situ* in the gravels at a number of places.[35] The aggraded nature of the gravels is well shown in sections, particularly in the northern part of the area, as at Kau.

Asyut–Samalut

In this part of the valley the Mousterian gravels suffered the same fate as earlier deposits, and they are poorly represented by local wadi terraces. These may be seen on the east side along minor wadies between Wadi Asyut and the cliffs of Maʿabdah near Manfalut, and Mousterian implements are found on their surface, unpatinated, as if weathered from the gravel, though none was found actually *in situ*.

In the Tell el-ʿAmarna bay, false terraces are well displayed. These are cliffs cut in the general surface débris by wadies that turn sharply across the Nileward slope instead of running directly down it. The cliff gives the appearance at first sight of a terrace margin, but its nature is readily seen if it is followed. According to the angle that the transverse wadi makes with the slope, the cliffed face increases or decreases in height.

In the bay near the ruins of Antinoupolis and at Deir Abu Hinnis 10- to 15-foot "terraces" are developed; that is, the wadi floor was lowered in antiquity below a sloping surface, leaving a marked intermediate platform at the height stated. Some of these wadies show no rock platform; the full height of 15 feet is made of gravels. Evidently the excavation followed a period of accumulation. Analogous features are seen immediately to the north of the tombs of Beni Hasan, where watercourses originating in the soft Pliocene strata descend rapidly through them along a curved course to the alluvium. No real terrace exists in either locality.

Many miles of barren ground intervene between these exposures and Wadi et-Tarfah near Samalut, where a broad wadi cut in extremely soft rocks contains mounds of gravel, also a marked gravel plain either side of it, 10–15 feet above its floor. The difference in elevation is plainly visible near the desert edge; with few exceptions the "terrace" is constituted not of solid rock but of loose superficial material.

On the west side of the Nile the 10- to 15-foot gravels are seen at intervals; but the nature of the country, already described, prohibits their full development. In particular, the accumulation of sand at the edge of the desert in almost unbroken line from Beni ʿAdi northward for 150 miles prevents direct observation of Mousterian gravels which certainly lie beneath it. Mousterian implements abound on the higher surfaces west of the dunes, and between them, throughout the region.

A marked level of redeposition at 10–15 feet is seen in the cobble gravels at Beni ʿAdi, and a number of similar examples may be seen farther north.

An important section was observed at Tunah el-Gebel, where the sand was locally concentrated into dunes with considerable bare patches of gravel between them.

About 2 miles north of that village a shallow wadi originating in the scarp of the 250- to

[35] On the west bank, among others may be mentioned the deep bays south and north of Abydos, Nazlat el-Kadi, and ez-Zarabi.

200-foot gravels runs down a long and gentle slope from about 150 feet to the alluvium; it is evidently an old line of drainage, and a 10-foot "terrace" is developed within it at its upper end. Toward the lower end the old surface rises above the wadi floor until it presents a cliff of some 25 feet to the fields below and thus heralds the full amount of aggradation noted along the Nile-Faiyum divide.[36] Mousterian implements recalling the later types found in those gravels also occur here *in situ* in the uppermost few feet of the gravels within the wadi and about 500 yards from the 250- to 200-foot scarp.

Samalut-Beni Suef-Hilwan

North of the ground just described, on the west side, sand dunes prevent useful observation almost as far as Sidmant el-Gebel; but at the point where the sand virtually disappears, about 2 miles south of the town, spurs of Mousterian gravel, resting upon older surfaces, are seen. North of Sidmant el-Gebel similar spurs, and gravel to a visible thickness of 25 feet, are scattered along the edge of the desert throughout the area with which the Faiyum volume deals.[37] Their relation to the Faiyum lake has already been discussed[38] and forms no part of these field observations.

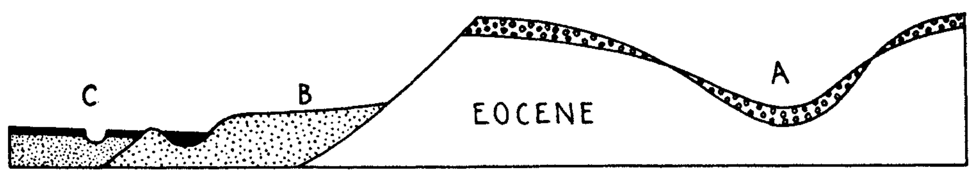


Fig. 17.—Diagrammatic Section to Show the Relation in Middle Egypt of the 25-Foot Gravels to the Lower Paleolithic Nile Channel

A Lower Paleolithic channel, with marginal gravels at 100 feet above modern alluvium
B Mousterian gravel accumulated from an unknown depth to 25 feet above alluvium
C Alluvium and suballuvial sands of the modern Nile

It will be realized that these are true Nile gravels, not wadi deposits. They are no longer isolated, but, supported by similar observations elsewhere, they indicate, in view of recent work, that the visible amount of mid-Mousterian aggradation was greater in Middle Egypt than in the Theban district (cf. Figs. 16 and 17). At the moment there is no conclusive observation of their total thickness in this part of the Nile Valley; it may be considerable. They are widely represented by analogous finer-grained deposits farther north, particularly in the Delta, where the gradient was extremely slight.

Of the exposures on the east bank north of Samalut little need be said. Only wadi gravels are known,[39] and in none of them have implements been found *in situ*, in contrast to the western exposures. Gravels with a marked upper limit at about 15 feet above the wadi floor are seen for considerable distances from the mouths of Wadi Sanhur and Wadi el-Bayad in the Biba-Beni Suef district and round the mouth of Wadi Lishyab near Wastah. Similar gravels appear in the mouth of Wadi Hof near Hilwan. All these exposures of gravel appear to conform to the general plan which has already been explained—of wadies starting normally, but induced to thicken their gravels where they approach their base level, the Nile.

The gravels may have been formed, or redeposited, at a comparatively late phase of the Mousterian aggradation. In the earlier phases the tributary streams probably occupied narrow channels of steep gradient, subsequently filled again. Traces of such buried courses are en-

[36] And the gravels adjacent to the alluvium are Nile deposits.

[37] *OIP* X 32–37.

[38] *Ibid.* pp. 37–38.

[39] Unless the gravels on the east side of the river opposite Beni Suef are of this age; see p. 91.

countered in borings made in the low desert or at the edge of the flood plain. Fourtau in his monograph[40] gives examples from Hilwan, near the edge of the desert, in which local limestone rubble and Nilotic sands interdigitate to a thickness of 31.53 meters (103 ft.) and rest at that depth on solid rock. A little nearer the Nile, in the main valley, the rocky floor sinks steeply to a depth of 43.20 meters (141 ft.) and then plunges deeply; that is, the valley of the tributary has been left and the bores have passed into the unfathomed deposits of the Nile Valley. At Hilwan the age of the upper beds is not known; but at Abu Ghalib northwest of Cairo a bore sunk through surface beds which I have reason to believe belong to the Mousterian 25-foot aggradation gravels passed through Nilotic sands and clays to a depth of 29 meters (95 ft.) and continued through a further 33 meters (108 ft.) of quartz sands and clayey sands without striking solid rock. The lower beds may be of Plio-Pleistocene age.

[40] "Contribution à l'étude des dépôts nilotiques," *Mém. présentés à l'Institut égyptien* VIII (1915) 57–94. For the sections at Hilwan and Abu Ghalib see his pp. 67–68 and 73. For discussion of this memoir see chap. viii.

VII

THE TRANSITION FROM MIDDLE TO LATE PALEOLITHIC TIMES

INTRODUCTION

Egyptian archeology is in need of a term to describe the cultures that followed the Mousterian, or Middle Paleolithic, industry. "Upper Paleolithic" naturally suggests itself; but to the majority of prehistorians this suggests the European Aurignacian, Solutrean, and Magdalenian, none of which seems to be normally represented in Egypt.[1] "Mousterio-Capsian" and "Capsian" have been used, borrowed from the Sahara and North African coast; but Capsian affinities do not appear in Egypt until a later date, and "Mousterio-Capsian" is neither euphonious nor descriptive of more than a few types of implement. M. Vignard has used the word "Sebilian" (from the village of Sebil on the Kom Ombo plain) to embrace the developments of this culture, and for the present it serves for description within the country. It is in constant use in this volume. However, it embraces not only industries evidently descended from the Mousterian, but later forms which may have had other origins; it therefore lacks precision or, if anything, embraces too much. It also causes an unwelcome departure from the simple and universally known division of the Stone Age: first, into Paleolithic and Neolithic; second, into progressive qualification of "Paleolithic" by the words "Lower" and "Middle." Hence the term "Late Paleolithic," employed in our previous volumes, will be retained here, "Late" being regarded as an epithet corresponding to "Upper" in Europe and to late Mousterian, Mousterio-Capsian, and Capsian in North Africa and probably in Western Asia.

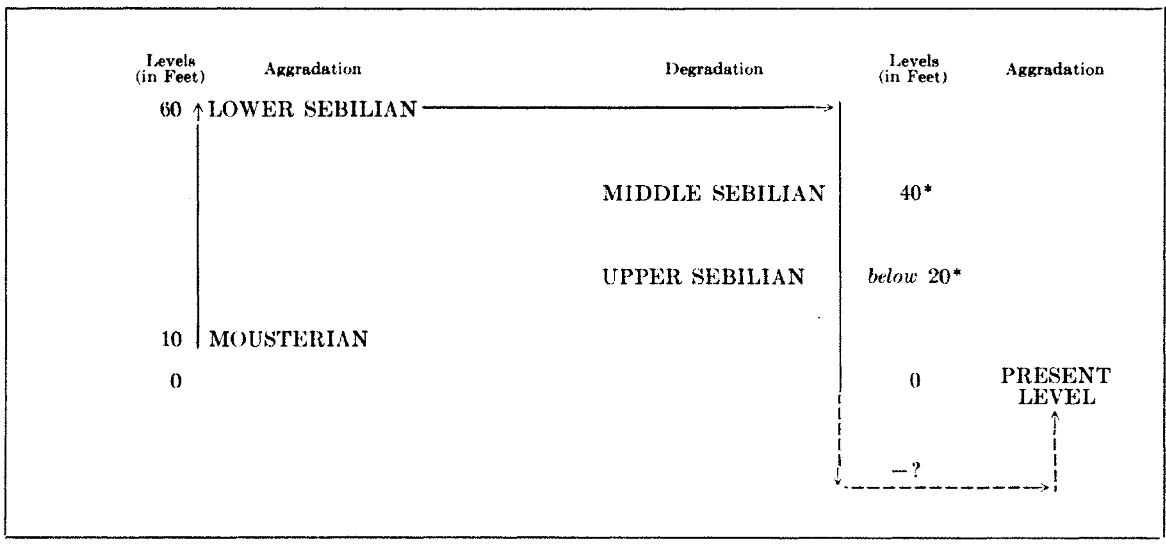
The difficulty in terminology arises from the fact that the Mousterian technique of working flint and similar material survived in Egypt in specialized form for a long time after the industry in its usual form and variety of implements had passed away. Only certain types, in modified form, were retained; and it is reasonable to assume either that other functions were performed by implements of perishable material (e.g. bone) or by surviving types used with greater skill, or that the need for those functions had disappeared. I do not think that we can call this post-normal Mousterian debased; the tools are well made and illustrate a high skill in precise repetition and in economy of material. Moreover, changes were effected until the old tradition was virtually lost; and in the resultant form certain "improvements" of no apparent importance to function, almost unknown to the Mousterian flint-worker, were rigidly maintained.

There is thus a class of infinite gradation, of which the earlier stages may be grouped together as "late Mousterian and early Sebilian"; and the group merges, on the lines indicated, into Middle Sebilian. In Nubia and as far north as the Kom Ombo plain this phase of the industry followed the period during which great thicknesses of silt were accumulated. The silt has been found to attain a height of 100 feet above the Nile, that is, above modern alluvium, at the northern end of the Second Cataract (e.g. at Wadi Halfa), sinking gradually to about 60 feet at the Kom Ombo plain. On the latitude of Luxor it has sunk to about 20 feet above

[1] M. Vignard found at Hu near Nag' Hammadi an industry which he considered to have Aurignacian affinities; see *Bull. de l'Inst. français d'arch. orientale* XVIII (1921) 1–20. For discussion see chap. ix. While this volume was in press M. Vignard definitely associated the Upper Sebilian with the Tardenoisian industry (Congrès préhistorique de France, Xe session, 1934, p. 92).

modern alluvium and survives only in dissected remnants. It is not known to what extent, if any, the silt was deposited below the present level of the modern alluvium in this district, and its occurrence farther north remains to be considered in this chapter; certain information has already been published.[2]

The Upper Sebilian people witnessed a new period of bed-erosion by the river. Their industry in flint and other hard rocks, which contrasts markedly with the Middle Sebilian, is predominantly microlithic and suggests Capsian affinities. We may thus distinguish it from a general class of older Sebilian, which serves to embrace the merging Lower and Middle elements and to define otherwise indefinite or small groups.



* See *OIP* XVII 48–52. The Middle Sebilian water level was as high as 70 feet a little north of Wadi Halfa (Dibeira West) and falls to 40 feet at Darau south of Kom Ombo. Between Kom Ombo and Edfu there are gravels at 20 feet with rolled Middle Sebilian, but no Upper Sebilian, implements.

FIG. 18.—DIAGRAMMATIC RECORD OF MOUSTERIAN–UPPER SEBILIAN LEVELS IN UPPER EGYPT

Until recently the older Sebilian industry was known only in Upper Egypt; but in 1927/28 it was found *in situ* in the Faiyum, in the deposits of two beaches marking pauses in the generally sinking surface of the Mousterian lake. It appeared that water had still been poured in from the Nile during the sinking of the lake, and that the level of inflow had fallen in the Nile Valley.

Thus it becomes evident that there were features in common between the histories of two great expanses of water controlled by the Nile, namely the Faiyum and the Kom Ombo plain, the former a lake, the latter an inundated marsh perhaps somewhat like the existing Sudd region bordering the White Nile in the Sudan. In both there is evidence of Mousterian accumulation, continuing in Lower Sebilian times in the Kom Ombo district, brought to a standstill at the altitude of the Mousterian beach of the Faiyum. In both, later Sebilian times are marked by falling levels and by erosion. The relations of those levels to the modern alluvium differ widely between the two areas,[3] but it is plain that a common factor was operative in both. One of the objects of the field season 1930/31 was to find that factor. The summary of levels is given in diagrammatic form in Figures 18–19. The 30-foot, Early Mousterian, terrace is omitted here for simplicity. Levels are given with reference to present height of alluvium, and the series in Figure 18 is as seen near Edfu.

[2] *QJGS* LXXXV 536–41 and *AJSL* XLVIII 170–83.

[3] See *OIP* X and XVII.

The levels in the Faiyum are given in feet above sea-level and (in parentheses) above the modern lake on a given date. The lake, now controlled by irrigation works as well as by evaporation and seepage, is at about 147 feet below sea-level. The Lower Sebilian level cited here, about 9 feet, is taken at the mouth of the Hawarah Channel, east of which, in the Nile Valley proper, the deposits are hidden below modern alluvium.[4] The finding of the Middle Sebilian level is described on pages 91–94.

The two facts that emerge from these diagrams are that the aggradation continued later in Upper than in Middle Egypt, and that the Sebilian levels of Middle Egypt are plainly shown by the lakes of the Faiyum to be lower than the Mousterian beaches.

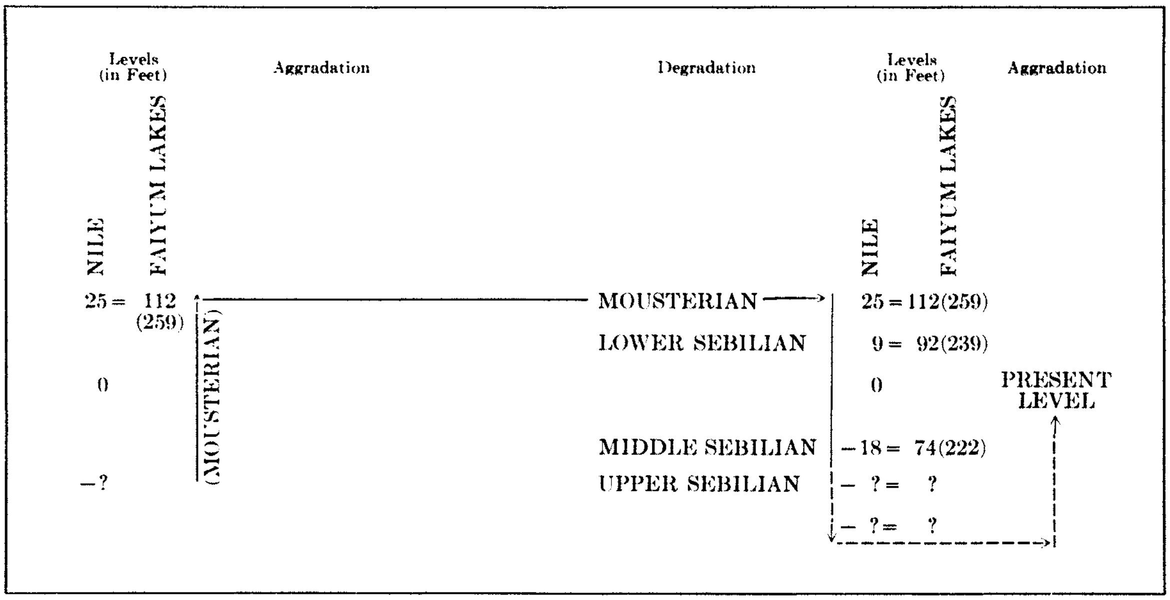


FIG. 19.—DIAGRAMMATIC RECORD OF MOUSTERIAN–UPPER SEBILIAN LEVELS IN MIDDLE EGYPT AND RELATION OF THE NILE TO THE FAIYUM LAKES

We do not yet know whether the falling level of upper limit from south to north implies a decrease of total thickness as well as a change of gradient, that is, whether the lower part of the silt is hidden below modern alluvium near Luxor. For the latter a little evidence is provided by borings (see p. 103), and the actual and visible thickness is reduced by nearly half between Wadi Halfa and Kom Ombo, where there is no profoundly deep channel to contain the silt. Even if the base of the silt lay below modern alluvium, there seems no reason to suppose that the loss of thickness already observed was abruptly made good at or about Luxor. Over the observed length of exposure the silt appears to thin and its summit to fall more rapidly than the modern alluvium from south to north; that is, its gradient is more marked. North of Luxor, therefore, the relationship of silt to 10- to 15-foot Mousterian terrace shown in Figure 16 may change.

THE SEBILIAN GRAVELS[5]

LUXOR–NAGʿ HAMMADI

Between Luxor and Kena, in the Higazah bay a few exposures of silt can without doubt be attributed to Sebilian times. Nearer Kena Beadnell found fresh-water shells on the sur-

[4] Unless the gravels on the east side of the Nile opposite Beni Suef are of this age. See p. 91.

[5] Discussion of climate is postponed to the end of this chapter, as the field observations enter largely into the question.

face;[6] but I have covered this ground on foot twice, and by automobile many times, and have unfortunately seen no trace of them. Since the fellahin have dug away an incalculable quantity of Pliocene marls of somewhat similar appearance for use on their land, it seems probable that any exposures of silt have gone with it or have become hopelessly obscured in the general confusion of the surface.

No silt has been observed in Wadi Kena; it may be obscured by recent wadi wash.

North of Kena I noted certain exposures in 1925/26:

1. Almost due north of es-Samata, but a little on the Nagʿ Hammadi side: Nile silt lying along a shallow wadi runs a mile or more into a low desert and is found in isolated patches up to 10 feet above recent alluvium.

2. In the low desert plain west of the Fau headland, on a level plain running 1–2 miles into the desert, *sebakh* (gray and brown) is covered by a few inches of stalactite, hard and crystalline, the surface of which is waterworn. Near the edge of recent alluvium, and extending only a foot or two above it, small granite and quartz pebbles are numerous.

3. On the other side of the Fau headland, that is, about north-northeast by north of Nagʿ Hammadi, at the foot of the great perpendicular cliff, thinly bedded Nile silt with layers of limestone pebbles is seen. It is exposed to a thickness of about 4 feet, but rises only a foot or so above recent alluvium.[7]

On the west bank north of Medinet Habu, Thebes, no silt has been seen *in situ* above the alluvium.[8]

Nagʿ Hammadi–Asyut

The impression is gained that, since the silt is already below the level of modern alluvium and its base is hidden, as it is in these sections, it is dipping beneath the later beds. It was the conviction that it might be traced *below* alluvium here and there in the bed of the Nile that caused me to seek an opportunity of descending among the mud banks when the river was low and of searching them methodically.

Two facts gave me reason for optimism. First, in the exposed Sebilian beds at the mouth of and within the Hawarah Channel, fine gravel predominates over silt, suggesting that in the north more rapid currents prevailed, probably supplied by greater local rainfall than then obtained in the south. It was reasonable to suppose that the predicted Sebilian deposits below alluvium might consist of gravel, which would have stood a greater chance of preservation from erosion than silts.

Second, I already knew of gravels that I believed to be of Sebilian age and to lie below alluvium, at Kau el-Kabir south of Asyut. Moreover, I had seen river sands and gravels of similar origin in the excavations extending below the level of alluvium at the Osireion at Abydos. Their water-bearing nature prevented the full exploration of this structure, and their base was not seen.[9]

The circumstances at Kau el-Kabir were peculiar. They have already been described,[10]

[6] T. Barron and W. F. Hume, "Notes sur la géologie du désert oriental de l'Egypte," Congrès géologique international, *Comptes rendus de la VIII[e] session, 1900* (Paris, 1901) p. 870.

[7] Exposures cited in *QJGS* LXXXV 538.

[8] See *OIP* XVII 47.

[9] Mr. Guy Brunton collected samples and recorded the completed section in January, 1926. It will be shown that the suballuvial gravels described here are to be associated with the Middle Sebilian beginning of degradation rather than with the summit of Lower Sebilian aggradation, although the vertical difference at the early stage was small. The fall of level of silt from Nubia to Nagʿ Hammadi is thus a fall of maximum aggradation, so far as known. The suballuvial gravels farther north, which continue this gradient within the present limits of measurement, are in fact shown to be slightly later. The true height of maximum aggradation ran probably about 20–25 feet higher, not more, as shown at Beni Suef and in the Faiyum (see pp. 91–94).

[10] Sir Flinders Petrie in *Man* XXV (1925) 130; Sandford in *QJGS* LXXXV 536.

and only the essential facts need be recorded here. Of outstanding importance is the inclusion of human remains, petrified and waterworn, among extinct species of mammals.

1. Hoards of bones and hippopotamus ivory, some fresh, some in a state of petrifaction, were found in shafts and tombs in circumstances which pointed to their having been gathered and concealed during the 19th dynasty.

2. Some of the ivory was carved. Contemporary hippopotamus bones were included. It has been suggested that the ivory was collected for carving, the hippopotamus bones for religious purposes. Yet an *extinct* fauna is represented among the fossil bones, and donkey is included among the fresh material (i.e., fresh in the 19th dynasty). Much of the assemblage thus seems to have been pointless; and the suggestion that the collector was so poor a naturalist that he could not distinguish fresh donkey bones from the remains, fresh and fossil, of the sacred hippopotamus, seems unlikely. The fact remains that perhaps nine-tenths of the whole of the bones are of hippopotamus, fresh or fossil.

3. A considerable number of the fossil bones had been rolled, and some severely waterworn. Moreover, in the interstices of the greater part of the fossil material were wedged pebbles of Nile gravel. It transpires, therefore, that the bones came from a deposit far coarser than the Nile alluvium, and that an extinct fauna is represented. A few pebbles may be found scattered over the low desert, relics of Pliocene and later sands and gravels; but it can confidently be asserted that no such fossiliferous deposit is to be seen on the surface in the deserts adjacent to Kau, and I can find no trace of its appearance in any of the hundreds of pits sunk in the district by archeologists and grave-robbers. Evidently, then, the deposit was accessible in the 19th dynasty, but it has since been destroyed or hidden. If one considers for a moment the enormous quantity of fossil bone recovered and the usual dissemination of such remains in a river gravel, one cannot fail to realize that the outcrop from which the collections were made was considerable. It seems inconceivable that such a deposit could have been entirely removed either by erosion or by human endeavor since the 19th dynasty. Man in Egypt, no less than in any other country, tends to dig away only the best of a useful stratum, and he is virtually incapable of sweeping away every trace of it, even should there be a motive for so doing. It is my firm belief, therefore, that the gravel is concealed in the old Nile channel, not on the desert edge, in other words, that it has been covered with alluvium since the 19th dynasty.

4. In Upper Egypt nearly all traces of contemporary life have been removed from Pliocene and Pleistocene strata,[11] with the exception of the silts of the Sebilian aggradation.

A comparison may be made between the fossil bones of Kau and those of Kom Ombo. I am indebted to Professor D. M. S. Watson for a provisional list of the former, and to M. Vignard for a letter in which he gives me M. Gaillard's most recent determinations of the fauna collected from the Kom Ombo plain, where their Sebilian age is beyond question. Unfortunately no implements were found with the bones at Kau, and the only shell is the Nile "oyster" *Etheria elliptica*, which incrusts fresh and fossil bones alike. The presence of this shell does not prove that the bones were found on the Nile mud, since it is a fossil form which still survives; that is, it may have incrusted the now fossil bones when they were first deposited.[12] Professor Watson has described some of the mammals from Kau as northern forms of southern and central African types. The lists, admittedly provisional, show similar genera from the two

[11] Probably by chemical action; a few fossils have been found in the travertines of Upper Egypt. Organic remains have survived in Pliocene and Pleistocene beds of the northern part of Middle Egypt.

[12] Mr. Guy Brunton showed me some slabs of rock similarly incrusted which had been utilized in 4th dynasty times at el-Matmar. They had not since been under the Nile, and the incrustations were therefore in existence when the slabs were used. The ancient habit of collecting objects from the river banks for a variety of purposes is interesting. At el-Matmar the nearest good stone was distant about 2 miles.

places. If the two collections could be studied side by side, a number of species might prove to occur in both.

Of the associated human remains, some of those from Kau are certainly as old as any of the fossil bones, and in identical state of preservation. They are, then, probably the oldest human remains yet found in Egypt and, on geological and paleontological evidence, of Paleolithic age. They have been examined by eminent anatomists, in particular by Dr. D. E. Derry, of Cairo, and Sir Arthur Keith, of the Royal College of Surgeons, London. Both these experts have been kind enough to provide me with copies of their reports, to be published later. Neither sees any special characteristics, such as are associated with the neanthropic Paleolithic races of Europe. Sir Arthur Keith regards the people whose remains he describes as more akin to the predynastic Egyptian than to any other race of which we have full knowledge. An identical report was given by Sir Elliot Smith also on a part of a human calvarium that I found early in 1926 in the silts of Kom Ombo, partially exposed on their surface, but in mineral state comparable with the abundant mammalian bones of the deposits. It is to be hoped that these reports will be published in full in due course. The recognition of the predynastic type at a date, by the balance of probabilities, Paleolithic is an important event and one from which other discoveries will probably arise.

Fauna	Kom Ombo	Kau
Homo sp.	×	×
Hyaena crocuta	×	–
Equus asinus	×	–
Equus sp.	–	×
Hippopotamus amphibius	×	×
Sus sp.	–	×
Bos primigenius	×	–
Bos africanus	×	?
Bos cf. *laini*	–	×
Bubalus nov. sp.*	×	–
Bubalis boselaphus†	×	–
Bubalis sp.	–	×
Gazella isabella	×	×
Struthio§ sp.	×	–
Crocodilus niloticus	×‡	×
Crocodilus nov. sp.	–	×
Testudo sp.	×‡	×
Fish: 1. Siluroid (synodontoid)	×	×
2. *Nodularia coelatura*	×	–

* I.e., an extinct species of buffalo.

† I.e., hartebeest or near ally.

‡ Not on M. Vignard's list, but I have observed specimens on the Kom Ombo plain.

§ Recently recorded by M. C. Gaillard in a paper by M. E. Vignard: "Les microburins tardenoisiens du Sébilien," Congrès préhistorique de France, Xe session, 1934, p. 99.

On the foregoing evidence, I regard it as reasonably probable that the Kau gravels are a concealed exposure of the Sebilian silts of the south, which have already been traced until they disappear beneath the modern alluvium near Nagᶜ Hammadi. With this may be combined the fact that near or at Kau the Nile was depositing sand and well rolled polished gravel of small pebbles, not silt.

If now we accept computation of alluvium accumulation in historic times at 4–4½ inches per century,[13] we shall find that about 10–12 feet of deposit have been added since the 19th dynasty. It is thus eminently possible that the gravel may still exist at that depth below the alluvium,

[13] For a review of this problem by Dr. James H. Breasted see *Scientific Monthly*, 1919, pp. 307–8.

if it has not been destroyed. Within the last century, however, the Nile's change of course has destroyed utterly the temple of Antaeopolis near Kau. During the French occupation of 1798 the temple still stood in the fields at a considerable distance from the cliffs.[14]

Evidence of the destruction of gravels containing pebbles similar in appearance to those wedged in the Kau bones may be found some 15 miles farther north, between Nakhailah and Abu Tig. In the river bed in front of, and immediately to the south of, Nakhailah is a long and broad bank of quartz sand containing feldspar mixed with Nile gravel of fine grain. The components, particularly the quartz pebbles, are highly polished—a prominent character of Sebilian gravels wherever they are seen, and one that has usually, though not invariably, been lost by older deposits of generally coarser grain. The ridge, about 100 yards wide, rises within 6 feet of the top of the alluvium, beneath which it is seen to pass.[15]

Hippopotamus and crocodile bones, black and heavily mineralized, some of them much waterworn, but no implements, were found. These two animals have been driven farther south in comparatively recent times.[16] Mineralization appears to be a fairly rapid process under suitable conditions.[17] The faunal evidence of antiquity is therefore of no value. Stress should be laid rather on the typically Sebilian appearance and polish of the gravel and on its very occurrence, since material of this nature is not now brought by the Nile from the south. Its situation, partly subject to present attack by the Nile, partly under an appreciable thickness of alluvium, suggests some local supply, and the suballuvial portion may be in its original position. From such a bank and partly buried exposure the 19th dynasty collection of bones may have been made.[18]

Between Nakhailah and Abu Tig, about half a mile south of the latter, similar polished gravel, with only a small proportion of sand, was seen above the river on the west bank, beneath 8 feet of alluvium. Only a foot of gravel was exposed above the water at the time; it may represent the top of a thick mass or be only a thin lenticle reincorporated in the alluvium. No bones or implements were found here.

How far the foregoing reasoning has proved to be correct will be shown in the results of the following investigation.

Asyut-Samalut

North of Asyut silts and gravels of Sebilian age or appearance are entirely absent from the low desert, which, where canals and similar works have trenched it deeply, generally consists of local gravels of doubtful age. The deposits of the Nile of Sebilian age are evidently to be sought under the modern alluvium.

On the desert edge a little north of the mouth of Wadi Asyut older Sebilian cores and flakes occur apparently in flaking sites, at the level of modern alluvium and a little above it. They are unrolled, and their presence therefore suggests that the river was at a lower level than the

[14] See comparison of maps in G. Brunton, *Qau and Badari* I (London, 1927) 3 and Pl. I.

[15] A considerable length of exposure was visible among palm trees in a brick yard on the south side of the town.

[16] A large crocodile made its appearance in the Delta in 1926 and caused much consternation. They are numerous in the Second Cataract, and their numbers are regulated by shooting. Young specimens are caught as far north as the Aswan Dam, which normally prevents their passage farther north. The hippopotamus has survived in the Atbara, but has not been seen north of it in the Nile for many years. Dr. Sheraf Bey, in papers read before the Zoölogical Society of Egypt in December, 1929, stated that two hippopotami passed the Second Cataract in 1812 and that the last two known in the Delta were shot there in 1658 (report in the *Egyptian Gazette* of January 13, 1930). See also G. W. Grabham and R. P. Black, *Report of the Mission to Lake Tana 1920–1921* (Cairo, 1925) p. 120.

[17] See remarks by C. W. Andrews in *GM*, 1912, pp. 110–11.

[18] Some years ago Mr. Henry Ayres of Cairo found a limb bone of hippopotamus, mineralized as described above, projecting from this sand bank. A "well-worked flint knife" was found on the surface. This was noted, thanks to Mr. Guy Brunton, in *QJGS* LXXXV 537, and I am indebted to Mr. Ayres for recent correspondence to the same effect. The flint knife is not now available.

sites or modern alluvium. Farther north they were seen on the prominent gravel spur in the center of the Tell el-ᶜAmarna bay, but the lower ground adjacent to the fields is entirely disturbed by digging and obscured by the remains of Ikhnaton's town.

The low level of the Nile in the spring of 1931 laid bare a critical section between Geziret Shaibah and the east bank, here steep cliffs of Middle Eocene limestone, about 1–2 miles south of esh-Sheikh Timai between Mallawi and Abu Kurkas (Fig. 20). At the time of my visit the Nile had abandoned a course along the east side of the island, and the bed was dry for about a mile, save for a few ponds at the south end. The feature that at once attracted attention was the broad hummock of hard gravel occupying the narrowest part of the channel, near the north end of the island. No doubt the presence of so resistant a mass has caused the Nile to concentrate its waters in the western or main deep-water channel. Evidently the currents are very strong in the eastern branch when the river is high, since a deep scour channel barely 20 yards wide has been cut in the gravel between the highest part of the hummock and the east bank. A broader course has been cut on the other flank, adjacent to Geziret Shaibah, beneath which the gravel dips. It is plain, then, that the Nile in its changes of channel has

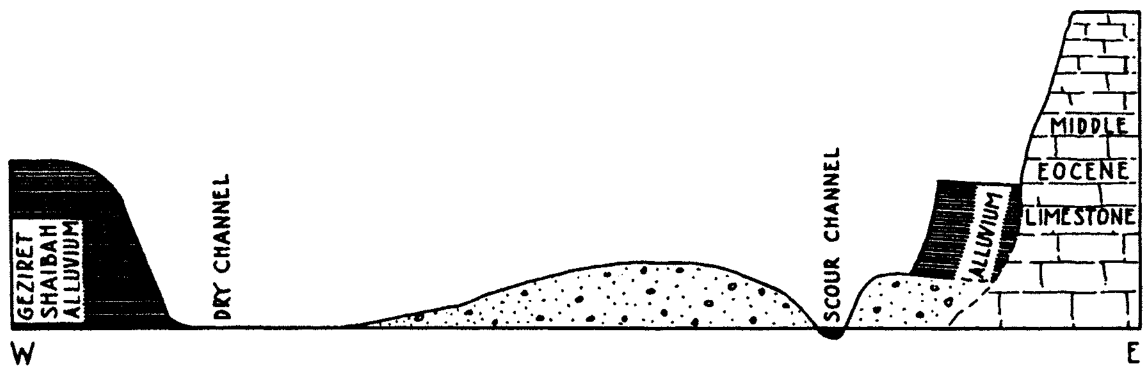


FIG. 20.—SECTION ACROSS A BRANCH OF THE NILE NEAR ESH-SHEIKH TIMAI, TO SHOW MIDDLE SEBILIAN GRAVELS

discovered a resistant mass, and that it is experiencing considerable difficulty in removing it. There is no suggestion that the Nile is now depositing the gravel.

The contact of modern alluvium and gravel is distinct and uneven. The alluvium contains only a few strings of pebbles derived from below, but quartz sand occurs more freely in its lower part than is usual. The gravel is essentially of Nile origin (in the Pleistocene sense), containing a high percentage of quartz and other igneous, also metamorphic pebbles, with much agate and similar material of southern origin. There is a less noticeable proportion of locally derived material. All the constituents show the high varnish characteristic of the Sebilian gravels of Upper Egypt and Nubia. Black and highly mineralized bones, many of them waterworn, are common. Hippopotamus, crocodile, *Bos* sp., and siluroid fish were identified; but none of these represents a fauna peculiar to Sebilian times, although they recall in every detail the bones of Kau el-Kabir. The evidence is rendered conclusive, in my opinion, by the presence in the gravels[19] of waterworn Lower or Middle Sebilian implements, including a "backed" blade which is certainly Middle Sebilian.

Every feature of the Middle Sebilian gravels of Upper Egypt is present here; and there seems no reason, in view of the evidence now put forward, to deny this identification. The gravels at their highest point are 11 feet below modern alluvium, that is, below the 43-meter level on Geziret Shaibah and the east bank (see Pls. XI, *B*–XII). Their base is not seen, but

[19] A knife was needed to get out some bones and implements.

they are exposed to a thickness of at least 10 feet. Loose on the surface of the hummock and in the scour channels waterworn Greco-Roman pottery occurs in abundance. No other period except the modern seemed to be represented by sherds. This suggests that a recent change of the Nile's course has swept away a town or other site, just as it is sweeping along the front of Antinoupolis,[20] which may indeed have provided a portion of the pottery. The district is particularly rich in Greco-Roman sites on the alluvium and desert edge. A comparison of the modern map with that of the French survey of more than 100 years ago (Fig. 21)[21] shows that considerable changes of the river's course have taken place in the interval. The island of Shaibah was then one of a line of small islets very close to the west bank; virtually the whole width of the Nile lay to its east. The shallow eastern channel has developed, exposing the gravels; Geziret Shaibah has greatly increased in size by the accumulation of alluvium on its flank; and a deep narrow main course of the Nile skirts it on the west.

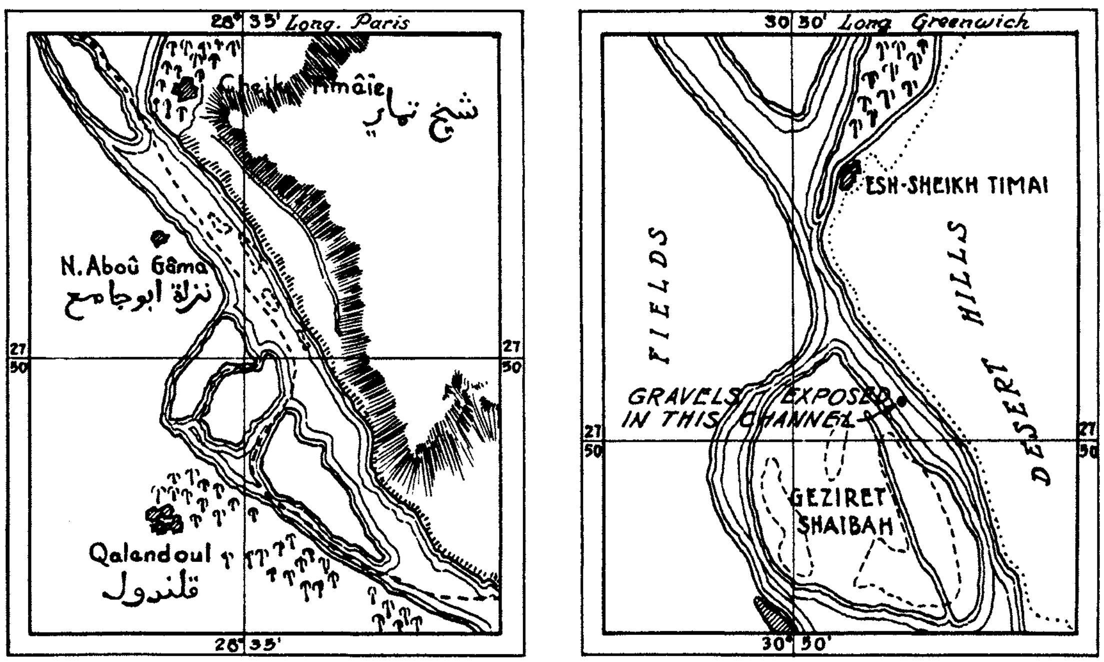


FIG. 21.—MAPS OF THE DISTRICT OF ESH-SHEIKH TIMAI

SAMALUT–BENI SUEF–HILWAN

In 1931 gravels of similar appearance were next seen at el-Babein, a little north of Deir Gebel et-Teir between Samalut and Matai. They were exposed in the Nile flood channel on the east bank, and small polished fragments of fossil bones were found in highly polished Nile gravel of the same texture as that at Geziret Shaibah. Quartz sand, with feldspar etc., predominated, and the top of the outcrop passed under the alluvium at a depth of 11 feet. The exposure is for the greater part concealed by recent silt in the flood channel, and the strata have lost cohesion, probably through long washing by the Nile. No change is to be seen in the

[20] Not to be confused with the temple of Antaeopolis, formerly near Kau. Antinoupolis (Antinoë) is on the edge of the Eastern Desert, opposite er-Rodah, and is shown on Fig. 8.

[21] The French occupation took place in 1798. Surveying, archeological, and scientific expeditions accompanied and followed the troops through the country, accomplishing magnificent work. The 2d ed. of their *Description de l'Egypte* appeared 20–30 years later; see the *Atlas géographique* of this series, published in Paris in 1826 by C. L. F. Panckoucke. The maps used in Figs. 21–22, however, are based on the 1st ed.

river's course at this site since the map of the French survey was made. The presence of Sebilian implements was not conclusive, because of the highly waterworn condition of the few specimens found. The gravel recalls in many details the exposure at Nakhailah.

The next important outcrop to the north was found at el-Hibah opposite el-Fashn, where the river turns sharply to the northwest. At the time of our visit a low mound of hard gravel was emerging on the west side of the present low-Nile channel, that is, almost in the middle of the river, where it has to withstand the full force of the current. It was exposed no more than 3 feet above the sinking river, about 18 feet below the eastern bank of alluvium. The cliffs of alluvium on the north side of the bend are being rapidly destroyed, as slices of sand and earth are undermined and eaten up by the river; part of the village of el-Hibah el-Gharbi which stands here has already been destroyed, part is abandoned. In a few years the eastern bank

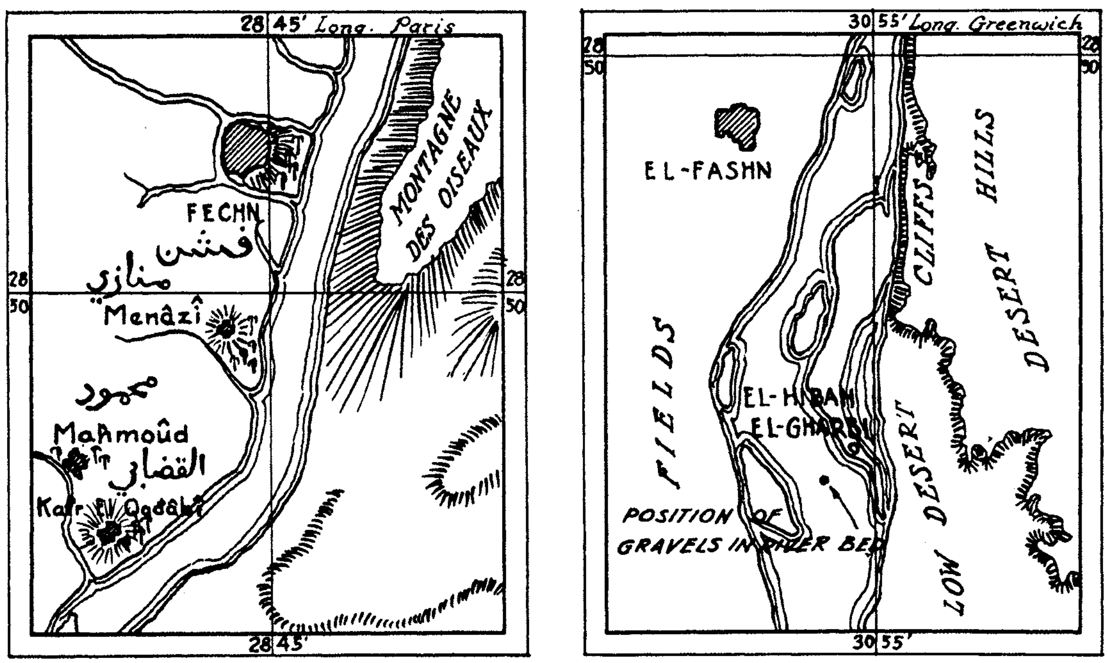


FIG. 22.—MAPS OF THE DISTRICT OF EL-FASHN AND EL-HIBAH

of the bend may have disappeared, and the gravel island will probably become the nucleus around which a new patch of alluvium will form. This is already beginning in shallows of the gravel; and its shelving surface below water makes approach difficult, even in a small rowboat. Comparison of the present situation with that found by the French survey (Fig. 22) shows that the whole of this vicinity has changed radically in a century. In view of previous description perhaps the gravel may be adequately described as essentially of Sebilian appearance. Heavy black mineralized bones occur hard set in the gravel, so firmly cemented that some could not be extracted under the conditions at the time of visit, even with a hammer; polished quartz pebbles are jammed in their interstices, as at Kau el-Kabir. Bones and tusks of hippopotamus and remains of crocodile and *Bos* sp. were found, that is, the usual indefinite fauna. Others, loose on the surface, of recent age, essentially the fauna of the fields today, were black on the outside but fresh within the black cortex.[22] A few implements waterworn and highly polished, of older Sebilian[23] appearance, were found in the hard gravel. Lying on the surface

[22] Cf. p. 87.

[23] I.e., of Lower or early Middle Sebilian type; it is impossible to draw a hard-and-fast line between the two.

in abundance were Greco-Roman and recent sherds, but none of greater age. Also a predynastic flake, polished like the Sebilian implements; a longer flake, possibly of late predynastic age, somewhat polished and scarcely waterworn; and a flint implement of 12th dynasty type, slightly polished and rolled, were found loose on the surface. The island, which when visited covered an area of about 2 acres (excluding a trail of alluvium overlapping the gravel at the downstream end), would be worth a detailed investigation with local facilities at some period of low Nile. The evidence already speaks for itself.

The last exposures to be noticed in the Nile Valley are situated on the east bank south of Beni Suef. The first is at the foot of a small but prominent hill known as Kom el-Asfar, separated from the main desert on the east by a narrow strip of cultivated ground. On the west side a coarse Nile gravel, with far-traveled pebbles up to 1½ inches in length, rises from beneath the alluvium to a height of about 3 feet. On the edge of the neighboring desert traces remain to the same height and may be followed northward to the Coptic cemetery opposite Beni Suef. The presence of Nile gravels of earlier stages a little farther south introduced the possibility that the bed might have been derived from higher deposits, but only by the Nile itself, for these are not lateral wadi gravels. A few hundred yards south of the cemetery the gravel rises again in a slight ridge, which is being actively worked for ballast by the municipality and other enterprises of Beni Suef, where large heaps may usually be seen on the quay. The top of the gravel lies between the 29- and 30-meter contours; that is, it rises less than 3 feet above alluvium. It is seen to a depth of 6 feet, the base not being visible. The pebbles are polished, as in a Sebilian deposit, but to a less extent; and the gravel is far coarser than any Sebilian deposit known to me in the valley. It is gritty with coarse sand, and fine irregular seams of silt occur. Despite careful search of the pits and of excavated material, not a trace of bone nor of human implements was found. The low level of these exposures suggests a connection with the Sebilian deposits that have been traced in the foregoing pages; but the texture and altitude of the gravel are quite distinct, and in none of the undoubted outcrops of the Sebilian phase north of Nagʿ Hammadi have all traces of bone and implements been absent. It may mark an early stage of the same phase, that is, the Lower Sebilian level of the Hawarah Channel,[24] or it may be a lower part of the Mousterian aggradation gravels already discussed.[25]

We have now arrived at a point opposite the mouth of the Faiyum, whither we shall follow the deposits. The survey of the mud banks of the Nile was continued as far as Wastah, but there were no exposures which call for attention.

Nile-Faiyum

In the preceding pages evidence has been produced to show that between Luxor and the neighborhood of the entrance to the Faiyum, a distance of some 350 miles, the Sebilian deposits fall from about 20 feet above alluvium to about the same level below it (Fig. 23). This represents a total fall with relation to alluvium of 120 feet from the Second Cataract northward, or 90 feet from the Middle Sebilian level at Dibeira West, a distance of about 700 miles. It implies an angular subtension greater by about 8″ between the Second Cataract and Luxor, by about 4½″ thence northward, or by about 7″ over the whole distance, than that of the present day, if the tops of the old deposits and alluvium are measured. Calculations on the bases of both old and new alluvia are impossible, since they are hidden. Of the thickness of deposits beneath the alluvium we have no precise information. Moreover, trial borings give only a limited amount of accuracy, because they usually pass down into deposits of similar lithological composition, but of widely different age. Fauna, implements, or pottery are nec-

[24] See pp. 83 and 93.

[25] E.g. as shown in Fig. 17.

essary to "prove" the bores.[26] In the Faiyum, however, we have a local store of useful information which we may discuss briefly, with reference to the table below and to *OIP* Volume X:

1. As a control we have the tops of the Mousterian gravels of aggradation.

2. After a pause of unknown duration there followed the Lower Sebilian lake, but without evidence that contact with the Nile had been broken in the interval. There is every reason to suppose that the lake had fallen *pari passu* with the lowering of the Nile.

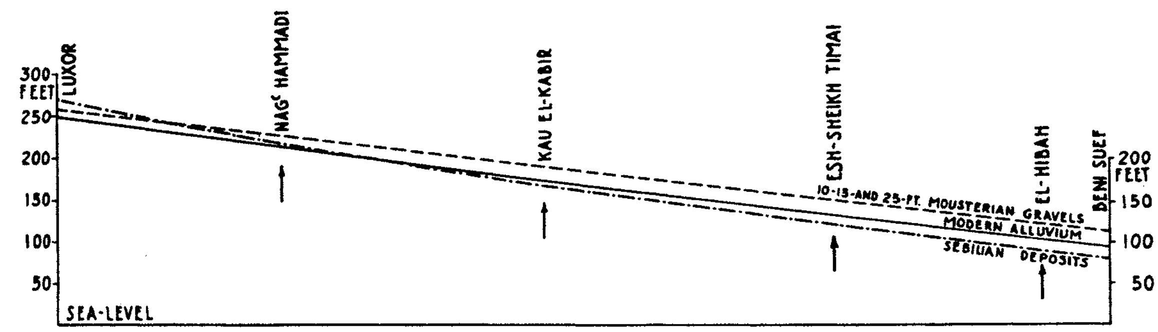


FIG. 23.—GRADIENTS OF MOUSTERIAN AND SEBILIAN DEPOSITS IN THE NILE VALLEY BETWEEN LUXOR AND THE FAIYUM (BENI SUEF). VERTICAL SCALE GREATLY EXAGGERATED

3. Lastly, there is the Middle Sebilian lake of the Faiyum; the equivalent deposits of the Hawarah Channel and Nile Valley have hitherto been supposed to lie under the alluvium.

These three levels may be tabulated as follows:

	Nile Valley		Total Fall in Hawarah Channel	Faiyum Lake
	Feet above Alluvium =	Feet above Sea-Level	Feet	Feet above Sea-Level
1. Tops of Mousterian gravels of aggradation	25	117	5	112
2. Lower Sebilian lake stage	9*	101	10	92
3. Middle Sebilian lake stage	?	?	?	74

* At Kom Medinet Ghurab at the mouth of the Hawarah Channel. Probably no more than 5 feet in valley.

4. If now we refer the level of the Sebilian gravels of el-Hibah (p. 90) to the above, a particularly interesting result is obtained. It should be noted first that the level at el-Hibah, −18 feet, is the altitude of a patch of gravel recently exposed and now beginning to yield to erosion. But no traces of it are to be seen at higher levels beneath the alluvium either *in situ* or disintegrated as at el-Babein (p. 89). Probably −15 feet is the maximum altitude which can be allowed at el-Hibah; the evidence admits of only −18 feet, to which, with the foregoing provision, we shall adhere. Second, the term "older Sebilian" has been applied to the suballuvial implements at el-Hibah (p. 90), to dissociate them from later, more Capsian-like forms; on the evidence of the available material it covers equally Lower and Middle Sebilian types, such as occur near esh-Sheikh Timai (p. 88), but this is certainly not the Lower Sebilian level. Lastly, over the remaining distance from el-Hibah to Beni Suef opposite the mouth of the Hawarah Channel the modern alluvium continues with almost uniform gradient, and we may project the level of −18 feet for the top of the old gravels, which we know to be falling; −18 feet serves as a safe factor for fall north of el-Hibah, if −15 feet is a fair estimate of true level there. We may, then, complete our table, with reasonable provisions for error, as follows:

[26] Even this evidence is at times open to doubt in the suballuvial deposits. See chap. viii.

	Nile Valley		Total Fall in Hawarah Channel	Faiyum Lake
	Feet above Alluvium =	Feet above Sea-Level	Feet	Feet above Sea-Level
3. Middle Sebilian lake stage	−18, −15*	77, 74	3–0	74

* Both are shown in Fig. 24.

From the foregoing, illustrated in Figure 24, interesting deductions follow:

1. North of Nagᶜ Hammadi, Sebilian deposits are seen at the foot of, not above, Mousterian gravels. This applies particularly to the Nile-Faiyum contacts; it is the precise reverse of the conditions south of Nagᶜ Hammadi, for example at Edfu and Kom Ombo and in Nubia.

2. Degradation after a Mousterian aggradation appears to be the rule in the northern region. There is no evidence that the Sebilian river attained the height of the Mousterian course, or that a period of excavation and filling to the level of visible Sebilian gravels occurred.

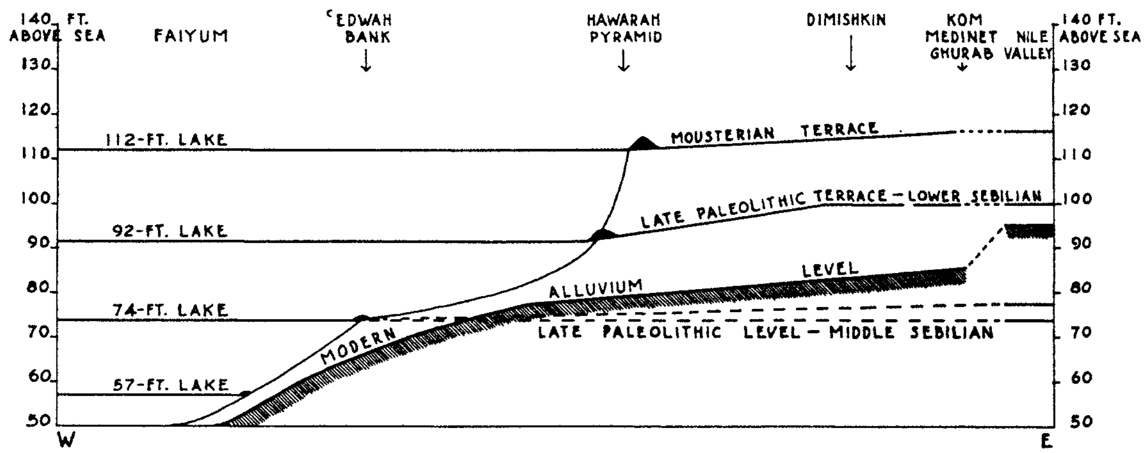


Fig. 24.—Gradients of Mousterian and Sebilian Deposits between the Nile Valley and the Faiyum. Vertical Scale Greatly Exaggerated. This Figure Is Based on *OIP* X 39, Fig. 10

The latter are probably of no great thickness and represent a pause in a period of down-cutting, probably contemporary with the turning of the river from aggradation to degradation in Nubia and at Kom Ombo; that is, this is a Middle rather than a Lower Sebilian stage.

3. The Nile maintained the Faiyum lake at ever falling levels from Mousterian to mid-Sebilian times. If a major oscillation of Nile level had occurred before the Sebilian gravels of the Nile bed had been deposited, it would have been recorded in the oscillation of the Faiyum lake levels. Instead, they fall by three main stages of 112, 92, and 74 feet (Mousterian, Lower Sebilian, and Middle Sebilian), which are bound into a continuous series by the step-like array of minor beaches found in the Faiyum at the following levels: 101.3, 98.9, 95.8, 93.8, 91.7, 89.5, 85.6, 78.0, 75.0, 71.7 feet.[27] Not only do these record continuity within the Faiyum, but they seem to render certain the belief that the suballuvial Sebilian gravels of the Nile are but a stage of the degradation phase.

4. The association of the suballuvial gravels with the 74-foot lake of the Faiyum serves to emphasize that this was a stage of some importance. Sebilian gravels which may be referred to the 92-foot lake are not in evidence in the Nile Valley, with the possible exception of those at Kom el-Asfar and opposite Beni Suef. Further search might now reveal them. In them is to be found the precise continuation in Middle Egypt of the gradient of the Upper Egyptian silt *maximum;* the Middle Sebilian stage marks an initial fall of about 20 feet below it.

[27] *OIP* X 58.

5. The 74-foot lake thus becomes of enhanced importance, since it ends a chapter in the history of Nile and Faiyum and of Man's relation to that history. Upper Sebilian implements are unknown *in situ* north of Nagᶜ Hammadi, in fact north of Esna or Edfu; they have not been found even on the surface throughout the region included in this volume.

6. After the stage of the suballuvial (=74-foot lake) gravels the long contact of Nile and Faiyum was profoundly modified. The Nile appears to have plunged below its Sebilian level of bed-erosion and to have cut a deep channel in which are hidden the subsequent stages of Man's development until he emerges, with a Neolithic art, in pre-Badarian times, as the bed of the Nile and its alluvium rose toward present levels. In the Faiyum the deduced rate of fall from the Nile for the Middle Sebilian beach, 3–0 feet, seems to show to perfection what was about to happen. After a solitary indication of a level scarcely 3 feet lower (71.7 ft.), all trace of the lake is lost. The Faiyum seems to have been given over to denudation.

The problems connected with this transitional period will be discussed in the following chapter.

CLIMATE (see Pls. XIII–XIV)

The climate of the transitional period between late Mousterian and Late Paleolithic times is a subject of particular interest, and in the Nile Valley a number of fairly well defined facts present themselves:

1. It has been shown that in Nubia local rainfall had already failed in the Sebilian phase of silt and aggradation, and that it has not since been revived to any appreciable extent during subsequent oscillations of river-level.[28] The mouths of pre-Sebilian wadies remained blocked with silt. On the east bank occasional streams of water from cloud-bursts in the Red Sea Hills may be assumed to have reached the Nile by the major wadies at all times.

2. Although rainfall thus failed in Nubia, there is a notable absence of wind-blown sand or dunes in the silt. Today the silt on the greater part of the west bank is deeply buried beneath dunes, and sand cascades from them into the Nile. This state of affairs had certainly not been reached in Sebilian times.

3. Similar conditions prevailed at least as far north as the Kom Ombo plain; but of the extensive fauna found in the silt there is not a single desert animal represented save gazelle, which is by no means a sure indicator of desert conditions, since it is as ubiquitous as other animals will allow it to be. The same is true of the fauna recovered at Kau (see p. 86), which, apart from river forms, requires a grass-providing habitat.

4. The first indication of desert, distinct from scarcity of surface water, is seen on the west bank about midway between Gebelein and Armant, where in 1931 I found the following section:

	Feet
Silt (top about 20 ft. above alluvium)	3
Lenticle of false-bedded wind-blown sand	3–4
Silt	2–3

It is a point of interest that this is situated in the track of a "sand river" which to this day sweeps off the high Libyan scarp, across the low desert, and into the fields. This is the only example known to me of the incorporation of wind-driven sand in the Sebilian silts, and it occurs exactly where it might be expected. It recalls also the computations by which Dr. John Ball estimated the southerly march of certain sand dunes across the Libyan Desert to have taken, so far, about 35,000 years.[29] This seems a long span for late and post-Mousterian times; but if

[28] *OIP* XVII 36–42.

[29] *GJ* LXX (1927) 214. This estimate is based on the Abu Maharik dunes.

we apply the factor for accumulation of alluvium, 4–4½ inches per century,[30] to the full known thickness of Sebilian silt, 100 feet, a period of about 26,000–30,000 years is required. Since the bedding and grain of the silt are similar to those of the modern Nile, there seems to be no reason why the rate of accumulation should not have been much the same. An estimate of the time taken to reduce the river to its present level remains to be computed; the figure applies only to the silt aggradation.

5. With this exception the foregoing evidence suggests only lack of surface water; we must not be too hasty in assuming that the country was a desert. The fact that Sebilian implements are limited, as far as I know, to the vicinity of the Nile and the Faiyum does not imply any more than the following:

The plateaus and plains were difficult to cross for lack of water; but so are many grass-covered lands.

Hunting was unprofitable away from the river.

Man had learned to live on fish, shellfish, and the Nilotic mammals, and did not need or wish to hunt far afield. On the whole it seems probable that the new diet came from necessity, and that the country adjacent to the Nile was not only short of water but was now becoming denuded of plants and animals. On the other hand, as already pointed out (p. 70), there is no evidence that the limestone plateaus ever in the history of Man carried a luxuriant cover of forests; there seems no cause whatever for such a belief. Now, at any rate, such vegetation as there had been was indubitably suffering from a climate immeasurably drier than that of Lower Paleolithic times, although the land was as yet far removed from its present sand-incumbered condition.

6. North of the region of exposed silt—for example, north of the Thebaid—there is no proof of contemporary local deposits in the wadies, but all wadies have been cut below the 10-foot Mousterian level; this is a totally different condition from that of Nubia. Occasional rains still send water down every wadi of the Eastern Desert, and the wadi washes of doubtful age are also of unknown thickness; where seen in section they become indistinguishable at depth from Pliocene deposits of analogous origin. On the western side surface run-off in times subsequent to the choking of the Nubian wadi mouths by silt is clearly indicated.

7. The circumstances just mentioned are reflected in the Sebilian beds, which are gravels and not silts. They are contemporary with fine sandy gravels in Nubia, and today the river lays down only alluvium over them. Their constituents were rolled from the south; they are not locally derived, except in some measure, no doubt, from older Nile gravels.[31] North of Nagʿ Hammadi evidence of a fast-flowing river is abundant in them and in their rolled bones and implements.

8. The strange scarcity of Sebilian implements on the desert surface north of Tell el-ʿAmarna calls for comment. It seems to suggest either that Man was living extremely close to the river or that his implements have since been lost. Paleolithic implements are almost as scarce on the surface, especially on the east bank. They are more abundant on the western gravel slopes. It will be remembered that in the northern parts of the area soft Eocene clays predominate; hence the contrast with the western gravel slopes is, I think, more than chance. In other words, there are such evident signs of erosion of the country of soft rocks that I believe absence of implements indicates that they have been carried away. Wind neither sweeps away such heavy objects nor covers them, save with aeolian material, which is not present to any marked degree. Since the slopes of the soft lands are commonly those of water erosion, and since rain falls on them from time to time at the present day, when the state of aridity

[30] See p. 99, n. 3a.

[31] Some constituents, e.g. agate, are far more abundant in the Sebilian than in older Nile gravels.

is extreme, it seems reasonable to suppose that water was the medium that carried away to the Nile, or buried in local washes where they may be found, implements lying on the surface. Today denudation is effected by both wind and rain. It seems impossible to escape the conclusion that in the past the change was gradual, and that the northern regions retained some run-off, as well as absorbed rainfall, after the south had lost the first and was losing the second.

How, then, will such a conclusion serve when it is applied to the Faiyum? Miss Gardner[32] includes lakes at 112 feet and 74 feet (35 m. and 22 m.) under the heading "Rainfall," with which I agree; but she is unwilling to concede that the Nile supplied the depression with water after the level of the Mousterian lake had been abandoned. Thus she writes: "The 22 m. level is hidden under alluvium in the Nile Valley and Hauwaret Channel; therefore, in the absence of numerous bore-holes, no direct evidence of the direction of flow at this or subsequent periods can be obtained."[33] The information contained in this chapter serves, I think, to remove such doubt and to show that the sinking Nile maintained a lake at correspondingly lower levels until at the 22-meter (74-ft.) level the two nearly balanced. At the end of the phase the water may have flowed Nileward, except when the river was in flood. This would tend to be so if the Faiyum were supplied locally by the rain which both Miss Gardner and I believe to have fallen. It seems therefore that reversed flow of water, Nileward, must be considered as a result of recent work. If the rainfall was considerable, and the basin inclosed, why was a lake no longer maintained?[34] If the basin was still in touch with the Nile, the surplus water could flow into the river.

To conclude, there seems to be a reasonable unanimity of opinion that during the transitional period from Middle to Late Paleolithic times the climate of Middle Egypt and of the Faiyum was not yet that of a desert, whereas the rainfall had failed in southern Upper Egypt and Nubia, and sand was already blowing locally from the high Eocene plateau. The great dunes of the northern Libyan Desert had probably started their southward march.

It has recently been shown that in Khargah Oasis the people were living around springs and that the flow of surface water had been seriously reduced at or about the close of Middle Paleolithic times.[35] The water supply depended on absorbed rainfall, transmitted in the water-bearing sandstone, rather than on local surface run-off.[36] In view of the observations in the Nile Valley this seems to be precisely what might be expected in the Libyan Plateau, well removed from any benefit that the proximity of the Red Sea Hills might confer on the local rainfall.

[32] *GJ* LXXIV (1929) Fig. 3 (opp. p. 416).

[33] *Ibid.* p. 378.

[34] Another solution of the difficulty lies in postulating a dry climate in the Faiyum, with the lake drying up. This is a convenient climatic change that seems to depend on negative evidence of there being no lake; unless there is further evidence, it suggests argument in a circle.

[35] *Man* XXXII (1932) 129–35. See also more recent publications mentioned on p. 17, n. 24.

[36] See also comments by Mr. O. H. Little in *GJ* LXXXI (1933) 526 ff.

VIII

THE BURIED CHANNEL OF THE NILE AND THE ADVENT OF NEOLITHIC CULTURE

INTRODUCTION

The Paleolithic deposits have now been followed until they virtually disappear below the river bed throughout the major part of the valley between Luxor and Beni Suef. The lake in the Faiyum fell and contracted *pari passu* with the Nile, which supplied it with a substantial part of its water until a crisis was reached and the supply interrupted. The cause of the change is not in doubt: the Nile lowered its bed below the level for supplying effectively the Faiyum depression as it then existed. The nature of the inhibiting factor is still a matter for discussion. One school holds that the level of a rock sill in the Hawarah Channel was reached, that the reduced Faiyum lake was thereby cut off from the Nile, and that evaporation and seepage then reduced the lake almost to dryness. A corollary to this theory is that a considerable amount of denudation, which undoubtedly took place in the deeper parts of the depression, was effected by wind, and that no solid material could be washed out by streams. Another school of thought maintains that the supposed rock barrier of Hawarah was not an effective obstacle, and that the Faiyum drained into the Nile Valley during the period of low level. It follows that the products of denudation could be removed in the normal way by streams flowing into the main valley; in fact, the Faiyum is regarded as a tributary of the Nile.

Both theories provide for the survival of a lake in an inclosed basin, or in contact with the Nile as before, below the last level—74 feet—discussed in chapter vii, but the evidence for its continued existence is not forthcoming below 71.7 feet (see p. 93).

If the sill is present in the Hawarah Channel at about 18 meters (59 ft.), as Sir Hanbury Brown seems to suggest,[1] the lake became an inclosed basin as soon as it passed below that level. Some signs of its later levels, or evidence of its ultimate fate, should be forthcoming in the lower parts of the depression; they have been not found. The eastern side of the Faiyum is deeply buried beneath a fan of alluvium deposited by the Nile when it raised its bed once more; and any beaches of the lake below 71.7 feet, formed on its downward grade, are concealed.

If, on the other hand, Sir Hanbury Brown's sketch (on p. 98 of his memoir) is correct in showing no rock sill in the channel even at 15.80 meters (51.8 ft.), and if there is no sill, the continual draining of the Faiyum to a falling Nile might have caused the progressive destruction of deposits; or the lake may not have been kept long enough at any level to form considerable deposits of a durable nature.

Two new issues thus enter into the discussion: (1) the depth to which the Nile cut its bed and (2) the nature of the denuding agents within the Faiyum. In the second we have to decide whether wind or running water was predominant, and the whole question of climate arises (see p. 104). In the first we find more unknown factors: we do not know how deeply the Nile cut its bed, nor do we know the depth of erosion in the Faiyum. The present depth of the Faiyum is about 165 feet below sea-level, but it remains to be proved that so great a depth was attained in the closing days of Paleolithic times. So far as the evidence goes, the

[1] *The Fayûm and Lake Moeris*, p. 92.

figure seems to represent the Paleolithic level; but it must be remembered that overdeepening by wind may have taken place in the interval between the maximum degradation of the Nile and the raising of its bed up the gradient of the Nileward drainage of the Faiyum or above the Hawarah sill. So far as I know this movement was post-Paleolithic and took place after the deserts had spread to northern Egypt.

The various conclusions arrived at in the past may perhaps be made mutually useful. One school of thought thinks the denudation in the Faiyum was wrought by wind; another school postpones the incidence of a predominantly desert climate until a later date. That date can hardly fall after the very close of Paleolithic times. Some common ground, therefore, may be found; and I suggest that it lies in treating with circumspection the present depth of the depression, beneath the Birkat Karun, as the level attained in late Paleolithic times.

The unknown factors in the Faiyum must be settled by proving beyond all doubt whether or not there is a sill in the Hawarah Channel at 18 meters or any other level. That can be achieved only by a number of borings, all of which will need to be carried into the solid rock far enough to show that it is in stratigraphic position, that is, that the bores are not passing through slipped masses[2] or large bowlders. If it be proved that there is a sill, then the denudation of the depression below its level must surely have been carried out by wind. If there is no high sill, the theory of stream erosion applies to the level of the bottom of the channel; and if there remains lower ground on the Faiyum side, it may be assumed to have been excavated by wind below that level.

The foregoing seems to be a fair statement of the case so far as the Faiyum is concerned, and in truth the discrepancy between the two views may not be so great as it seems. In a country like northern Egypt a theory that attributes denudation entirely either to wind or to water must be at a disadvantage. The two have worked together in the past as they do today, and at best we may determine one or the other to have been predominant in the past in certain circumstances. Even today it is often difficult in some situations to decide which is the more destructive (cf. Pls. XIII–XIV).

Most geologists are inclined to think that the Faiyum depression lost its lake for a while. Whether reduction of surface level was caused by the débris being blown out or washed out, or both, becomes a secondary consideration when we look forward. We find that in any event the Nile returned to the depression in due course and continued the historical record, so ably deciphered, in Lake Moeris.[3]

Apart from the general question of climate and of its relation to Man, the Faiyum need not be further discussed here. We are concerned with the Nile and with its tributaries where they supply useful data. The Faiyum fails, as we have now seen, to fulfil that function after the levels of the 74-foot lake have been considered. It is of use again when the reborn Lake Moeris takes up the story in Neolithic times. It will become of further use, positive or negative, to the study of the Nile Valley when we know the profile of the floor of the Hawarah Channel.

THE LOWER BURIED CHANNEL

In the Nile Valley a number of problems present themselves. A deep channel exists below the alluvium, and it is filled with sands and gravels. But we do not know when the channel was cut, or how, or when it was filled, or the depth.

[2] As at Beni Suef (see Fourtau, *loc. cit.*), where Eocene limestone was reached at 33 meters below flood plain. M. Fourtau remarks (p. 66): "Il est, d'ailleurs, plus que probable que nous nous trouvons ici en présence d'un accident tectonique de très faible amplitude. ..." Cf. Sir W. Willcocks, *Egyptian Irrigation*, 3d ed. (London, 1913) II, Pl. LXIX (facing p. 690), for details of a cross-section. See also p. 7.

[3] See Misses Gardner and Caton-Thompson in *Journal of the Royal Anthropological Institute* LVI (1926) 301–23 and *GJ* LXXIII (1929) 20–58.

The early researches of Horner[3a] and others have served to show that the alluvium of today will be buried tomorrow, and that such accumulation has been going on throughout the historic period. Moreover, the rate of vertical growth of deposit may be computed by the age and level of ruins buried in it. Thus not only the ancient towns of the Delta but the ruins of Memphis, Hermupolis (el-Ashmunein), and Thebes have been swallowed up in greater or less degree by the rising tide of alluvium. The computation of rate is a purely archeological problem, which has received continual attention for about 50 years. We may accept the general figure of 4–4½ inches per century as almost the only fact of archeological or geological importance that we really know concerning the bed of the Nile.

So impressed have most of us been by the proved accumulation of silt through the last few thousand years that the lessons which it has taught have been applied to a more remote prehistoric period. It has been realized, however, that the Nile must have a bottom at some depth, and that the excavation of the living rock to that level must have preceded the period of accumulation. Thus we find commonly in archeological and geological literature alike such statements as "after base level at some great, but still unplumbed, depth had been reached in the Nile Valley, aggradation followed." The established facts of recent Paleolithic research in Egypt have caused such a profound movement to be attributed to post-Mousterian times. Undoubtedly, as we have seen, the Nile excavated its bed at that time; if the Faiyum conformed to that movement, it follows that the valley was cut well below present sea-level. If the depth of the Faiyum is deceptive on this count, what evidence is there that the Nile cut to unplumbed depths in post-Mousterian times? There seems, on inquiry, to be very little.

The floor of the Nile Valley is, in fact, unfathomed. Borings and excavations for wells, canals, and foundations are always being made somewhere in the valley, and so far they have reached its bottom only in circumstances which show that the rock encountered is not really at the bottom.[4] Most of the borings are made without scientific interest or observation, and records, if any, are lost. So are the samples from the bores. A percentage of useful data finds its way, however, into government hands and thence to the Geological Survey. To its present Director, Mr. O. H. Little, I am indebted for the opportunity to examine all the sets of samples in the Geological Museum. Most of them from within the area treated here had already been published in the valuable treatise of M. Fourtau,[5] and new records serve only to confirm his examples. Only one new boring will be included here, since it introduces new features; it was made at the Oriental Institute's new Egyptian headquarters near Karnak, north of Luxor (see p. 107).

All borings, being costly undertakings, are put down to serve some economic necessity, to test ground, or to find water. The last objective is gained at about 100–115 feet (30–35 m.) beneath the surface of the alluvium. Engineers invariably affirm that if they bore deeper the water they obtain is saline. Cost increases with depth, as does the risk of losing valuable tools; hence work invariably stops at between 100 and 150 feet. When, therefore, we say that

[3a] L. Horner, "An Account of Some Recent Researches near Cairo, Undertaken with the View of Throwing Light upon the Geological History of the Alluvial Land of Egypt," *Philosophical Transactions of the Royal Society of London* CXLV (1855) 105–38 and CXLVIII (1858) 53–92. This author was the first serious investigator of the use that might be made of measuring thicknesses of silt to obtain a chronological record. He was responsible for nearly a hundred borings and excavations. On these sections, in connection with the assumed ages of the obelisk of Sesostris I at Heliopolis and the colossus of Ramses II at Memphis, he based estimates of the rate of silt deposition. When reviewed in the light of modern knowledge (see Dr. James H. Breasted in *Scientific Monthly*, 1919, pp. 307–8), it is found that the rate of accumulation of silt has averaged at Heliopolis 3.90 inches and at Memphis 4.08 inches per century. Petrie (cf. *OIP* XVII 53) estimated the rate at 4½ inches, but this figure may be rather high. In the present volume both figures, 4–4½ inches, are retained, with some belief that the former is the more accurate, at any rate for the vicinity of Cairo.

[4] As at Beni Suef.

[5] Cited on pp. 80 and 98; see also an earlier paper in *Bull. de la Soc. géol. de France*, 3. sér., XXVI (1898) 545–60.

the Nile bed is of unknown depth, we should imply only that it exceeds, so far as yet known, 115 feet (35 m.) in Upper and Middle Egypt. As the Delta[6] is entered, however, far greater depths are found, for example, 267 feet (81.5 m.) in Cairo, while at Abukir on the sea coast 535 feet (163 m.) of loose material were penetrated without solid rock or a stratum of Pliocene or earlier age being struck.[7]

With Cairo and the Delta we are not concerned here, but we may remember that greater depths are known there than in Upper Egypt. In any bore the rock floor may be at any depth below the level attained. The most southerly bore recorded by Fourtau from the specimens in the Geological Museum is at el-Mataᶜnah, not far south of Luxor; it passed through 115 feet (35 m.) of loose sand and gravel. We may contrast this with the present bed of the Nile a little south of Esna, and thence throughout Nubia, where solid rock is within a few feet of the surface.[8] How in post-Mousterian times can a channel have developed to such a depth in so short a distance and to more than 250 feet below sea-level at Cairo? Although we have no precise knowledge of the depth of the channel then cut, the greatest demands that the Faiyum's deepest part could make upon such an excavation amount to about 275 feet[9] below the present flood plain at Beni Suef. On the gradient of the present river this would mean the same amount at Cairo, or about 225 feet below sea-level there. Thus, whatever allowance is made for post-Mousterian time, there remains an unplumbed balance which was probably not cut or filled at that time.

We may inquire at what previous period the work of excavation may have been done, and when the channel may have been filled from and to unknown levels. It has been shown in chapters ii–iv that there were three periods of excavation in the Nile Valley before Pleistocene times: the Pontic, when the valley was cut, and two during the Third Mediterranean period. Of the latter the first came between the marine and estuarine phases of the Pliocene gulf, the second between the estuarine Pliocene beds and the Plio-Pleistocene sands and gravels that filled the valley before the terrace stages began. The deep valley may have been cut in any one of these three. It seems natural to assign it to the Pontic period, not as the most remote and least known, but because the whole valley subsequently lined by Pliocene gulf deposits was obviously then already excavated, and because the bottom of the Pliocene series also is unfathomed. Only in tributary wadies and rarely near the sides of the valley in Upper Egypt is the base of the Pliocene seen. Canal and other shallow sections show it to continue downward unchanged. I know of no bores that have been sunk deeply into it in Upper Egypt, since water derived from its marls would almost certainly be saline; but at any rate in Lower Egypt Lower Pliocene rocks descend below present sea-level,[10] and their base is seen in marginal deposits only.

The fact that Pliocene gulf deposits continue for many miles south of their generally recognized boundary at Esna[11] requires the modification of a previous belief that the Nile fell into a deep trench at this point, where it leaves its valley in Nubian sandstone and Esna shales. We now know that west of the Nile the gulf is continued southward at least as far as Kom Ombo, and that it is partly hidden beneath the Plio-Pleistocene 150-foot gravels and partly exposed

[6] Fourtau (*Mém. prés. à l'Inst. égyptien* VIII 65) considers deltaic deposits to occur from Minyah northward.

[7] Data and samples are in the Geological Museum, Cairo. Cf. also the Royal Society's boring at Zakazik, which passed through 345 feet (105 m.) of sands etc. without touching solid rock; see J. W. Judd in *Proceedings of the Royal Society of London* LXI (1897) 32–40. See also Blanckenhorn, *Hdb.* p. 153.

[8] See *OIP* XVII chap. i.

[9] I.e., if we make no allowance for overdeepening by wind, take the bottom of the Birkat Karun to be about 160 feet below sea-level and the flood plain at Beni Suef 92 feet above sea-level, and add a reasonable estimate of gradient Faiyum to Nile.

[10] As in Wadi Natrun.

[11] *OIP* XVII 11–12.

along the foot of the Eocene scarp. The Nile intrenched itself between the east side of the 150-foot gravels and the solid rocks of the Eastern Desert from Gebel Silsilah northward, but at Esna it was turned westward a little by the eastern cliffs and so entered the Pliocene gulf from the side many miles north of its head. If the gulf could be followed under the 150-foot gravels, I have no doubt that the apparent discordance of the deep trench first encountered at el-Mataʿnah would disappear. No such discordance exists if the deep channel is considered to have been cut, at least from Kom Ombo northward, in Pontic times, and to have received its deeper filling in Plio-Pleistocene times.

Of the unconformity between marine and estuarine Pliocene deposits nothing is known beyond the fact that estuarine and fresh-water beds were laid down at present flood-plain level from Wadi esh-Sheikh northward, their bases being below flood plain, that is, less than about 100 feet (30 m.) above sea-level. They occur among the lower exposures of the marine strata. Apparently a considerable amount of erosion took place, and the bottom of the infilling deposit is hidden once more. In Upper Egypt, however, the level of quartz sand seems to mark the limit of erosion; on the whole, this is distinctly above flood plain, although the sands may be of considerable thickness. There is no proof that the valley was not excavated to profound depth at this time, but it seems improbable.

Of the third period one thing is certain: that it was the first that could provide the type of material which certainly fills the deep channel in the valley from the greatest depths so far plumbed. In the Geological Museum in Cairo I found that "Nile gravel,"[12] as we now understand it, occurred in all the bore samples of Upper and Middle Egypt at varying intervals from the bottom. The sands have the same composition. It has been demonstrated in chapters ii–iv that sands and gravels of this composition do not occur in the Pliocene series, and that they arrived in large quantities during the Plio-Pleistocene subaqueous phase. They followed, and perhaps accompanied, a period of erosion; and they continued to accumulate until the Pliocene gulf was filled with débris once more. Of the depth of intra–Plio-Pleistocene erosion we have little knowledge, but its visible level is well above flood plain. That does not deny the possibility that there had been an earlier and deeper level. On the whole, the change of level seems too great to have passed without leaving marked traces in other parts of Egypt, and the work of excavating a deep valley in Eocene limestone (if not already cut in Pontic times) to be a task out of all proportion to the small place the phase occupies in the general sequence.

If the Pontic is the most probable period of excavation, the Plio-Pleistocene closing phase of the Third Mediterranean period is the most probable—and first possible—occasion on which the quartz-feldspar Red Sea Hills rock filling could have been provided. I submit, therefore, that of several possible solutions the following is most fruitful:

1. That the Nile Valley was cut to its maximum depth in Pontic times.
2. That the Pliocene gulf facies, marine and fresh-water, in Upper Egypt provided deposits of decreasing coarseness from the side to the center of the valley.
3. That a deficiency of deposit along a median line of the valley caused subsequent longitudinal movements of water to concentrate along it. The Pliocene deposits here, moreover, were very fine marls and clays, including loesslike material as soft as fuller's earth.
4. That the combination of deficient and exceedingly soft deposits between the lateral coarse deposits left the greater depths of the Pontic valley only partly filled and easily scoured.
5. That the Plio-Pleistocene invasion of hard gravel or sand and the overloading of the existing, partly blocked, channel caused scouring and overdeepening and finally deposition perhaps from the Pontic rock bottom upward. This was conducted at the expense of Pliocene

[12] Quartz pebbles from the Nubian sandstone, igneous and metamorphic rocks and loose feldspar crystals from the Red Sea Hills complex.

marls etc.; and the bastions of hard breccia, conglomerate, and travertine were probably little attacked. This may account for the virtual absence of hard Pliocene rocks from among the pebbles of samples from bores.

There is no need to assume that the profoundly deep channel was of late Pleistocene age. Some of it is below the greatest depths reached in Pleistocene times and presumably is Pliocene or Plio-Pleistocene; some of it is certainly of Pleistocene and Recent age.

THE UPPER BURIED CHANNEL

Can we ascertain from the deposits themselves how much is likely to be of Pleistocene date, or determine any sequence? Fourtau[13] has made it clear by his sections that in Upper Egypt the sands and gravels as a whole are strongly false-bedded and current-bedded. They seem to demand unquestionably fluviatile conditions and at times a fast current. At Minyah he detects a change to a less violent deposition, such as might be expected in a delta;[14] and this is maintained in the sections farther north. With admirable caution he has tested the possibility of drawing a dividing line between a lower group of sands and gravels and an upper group of sands, clays, and subordinate gravels in which flakes and crystals of black and white mica and hornblende are abundant. He has shown that in some sections (cf. Luxor) the latter types occupy the upper part to 20 meters (66 ft.), but that in others they descend to low levels (cf. Tahta, 39 m. = 128 ft.), as though the Nile had torn away the coarser beds to this depth and then redeposited the whole, with admixture of mica and hornblende. The question thus arises whether the later period was one of deposition, erosion, or both. Fourtau concludes that locally it might be either. This main distinction of two groups seems to hold good, and we cannot overemphasize the power that a great river possesses of digging deep holes in its bed. He considers the average thickness of the later series to be 25–30 meters, at any rate in the Delta, but reiterates that the estimate is a very elastic one.[15]

The classification founded on mineral analysis holds good within certain limits: the minerals are likely to occur in Plio-Pleistocene rocks exposed high above the flood plain in the adjoining deserts, but normally they are not abundant. Of the later Middle Paleolithic (Mousterian) silts mica is highly characteristic, and it can be seen in them throughout their exposures. Mica, hornblende, and magnetite are here and there exceedingly abundant on the banks of the Nile today; with local additions en route, they have come from the Abyssinian mountains.[16]

Fourtau's separation of the deposits of the buried channel into Nilotic (mica etc.) and Pliocene and Pleistocene (coarse gravels etc.) seems to gain support from recent work in the valley. I feel that we are justified in modifying his second designation to read Plio-Pleistocene, in the sense of its use in this book. His Nilotic (mica) group seems to fall within the range of Mousterian and later deposits which have been traced in chapters vi–vii. It is true that mica-bearing silts occur in the exposed cross-sections in the channel of the 100-foot stage, as at Kom Ombo[17] and Rus.[18] In both places the center of the channel was seen at or about present flood plain, about 100 feet below the marginal terrace. It seems unlikely that the center or scour channels would descend to the depths mentioned above. On the other hand, if we apply to Mousterian and later stages the same difference of level from the margin to the center of the channel, the levels of 20 and 34 meters are well within the limits of channel cross-section. I am prepared to believe, then, that the Nilotic beds of Fourtau are in fact the bases of the Mousterian preaggradation gravels, or Sebilian gravels, for which we have been searching.

[13] *Op. cit.*
[14] *Ibid.* p. 65.
[15] *Ibid.* pp. 89–94.
[16] W. F. Hume, *Geology of Egypt* I 59 and 96.
[17] *OIP* XVII 32–33.
[18] *OIP* X 33.

Their lowest levels below alluvium in Upper Egypt are recorded in all too few sections:[19]

	Depth of Nilotic Beds		Depth of Bore	
	Meters	Feet	Meters	Feet
el-Mataᶜnah I	16–21	52– 69	35	115
el-Mataᶜnah II	18–20	59– 66	35.7+	117+
Luxor I	16–19	52– 62	30.5	100
Luxor II	13–20	43– 66	30	98
Kena	6–18	20– 59	30	98
el-Higz, district of el-Balyana	28–34	92–112	34+	112+
Tahta	36.5–39	120–128	43	141
Asyut	35.5–46	117–151	46+	151+

Bores at Minyah and Beni Suef passed through only a few meters of Nilotic deposit (Beni Suef 11.6 m.[20] = 38 ft.) before entering coarser deposits. There is a dearth of records in Middle Egypt. It will be noticed above that the depth of Nilotic deposit falls from south to north. The trend is maintained even in the Delta; a bore at Abu Ghalib, northwest of Cairo,[21]

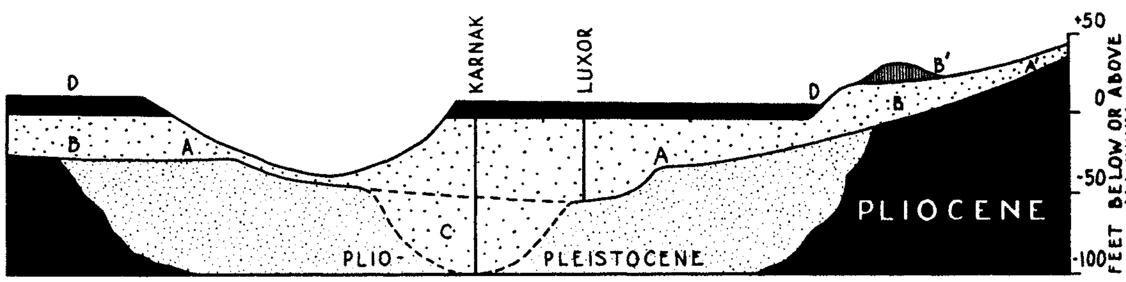


Fig. 25.—Section of the Nile Valley in Upper Egypt According to Views Explained in Text

A–A Surface upon which flood-plain gravels of the Nile accumulated in Mousterian times, before aggradation, and river channel of that time
A–A' Lateral valley of the same period
B Valley gravels at end of 10- to 15-foot aggradation and Nile deposits, re-eroded, below alluvium
B' Remains of Sebilian silts, resting on the aggraded gravels *B*
C Deep channel proved in bore at Chicago House, Karnak, possibly cut during Sebilian re-excavation of the Nile Valley
D–D Modern alluvium and river channel

showed Nilotic clay and sand to a depth of 29 meters (95 ft.) below the edge of the desert, which here is little above alluvium. The Mousterian and Sebilian gradients behave in precisely the same way; but to endeavor to attach given beds or thicknesses to one or other of these two gradients would be ineffective. All we can say is that the gravels of the later stage were recessed to an unknown depth into older gravels, and that since their exposures are covered directly by Nile silt (the "terre végétale" of Fourtau) a fair idea of the summit level is probably obtained. Flint implements have not previously been found *in situ* in the suballuvial deposits, and these are early days of this new line of inquiry (see Fig. 25).

To summarize: The mica-hornblende Nile deposits which may be of Mousterian and Sebilian age appear in deep channels at Asyut to 151 feet below alluvium, that is, only 20 feet above present sea-level. They are not seen at great depth in the scanty records of Middle Egypt, but reappear in the Abu Ghalib bore. Since the general level of that district is about

[19] Fourtau, *op. cit.* pp. 59–63. In some sections they recur at higher levels (*ibid.*).
[20] *Ibid.* p. 65. [21] *Ibid.* p. 73.

16 meters (52 ft.), above sea-level, these 29-meter deep Nilotic deposits are well below present sea-level, even if a generous allowance is made for the slight height of the desert edge.[22]

There is thus ample depth for the later Paleolithic periods of erosion in Middle Egypt, but there seems to be no means of estimating how much is to be attributed to the Sebilian degradation that broke the connection of the Nile and the Faiyum. It was foreshadowed by the falling levels of lake and river in Middle Paleolithic times and by the Sebilian suballuvial gravels to 18 feet below alluvium, and the downward movement certainly continued. The older Sebilian Nile gravels may have remained as a marginal feature forming the banks between which the Nile sank yet deeper in late Sebilian times; in the end it raised its bed, once more covered them, and flooded the Faiyum. The new, Neolithic, lake in the Faiyum, which became the historic Moeris, seems to have attained a maximum level of 18 meters (59 ft.) above sea-level, then sinking and remaining to form a beach at 2 meters (7 ft.) below sea-level in later Neolithic times; people of the 4th dynasty later lived on the beach.[23]

Subsequent history appears to record only sinking levels of the lake, until the present shrunken survivor is 45 meters (147 ft.) below sea-level. Its level has been governed from antiquity to the present day, with occasional lapses, by irrigation works within the Faiyum and at the mouth of the Hawarah Channel, where the Bahr Yusuf enters. This canal flows near the edge of the Western Desert north of Deirut (see Fig. 2) and has the appearance of a natural channel; no engineer would have dug a canal with so irregular and meandering a course. It was probably "trained" by irrigation works at an early date, having previously been a lateral channel which collected seepage water from the higher alluvium near the actual banks of the Nile. Such side channels are common in mature rivers with wide alluvial valleys.

Were it not for irrigation works, the whole Faiyum depression would be flooded again to about 26 meters (85 ft.) above sea-level for at least a part of each year. That this happened in Neolithic times is proved not only by the lake at 18 meters (59 ft.) but by the great cone of Nile silt which spreads out delta-like from the western end of the Hawarah Channel, falling rapidly toward the perimeter.[24]

CLIMATE

It seems reasonable to assume that a considerable degree of aridity had extended over most of Upper and Middle Egypt by Neolithic times. As we have seen, it had probably claimed Nubia and the southern part of Upper Egypt at an earlier date. Probably too the Libyan Desert, or a large part of it, had suffered a similar fate long before the Neolithic period, and the population had concentrated round the wells and oases.[25] The limits of thorn scrub in the far south and of the Mediterranean rain belt in the north in Neolithic times cannot be gauged with any accuracy, but I would venture the opinion that both have since retreated long distances. A vegetation adapted to a slowly decreasing rainfall is astonishingly tenacious, and

[22] See p. 80. The exact spot is not known, but the bore may be assumed to have been connected with one of the agricultural enterprises that started operation on the desert edge here. All the operations were conducted on the same general level. Most of them failed, and their ruins are buried in sand.

[23] See *GJ* LXXIII (1929) 51; Miss Gardner's A. L. ("above lake") levels are correlated with sea-level in *OIP* X 73. But in *GJ* LXXIV (1929) Fig. 3 (opp. p. 416) the upper level is given as Final Capsian, the lower as Neolithic, and two intermediate levels, 10 meters (33 ft.) and 4 meters (13 ft.), are interpolated, both of Neolithic age.

[24] The apex of the cone is at about 20 meters (66 ft.) above sea-level, but the upper levels of silt may be of comparatively recent age.

[25] P. Bovier-Lapierre, "Les explorations de S.A.S. le Prince Kemal el Din Hussein; contribution à la préhistoire du désert libyque," *Bull. de l'Inst. d'Egypte* X (1929) 33–44. Data collected in the Libyan Desert in the autumn of 1932 that refer to this question cannot adequately be added here; in general, with certain amplifications they support the conclusion (see *GJ* LXXXII [1933] 219–22).

with suitable environment is ever ready to reclaim lost ground. In Upper Egypt the struggle of plant communities to maintain themselves was lost; they survive only in wadies and around water holes. In the northern part of Middle Egypt rain still falls heavily a few times in nearly every winter, and, apart from the immediate crop of plants that wither with the advent of late spring, some patches of scrub manage to survive in fairly exposed positions. Farther north, especially east of the Nile, the desert gives place imperceptibly to semi-desert and to scrub- and grass-covered ground. A slight change for the better would move the whole of this system southward. But the whole of the semi-desert belt, although it provides grazing land and allows free movement to human beings with their flocks,[26] leaves little trace on the ground by which its presence might afterward be distinguished. Occasional rains tear the ground, as in the barren desert, and locally sand still blows and abrades exposed surfaces. From the human point of view the difference is important, namely that of supporting life or of forcing evacuation of the territory. Of the diversity of present conditions along the banks of the Nile in Upper and Middle Egypt, Plates XIII–XIV give some indication.

I suggest, therefore, that the precise determination of the habitable or uninhabitable, semi-desert or desert, state of these borderlands of northern Middle Egypt in final Paleolithic, pre-Neolithic, and Neolithic times is generally impossible. In exceptional circumstances a definite opinion is justified. Thus the population of the Faiyum depression and its environment has been proved.[27] The district seems to have been considerably more habitable than at the present day: grain was raised, and apparently flocks were grazed, by Neolithic peoples.

But it is still impossible to mark the dividing line between desert and the advances and retreats of the Mediterranean rain belt from the latitude of the Faiyum. There is a gradation from desert to non-desert in which we must make arbitrary divisions; and, as far as I know, the climate of the northern part of the area had approached, though it had not attained, its present state, latitude for latitude, in Neolithic times. With this we may contrast the state in the nearest period to which we can give a date in terms of human industry, the pre-Upper Sebilian time of the suballuvial Nile gravels and 74-foot Faiyum lake. The climate in the south seems to have been already that of the present day; in the north evidence indicates that the country was not yet desert. Between the Sebilian and the Neolithic the north graded from non-desert to desert and to local grassland and semi-desert, while the Paleolithic culture passed away. Of the relics of the passing of climate and culture we see little that we can interpret. The latest culture stations of Paleolithic appearance—for example, Hilwan in the north and the Upper Sebilian of Kom Ombo and Edfu in the south—provide certain types which might appear in a Neolithic site, but they do not prove a transition from one to the other. Similarly the Neolithic stations of Egypt fail to attach themselves to any preceding industry that we know within the country. Here, then, in the study of climate and human industry, a blank page in history remains to be inscribed.

Within broad limits the gradation of rainy to dry climate is well shown in the decreasing amount of dissection, by small wadies and stream courses, of the beach and other lake deposits from Mousterian to Neolithic. It can be observed in *OIP* Volume X, Plates V–IX. Although erosion by wind-blown sand is now severe on the plateau surrounding the Faiyum,[28] and although clouds of dust and grit are raised on the floor of the depression, remarkably little wind erosion has taken place in some localities. For example, the Faiyum Neolithic people lived around and sheltered under eroded deposits of the 74-foot lake on the north side of the depres-

[26] Movement is possible over poorly watered ground with the aid of grazing domesticated animals where human beings alone would find progress difficult; i.e., milk takes the place of water.

[27] See p. 98, n. 3.

[28] *OIP* X, Pl. X, *B*.

sion, at and near Kasr es-Saghah. Their implements still lie close to the eroded hummocks, which have therefore suffered virtually no erosion since Neolithic times.[29]

We are thus brought back to our starting-point. *Locally* for a very long time sand has been blowing in the Nile Valley and over the Libyan Desert; we find ancient dunes in places still particularly afflicted with sand. But for such occurrences, the continuation of a non-desert climate may be discerned in the north until Neolithic times; in the extreme north it still continues. In the far south it was replaced by aridity in Paleolithic times, and drifting sand came later. Drifting sand and surviving grassland and sparse, naturally watered, cereal crops may still be seen side by side in northern Egypt; in Neolithic times they may have been seen 200 miles or more farther south. I can find no closer parallel to the conditions in late Paleolithic and Neolithic Middle Egypt than that provided by the Mediterranean seaboard of today or (to compare with its broken plateau) by the Missouri plateau with its upland grazing grounds and encroaching bad lands.

APPLICATION TO ARCHEOLOGICAL PROBLEMS

A brief survey of the application of the foregoing to purely archeological problems may now be undertaken. I do not propose to review the question of the rate of rise of alluvium with reference to ancient monuments; the ground has been trodden many times. A logical conclusion to be drawn from the observation that the alluvium is rising is that excavation of its greater depths might reveal the most ancient civilizations. That is undoubtedly true. The difficulties lie in finding a site beneath the mantle of alluvium and in reaching it with anything larger than a bore tube. The whole Nile Valley is a reservoir of water that flows in an inexhaustible stream into any excavation that probes deeply below the level of saturation.

If the technical difficulties of locating and exploiting a site can be overcome, where should be suitable areas to start investigation? The following seem to be points worthy of consideration:

1. From the earliest days Man seems to have had a predilection for living in the country now desert or near its edge. One side or other of the valley might produce better results than the middle. So far as town sites are concerned, this does not apply to the more civilized times of the organized towns of the Delta and of Upper Egypt.
2. The west bank is heavily veiled in sand, which comes to a halt on the alluvium, or has advanced over it very slowly, and nowhere for any great distance. The dunes afford some shelter from wind where there are no cliffs, as on the west side in Middle Egypt, and more or less saline lakes and seepage areas among them support some vegetation fit for grazing.
3. The west bank north of Denderah has been left unassailed by the Nile, so far as known, since Paleolithic times. The Sebilian channel was already at or near the foot of the eastern cliffs.
4. The east bank has suffered progressive destruction; thus large quantities of Roman and other pottery are found in the river bed north of Antinoupolis and near el-Hibah, and temples have been destroyed (that at Kom Ombo has been saved by huge stone facing-walls; others have disappeared entirely, as at Kau el-Kabir).
5. The east bank was convenient to live upon during historic and prehistoric times, especially for fishing and river traffic, but it offered little grazing. The alluvium at the foot of the east bank may be, except locally, of fairly recent origin.

[29] With this may be contrasted the occurrence of blown sand to the very bottoms of Nilotic deposits at the margins of the Delta (Fourtau, *op. cit.* pp. 71–72), where sand has evidently been blowing for an exceedingly long time.

6. The west bank seems likely to be the more profitable, on the grounds of the river's action and of the daily needs of any people.[30] Religious motives also may in rather later times have favored the west bank.

7. Situations on the top of the recently identified Sebilian gravels north of Nagʿ Hammadi might offer special advantages, both in antiquity and for excavation. The deposits are for the most part gravels, which are suitable for habitation (as opposed to undrained and swampy ground). They are often cemented, hard, and resist erosion far better than alluvium; they tend to survive, with their surface accumulations. From the archeologist's point of view they provide a datum of known age.

8. Consideration of the borings published by Fourtau shows that the "terre végétale" does not exceed a few meters in thickness, and that below lie sands and silts which are not likely to be profitable. No peat beds are known at depth south of the Delta.

9. Man seems to have disappeared from the scene with Sebilian times in Upper and Middle Egypt, except in the Kom Ombo–Edfu district and in isolated stations such as Hilwan. Even these sites leave a gap between the end of the Paleolithic and the Neolithic. Presumably Man was living on the banks of the river and scarcely left it. In the north the continuation of erosion of the soft deserts by wind and rain has helped to mask his stations remote from the Nile itself, but more will certainly be found. Accumulation of alluvium has hidden the remainder occurring within the actual banks of the alluvial tract.

10. There appears to be little chance of preservation by submergence under alluvium south of about Esna.[31]

11. From time to time pottery is found in bores at considerable depths in the Nile Valley.[32] This occurred in the well recently put down at the Oriental Institute's new headquarters at Karnak near Luxor. The section was as follows:

Bed		Meters	Feet
5	Nile silt and sand with broken pottery	20	66
4	Nile sand with jaw of sheep (possibly goat or ibex)	2	7
3	Black Nile mud, broken pottery	8	26
2	Sand, grading upward to silt, and black mud	2	7
		32	106
1	Coarse sand and gravel with pebbles, quartz, agate, flint, and rocks of Red Sea Hills complex, with high polish on surfaces; matrix of hard lime cement*	1+	3+

* Bore discontinued on reaching this hard bed; penetrated for about a meter.

Nilotic deposits with pottery are thus penetrated to 30 meters (98 ft.) below the present level of alluvium. The Plio-Pleistocene beds lie directly below, cemented into an exceedingly hard rock. The bore is situated within 50 yards of the bank of the river. Barely a mile away, at the borings in Luxor quoted on page 103, Nilotic beds in the sense used by Fourtau, that is,

[30] The truth of these deductions seems to be well illustrated by the highly successful excavations at Marimdah and Beni Salamah, on the western edge of the Delta, conducted by Junker, Menghin, and others for the Akademie der Wissenschaften in Wien, latterly in conjunction with the Egyptian Museum of Stockholm. See *Anzeiger der Akademie der Wissenschaften in Wien*, Philos.-hist. Klasse, 1929, pp. 156–249; 1930, pp. 21–83; 1932, pp. 36–100.

[31] As is made clear in *OIP* XVII 54.

[32] Dr. Breasted, in *Scientific Monthly*, 1919, p. 307, cites Horner (cf. p. 99, n. 3a) as follows: "In a large majority of the excavations and borings, the sediment was found to contain, at various depths and frequently at the lowest, small fragments of burnt brick and of pottery." He also recalls the presence of pottery in alluvium at 22 meters at the southern apex of the Delta and at 27 meters on the Mahmudiyyah Canal (for the last see J. de Morgan, *Recherches sur les origines de l'Egypte* I [Paris, 1896] 19–20, n. 2).

mica-bearing, not the Plio-Pleistocene sands and gravels, were proved to only 62 and 66 feet, at the Luxor Hotel and the Karnak Hotel respectively. The sherds from the Oriental Institute bore could not be identified with known types, since they were too fragmentary, but wheelmade pottery was present. The levels are far below the generally accepted figures of silt accumulation during historic times, and the possibility of habitation levels with wheelmade pottery at such depths can, I think, be ruled out of the question. The real problem seems to be whether the Nile channel has scoured to such depth in comparatively recent times, or whether the sherds have sunk through older beds to their present positions.

Low Nile is at about 73 meters (240 ft.) above sea-level at Luxor,[33] and the top of the bore is at 77 meters (253 ft.)—a difference of only 4 meters (13 ft.). If a depth of about 5 meters (17 ft.) be allowed for the water at low Nile, the lowest level of sherds still lies 21 meters (69 ft.) below the river bottom. There is no particular reason why the Nile should scour deeply here; on the contrary, expensive works have to be maintained to prevent its lateral movement from sweeping away Luxor and Karnak and the Institute's headquarters. But similar works in the past may have caused the river to scour and undermine them; and, in view of the soft beds indicated by the Luxor bores, the depth of scour *might* reach the lower limit of included pottery. That possibility cannot be ignored; but more probable is the view that this great excavation was made at an earlier date, for example during Middle and Upper Sebilian degradation, when the normal Nile level stood much below its present position. On the other hand, the pottery is of a type clearly later than any that could be associated with the deposits if they were in their normal position at the depths of such a cavity. Either, then, the deposits are of the period of the pottery and represent a profound scour of contemporary age; or the deposits are part of a normal series formed when the Nile was deeply intrenched, and the pottery has been introduced from above. It is true that the nature of the deposit shown in the bore and its waterlogged condition give it little power to support bodies of greater density than itself, and it seems probable that heavy objects might find their way to great depths from the bed of the Nile, that is, once they were below the level of saturation.[34] But the pottery has a density not much above that of the very clay from which it was probably made, and whether the difference is sufficient is a debatable point. Since flat bodies sink through viscous substances by turning on edge, traveling slowly downward through a medium that might support them if they remained horizontal, it is reasonable to suppose that sherds may do likewise.

To conclude, therefore, I suggest that, taking into consideration the nature of deposits exposed in the upper 30 meters of the Institute's bore at Karnak, the pottery may have found its way to these great depths by sinking through pre-existing beds. On the other hand, a scour *may* have occurred here, in the undermining of old training works, or in the more remote past a channel may have been cut. The contrast in level between this bore and those of the hotels in Luxor near by is so sharp that a distinct excavation seems to be indicated (see Fig. 25). In no circumstances is it necessary or permissible to postulate on the present evidence a habitation level at this depth in historic or Neolithic times. Yet there is no reason to suppose that very ancient habitation sites do not lie beneath the surface of the alluvium; unquestionably some are so situated. Such may, I believe, be found, especially along the west side of the valley, at less depths than these beneath the surface of the alluvium. In the more central parts of the river's flood plain there are too many possibilities of destruction or of incorporation of material at later times.

[33] Quoted from the *Almanac* of the Ministry of Finance, Cairo (issued annually by the Egyptian Government), ed. of 1927, p. 54.

[34] "Locse sand" is marked in some sections of the Nile bed by Sir William Willcocks; see his *Egyptian Irrigation*, 3d ed. (1913) II, Pl. LXIX (facing p. 690), and the mass of evidence that he gives (*ibid.* I 60–108) concerning the large volumes of water that pass rapidly through sands and diluvial deposits below the surface of a flood plain.

IX

HUMAN INDUSTRIES

Many methods have been employed to illustrate flint implements; all of them have disadvantages. The most artistic means of reproduction lies, no doubt, in sketching; first-class artists are few, however, and rarer still are those who can portray faithfully the features useful to the typologist. Moreover, strong artistic individualism enters into such portrayal and makes comparisons of types a difficult matter.

The question of technique of illustration has arisen recently from a new angle. The publication of a representative collection of Nilotic paleoliths has been seriously considered, and, although this is yet in its infancy, the first and essential step lies in the adoption of a standard means of illustration that might be followed in international publications on the same subject.[1] To overcome the difficulties given above and to achieve uniformity of treatment, photography suggests itself. With this in view a method was tried in the concluding plates of *OIP* Volume XVII combining the use of enlarged photographs, of line drawing upon them, and of rephotographing to natural size. This treatment was successful for small flakes. In the present volume I have simplified the work by drawing on the natural-size photograph with the aid of a hand lens and a very fine-pointed draftsman's pen. For bigger material photography alone may be employed. With the example of Currelly's photographs[2] before us there is no reason why a high standard of reproduction should not be maintained. A further point arises in the question of uniformity, with a view to international co-ordination, in the disposition of the pieces to be reproduced. By convention high light is shown from the top of a plate; if coups-de-poing are figured point downward, as is often the case, the best light is wasted on their butts, which may be of unbroken cortex. Accordingly it is suggested that by convention these implements should unfailingly be portrayed point uppermost. Of flakes, the end formed by the striking-platform is often the more important for study, and it is therefore given the most advantageous light.[3] Finally, it is urged that every effort be made to illustrate all material at its natural size. This policy is followed without exception in these volumes.

With the foregoing considerations in mind, I sought the collaboration of Mr. H. J. Hambidge, of the University Museum, Oxford, an expert photographer and technician; and the illustrations of implements that accompany this volume are to be credited to his patience and skill. I take this opportunity of expressing my thanks.

In choosing implements to be figured we have to deal with certain matters of policy that were discussed in *OIP* Volume XVII; that is, it is beyond the scope of these chiefly geological volumes, designed to prove the relative ages of Paleolithic industries, to enter into lengthy typological discussions. Moreover, the quantity of material definitely "dated" by geological means is outweighed by the vast numbers of implements that incumber the surface. These are

[1] On the lines of the corpus of pottery types proposed by Mr. Oliver Myers.

[2] "Catalogue général des antiquités égyptiennes du Musée du Caire." Nos. 63001–64906. *Stone Implements*, par M. Charles T. Currelly (Cairo, 1913). The plates are of great beauty and of high technical merit, and it would be difficult to find their rivals in any publication of the last 20 years. The accompanying text is purely a catalogue. Most of the paleoliths figured are surface-found specimens, with uniform brown patina; material found *in situ* varies widely in texture and color.

[3] To supplement the illustrations of flakes an analysis of their striking-platforms and of used cores from which similar flakes have been struck is included in the text; see. p. 117.

of typological interest and could not be omitted from such an analysis; but they lack proof of age, except by analogy of type, and therefore have no place here. The present object, then, is to provide stratigraphic evidence of age of types, and to leave the analogy. The implements chosen for illustration in this volume, therefore, have been removed from geologically dated deposits. A few, found on the surfaces of given deposits, are included for purposes of contrast and to show that allied forms occur *in situ* in later geological strata.

With regard to choice, on the foregoing lines groups from certain sites are chosen where available, with additions to show that the type is not localized to the group. Care has been taken to avoid as far as possible reproducing the same types as appeared in *OIP* Volume XVII. Thus that volume will be found to illustrate in some detail the Chellean industries of the 100-foot terrace and the Mousterian of the 10-foot terrace; here those industries have been sparingly shown. Instead, the Chelleo-Acheulean types of the 100-foot terrace, the development of the Acheulean types of the 100- and 50-foot terraces, and the Early Mousterian implements of the 30-foot terrace receive more attention. The transition from Mousterian to Sebilian is illustrated in *OIP* Volume XVII; north of Luxor the Sebilian is seen only at intervals, and the Upper Sebilian is yet to be found. In Middle Egypt, however, the later Mousterian types are present in the gravels rising from 10–15 feet to 25 feet, and they will receive some attention here. Throughout it must be remembered that the implements are examples chosen to define lines of development; I do not pretend that this chapter is in any sense a detailed account of the contents of the collections.[4]

THE LOWER PALEOLITHIC STAGE

Implements of the 100-Foot Terrace

Implement No. 1, from the gravels of Beni ʿAdi, serves as a type of the sharply triangular implements with heavy butt that are associated with this terrace. In this instance the blows were delivered on two edges. The third, which is remarkably straight, is formed in part by the junction of the flakes detached from the other corners of the triangle; it also marks the edge of a natural fracture older than the flakes. Owing to the tough nature of the impure chert, much of the work was done by battering off small flakes and chips, and the zigzag line is thus not so prominent as is usual in implements of this class. The butt was reduced to useful size by the removal of three flakes. The implement was made from a large cobblestone from the gravels of Oligocene origin, and the naturally battered surface takes the place of the usual crust. In spite of the fairly straight edges, the specimen is certainly allied to the class of primitive Chellean implements first described by Père Bovier-Lapierre[5] from ʿAbbasiyyah, illustrated in *OIP* Volume XVII, Plates XIII–XV, from the 100-foot gravels of es-Sibaʿiyyah.

No. 2, from the 100-foot gravels of Kena Hill, illustrates a well known type of Chellean implement, bifaced instead of triangular, made by the skilful removal of a few large flakes. A

[4] The use of the terms Chellean, Acheulean, and Mousterian may be criticized. The first two will probably be accepted; the third is used as a matter of convenience to describe a flake industry with a striking-platform in most cases prepared by flaking. The "Early Mousterian" of Egypt bears a remarkable resemblance to certain European forms; the typical Egyptian Mousterian, somewhat later, seems to be less closely allied. By reading "Egyptian" always before "Mousterian" perhaps a reasonable degree of accuracy may be obtained. At the time of writing there is a strong tendency in France to refer early forms of these flake industries to the Levalloisian, a "cousin" of the Mousterian that has been elaborated into at least seven divisions; a few years ago these flake types were termed by the same authorities Mousterian A, B, C. The brilliant researches in France no doubt justify the distinctions made, but I feel that we are not yet in a position to apply the results in Egypt. The use for the present of the terms "Early Mousterian" and "Egyptian Mousterian" is intended to cover a later possible distinction of Mousterian and Levalloisian groups. For a valuable statement of recent research in France see H. Breuil in *Bull. Soc. préhist. franç.*, No. 12 (1932). See also p. 67, n. 9.

[5] See p. 55, n. 5.

fairly straight edge, for the size of the flakes, also points to the skill of the maker. The butt is untouched. There has been much development of technique between the type of No. 1, largely battered into shape, and that of the well formed No. 2, also made of an intractable chert of a Lower Eocene "melon" concretion.

No. 3, from the gravels of el-Haita in Wadi Kena, is of much the same style as No. 2, bifaced and with fair bilateral symmetry, still retaining an untrimmed butt of considerable size. The point concentrates the full weight of the implement and was made by about four blows; there is no retouch. Small flakes became detached from the edges by use or rolling in water at the time of incorporation.

No. 4, from the gravels at the foot of the travertine scarp in the northern part of the Abydos bay, southwest of Suhag, shows a marked development. Again a pebble was used, and the untouched surface forms an entirely effective butt, while the opposite end was carefully reduced by skilful primary flaking. There is a little secondary work or retouching of the point. The two flaked surfaces are almost identical, and bilateral symmetry is fully attained. Chellean skill is well demonstrated in this specimen, and it is but a short step to forms that suggest a transition to early Acheulean technique—for example No. 5, a broken specimen from the same gravels at Beni ʿAdi as No. 1. Again a cobblestone of tough chert was used, but almost the whole of the outer surface was removed. The butt accordingly lost weight and became ill adapted for the hand; in fact, its sharpness would certainly prevent such use without some protection. There are marked recesses (each marked *a* on Pl. XIX), however, in the edges of the implement at the most suitable points for binding or hafting. These may be observed on other specimens of similar type, and the possibility of such a method of use cannot be ignored. The implement has a lense-shaped cross-section; the edges are straight and were evidently carefully retouched. Unfortunately the point has been broken, but there seems to be good reason for assigning the specimen to an advanced Chellean or early Acheulean age.

No. 6, from the same position in the Abydos bay as No. 4, presents certain problems. I know of no similar specimens from other exposures of the 100-foot gravels, although the type occurs infrequently on the desert surfaces near the Nile. On the other hand, it is slightly waterworn and was found in the gravels, exposed by a small rill which had cut through them. It had certainly not been introduced into the gravels at a later date. The flaking is of Chelleo-Acheulean type, and although the implement is not supported by others found *in situ* there seem no grounds for dissociating it from that connection. All three sides and the butt are flaked; the point received special attention.

No. 7, from the gravels at el-Haita, an example of the coarse flakes that occur in the 100-foot terrace,[6] is the best available example that was found *in situ*. The Egyptian flakes of Clactonian[7] aspect are not yet well established. It is plain that they are rare in the 100-foot gravels between Luxor and Hilwan, although they and the cores from which they were struck are more common farther north and south. In the example figured here the same general plan is seen; but the cone of percussion is at the very edge and none of the striking-platform remains, a feature not unknown among the flakes of Clactonian type. Some small chippings along edges seem to be intentional or to have resulted from use. The specimen is a little waterworn and bears a slight patination. Examples found on the surface have a flaking angle of about 110°–120°.

[6] See *OIP* XVII 28 and 73.

[7] See p. 56, n. 6. Breuil in *Bull. Soc. préhist. franç.*, No. 4 (1930), records his discovery of Clactonian forms in alluvial deposits at 60 feet above the river Vaal in South Africa, and he is confident of the presence of the industry in Egypt. During the publication of this volume Professor Breuil has published his important monograph, "Les industries à éclats du Paléolithique ancien. I. Le Clactonien" (*Préhistoire* I [1932] 125–90). In this he also proposes to substitute the name "Abbévillian" for "Chellean."

Nos. 8 and 9 are types of implements more advanced than are usually found in the 100-foot terrace. No. 8, from the el-Haita gravels, is strongly plano-convex, with edges carefully flaked after primary roughing-out of the whole implement. The flatter surface lacks the beautiful "fish-scale" flaking of highly developed Acheulean forms and is slightly bowed; that is, though the design is plano-convex, the lower face is not flat. All cortex is flaked off, but one edge is irregular and bears scars resulting from battering or use. The point is broken, and the side of the implement may have been used for some purpose at a later, but remote, time. No. 9, from the gravels at Bir Arras, near the mouth of Wadi Kena, is remarkably thin and suggests an early form of Acheulean ovate implement; the flaking, however, is far below the standard of that type, or that of No. 8, and the edges, which are straight, were scarcely retouched. It was found at a depth of a few feet in the gravel, lacks all patination, and is unrolled. Acheulean flaking-sites occur near by, and the specimen was probably incorporated and covered with sand and gravel without suffering any damage; there seems little chance of its later incorporation.

The series of types from the 100-foot terrace may be brought to an end by No. 10, from the same gravels in the Abydos bay as Nos. 4 and 6. Like No. 8, it is of plano-convex form, though the lower side was not reduced to flatness and is marked by deep flake-scars. As in No. 4, which it resembles, a cobblestone of Oligocene derivation was used; and the butt is untouched save for the concentration of two or more minor flakes and for a larger scar (*a* on Pl. XXI) at a point similar to the niche in the butt of No. 5. Apart from its approach to a plano-convex plan and its almond-shaped point, the implement does not display a high order of work; the edge is remarkably straight, but, perhaps in view of the difficult nature of the material, scarcely any secondary work was attempted.

Thus, although Acheulean style of work may be recognized in Nos. 5 and 8–10, and perhaps in No. 6, there is no reason to assume that it had reached high developmental stages during the period of the 100-foot terrace. The truth of the statement may be emphasized by the comparison of these implements with No. 11 for example, a deeply patinated and unrolled *limande* from the surface of the 100-foot terrace of Bir Arras. The perfect bilateral symmetry, the control of the primary flakes, and the regularity of the secondary work are in a class entirely apart from that of the earlier specimens. This is seen also in the ovate implement No. 12, from the same place, in which a scraping or cutting edge, sharp even today, was produced. The lower surface (not shown) was spoiled by later flaking, probably Mousterian, of a totally dissimilar character, and one edge has suffered accordingly. Associated with these implements on the surface of the 100-foot terrace and in Acheulean working-sites near by was a chopper in the form of half an ovate, broken across the longer axis. I have recently found another on the opposite side of Wadi Kena, in Wadi Grayya; but such implements have not yet been found *in situ*. The edges of none of the implements figured or discussed above show any indication of the twist so characteristic of some Acheulean types in Europe.

Implements of the 50-Foot Terrace

A considerable variety of implements has been found in this terrace. All types of the 100-foot terrace appear in rolled condition, as derivatives, but it becomes a debatable point to decide which of the later forms are derived and which are of the age of the 50-foot terrace. This applies to No. 13, from the 50-foot gravels of Beni ʿAdi; its form and straight edge with some secondary flaking suggest its Acheulean design. An *arête*, formed by the junction of flakes along one face of the implement, is markedly asymmetrical; on the other face the flaking was carried over the whole surface and no rib produced. As in earlier examples, allowance must be made for difficulties presented by certain materials, but, even so, this cannot be regarded as a well defined Acheulean type, and it might occur in the older gravels; it serves as a connecting link between them.

A remarkable group of implements came to light in 1926 at Kena, when by good fortune I camped on the southwest side of Kena Hill on the 50-foot terrace gravels near some excavations for *sebakh* (marl) that lies below them. In the pits so provided I was able to extract a considerable number of implements from varying depths in the gravel. This collection comprises points or coups-de-poing, ovate implements and disks in all stages of manufacture, and a few flakes. The specimens are virtually unrolled and have the natural color of the flint or a thin white crust. Their condition suggests that they were incorporated without traveling any considerable distance. A few are slightly rolled.

No. 14 is a large coup-de-poing from this site, broken at the tip. The outer surface of the flint was entirely removed, and the perfect semicircular outline of the butt is of Acheulean design. The edges are sharp and straight, and flaking was carried carefully over one surface; the opposite face has an unfinished appearance. The breaking of the point is recent; the specimen had been loosened by men digging for *sebakh*, but in a prolonged search I failed to find the missing piece.

No. 15 presents a remarkable contrast. Tabular flint was used, and the butt is perfectly suited for use in untouched condition. The implement was roughed out by less than twenty blows delivered alternatively, leaving zigzag edges. The point was developed by the most delicate work. I know of no other specimen like this in Egypt, and its provenance here in the Kena gravels is above suspicion. It is virtually unrolled and almost unpatinated, such patina as exists being creamy white.

No. 20 is another point from the same place, in similar condition, which was made from a pebble. The butt is untouched, and the plan of the implement is plano-convex, with a sinuous edge on one side, the other straight. The lower face (*a*) was produced by about four blows; it is not a single flake-scar. Blows delivered at right angles to the surface caused portions of the lower surface to fall away; the cones of percussion survive. A natural fracture has defaced the upper side (*c*), but an asymmetric ridge seems to have run riblike from butt to point. The carefully retouched edges (*b*) suffered in use or during incorporation in the gravel. The scars of these chipped surfaces bear a creamy patina similar to that of the rest of the implement. The type is rare in Egypt, as far as I know, though a few specimens are comparable with it (cf. No. 24).

No. 19, a roughly made point with the end of the butt struck off by a single blow, which may have been of natural origin, presents a strong contrast to Nos. 15 and 20 and helps to illustrate the wide range of types, of more or less similar age, that are assembled in the small area of the Kena exposures.

The ovate implements and disks are the most characteristic Acheulean types of this site. None shows a twisted edge; all are straight, bilaterally symmetrical, flaked over the whole of both surfaces (except in unfinished specimens) with abundant secondary flakes round the edges. All have a creamy patina. No. 17 bears some resemblance to No. 16 and suggests a line of development from this type to No. 18. They are represented in the 50-foot terrace in other districts by such specimens as No. 22, from the edge of the Western Desert a few miles south of Abydos, an implement of beautiful workmanship and symmetry barely ½ inch thick.

The height of purely Acheulean skill in Egypt seems to have been reached in these ovate implements and in coups-de-poing such as Nos. 11 and 21. The latter comes from 50-foot gravels due west of Suhag at the desert edge. Its upper surface (*b*) is almost entirely covered with flakes, and the edge is not only of perfect symmetry but minutely retouched and remarkably sharp. The lower surface (*a*) was produced by a few blows, is not a single flake-scar, and was not worked by secondary flaking. This beautiful example of Acheulean skill recalls some of the more highly developed forms of Europe. I feel there is sufficient justification, based on the above mentioned implements, to claim an Acheulean age for the completion of the 50-foot terrace. To the assemblage may be added small coups-de-poing such as No. 23, a surface specimen from the Abydos bay of a type found *in situ* at el-Kab,[8] and the unique implement No. 24, from the surface of the 300-foot (Plio-Pleistocene) gravels at ez-Zawaʾidah between Ballas and Nakadah under the cliffs of the Theban Hills. This is of strongly marked plano-convex plan, the upper surface (*b*) covered with beautifully controlled flaking, reinforced by secondary flakes at the point and edges. The under surface (*a*) is evidently a single flake-scar, and it was worked over most of its area by fish-scale flaking. The edges are beautifully finished over about two-thirds of the length of the implement, the butt is untouched, and there is no retouch round its junction with the ventral surface. The specimen is unique, as far as I know; it recalls in many respects No. 20, and together they suggest some influence of Acheulean age that was not entirely of local Acheulean tradition.

THE MIDDLE PALEOLITHIC STAGE

Implements of the 30-Foot Terrace

Apart from implements derived from older gravels, the 30-foot terrace contains remarkably few signs of contemporary Man. The derived specimens need no description; the new forms, few in number, re-introduce[9] an industry founded on the core and detachment of flakes. It is plainly of the "Mousterian" plan. No. 25, from the gravels near ez-Zawaʾidah, is a typical example of an Early Mousterian or Levalloisian core, prepared by about a dozen blows delivered on a shapeless lump of flint. It may be matched by many European examples and recalls especially the type of the Thames gravels near Swanscombe (Baker's Hole).[10] The flake struck from it no doubt was thick and broad, its striking-platform bearing traces of a limited number of blows which went to prepare the core. Of this type are No. 26, from 30-foot gravels between Bir Arras and el-Haita in Wadi Kena; No. 27, from 30-foot gravels south of the Oases Railway; and No. 28, from similar gravels in Wadi Serai southeast of Kena. No. 27 was found on the surface, but is waterworn and had evidently been weathered from the gravels fairly recently. Casts of Nos. 26 and 27 if mixed with casts of flakes from Baker's Hole could scarcely be distinguished, so close is the similarity. Both are thick, with plain flake surface and roughly prepared upper surfaces. The platform of No. 26 shows a considerable degree of faceting; that of No. 27 is made of two major flakes and a small, perhaps accidental, scar. The flaking angles are 105° (No. 26), 105° (No. 27), and 110° (No. 28).

In the three specimens Nos. 25–27 there seems to be a remarkably close similarity to a known European type, a subject that, in general, I am unwilling to stress at the present stage of research in Egypt. Chellean and Acheulean forms indicate similar associations, and the arrival of a core-and-flake industry distinct from the Clactonian in the Nile Valley at this stage may be regarded as an important point of Paleolithic chronology and potential association with Europe. By way of contrast, the typical Egyptian Mousterian core No. 29, from a surface

[8] *OIP* XVII 75, No. 19.

[9] A flake industry has already been encountered in the gravels of the 100-foot terrace. There the striking-platforms of the flakes show no facets or signs of careful preparation; but most of those from the 30-foot terrace are faceted.

[10] This is one of the few definite associations with a European industry of marked type that I consider at present to be justified; see p. 67, n. 9. By so associating a type I do not infer that Egypt was populated by a particular race; the spread of an industry may be wider than that of the race with which it is specially associated in other parts of the world. Until skeletal remains are found we cannot infer that Egypt was inhabited by Neanderthal or other races; we are only entitled to suggest a probability.

site upon the 30-foot terrace west of Suhag, is illustrated here. It serves to show how widely 30-foot and post-30-foot core-and-flake techniques of Egypt differ from one another.

Implements of the 10- to 15- and 25-Foot Gravels

Considerable attention was paid in *OIP* Volume XVII to the cores and flakes of this terrace in Upper Egypt. Here I propose to illustrate a minimum number of implements from that district and to concentrate on more northerly sites.

First, a distinction may be noted between the heavy core of the type shown in No. 30, probably derived from the immediately adjacent 30-foot gravels in the same wadi near Nakadah, and lighter specimens such as Nos. 36 and 37 from the Western Desert edge between Nagᶜ Hammadi and Abydos. Similarly there is a contrast between the thick flakes Nos. 31 and 32 from the 10- to 15-foot gravels at Nakadah, which recall the 30-foot type but are much less coarse and have carefully prepared striking-platforms, and the delicate specimens Nos. 33 and 34 from the gravels of the same district. Nos. 31 and 32 suggest a fairly close association with, and development from, the early type. Nos. 33 and 34 seem to be of some other origin; the striking-platform of No. 33 is entirely without facets, that of No. 34 has been carefully prepared.

No. 35 is a highly developed type of the 10- to 15-foot terrace of Upper Egypt. The specimen chosen here comes from contemporary deposits at el-Haita in Wadi Kena, and in flake and core marks a high standard in the delicacy of the workmanship. It is accompanied by more pointed, but equally broad, flakes struck from cores of the sharply triangular type seen in Nos. 36 and 37, a product of Egyptian Mousterian work that litters the desert in countless thousands. In some instances the point appears to have been used. At this stage of evolution the series of implements found *in situ* in the 10- to 15-foot gravels of the greater part of Upper Egypt comes to an end.

On the surface of the Mousterian terrace, but not in it, as far north as the Asyut district occur implements of the types shown in Nos. 38–41. The core No. 38, of the normal Mousterian type of Egypt, has been turned to some purpose after the removal of its flake; the striking-platform has been sharpened to form a blunt point, and the original platform and bulb of percussion have been destroyed. This, in my experience, is rare. So is the trimming of a flake, as in No. 39; both seem to have been so treated when they were made, not subsequently.

More familiar are the beautifully finished flakes Nos. 40 and 41, which have delicately prepared striking-platforms. They come from the terrace surfaces west of Nagᶜ Hammadi and west of Suhag respectively, while Nos. 38 and 39 were found a few miles south of Nos. 40 and 41 respectively. The continuation of the Mousterian industry after the period of the 10- to 15-foot terrace is thus indicated in Upper Egypt by the discovery of developed forms on the surface. The types of Nos. 38 and 39 have not yet been found *in situ*;[11] but the flakes Nos. 40 and 41, only slightly developed from the type of No. 35 of the 10- to 15-foot terrace, have been so found. In the south they occur at the bottom of the late Mousterian–Sebilian silt; in the north they have been found in the 25-foot Nile gravels and in the 112-foot (Mousterian) beach of the Faiyum. We have not to go as far north as the Faiyum, however, to find them *in situ*, for the type occurs in 10- to 15- and 25-foot gravels at Tunah el-Gebel between Deirut and Mallawi on the west bank (p. 79). These implements, not found *in situ* in the south until the silt is met, are illustrated by Nos. 42 and 43. They may be matched by illustrations both in *OIP* Volume X, Figures 18, No. 2, and 19, No. 1, from the Faiyum, and in *OIP* Volume XVII, No. 39, from the borders of the Sudan. They were struck from cores such

[11] Notched flakes occur, according to Seligman (*Journal of the Royal Anthropological Society of London* LI [1921] 143); but *in situ* they are not common, nor are they of this plan.

as No. 44 and the more delicately prepared No. 45, both from the same gravels at Tunah el-Gebel, where several specimens were found. The core No. 45 seems to bring the preparation of the striking-platform and the governing of the shape of the flake to an extremely high pitch. The angle of platform and flake-scar is about 65°, of the flake and platform about 105°, in the figured specimens from Tunah el-Gebel and in others from the same site. Longer and stronger flakes were made with the same premeditation and skill when required, for example No. 46, which shows precisely similar features and the same angle.

The actual difference appears to be small between flakes of the type of No. 35, *in situ* in the Mousterian terrace of Upper Egypt, and Nos. 40 and 41, upon that terrace, or Nos. 42 and 43, in the gravels of the same stage where accumulation continued longer. Small though it may be, it is evidently of some chronological value. The use of cores specially prepared for the removal of a flake from each end seems to have similar value. A single example from the 10-foot terrace was figured in *OIP* Volume XVII; I do not know of any in the 10- to 15-foot gravels between Luxor and Deirut. The core No. 44, however, from Tunah el-Gebel, was prepared in identically similar manner at each end; a flake was struck from one end, and there was an attempt (see Pl. XXXVII) to remove another from the opposite striking-platform. Only a small flake was obtained; but a study of the core shows that the removal of the flake was not accidental, but was part of a definite and previously prepared plan, which in this instance did not succeed.

Another core of similar design from the important site at Tunah el-Gebel shows the same preparation of opposing ends, whereas one platform served no purpose whatsoever in the detachment of the first flake. In the Mousterian lake deposits of the Faiyum and the adjacent 25-foot gravels of the Nile Valley such double-ended cores are found. Later they became the common type, on a smaller scale, as the industry developed into that form which we know here as Lower Sebilian. This in itself indicates the presence of a time scale, which I maintain may be realized yet earlier, in the 10- to 15- and 25-foot gravels of Upper and Middle Egypt.[12]

Late or Post-Mousterian Implements

There is yet another class of Mousterian implement, probably not of local evolution, perhaps combining cultural elements not of Mousterian development, namely the tanged or shouldered point. Professor Seligman[13] has given a most useful account of this implement in Egypt; although he records it as "recently weathered out," that is, lacking desert patination, there seems to be no evidence of its occurrence *in situ* at least in Upper or Middle Egypt. Although I have found a few of these points, some without desert patination, some in wadi wash, I have never found them *in situ* in Mousterian gravels, nor do they occur anywhere in the Mousterian–Sebilian silts or later Sebilian sites. They are by no means numerous in the Nile Valley. They have long been associated with western influence, and they have been called variously Mousterian and Mousterio-Capsian. Their apparent absence from the stratigraphic series seems to indicate a brief period of manufacture or introduction, and comparative scarcity. In time, no doubt, they will be found *in situ*. Something of the sort seems to be indicated in a few of the flakes found in the Mousterian (112-ft.) beach of the Faiyum.[14] They are reported to have been found in Khargah Oasis in stratigraphic position above "Old Sebilian"; and they are described as Aterian, with reference to their non-Egyptian affinities.[15]

[12] From the North African coast the nearest approach to the double-ended core is illustrated by E. G. Gobert and R. Vaufrey, "Deux gisements extrêmes de l'Ibéromaurusien," *L'Anthropologie* XLII (1932) 449–90.

[13] *Op. cit.* pp. 128–29 and 136.

[14] *OIP* X Fig. 19, p. 53.

[15] See Miss Caton-Thompson in *Man* XXXI (1931) 77–84 and XXXII (1932) 129–35.

To indicate their long known presence in the Nile Valley, a representative series is illustrated here in Nos. 47–52. All except No. 52 have plain flake surfaces on the side not figured. No. 52 is flaked over both sides and may indeed be of much later date. Nos. 47 and 48 are from el-Haita, No. 49 from the wadi floor at ez-Zawaʾidah between Nakadah and Ballas, No. 50 from between Denderah and el-Marashdah, No. 51 from *sebakh* diggings at the desert edge west

*Analysis of Cores and Flakes Illustrated in This Volume**

		1	2	3	4	5
		Striking-Platform			Angle of Platform and Bulbar Surface (in Degrees)	
Core No.	Flake No.	Plain	Faceted Coarse	Faceted Fine	Core	Flake
	7	×				(Group: 110–120)
25			×		65	(=115)
	26		×			105
	27		×			105
	28	×				110
29			×		55	(=125)
30			(unfinished core)			
	31			×		110
	32			×		105
	33	×				105
	34			×		100
	35			×		105
36			×		70	(=110)
37			×		65	(=115)
38			(striking-platform subsequently flaked)			
	39			×		100
	40			×		105
	41			×		105
	42			×		100
	43			×		105
44			×		65	(=115)
45			×		65	(=115)
	46		×			105
	47	×				100
	48		×			105
	49		×			120
	50	×				110
	51			×		110

* In No. 7 only the cone of percussion remains, and the figures here given are obtained from a small group of surface-found implements of the same class.

The Sebilian implements are excluded because the striking-platforms have been subsequently removed by flaking.

The neanthropic cores and flakes of Hilwan were made on a plan entirely dissimilar to the foregoing, and the bulbar surfaces are at right angles to the flat striking-platform.

of Nagʿ Hammadi, No. 52 from the surface near ʿArab Miteir east of Asyut; that is, three are from the east side of the Nile, three from the west. Of Nos. 47 and 48 from el-Haita the former is struck from a plain, unfaceted platform; that of No. 48 appears to have been faceted, but most of the platform was flaked away afterward. The striking-platforms of Nos. 49 and 51 are faceted on the normal Mousterian plan; that of No. 50 is quite plain. No. 52, having been flaked over the entire surface, gives no indication of the method of manufacture. The shoulders of Nos. 47, 48, and 51 have been obtained by secondary flaking. No. 49 has no defined shoulder, although it appears to be of the same general type; and the recess in No. 50 seems to have been governed by the preparation of the core. The shoulders of No. 52 are prepared by retouching of the edges by rather coarse flaking, though the upper and lower surfaces are carefully made. To conclude, Nos. 47 and 51 appear to be of Mousterian type; No. 48 has a far heavier method of retouch, as has No. 52; Nos. 49 and 50 are more or less accidental forms.

It may be useful at this point to provide an analysis of the cores and flakes discussed above, to supplement the illustrations of certain of their surfaces. Such a summary seems to serve more purposes than the inclusion of figures of the striking-platforms, some of which are quite plain. From the analysis it emerges that on cores from which flakes have been struck the facets are usually few and rather large. The actual margin of the core which is struck off to form the butt of the flake may or may not have received additional and neater preparation, as shown in columns 1–3 of the analysis given on page 117.

In measuring the angle between the striking-platform and the general bulbar surface the plan adopted by Chandler[16] is followed. It would seem that the angles of cores (col. 4) should be the supplements of the angles of flakes struck from them; this equivalent is shown in parentheses in column 5. But these conversion figures are in excess of the general average of the angles actually measured on flakes, and one is led to the conclusion that angles measured on the surviving parts of parent cores are not absolute indices of angular subtension of platform and bulbar surface of flakes struck from them. In this and in general practice experience shows that it is extremely difficult to measure these angles with absolute accuracy; hence, to remove any suggestion of false accuracy, the angles here given are approximated to the nearest 5°. The small range of angles of these Egyptian flakes (100°–125°) is noteworthy.

LOWER AND MIDDLE SEBILIAN IMPLEMENTS OF THE SUBALLUVIAL GRAVELS

Since the Sebilian industries are described in *OIP* Volume XVII and in other publications, no further analysis will be undertaken here. Selected examples of implements found in the gravels of the Middle Sebilian stage north of Asyut are illustrated for record and comparison. Nos. 53–56 are from the esh-Sheikh Timai–Geziret Shaibah channel, No. 57 from the gravels at el-Hibah opposite el-Fashn. Of these No. 55 is a backed blade, the retouch being from one side only; a similar form is recorded by M. Vignard from his second level (Middle Sebilian).[17] No. 54 is a simple flake with prepared platform, but the bulb of percussion was removed—a typical older Sebilian method of retouching. No. 53, a familiar Middle Sebilian form, has lost the bulbs of percussion (positive or negative) of the surfaces shown, as a result of retouching; the bulb of the flake of detachment is extremely small. In No. 56 most of the bulb was removed by retouch. These few flakes show characters typically Sebilian and illustrate methods practiced in Egypt by the Lower and Middle Sebilian people only; the type of No. 55 is not represented in any Lower Sebilian collection, it appears only in the Middle division. In point of size and general technique Nos. 53, 54, and 56 also belong to the Middle Sebilian. No. 57, severely waterworn, suggests Lower rather than Middle Sebilian affinities.

As to other industries probably contemporary with the Upper Paleolithic age in Europe reference should be made to M. Vignard's discovery, at a site 4–6 meters above flood plain at Hu, near Nagʿ Hammadi, of an industry for which he claims an Aurignacian age.[18] At slightly higher levels occur Neolithic implements, which I have seen there; but M. Vignard makes it clear that in patina and in other characters the industry of the *champ de bagasse* (sugar-cane field) is to be distinguished from it. His illustrations seem to bear this out. Burins occur in

[16] R. H. Chandler in *Proceedings of the Prehistoric Society of East Anglia* VI (1930) 79–116.

[17] *BIFAO* XXII (1923), his Pl. XIII 8.

[18] *BIFAO* XVIII (1921) 1–20.

plenty; also backed blades, *grattoirs, museaux*, and retouched flakes are shown in considerable profusion. Many of them certainly have a markedly Aurignacian appearance, and at least the burins are absent from the older Sebilian. On the other hand, some of the types illustrated might well be Neolithic, but not all. It seems strange that Aurignacian work has not been found in other parts of the Nile Valley. Perhaps in due course it will appear, but for the present all we can do is to record M. Vignard's discovery as an isolated occurrence which is not yet fully understood. Potential associations with graffiti have already been mentioned.[19]

THE HILWAN SITES

The last industry that demands attention here is found at Hilwan,[20] where flaking- or habitation sites have been known for many years. They are not known in relation to a geologically dated deposit, and their age can be deduced only from typological comparison. Many collections have been made from the sites (some now built over), but those on the north side of the town between the railway line and the path to ᶜIzbah el-Waldah are still rich. A small series chosen from a collection made here by my wife and myself in 1931 is figured (Nos. 58–72). The industry includes:

1. An abundance of cores of neanthropic type. The smaller examples (cf. No. 72) might be matched from many Upper Sebilian, Capsian, Mesolithic, or even Neolithic stations. The larger cores recall Paleolithic work, but the type survived even into predynastic times in Egypt. The double-ended core of Upper Sebilian form, possibly a survival of Mousterian influence in Upper Egypt, is not seen at Hilwan so far as I know.
2. Simple blades and long flakes struck from the foregoing cores (cf. Nos. 64–70).
3. Backed blades, the flaking usually from one side only, recalling the Middle and Upper Sebilian types but with the retouch carried to a far greater depth in the flake, its width from edge to back thereby being severely reduced (cf. No. 71).
4. Many varieties of crescents, representing modifications of the backed blades by the carrying of the retouch over both ends of the flake (cf. Nos. 58–63). With the exception of the crescent the many geometrically shaped flakes of the Upper Sebilian seem to be lacking.

There is no good reason for associating the Upper Sebilian and Hilwan industries: the later geometric forms and neanthropic core forms are foreign to the older Sebilian, and the Hilwan industry belongs to some phase of that foreign influence which for the present perhaps we may conveniently call Capsian. I know of no evidence that polished material has been found with the Hilwan types illustrated here, although important Neolithic sites, with abundant flint flakes, occur not far away.[21] I found fragments of ostrich eggshell with these specimens, but there was no proof that they had been intended for beads or other ornamental purpose.

Though no close comparison can be found between it and the latest known Paleolithic industry in Egypt, beyond certain general indications of outside influences, the Hilwan material is at any rate entirely distinct from the familiar flint work of the Neolithic sites of the Faiyum and of Upper and Lower Egypt (as at Marimdah and Beni Salamah).[22] One may perhaps express the opinion that the Hilwan cores, flakes, and crescents had an origin in common with the foreign types of the Upper Sebilian, but that they are probably younger and long preceded the Neolithic industry of Egypt—in other words, that they are of final Paleolithic or Mesolithic age.

[19] *OIP* XVII 80.

[20] Recent publications by Père Bovier-Lapierre will be found in *Comptes rendus du Congrès internat. de géogr., Le Caire, 1925*, IV 268–82 and 298–308.

[21] Cf. O. Menghin and M. Amer, "The Excavations of the Egyptian University in the Neolithic Site at Maadi. First Preliminary Report (Season 1930–31)," Egyptian University Faculty of Arts, *Publication* No. 19 (Cairo, 1932).

[22] Cf. the excavations by H. Junker and others; for further reference see p. 107.

Of Late and post-Paleolithic times, then, as of many other aspects of Man's past in the Nile Valley, we are only beginning to learn a little. It has taken six years to complete a reconnaissance of the ground between Semnah and the sea; and, at the end, some of the real problems of pre-Neolithic times begin to detach themselves from the background of Man's more ancient past. A general plan which has been found to be a working hypothesis up and down the valley during these years has been presented in this and other volumes; the ground north of Dahshur and Hilwan, already surveyed, remains to be published to complete the report of the reconnaissance. If a general history, with some pages missing, has been provided, a chronology has been initiated thereby in which we are at least becoming aware of the dark ages and learning where light is required.

X

SUMMARY

This volume describes about 400 miles of the Nile Valley and some of its tributaries between Luxor and Beni Suef, with notes on the east bank between Beni Suef and Hilwan (see Fig. 1 and folding map at end). New light is also brought to bear on the relationship of the Faiyum to the Nile.

GEOLOGY

Physiography

At Luxor the Nile is flowing through a gorge cut in massive Lower Eocene and Cretaceous limestones to a visible depth of considerably more than 1,000 feet. The floor of the valley is covered with a thick blanket of alluvial deposits, and the rock bottom has not yet been reached in borings. The sides of the valley are broken by gigantic slipped masses of Lower Eocene rocks and, in Middle Egypt, of Middle Eocene clays and limestones. In the south the sliding surface was provided by unguent Esna shales which, with white limestones also of Upper Cretaceous age that cover them, are exposed from Luxor to Kena, where they dip in a northerly direction below the Lower Eocene in the river bank. Beneath the Esna shales lie enormous thicknesses of Nubian sandstone, exposed here only on the east side of the Nile for a short distance between Luxor and Kena, where it forms the extensive Lakeitah plains. Low sandstone ridges stretch eastward to the older igneous and metamorphic complex of the Red Sea Hills. On the north and south the Nubian sandstone is capped by towering masses of Esna shale and overlying Upper Cretaceous and Lower Eocene limestones, outliers of the main limestone plateaus which form the bounding walls of the Nile gorge. The sandstone is exposed also in similar plains on the east side of the great outliers, between them and the Red Sea Hills, and it probably forms the floor of Wadi Kena, a broad trench between the plateau and its outlier.

Although the general dip of all these rocks is northerly, they are corrugated by two distinct sets of folds or rolls: the first of general north-south trend, of great amplitude, consisting in this area of a syncline, in which lies the Nile Valley north of the Theban Hills, and two anticlines, marked by Khargah Oasis on the west and Wadi Kena on the east (see Fig. 2).

Across this system the second or Tethyan group of sharper folds, often accompanied by faults parallel to them, runs on a trend about northeast-southwest. One anticline, which crosses the valley at Kena, is probably responsible for the structure of the Theban Hills and for the deflection of the Nile round them. A second anticlinal system forms the depression of Wadi Araba on the Red Sea coast, and it is suggested here that its Nileward prolongation may be observed in the cliffs between Samalut and Minyah and in the desert west of the Nile.

These folded structures have guided the course of the Nile, and there is no satisfactory evidence whatsoever that the river lies in a rift valley. It is probable that the valley has been formed since Miocene times; an Oligocene system flowed on a somewhat similar course at some distance to the west. Thus it appears that the great scarps of the Lower Eocene limestone could not have existed in Oligocene times and that they have been created by retreat of the edges of the outcrop and by denudation of its southern, eastern, and western faces. The Nile, once committed to its present course and intrenched in a deepening valley, had no opportunity to escape. It was irrevocably imprisoned by late Miocene elevation, which stimulated profound vertical erosion; and the great gorges of the river and of its main affluents from the limestone plateaus were cut in Pontic (Mio-Pliocene) times.

Pliocene

The slipping of the sides of the gorges (see Fig. 3) probably took place in Pontic times, or before the Middle Pliocene, when the rising waters of the Third Mediterranean period flooded the newly created system of valleys to a height of nearly 200 meters above present sea-level. The Nile Valley was converted into a gulf at least 500 miles long throughout Middle and Upper Egypt almost to the borders of Nubia. Tributaries such as Wadi Kena and other major drainage channels of the limestone plateaus were flooded (see Figs. 4–5), and it is now shown that part of the Lakeitah plains and some low ground southwest of Minyah were also under water. The affluent streams on the west bank have been traced by remaining deposits; their banks have been destroyed by erosion.

Accumulation of deposits, coarse near the valley sides and at the mouths of tributaries, fine in still water, also took place round the detached rocks of the landslips and between them and their parent cliffs, and there is no sign that further general slipping has taken place. In Middle and Lower Egypt the deposits within the valley have been grouped into Middle Pliocene marine and Upper Pliocene estuarine beds, and there appears to be some unconformity between the two (see Fig. 6). In this volume evidence is advanced to confirm the unconformity and to trace it through Middle and Upper Egypt. The waters of the gulf were probably brackish or fresh in the south, and the fresh-water and estuarine zones progressed northward in Upper Pliocene times. Great thicknesses of travertine, intimate members of the Pliocene series, are considered to belong to the upper part; and the preceding period of erosion is believed to be represented in the south by quartz sands of variable thickness, to which a defined stratigraphic position is thus assigned (see Figs. 7–8).

The closing events of Pliocene time were renewed erosion and the piling up of sands under water, then of coarse river gravels and bowlder beds (see Fig. 9), until the valley was choked probably to 200 meters above present sea-level. These final phases are assigned to an extremely late Pliocene or Plio-Pleistocene interval.

Plio-Pleistocene

With the last filling of the valley came the introduction of coarse igneous material and feldspar-bearing sands from the Red Sea Hills (see Figs. 10–11). There is no evidence that they had reached the Nile Valley at any earlier period—a fact that is difficult to explain on the evidence of surviving physiographic features. The interval between the completion of the gulf phase and the oldest strata that can be proved to be of Pleistocene age was occupied by the re-establishment of the river in its valley, with its bed several hundred feet above its Pontic floor. In Upper and Middle Egypt the highest terrace of which traces survive is at 300 feet above Nile flood plain, its gravels rising in the south to almost 550 feet above sea-level. Near Cairo higher gravels of Plio-Pleistocene composition occur in small patches to 820 feet above sea-level; of these there is no trace farther south. Since the 300-foot terrace in the south is so near the height of Pliocene submergence, it may be but little younger than the youngest gulf deposits. Normally the sequence consists of rock-cut terraces, with gravels, at 300, 200, and 150 feet (see Fig. 12). They were formed within the Pliocene gulf or between its western side and the Eocene bounding walls of the original valley. These altitudes above river-level bear a close relationship to the general sequence of Mediterranean beaches of Pleistocene age (see Fig. 13); that is:

The 300-foot Nile terrace = 100–90-meter or Sicilian beach.
The 200-foot Nile terrace = 60–55-meter or Milazzian beach.
The 150-foot Nile terrace falls 9 meters below, but may also be tentatively correlated with, the Milazzian.

These terraces have now been traced from Wadi Halfa nearly to Cairo. If this correlation is accepted (and there seems no cause to doubt it) and if the final gulf phases are assigned to the Pliocene, the use of the term "Plio-Pleistocene" in the Nile Valley can be restricted: it includes the coarse beds above the final subaqueous quartz-feldspar sands of Upper Egypt and the gravels with rocks from the Red Sea Hills at altitudes more than 300 feet above the present flood plain in northern Egypt.

Pleistocene: Lower Paleolithic

100-foot terrace.—The oldest terrace in which Paleolithic implements occur lies 100 feet above flood plain or (in wadies) above wadi floor, and has now been traced from Wadi Halfa to Cairo. It contains a mixed assemblage of Chellean implements and some which suggest Acheulean affinities. Coarse flakes of Clactonian appearance also occur. Since implements are entirely absent from the 150-foot terrace, the evolution to the dawn of Acheulean technique seems to have taken place in the long interval between the abandoning of the 150- and of the 100-foot level by the Nile. In view of its height and its included implements this stage may be coupled with the Tyrrhenian stage of the Mediterranean.

From Luxor to Asyut the river meandered; thence northward to Beni Suef it followed the higher terraces along a straight course. North of Beni Suef it left the western side of the valley and at Hilwan impinged on the eastern cliffs (see Fig. 14).

50-foot terrace.—This follows the 100-foot terrace, meandering on a slightly different plan from Luxor to Asyut, then flowing along the west side of the valley. Owing to its position, it has suffered more severely from river erosion than has the 100-foot, which it has protected. The implements found in its gravels consist of derived specimens from the higher terrace, and of a well developed Acheulean industry. It falls within the vertical range of the Monastirian stage of the Mediterranean and presumably is to be associated with it.

Middle Paleolithic

30-foot terrace.—This stage is strongly marked between Luxor and Asyut, gravels left by the meandering Nile being seen for long distances banked against the edges of local wadi terraces of 50-foot (Acheulean) age. North of Asyut the 30-foot terrace cannot be traced with certainty, and in the northern part of the area gravels of this altitude in wadies and near the Nile cannot, in the absence of implements, be distinguished from others of similar height but of younger Mousterian age (see Fig. 15). The true 30-foot terrace is of Early Mousterian age and contains large cores and thick, heavy flakes reminiscent of the Old Mousterian (A and B) of the river Somme and of England.

10- to 15- and 25-foot gravels.—The Egyptian Mousterian industry achieved its greatest development in Upper Egypt after the 30-foot terrace had been abandoned by the river. The implements are found in great abundance on surfaces of this and greater age, and *in situ* in gravels that rise 10–15 feet above the wadi floors. The deposits formed by the Nile at this time have been almost entirely destroyed or hidden beneath recently accumulated alluvium. There are plain indications in the wadi gravels that they were adjusted to an ascending river-level; that is, the rock bottom on which the gravels rest, the true terrace feature, sinks from sight as the Nile is approached and the superincumbent gravels thicken (see Fig. 16). Remote from the Nile the rock platform rises generally about 8 feet above the wadi floor, and the gravels upon it are thin; near the Nile the gravels occupy the full visible thickness of 15 feet above wadi floor, and shallow excavations near the edge of the alluvium often fail to reveal the platform. From a study of past wadi gradients, and from external evidence south of Luxor, it appears that in Upper Egypt the true Nile level of the time was probably not far below the summer low-water level of the present day.

In the northern part of Middle Egypt there is sufficient indication that the river lay at a lower level, and this is supported by external evidence. Here, moreover, the gravels have a visible thickness of 25 feet (see Fig. 17) and contain in their upper part later types of Mousterian implements than appear in the 10- to 15-foot gravels of Upper Egypt, while older forms are missing, probably to be found in the lower part of the gravel, below modern flood plain. There is thus strong reason to believe that a degradation was initiated by a fall of sea-level,[1] and that its stimulus was felt in some degree as far as Luxor; that later rise of sea-level caused aggradation to a level of 25 feet above modern alluvium in the north, and that this too was transmitted southward. Adjustment to both movements was far less complete in the south than in the north. Intermediate stages may be traced. Both the 30-foot Early Mousterian terrace and the 25-foot aggradation gravels of the northern part of the region fall in general within the Monastirian levels of the Mediterranean, the 8-meter (26-ft.) stage being a later phase that thus finds confirmation in a remarkable way in the Nile, preceded by Mediterranean regression.

The relations of the Lower and Middle Paleolithic levels in Egypt to the Mediterranean beaches may be summarized as follows:

The 100-foot Nile terrace = 35–30-meter or Tyrrhenian beach.
The 50-foot Nile terrace }
The 30-foot Nile terrace } = 20–18-meter or Monastirian beach.
The 10- to 15- and 25-foot Nile gravels = 8-meter late Monastirian beach.

The Transition from Middle to Late Paleolithic Times: The Advent of Modern Conditions

The disturbance of gradients continued, accompanied by the arrival of vast quantities of silt, similar to the modern alluvium, from the Sudan. Aggradation was maintained in the southern part of the area, considerable thicknesses of silt, instead of the earlier gravel, being accumulated and overlapping the lower parts of the 10- to 15-foot wadi gravels. Here are found late Mousterian implements of the type associated with the upper part of the 25-foot gravels of the north. This continuation of aggradation was brought about by changes in the far south which caused the transport into Egypt of superabundant material, not by change of sea-level. During the time occupied by accumulation the Mousterian industry developed to such a point that another name, Sebilian (Lower and Middle Sebilian), has been applied to it (see Fig. 18).

The level attained by the silt falls from 100 feet at Wadi Halfa to about 20 feet at Luxor; its summit has been traced northward and is found to coincide with that of modern alluvium at about Nagᶜ Hammadi. Farther north work described in this volume has led to the identification of gravels containing rolled implements of Lower and Middle Sebilian type and fossil bones. Fossil human remains seem to be associated with them at Kau. No implements of Upper Sebilian age were found. This industry differs from Lower and Middle Sebilian in the presence of predominantly microlithic forms, and suggests some contact with foreign influence. The newly discovered gravels occur below modern alluvium north of Nagᶜ Hammadi, and no trace whatsoever of them or of Sebilian silt can be found above alluvium. They have been found at intervals, and their summit seen to sink. They represent the continuation of the gradient of an early stage of the degradation after the maximum accumulation of silt (see Fig. 19). Middle Sebilian levels fall from about 70 feet near Wadi Halfa to 40 feet at Kom Ombo and 20

[1] I.e., widespread change of level of land with relation to the Mediterranean Sea or vice versa.

feet near Edfu. Their summit is now traced from about −11 feet (below alluvium) near Abu Kurkas to −18 feet near el-Fashn (see Figs. 20–23). Gravels perhaps contemporary with the highest level of Lower Sebilian aggradation, perhaps older, occur near Beni Suef at a little above flood plain.

From these levels it is possible to reconstruct the gradients of Sebilian overflow channels into the Faiyum depression, and to show that flow from the Nile to the Faiyum was maintained until Middle Sebilian times (74-ft. lake of the Faiyum; see Fig. 24). Thereafter there is a gap in the sequence. The Nile lowered its bed still farther in Upper Sebilian times, but there is as yet no proof of the depth attained. Later it began to raise its bed again, a process upon which it is still engaged, at a computed rate of 4–4½ inches per century. Studies of borings made in the valley (cf. Fig. 25) show that true Nilotic silts and sand lie unconformably on older, probably Plio-Pleistocene, gravels at a depth of about 35 meters (115 ft.) in Upper and Middle Egypt. The Nilotic beds are probably in part basal beds of Middle and Upper Paleolithic age, when they are within the normal vertical range of the river. Locally, deep holes may also be scoured in soft deposits, even at the present day, and may account for the presence of pottery, bones, etc., at low levels. Such objects may also sink, by virtue of their own weight, through waterlogged river quicksands and silt.

CLIMATE

The cutting of the Pontic valley and of its tributaries indicates a considerable or abnormal rainfall accompanied by elevation of the land or profound marine regression. The Pliocene deposits give every indication of the maintenance of similar climatic conditions. The Plio-Pleistocene terraces suggest a liberal run-off of water, as do the gravels of the 100-foot and 50-foot terraces. The lowering of the river bed from one terrace to another throughout the long series from 300 to 100 feet need not be associated in any way with variation in amount of rainfall.

After the 50-foot stage changes of climate made themselves felt in the Nile Valley. The southern Nubian tributaries lost a large part of their supply, but there is no indication of such a failure in the 30-foot terrace of Upper Egypt. With the advance of Middle Paleolithic time, however, the change crept northward, and the 10- to 15-foot gravels of Upper Egypt are notably of uneven texture, lenticles of bowlder beds and fine grits suggesting occasional torrents rather than steadily flowing streams. No signs of desert-like conditions are to be seen. North of the central part of the region—for example, north of Kau el-Kabir—the 10- to 15- and 25-foot gravels lose the torrent-like character and are evenly graded, consisting usually of small pebbles. There is no indication that the rainfall had failed in this part of the Nile Valley. In the Faiyum certain beds of the same age suggest that the run-off was reduced on the western plains, but that nevertheless a considerable amount of water erosion and deposition took place. Man could still wander at will at any rate between the Nile and the Red Sea, and westward beyond Khargah Oasis.

In the following period of silt aggradation in the south the surface run-off failed in Nubia, and blown sand makes its appearance in the deposits at Armant near Luxor. The rainfall in Nubia has not since been restored, and the mouths of wadies remain choked with the ancient silt, which is curiously free from blown sand. In Upper Egypt also the run-off was severely reduced, except for torrents from the Red Sea Hills, and Sebilian implements have not been found far from the river or from some permanent source of water. The mammalian fauna, however, except for riverine forms and gazelle, indicates the presence of grassland. Moreover, in Upper and Middle Egypt the wadies have been cut below the Mousterian level, in marked distinction from the conditions in Nubia, and north of Nagᶜ Hammadi there is abundant evidence of a fast-flowing river. In the Faiyum the Mousterian beaches were severely reduced by water erosion, but on the Libyan Plateau sand dunes had probably started their southern march from the coastal region of the north. In Khargah Oasis the people had gathered round springs; but surface water had not entirely disappeared, and gravel banks were still formed.

Complete failure of rainfall thus seems to have started in Nubia and to have spread slowly northward along the Nile. The western plains and plateaus probably lost their surface run-off in later Middle Paleolithic times, and thereafter their climatic history may have been very different from that of the Nile Valley. This dissimilarity persists, in certain respects, at the present day. The condition of absolute desert may be of late date near the Nile Valley. In Neolithic times there was a greater freedom of movement west of the Nile, especially in the north, than is now possible, and crops were raised on ground now barren.

Too strong emphasis cannot be laid on the recognition of the many climatic and ecological changes that mark the growth of absolute desert. Rainfall with surface run-off, failure of run-off and of rainfall, failure of springs, of grassland and savannah, of semi-desert vegetation—all these changes vary locally not only from meteorological causes but above all from the nature of the strata. Having in mind these factors, the peculiar position of the Nile Valley, and the climatic changes that have crept slowly along its course, I can see no evidence, reason, or justification for defining its climate in terms of "pluvial" or "interpluvial" periods.

HUMAN INDUSTRIES

A chapter is devoted to the brief illustration and description of types, and their stratigraphical position is discussed in the first part of this summary. The industries may be tabulated as follows:

100-foot terrace	Primitive Chellean, Chellean, and Chelleo-Acheulean or early Acheulean, also a coarse-flake industry or Egyptian form of the "Clactonian"
50-foot terrace	Developed forms of Acheulean culture, with all types of the 100-foot terrace as derived specimens
30-foot terrace	Early Mousterian flakes and cores, also Acheulean implements probably derived from the 50-foot terrace
10- to 15-foot terrace of Upper Egypt	Typical Mousterian industry of Egypt
25-foot gravels of Middle Egypt; Base of silts of Upper Egypt	In part contemporary with 10- to 15-foot gravels of Upper Egypt, with same industry, but containing later forms identical with those of the base of the Upper Egyptian silts
Aggradation silts of Upper Egypt	Final development of Mousterian culture: industries descending from it termed Lower Sebilian (occurring
Degradation gravels of Upper and Middle Egypt, suballuvial in the north; Further degradation	at the top of the silts) and Middle Sebilian (marking the beginning of degradation throughout the valley), followed by Upper Sebilian (with foreign technique) in Upper Egypt, not yet identified in Middle Egypt in geologically dated deposits
Accumulation	End of Paleolithic, then Neolithic to Recent.

INDEX

[Egyptian place-names include some, such as Cairo, Alexandria, and Luxor, which are thoroughly at home in the English language. In compound names more or less phonetic spellings of certain elements have likewise become relatively fixed in popular English usage. To facilitate pronunciation by the reader such spellings are here retained for the following terms:

Spelling Adopted	Written in Arabic as	Meaning
beit	*bait*	house
beni	*banī*	sons
deir	*dair*	monastery
gebel	*gabal*[1]	mountain
gezirah (construct, *-ret*)	*gazīrah* (construct, *-rat*)	island
kom	*kūm*	heap
medinah (construct, *-net*)	*madīnah* (construct, *-nat*)	city
tell	*tall*	mound

On the same basis the Arabic article is here transliterated not as *al-* but as *el-*, with assimilation before dentals, sibilants, *n*, and *r*. An *e* is used for Arabic *a* in a few other cases analogous to the foregoing, e.g. in the names Deirut and Denderah. Elsewhere its use is called for to harmonize with preceding *e*'s, e.g. in the diphthong *ei* in the terms Gebelein and esh-Sheikh. An *e* takes the place of Arabic *i* in such names as Edfu and Esna. An *o* is used not only for Arabic *ū* in Kom and in elements harmonized therewith (e.g. Kom Ombo) but also for Arabic *au* in such names as er-Rodah.

For the greater part, however, the geographic names or elements found in this volume are relatively unfamiliar to English or American readers. The written Arabic forms of such terms have when available been exactly transliterated in our Index. In the text proper the same spellings are used, but diacritical markings are omitted. Cross-references to spellings used in the Prehistoric Survey's previous reports and to other common spellings are also included in the Index. The original Arabic forms have been obtained primarily from the map of Egypt 1:50,000 by the Survey of Egypt, supplemented by its English and Arabic volumes of indexes to place-names appearing on its 1:100,000 map series and by Baedeker's *Egypt and the Sudan*, 8th ed. (Leipzig, 1929).[2]

The system followed for exact transliteration is that worked out for the archives of the Oriental Institute by Dr. A. A. Brux and published under the title "Arabic-English Transliteration for Library Purposes" in the *American Journal of Semitic Languages and Literatures*, October, 1930, Part 2. Previous systems are discussed, and the reasons behind the Oriental Institute's system given, in Dr. Brux's paper. The problem of geographic names in particular is treated at its end.—EDITOR.]

[1] Since in Egypt *j* is sounded as *g*, we use the latter symbol throughout our Egyptian place-names.

[2] Edited by Georg Steindorff. Arabic transliterations apparently by Dr. Curt Prüfer; see its p. xxviii.

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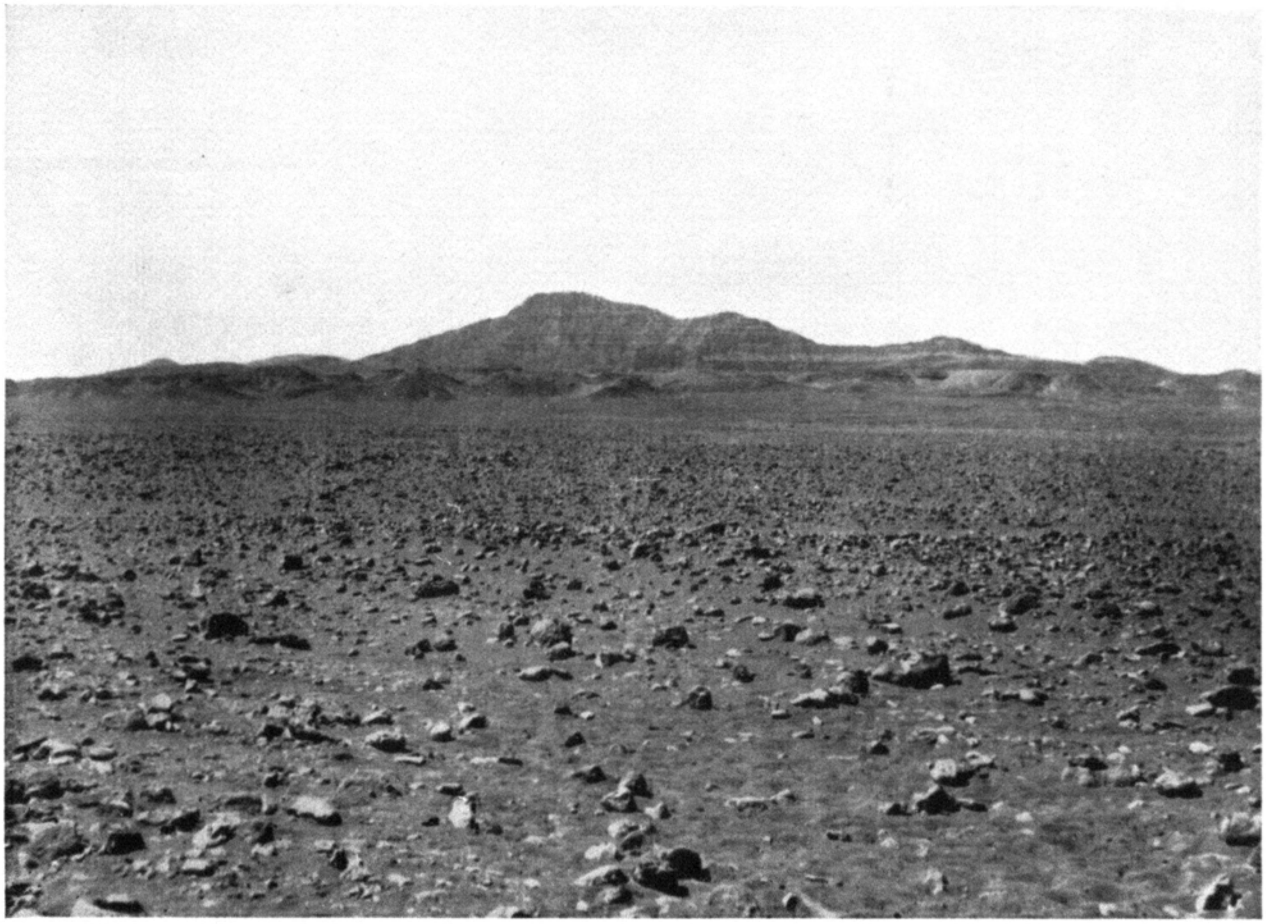
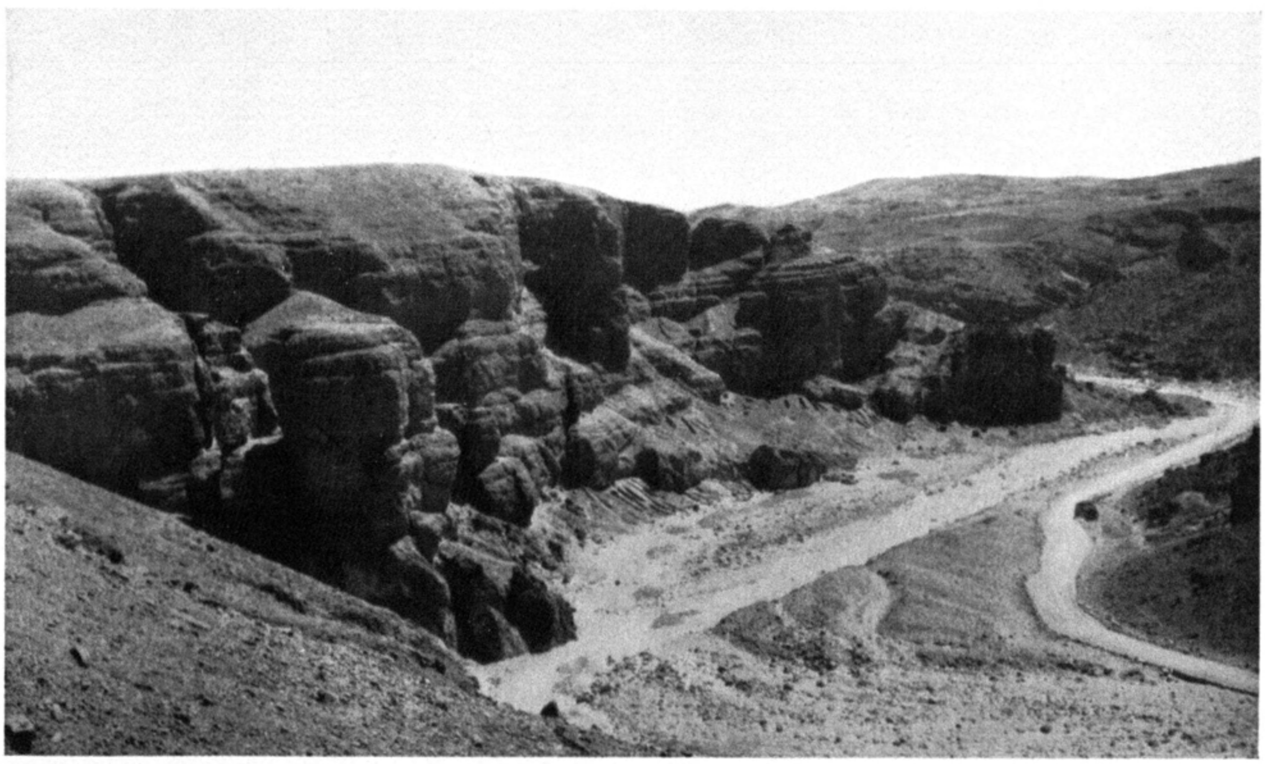
PLATE I



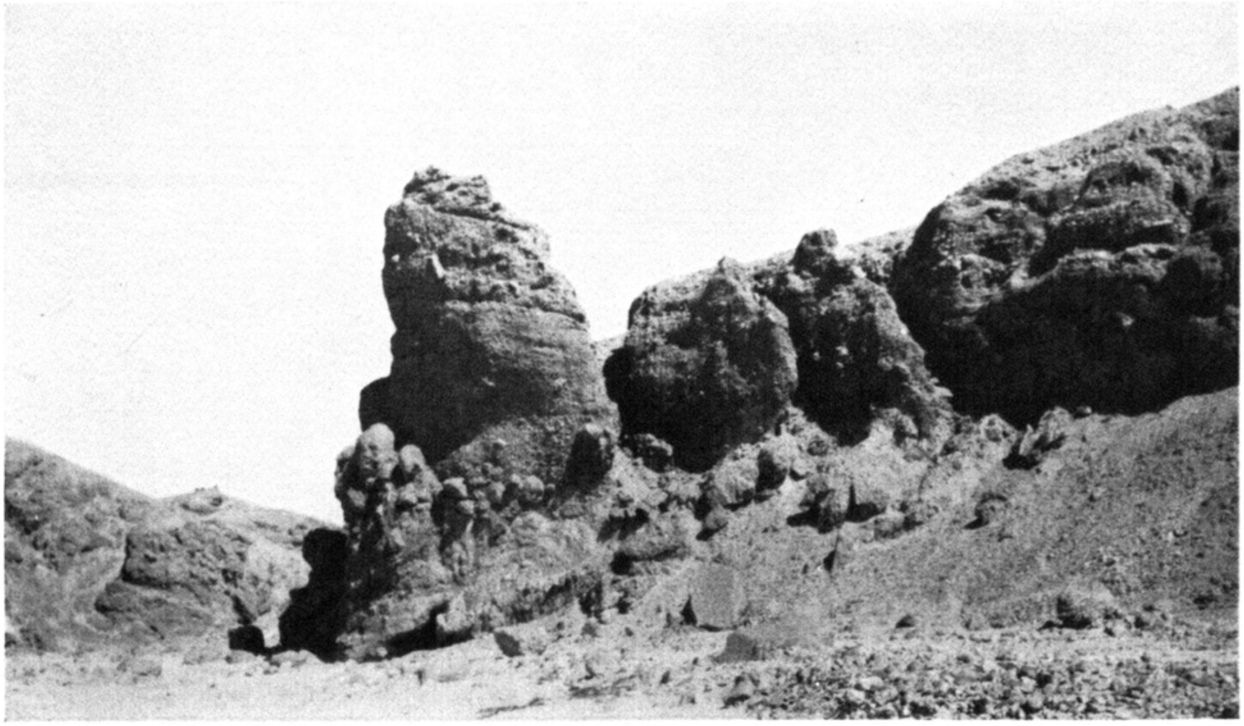
A



B

A.—Gebel Rakhmaniyyah, with dissected Pliocene platform skirting the base, seen from Wadi Madamud, looking southward. *B*.—Pliocene gulf deposits cut by deep wadi. Valley of the Kings' Tombs, Thebes.

PLATE II



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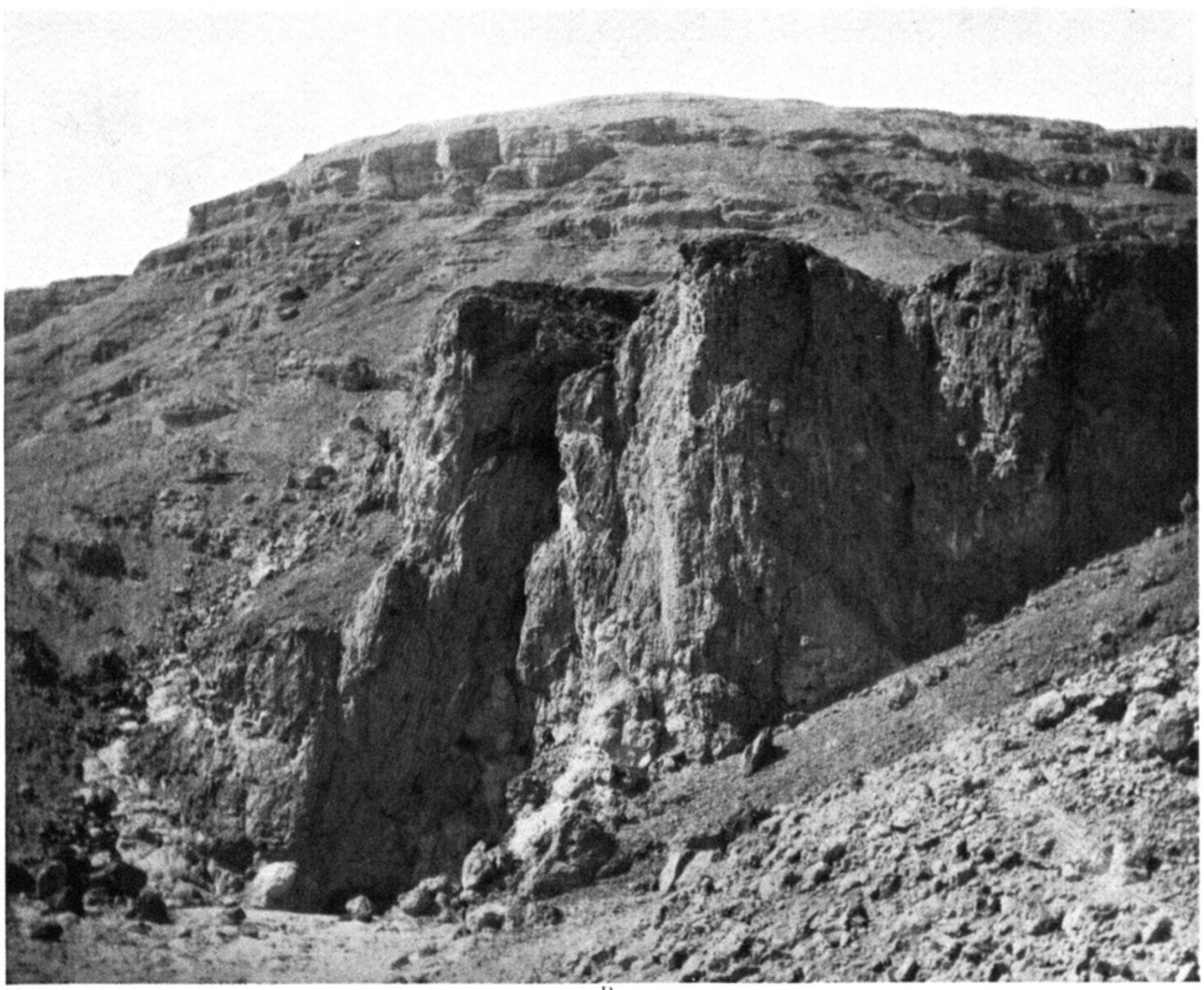
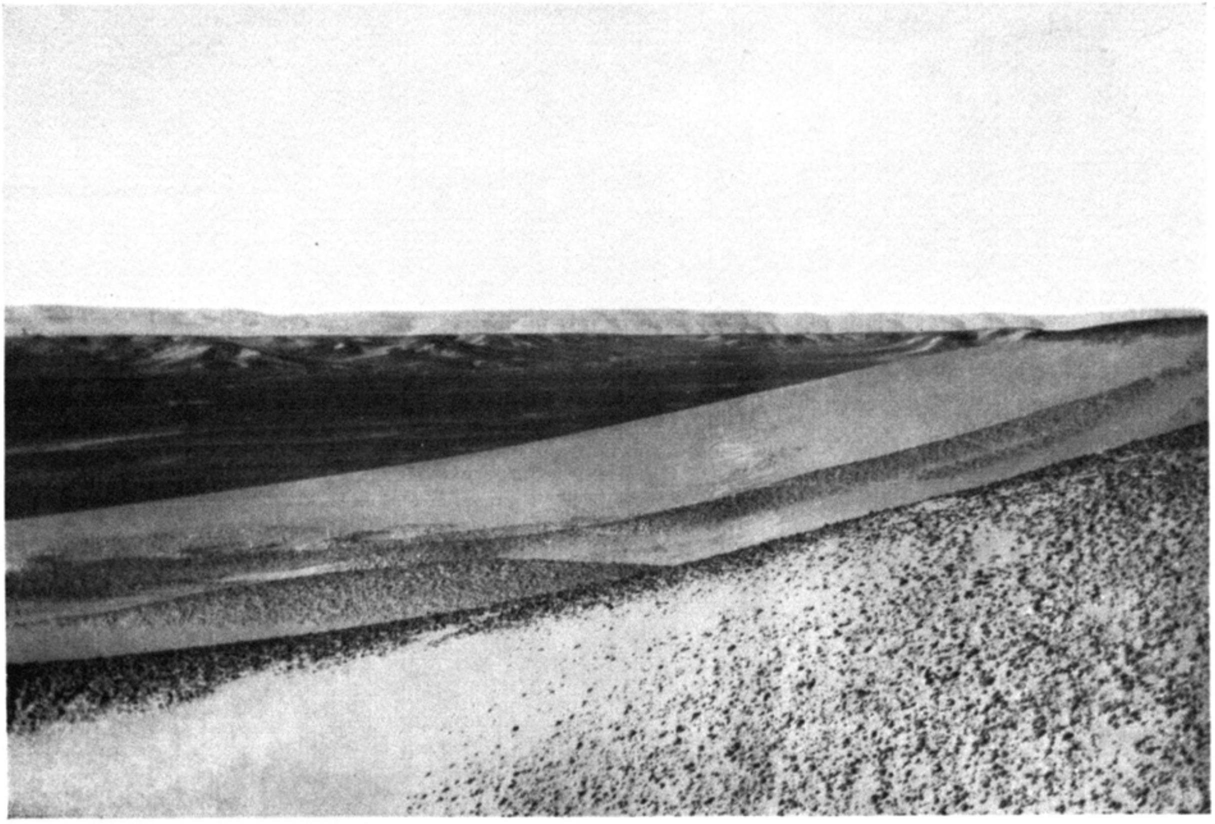


B

A.—Pliocene gulf deposits. Cliff profile in North Valley, Wadiyein, Thebes. *B*.—Undercliff of Pliocene travertine banked against Eocene strata in north side of Wadi Kasab, about 15 miles from the cultivated land of the Nile Valley.

PLATE III



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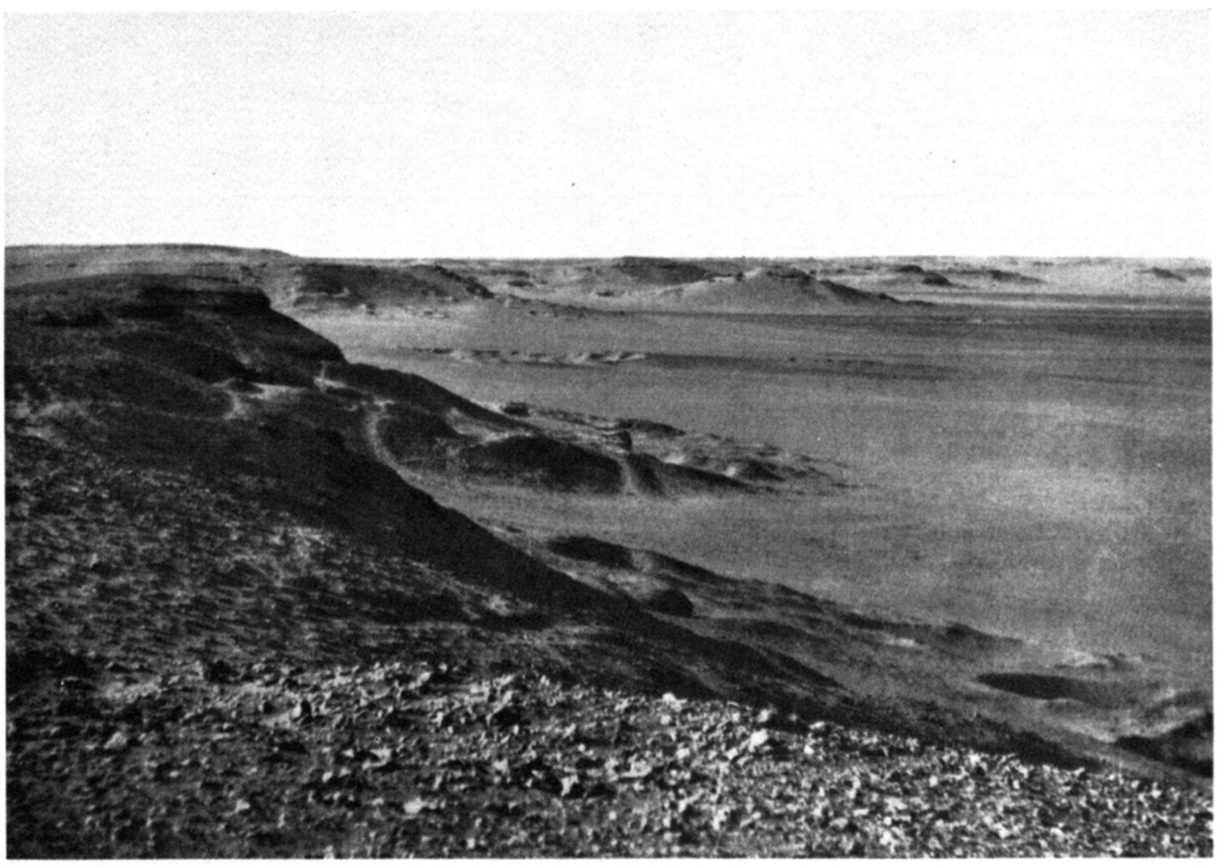
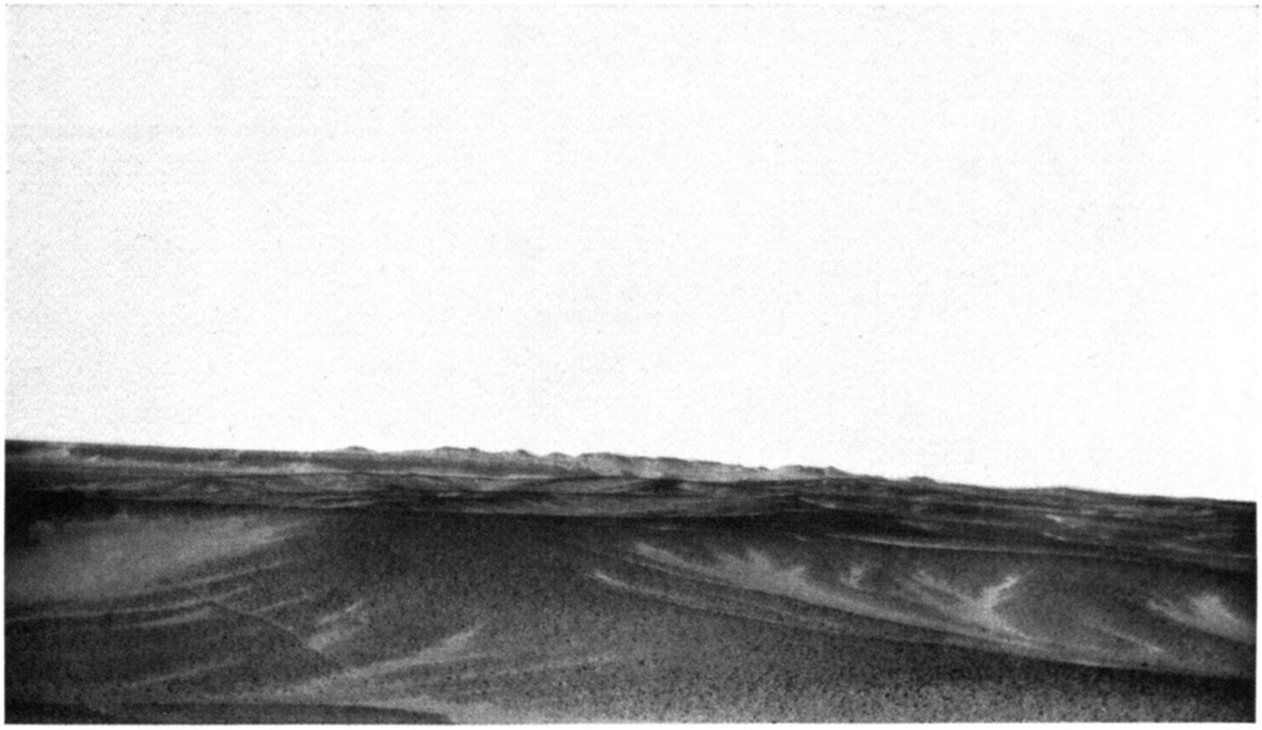


B

A.—The Pliocene platform, or upper limit of deposits, sprinkled with dark gravel, contrasting with the light-colored rocks of the Eocene scarp in the bay north of Abydos. *B*.—Extensive tract of country formed of Pliocene rocks west and north of Beni ʿAdi, southwest of Manfalut.

PLATE IV



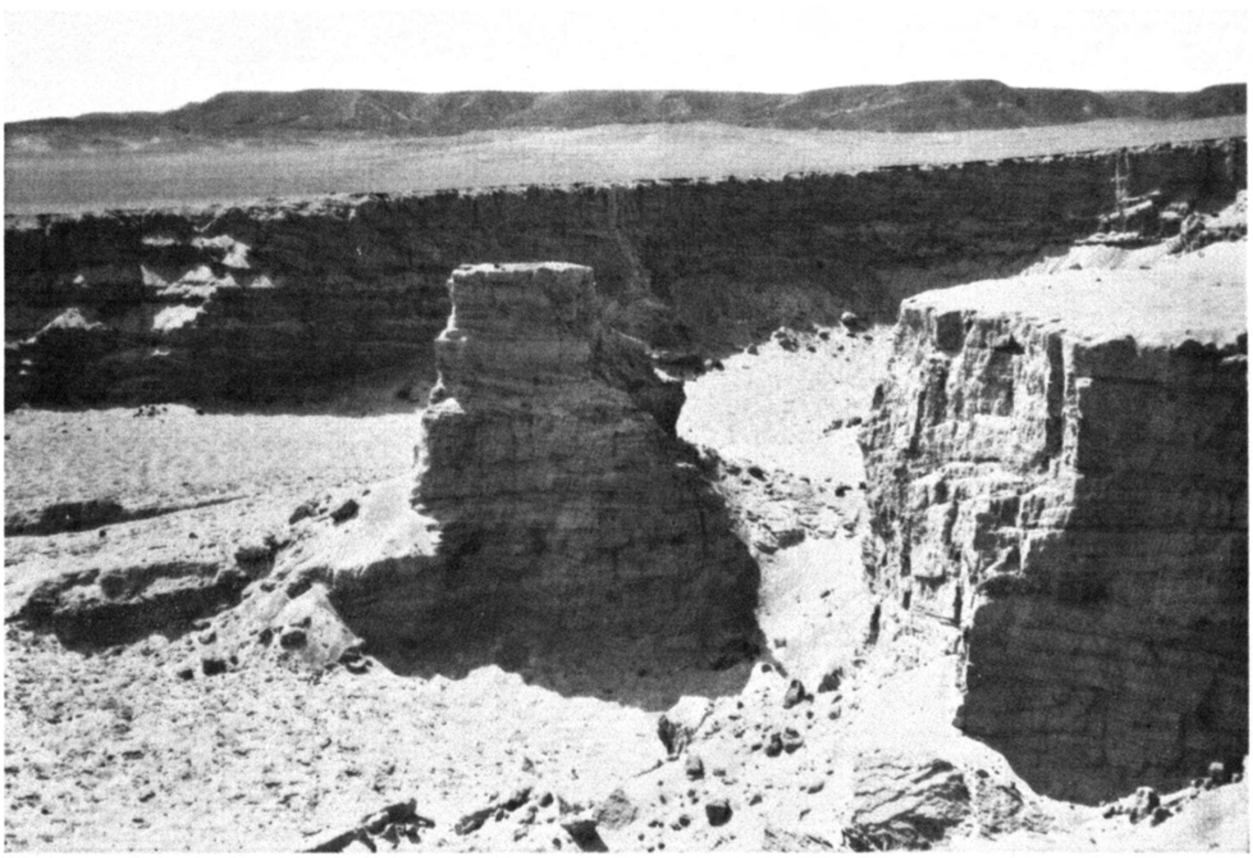
A

B

A.—Cobble gravels, probably deposited in Pliocene times, forming ridge west of el-Fashn, on skyline; in foreground, gravels of Pleistocene age. *B*.—Thick cobble gravels and conglomerate forming ridges at el-Hibah east of el-Fashn; Middle Eocene strata visible on left and in central middle distance.

PLATE V

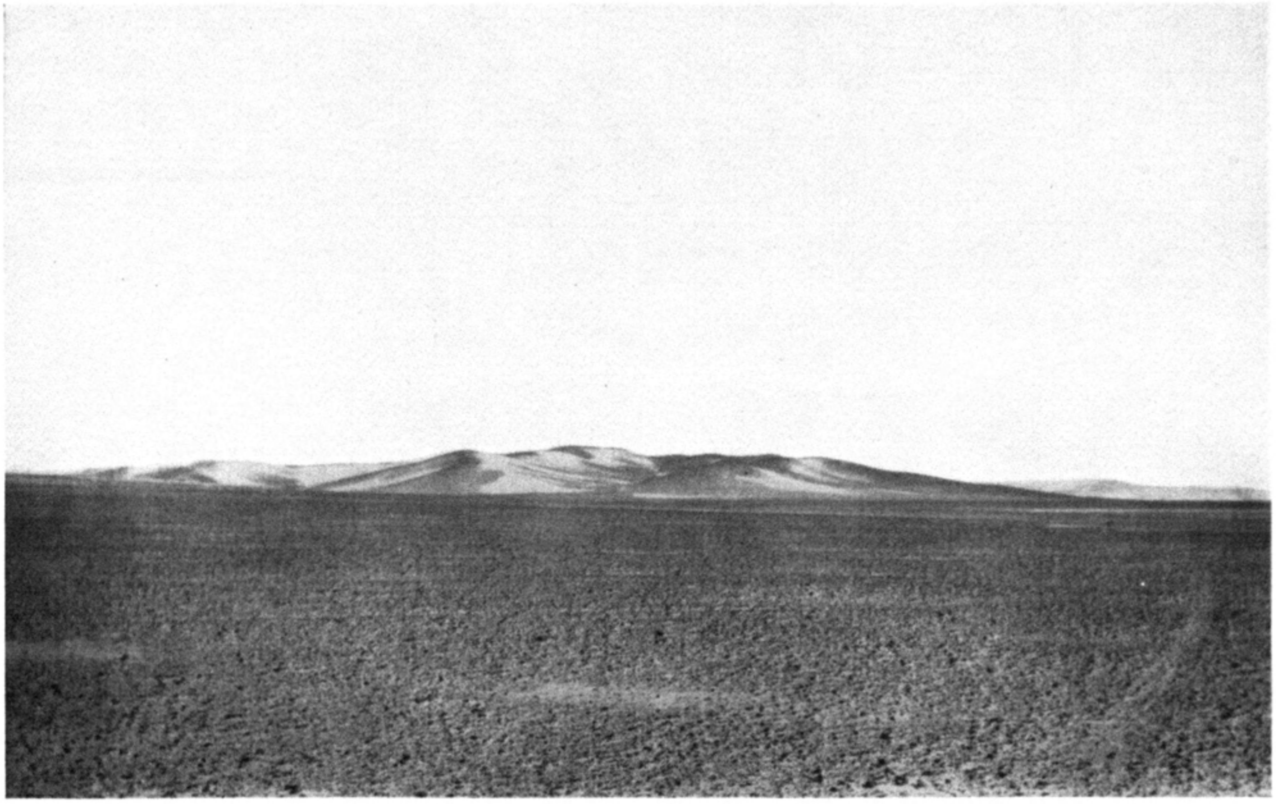
A



B

A.—Plio-Pleistocene beds at Gebel esh-Sheikh Abu Farwah near el-Matmar, looking east. *B*.—Plio-Pleistocene sands exposed in quarry on south side of Kena Hill.

PLATE VI



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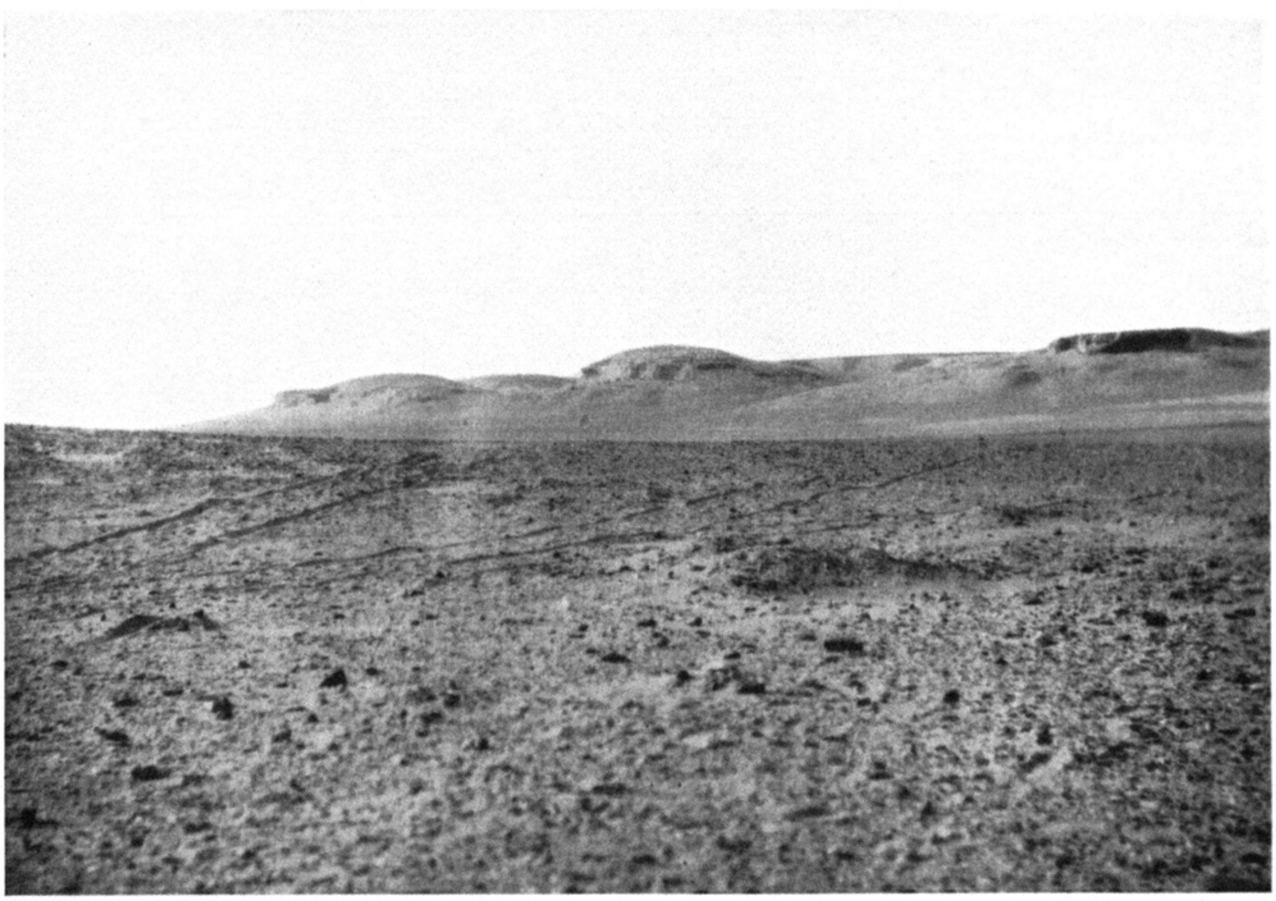
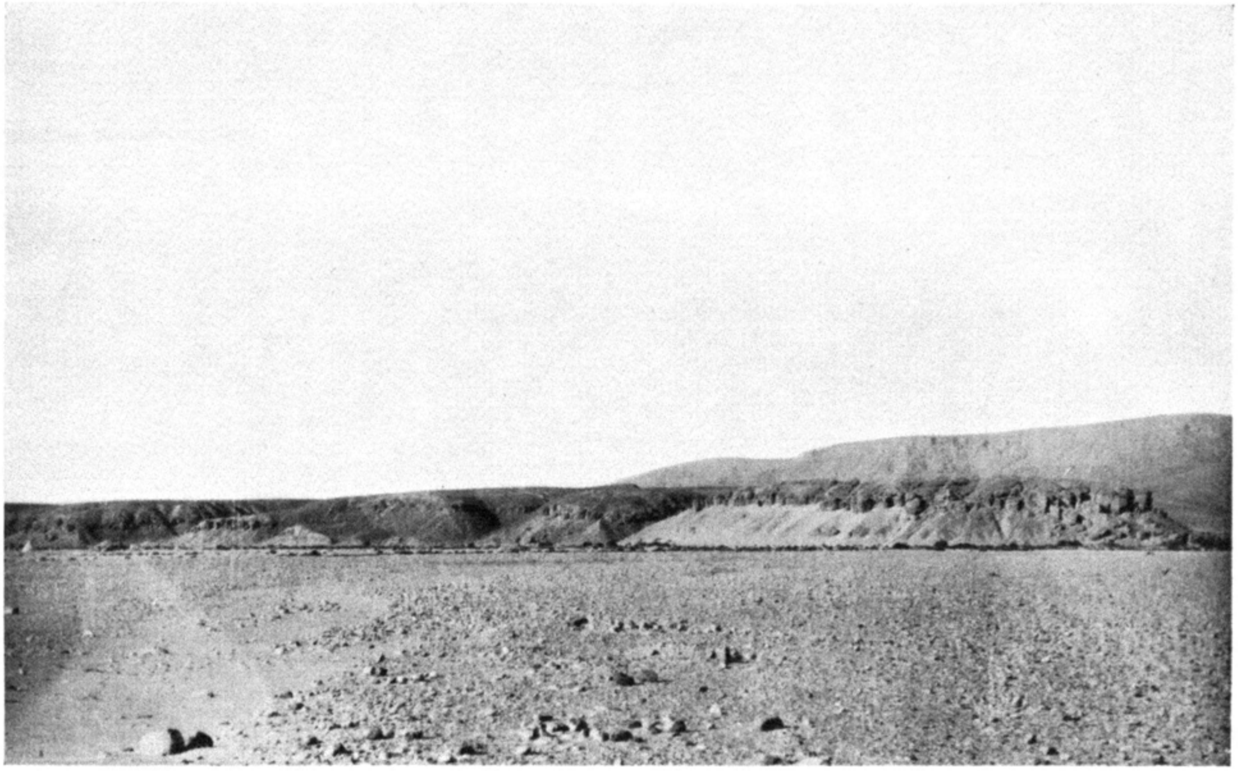


B

A.—Gravel slope abandoned by the Nile during the Plio-Pleistocene and Pleistocene eastward shift of its bed; Pliocene cobble gravels in background. View looking north from a point northwest of Dalga. *B*.—Cliff of 200-foot Plio-Pleistocene terrace capped with gravel; 100-foot terrace at its foot with gravel slope toward the Nile Valley, near Tunah el-Gebel.

PLATE VII



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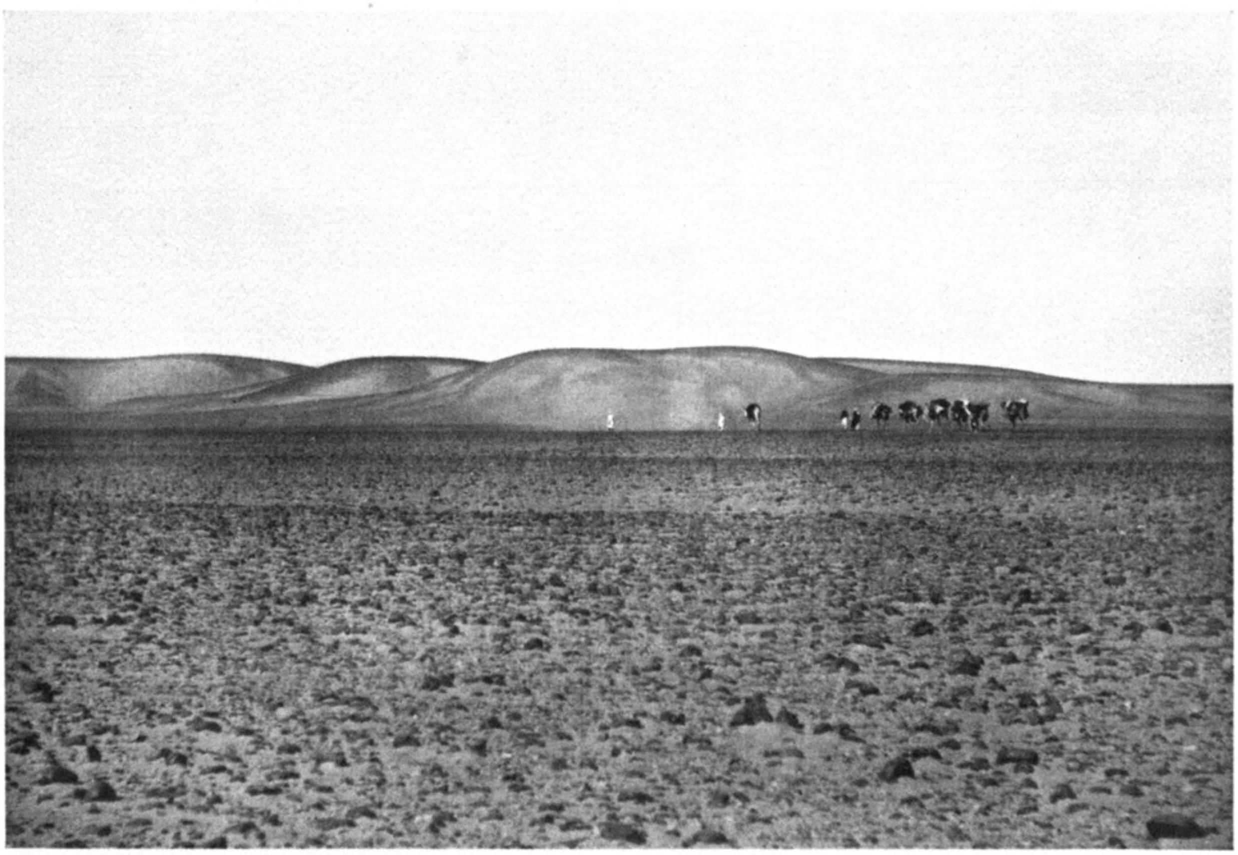
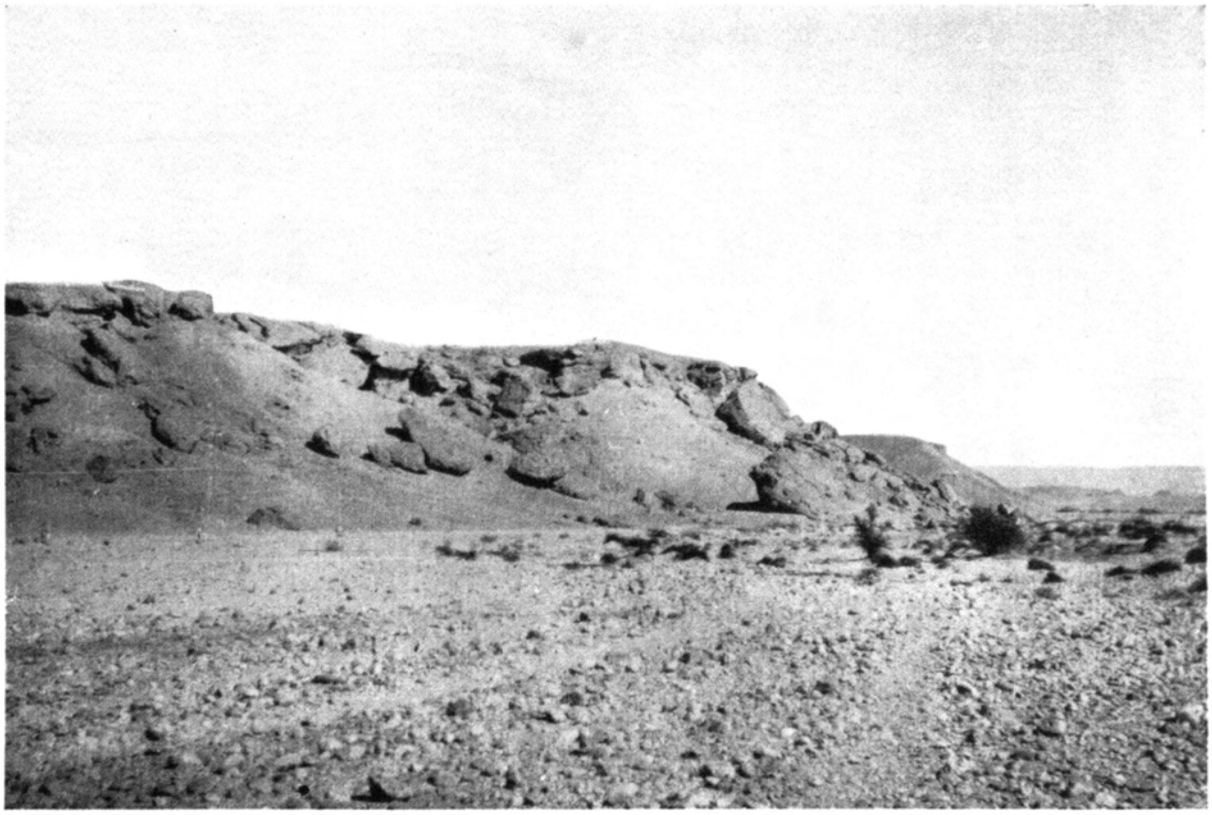


B

A.—100-foot Chellean terrace at Bir Arras near mouth of Wadi Kena. *B*.—100-foot terrace gravels deposited by the Nile in the bay north of Abydos.

PLATE VIII



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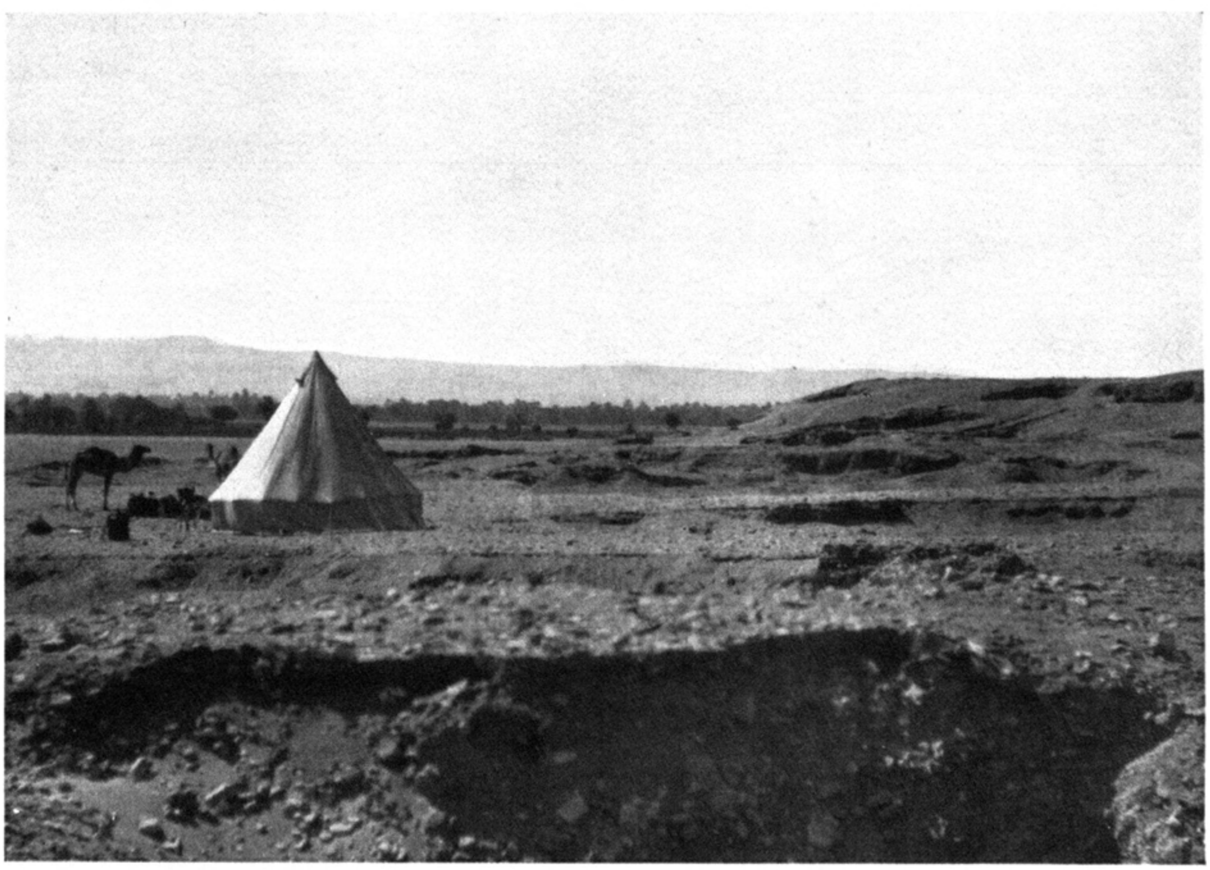
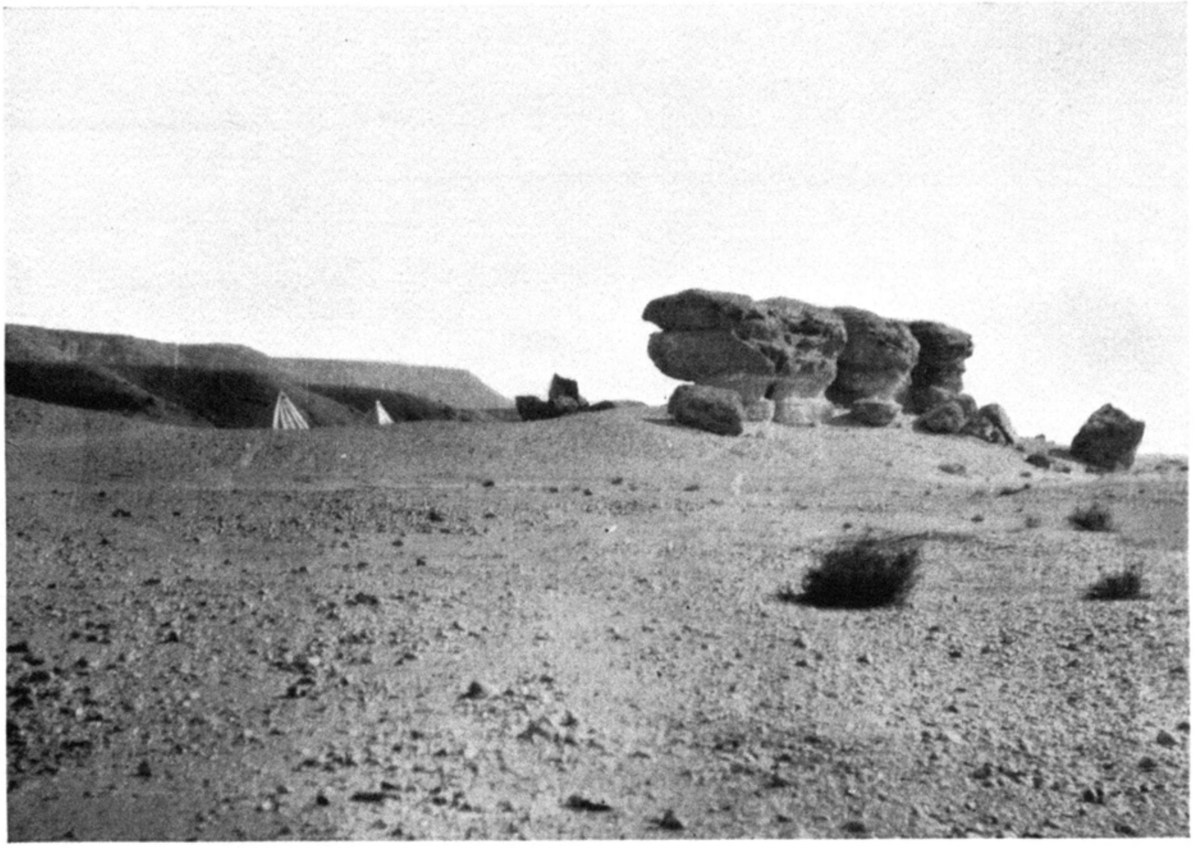


B

A.—Scarp of 50-foot Acheulean terrace in Wadi Kasab. Higher gravels occur behind it and on the right. *B*.—50-foot gravels on southwest side of Kena Hill, with 100-foot gravels on the right; in the foreground, pits dug for Pliocene marl, exposing Acheulean implements *in situ* in the gravels.

PLATE IX



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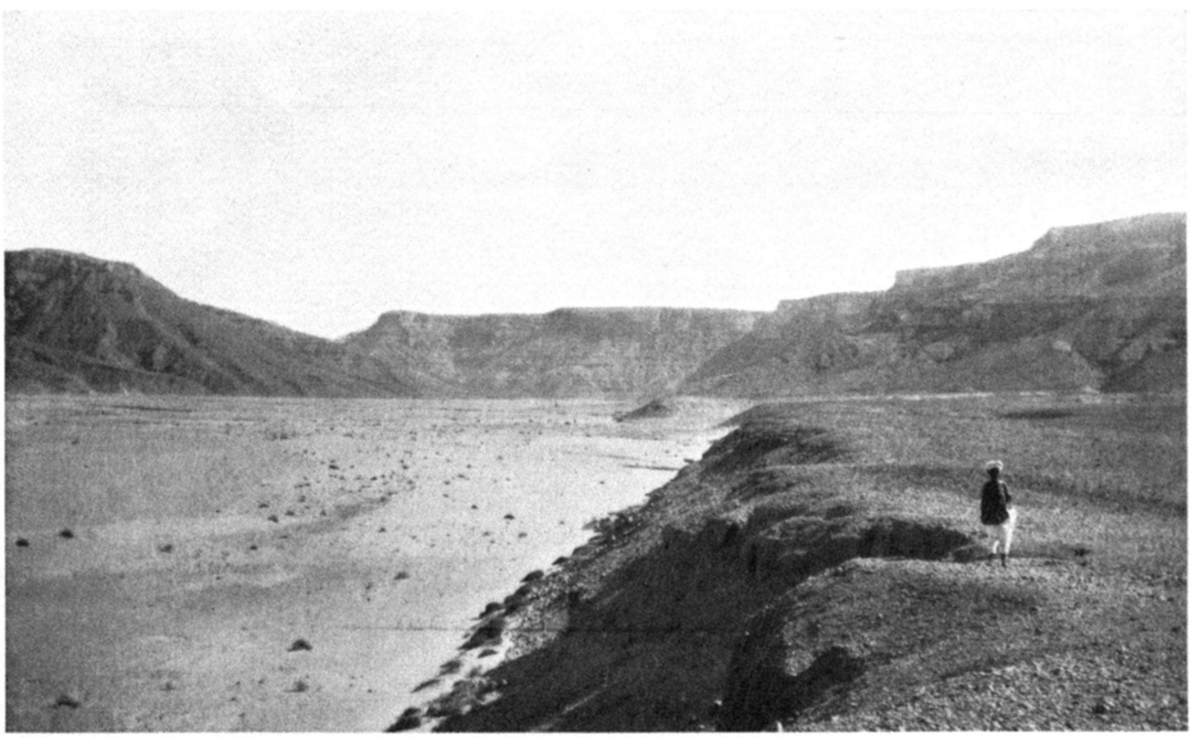
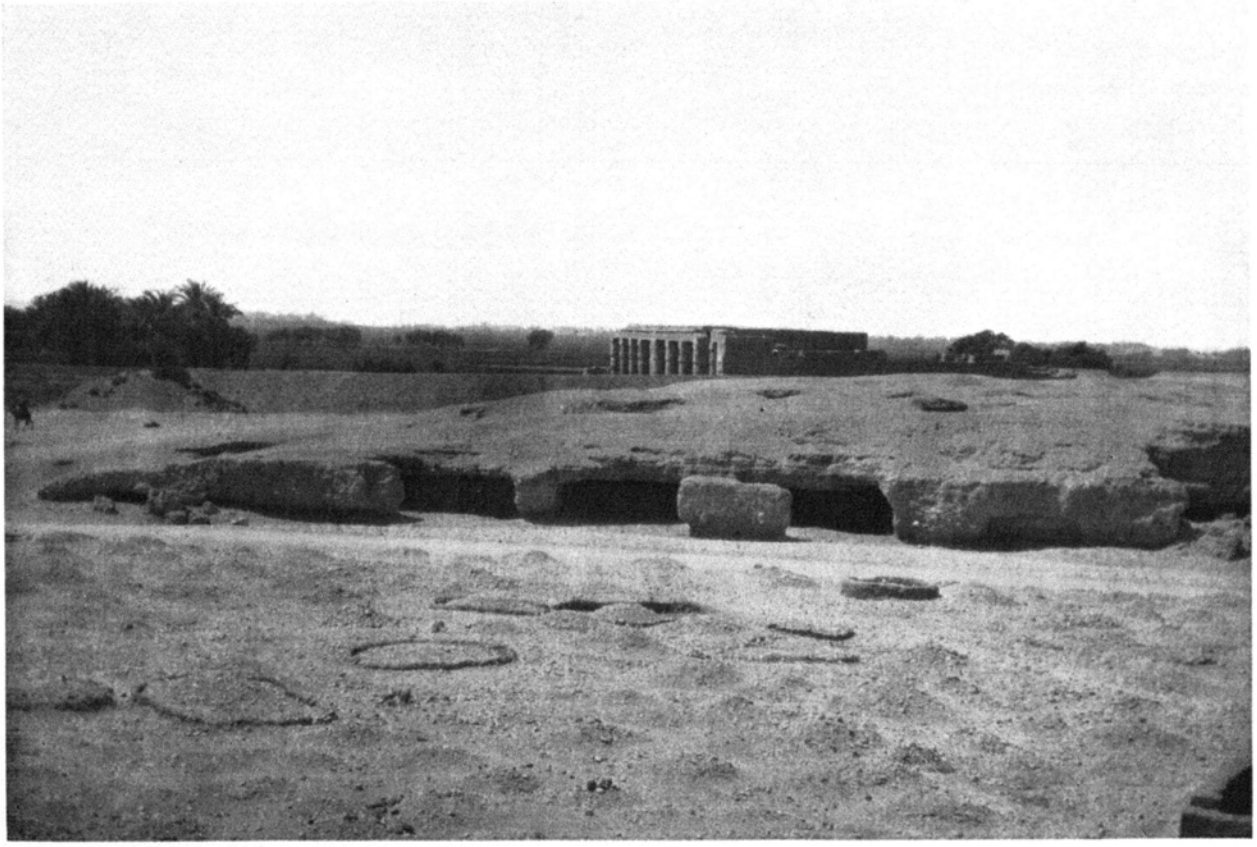


B

A.—Dissected remnant of 30-foot Early Mousterian terrace gravels on Pliocene beds at mouth of Wadi Kasab.
B.—30-foot terrace at mouth of Wadi Kasab.

PLATE X

A

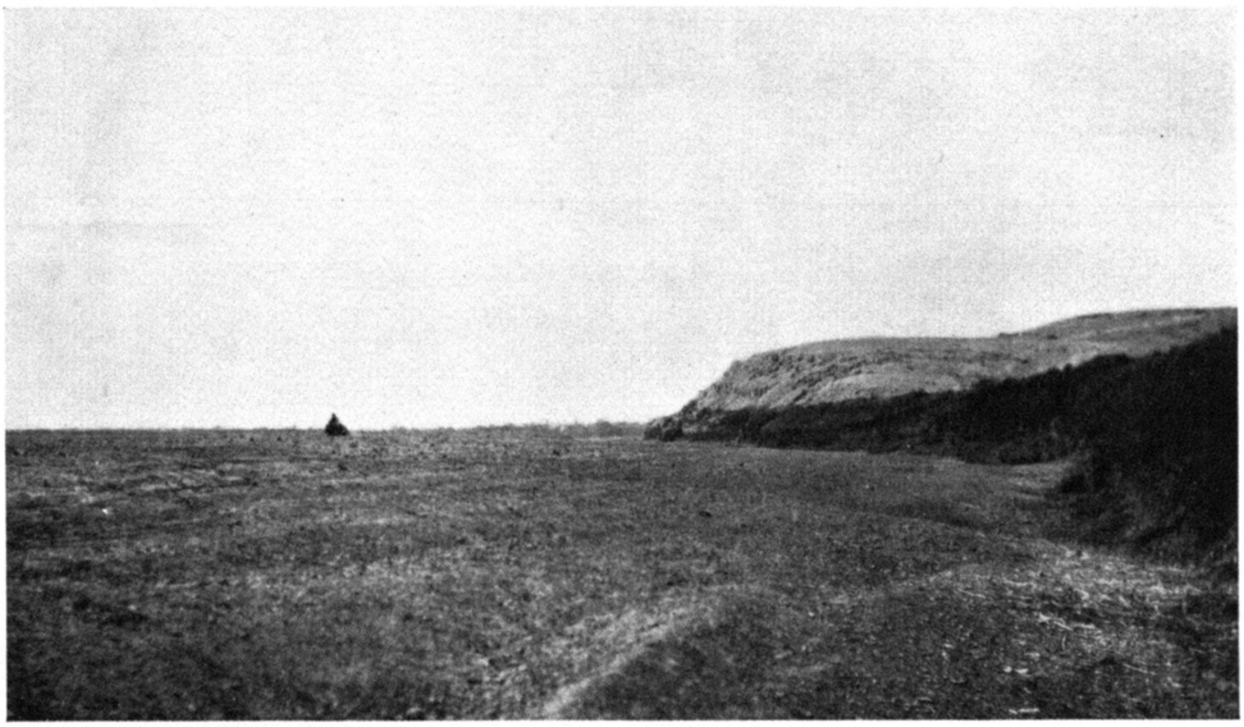


B

A—Thin 10–15-foot Mousterian gravels on Pliocene marl about 3 miles from the Nile on the west bank. Wadi cut in featureless slope between Denderah and el-Marashdah. *B*.—10–15-foot gravels at mouth of Wadiyein, Thebes, containing abundant Mousterian implements; base of gravels not visible.

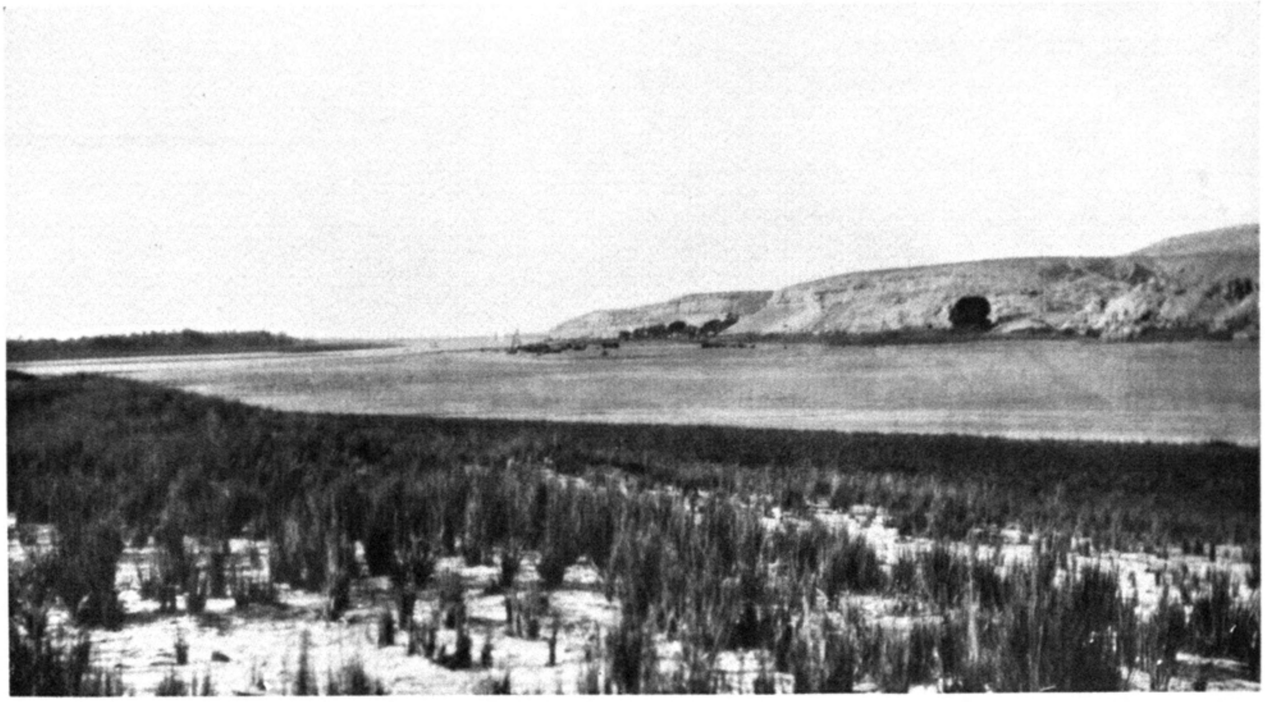
PLATE XI

A



B

A.—Mousterian gravels at the desert edge, washed by the Nile during floods, their base hidden beneath the modern alluvium, near Nakadah, Theban Hills. *B*.—Middle Sebilian suballuvial gravels exposed in the Geziret Shaibah-esh-Sheikh Timai channel. The figure in the center is upon the highest part of the gravel, which passes under the alluvium on the right.



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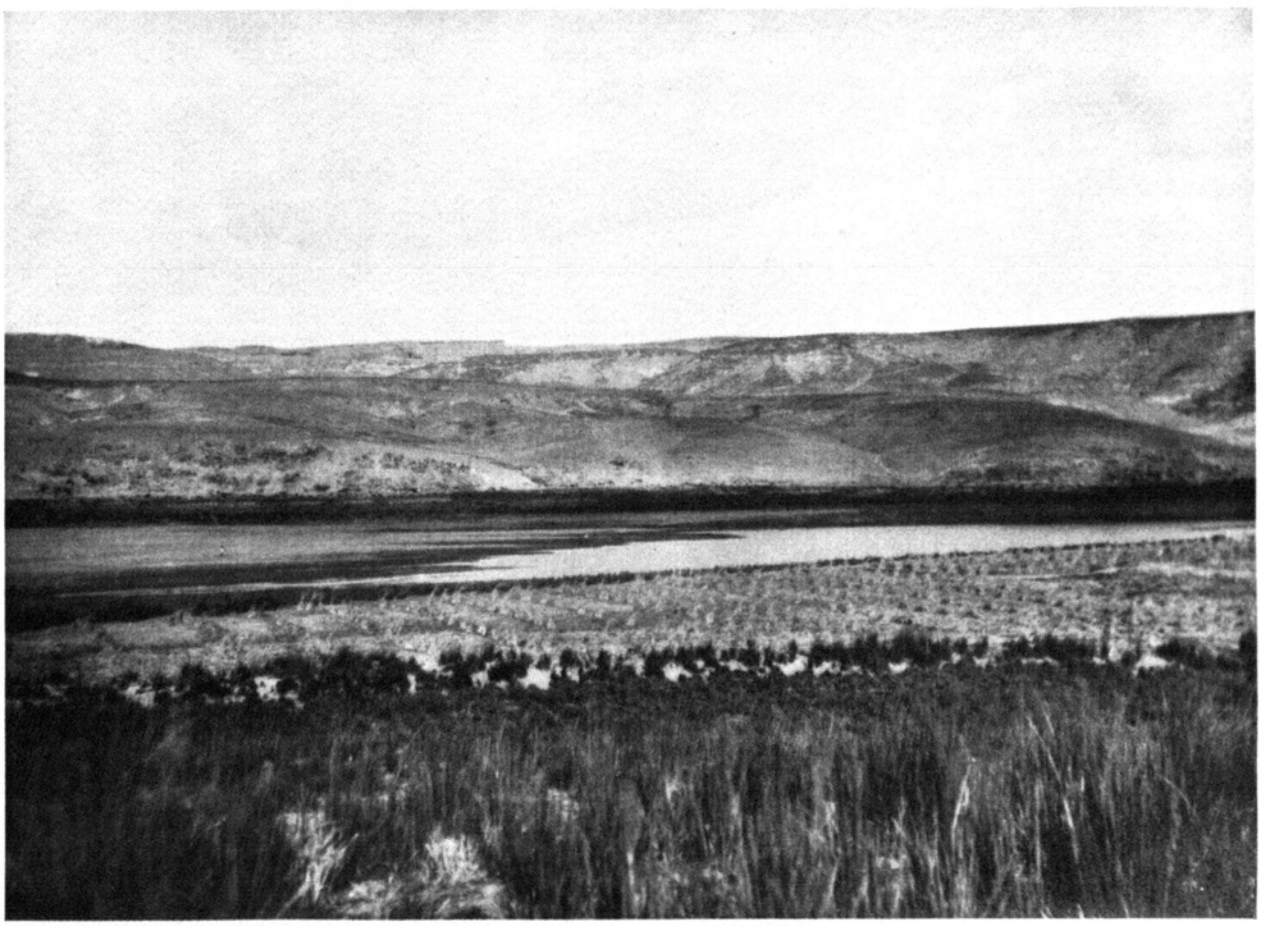


B

A.—The northern part of the channel between Geziret Shaibah, in foreground, and esh-Sheikh Timai, in center background. The Nile appears on extreme left and flows toward esh-Sheikh Timai. *B*.—Looking eastward across Middle Sebilian gravels exposed during period of low Nile; Geziret Shaibah in foreground.

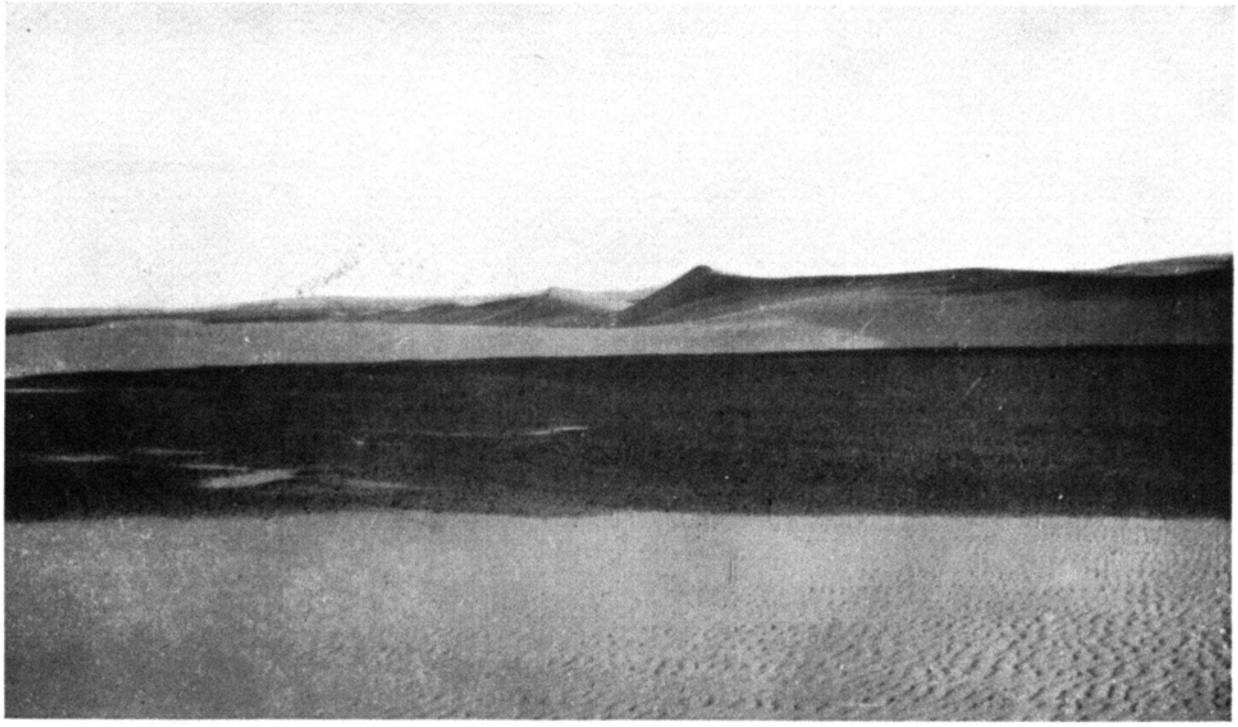
PLATE XIII

A

B

Examples of Modern Climatic Conditions in Upper and Middle Egypt

A.—"River" of sand drifting down wadi from Western Desert plateau near Abydos. *B*.—Mouth of Wadi Umm Dud, with mouth of Wadi Abu Halafi in distance, in Eastern Desert plateau east of Kau; in foreground, a confusion of bowlders left by a torrent which has swept down the wadi since 1926, entirely altering the appearance of its floor and, at the mouth of Wadi Abu Halafi, lowering it 20 feet (by removing previous accumulation of great bowlders etc.). Photograph taken in 1931.



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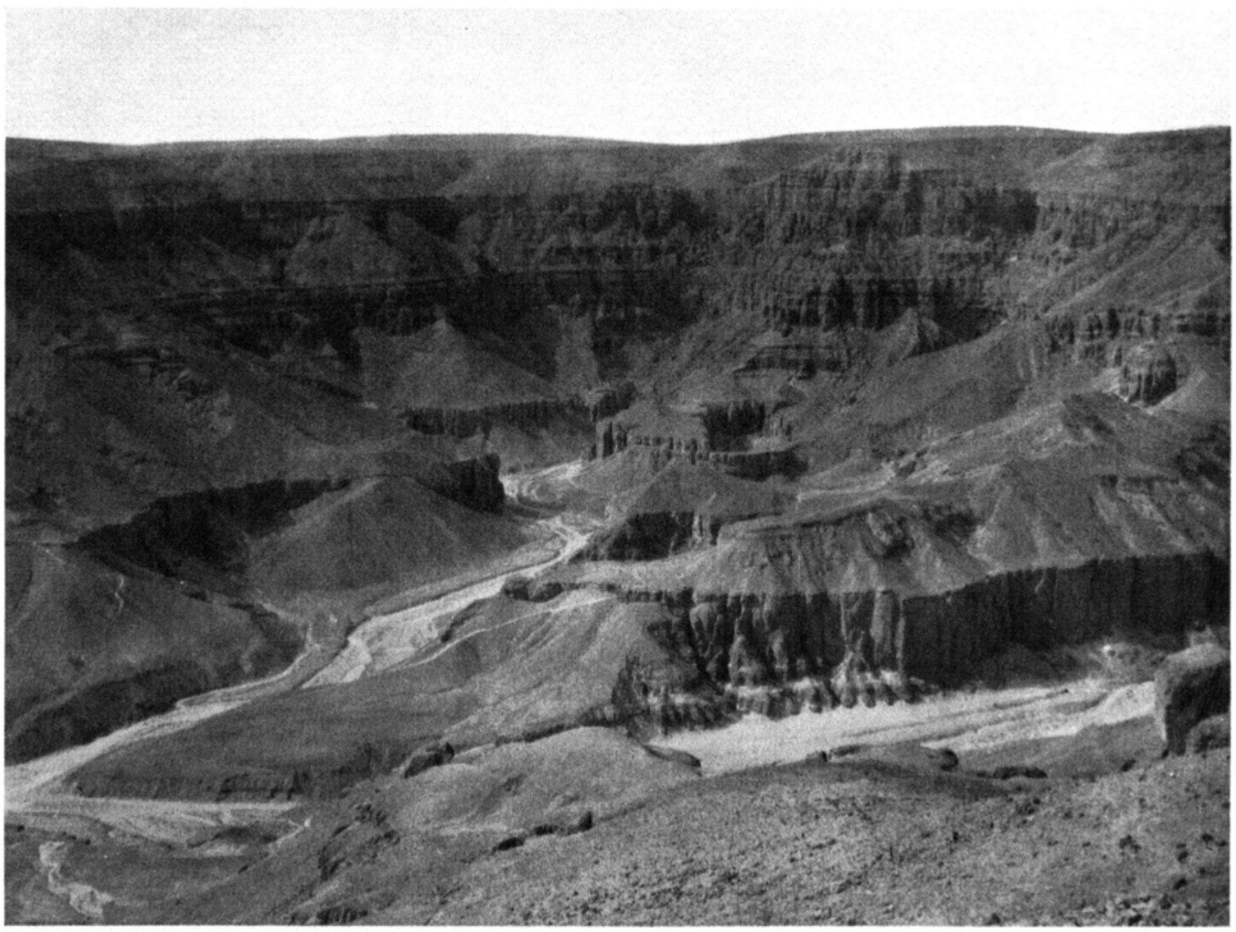
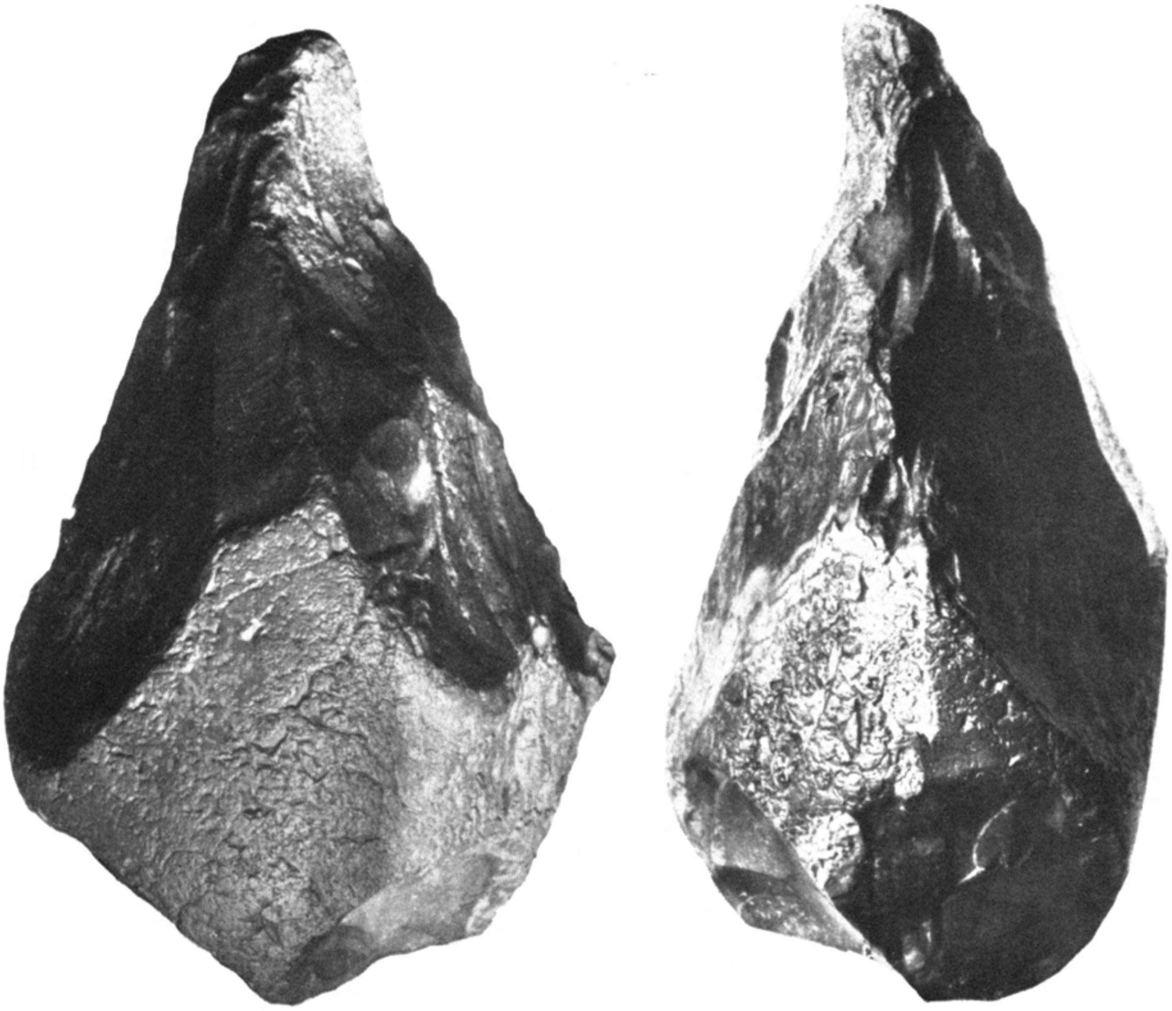


B

EXAMPLES OF MODERN CLIMATIC CONDITIONS IN UPPER AND MIDDLE EGYPT

A.—Sand dunes 50–75 feet high bordering the western side of the Nile Valley. View looking south from a point about 12 miles southwest of Minyah. *B*.—The scarp of the Theban Hills and the head of North Valley (center middle distance); Pliocene gulf deposits in immediate foreground (bottom left). Dissection has been in progress since Pontic times, but a static condition of desert now prevails. Rain is virtually unknown here, but water flowed down the wadi for a few hours some years ago.

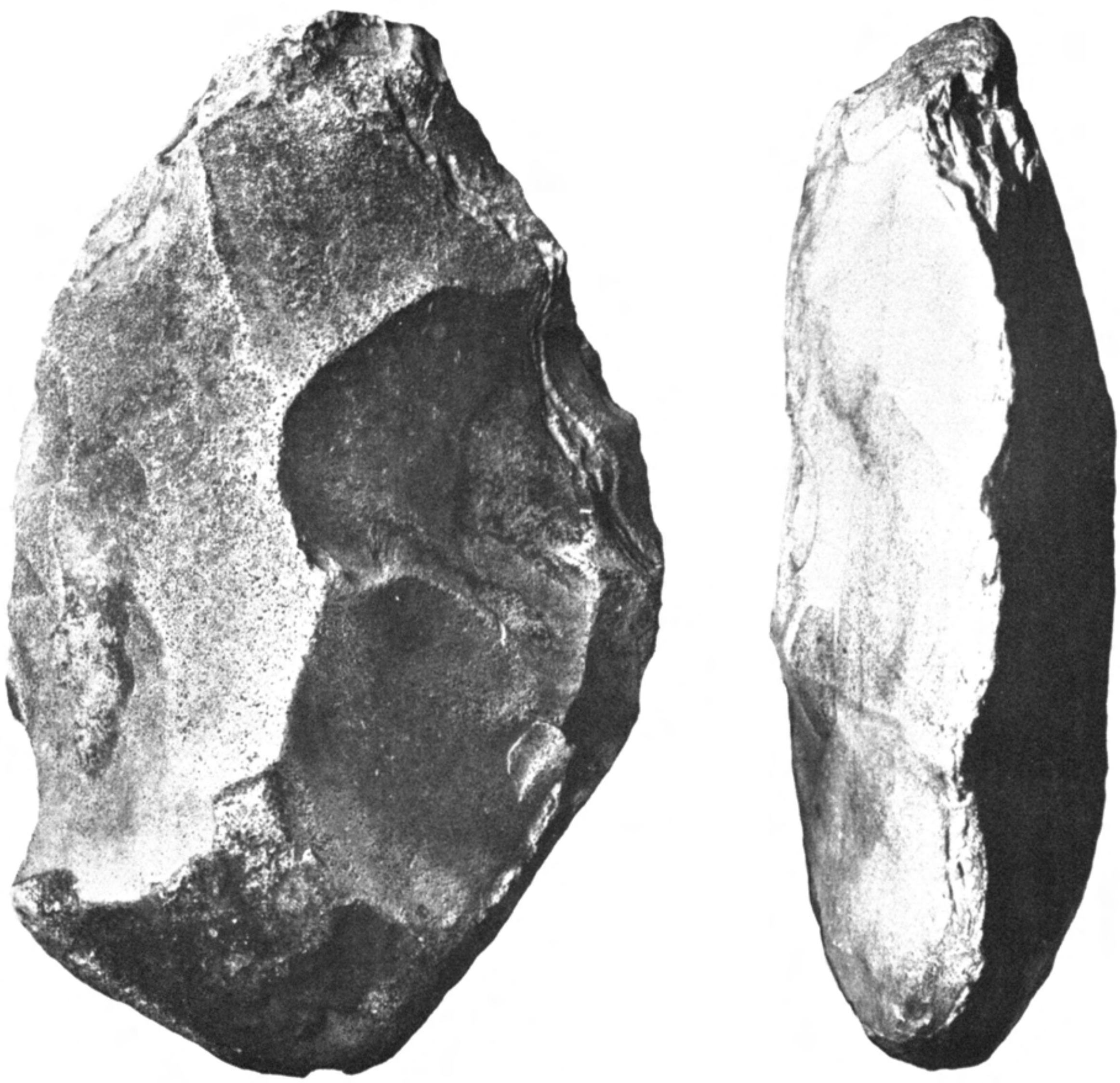
PLATE XV



1

1.—Primitive Chellean coup-de-poing from 100-foot gravels near Beni ʿAdi

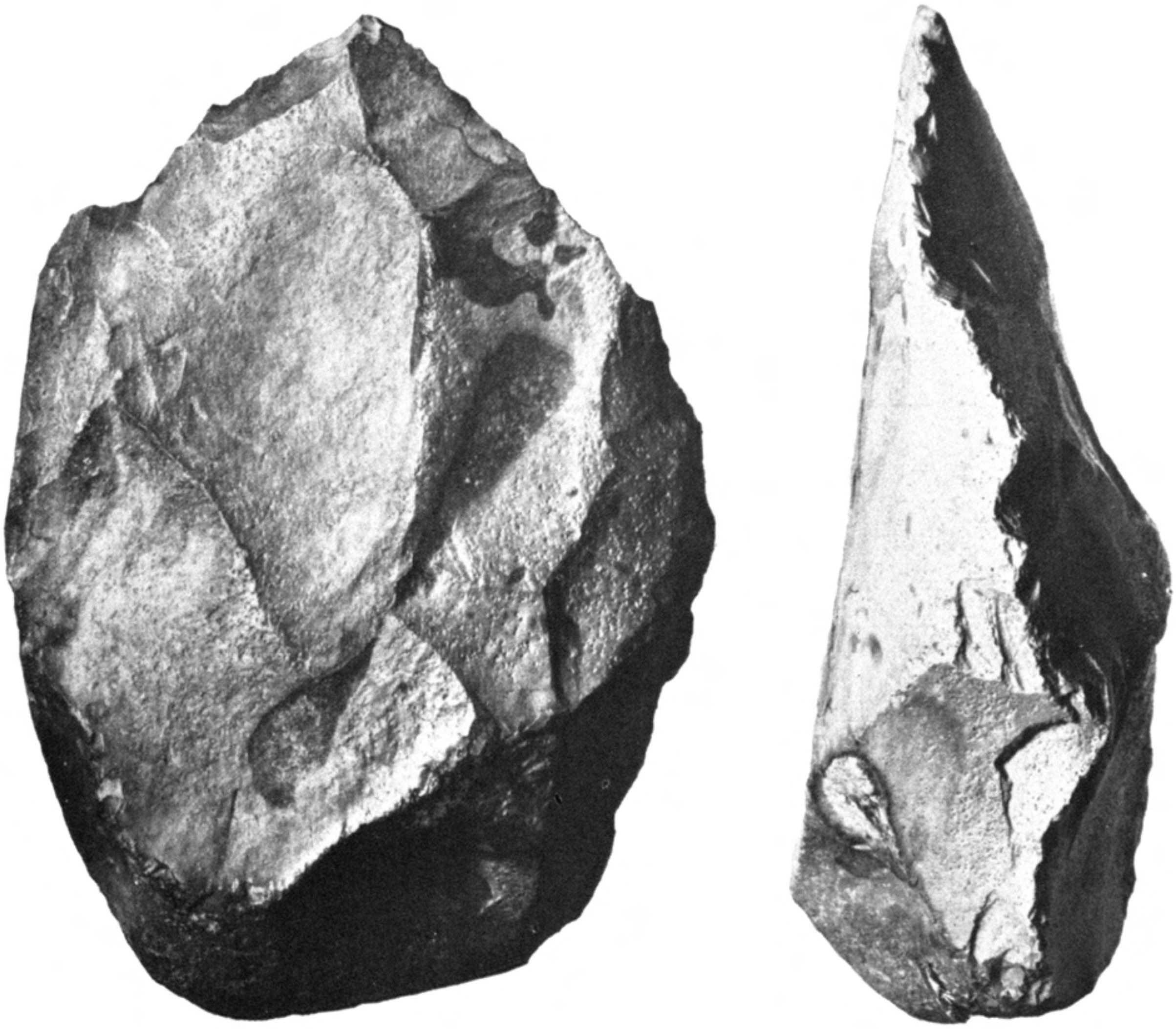
PLATE XVI



2

2.—Chellean coup-de-poing from 100-foot gravels on southwestern side of Kena Hill

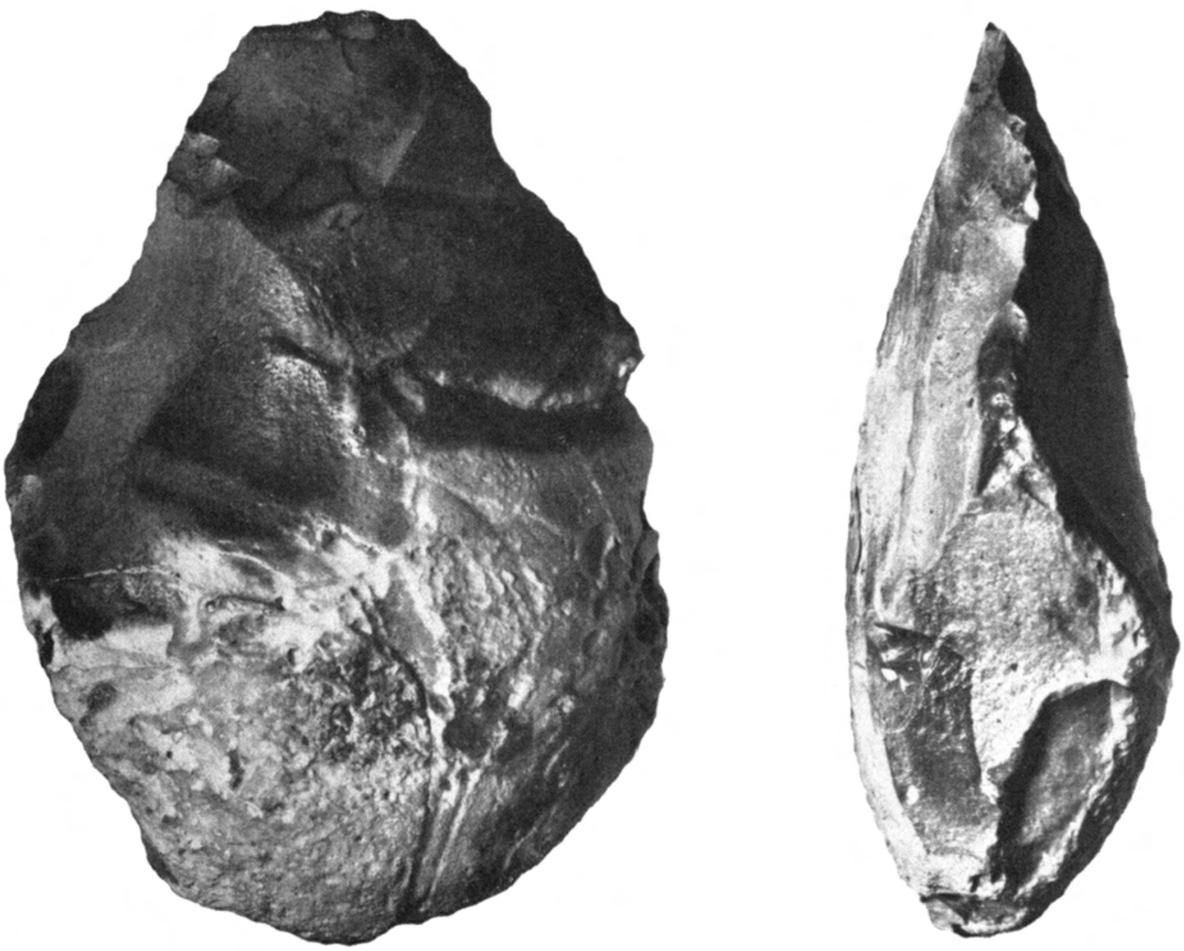
PLATE XVII



3

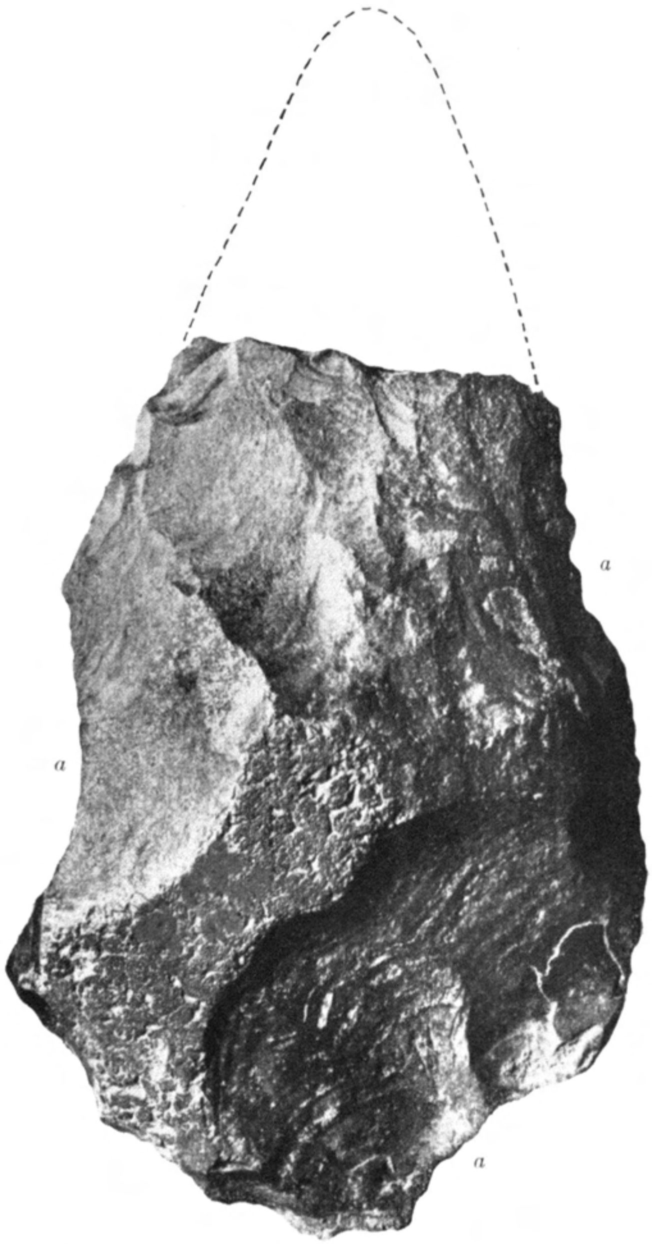
3.—Chellean coup-de-poing from 100-foot gravels at el-Haita, Wadi Kena

PLATE XVIII



4

4.—Chellean coup-de-poing from 100-foot gravels in northern corner of Abydos bay, southwest of Suhag



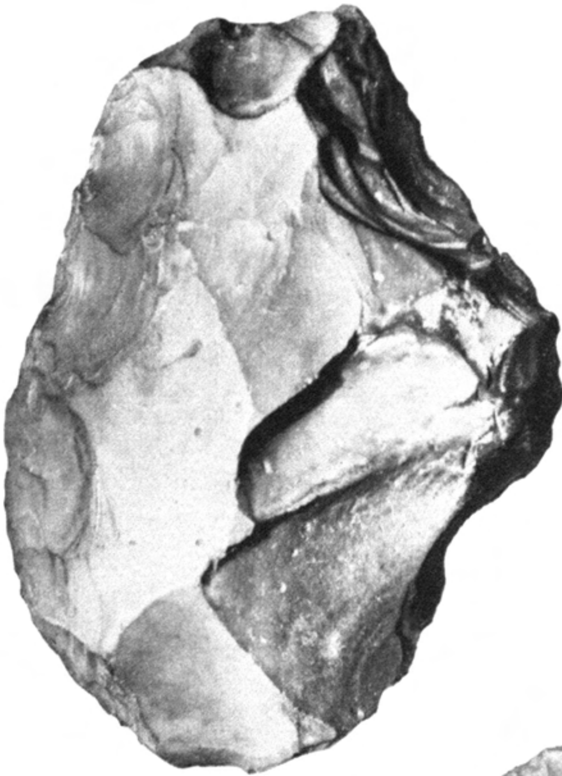
5

6

7

5.—Chelleo-Acheulean implement from Beni ʿAdi (found with No. 1). *6.*—Picklike implement from 100-foot gravels in the Abydos bay (found with No. 4). *7.*—Thick flake from 100-foot gravels at el-Haita.

PLATE XX



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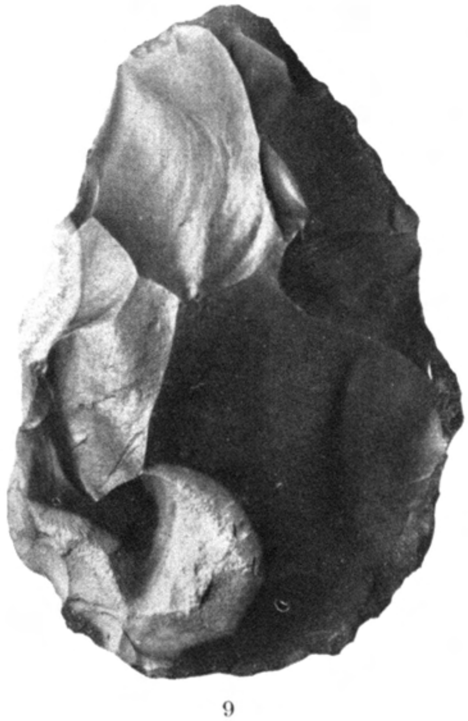
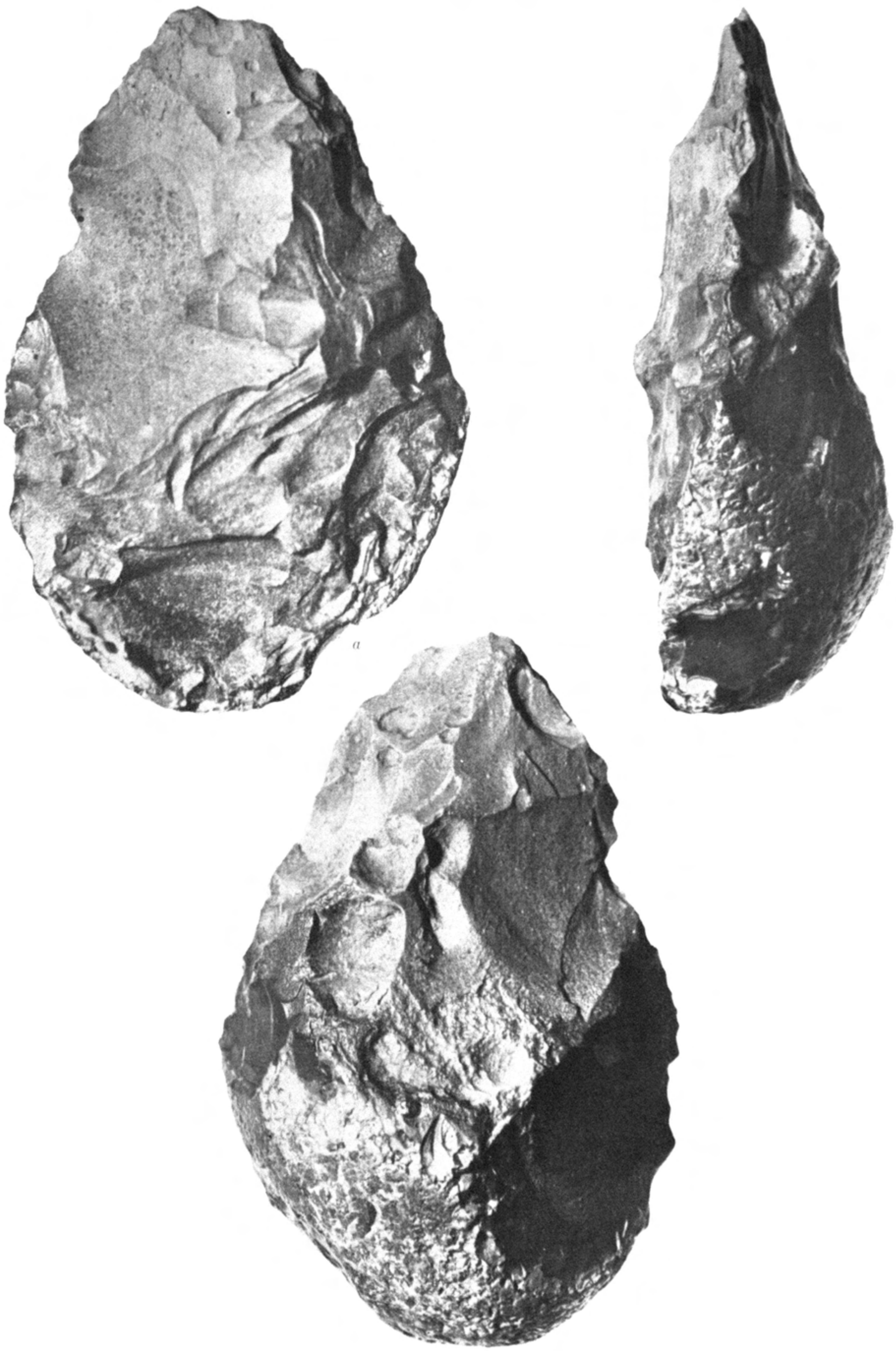


9

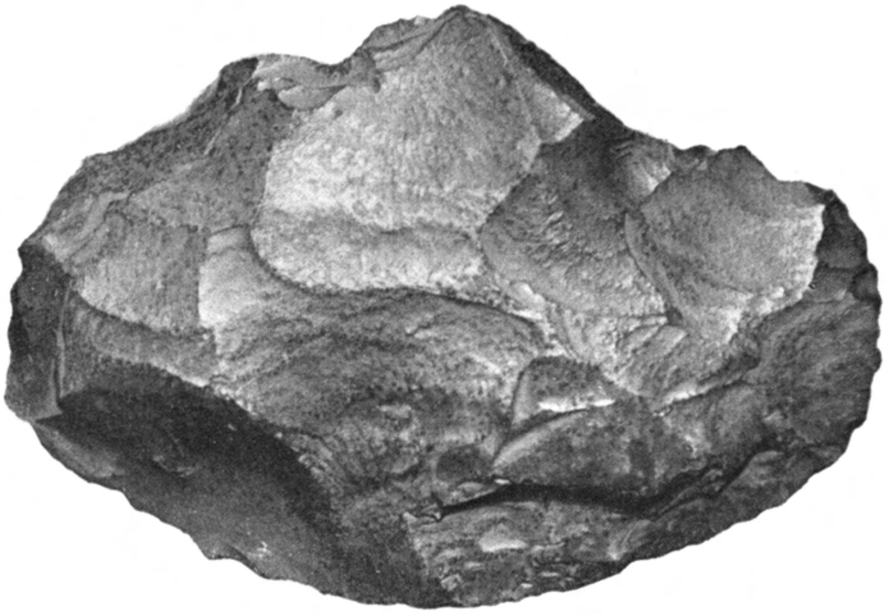
8.—Acheulean coup-de-poing, approaching plano-convex type, from 100-foot gravels at el-Haita. *9.*—Acheulean implement from 100-foot gravels at Bir Arras.



10

10.—Chelleo-Acheulean coup-de-poing from 100-foot gravels in the Abydos bay (found with Nos. 4 and 6)

PLATE XXII



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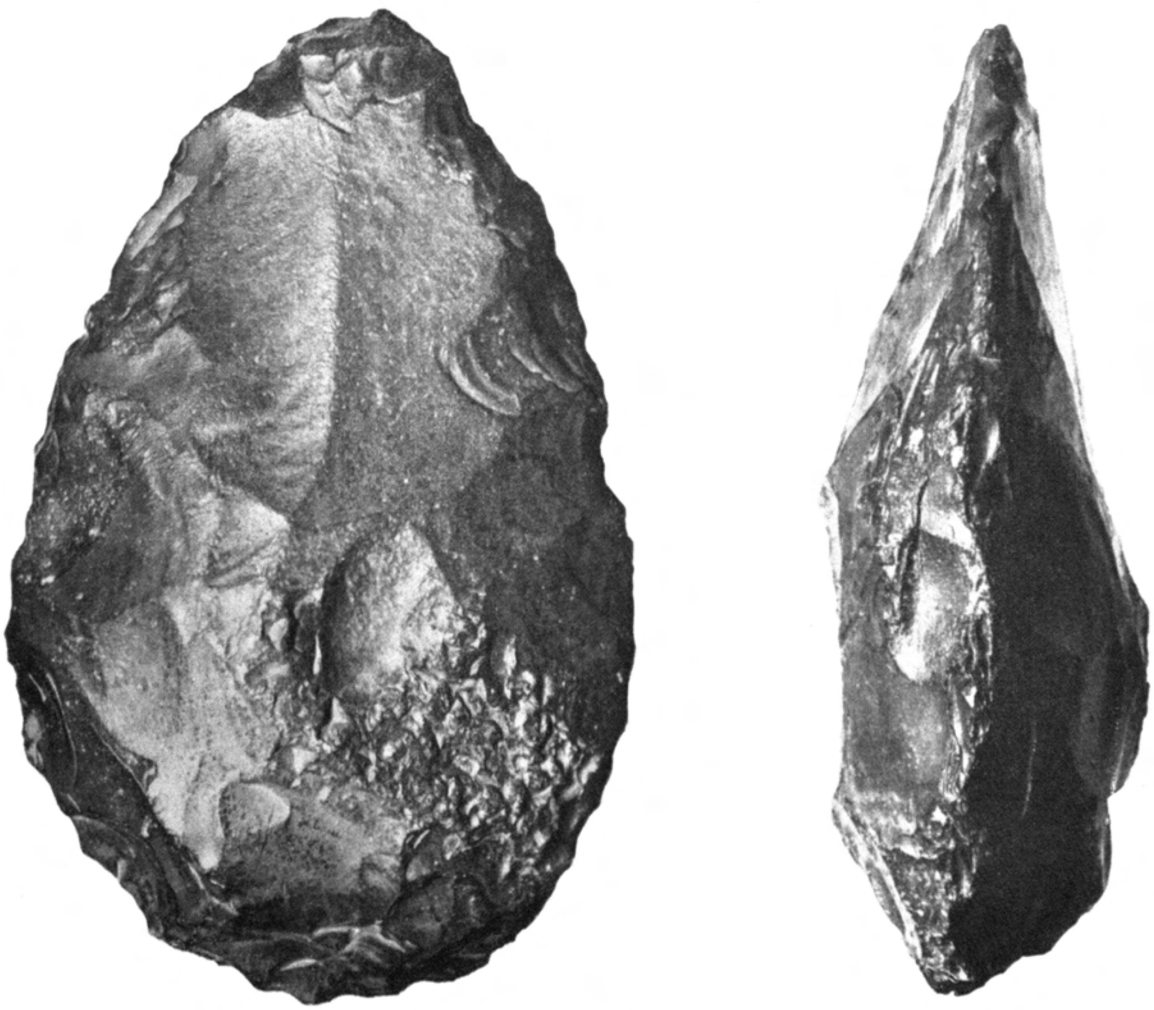
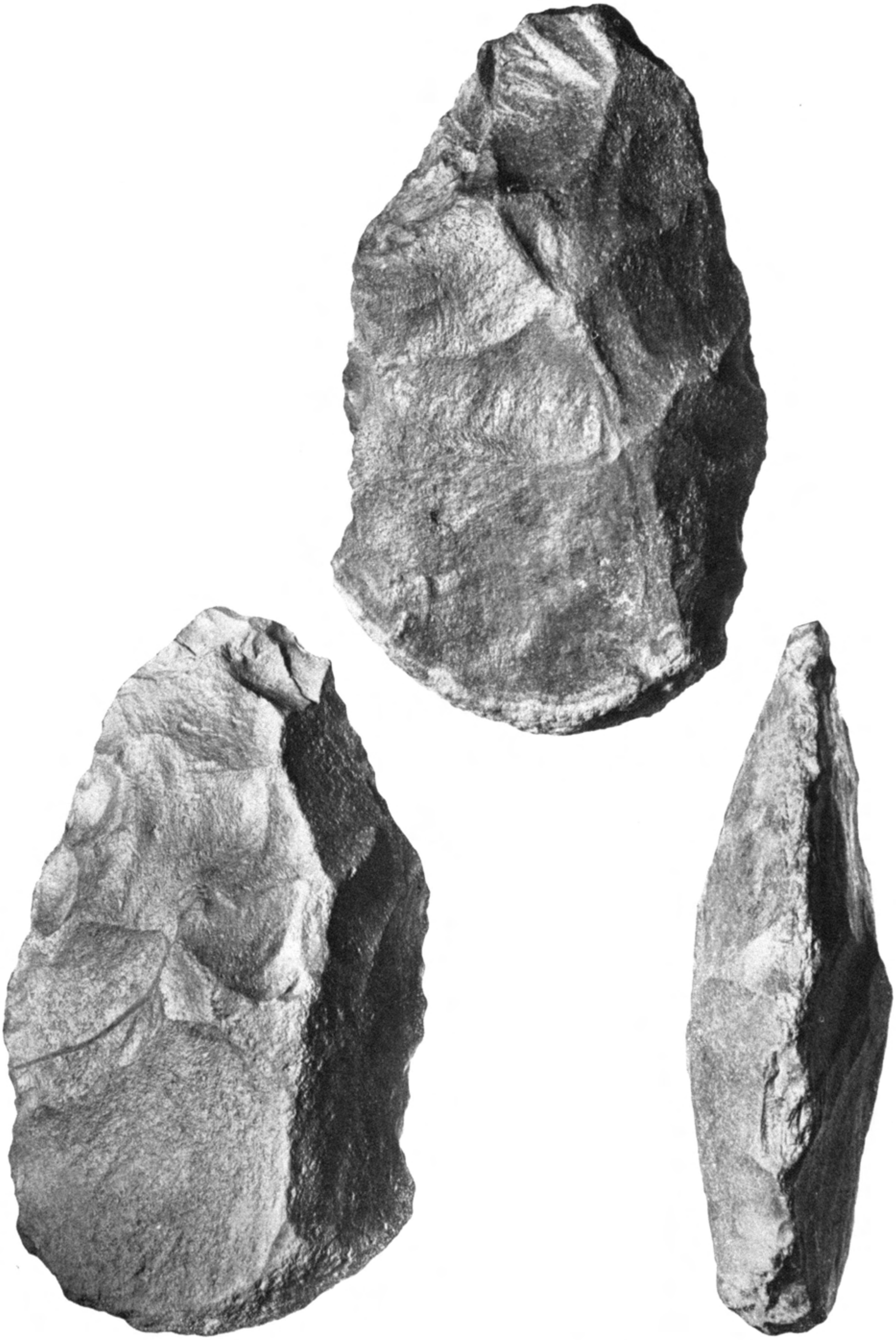


11

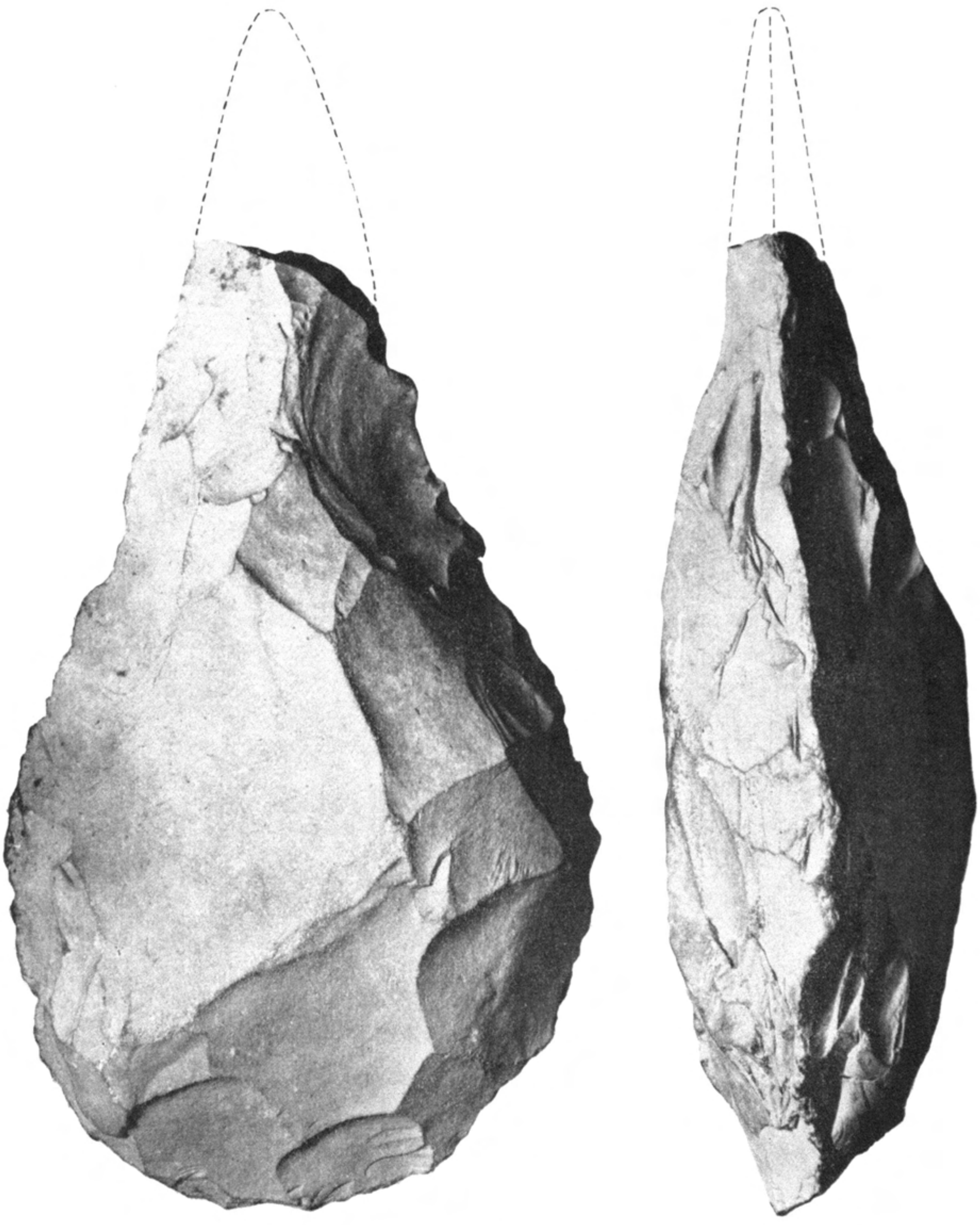
11.—Acheulean coup-de-poing of semi-ovate type, unrolled, from surface of 100-foot gravels at Bir Arras (for comparison with No. 10). *12.*—Acheulean ovate implement from 100-foot gravels at Bir Arras.

PLATE XXIII



13

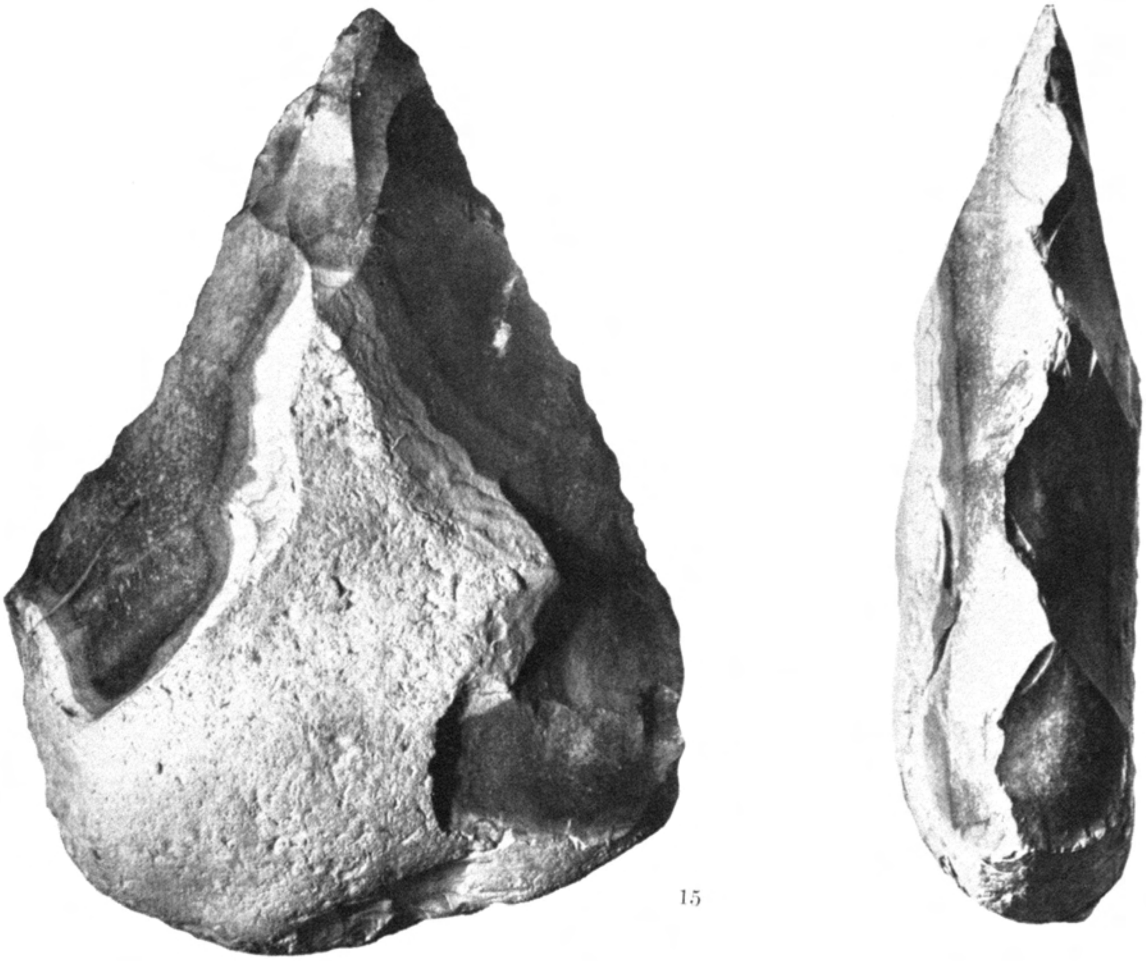
13.—Acheulean or late Chellean coup-de-poing from 50-foot gravels near Beni ᶜAdi



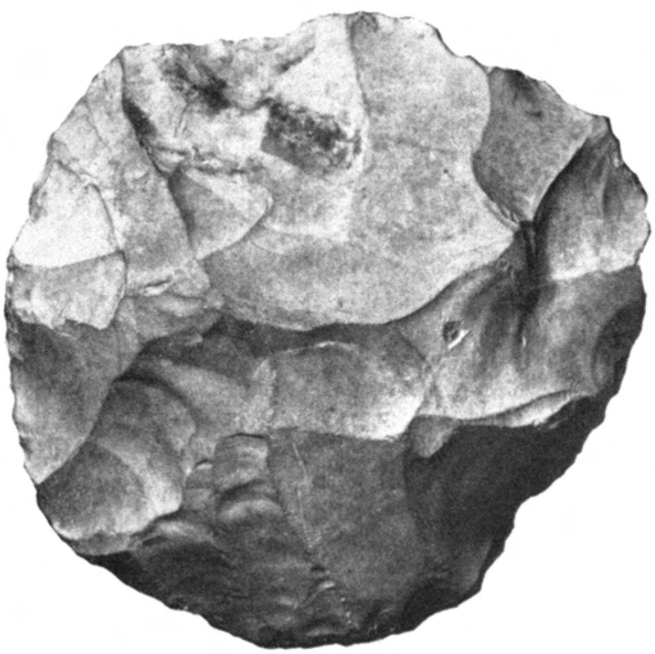
14

14.—Large coup-de-poing from 50-foot gravels at Kena, on southwest flank of Kena Hill

PLATE XXV



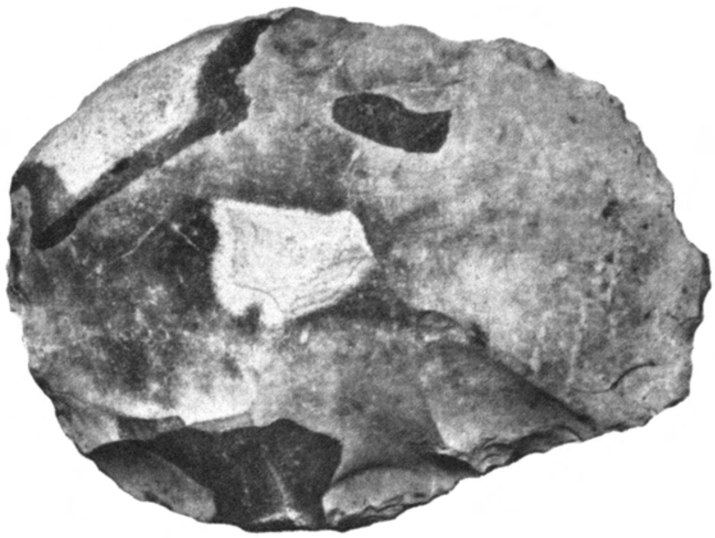
15



16

15.—Sharp-pointed implement from 50-foot gravels at Kena, on southwest flank of Kena Hill. *16.*—Disk from 50-foot gravels at Kena, on southwest flank of Kena Hill.

PLATE XXVI



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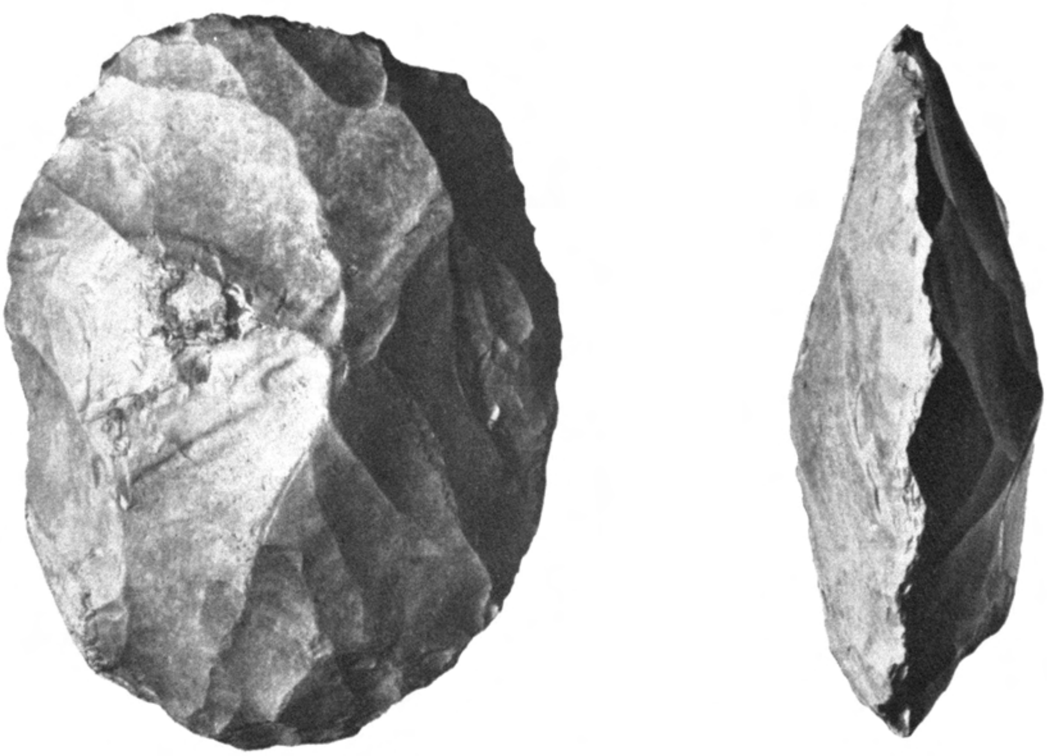
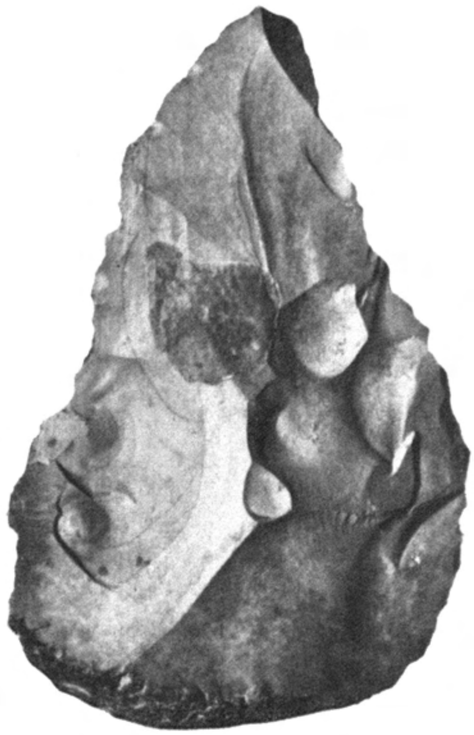


18

17–18.—Ovate implements, without twist, from 50-foot gravels at Kena, on southwest flank of Kena Hill

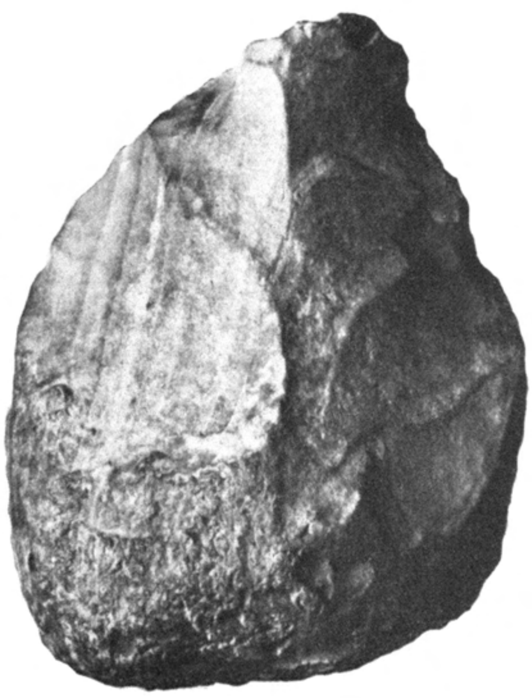
PLATE XXVII



a

b

20



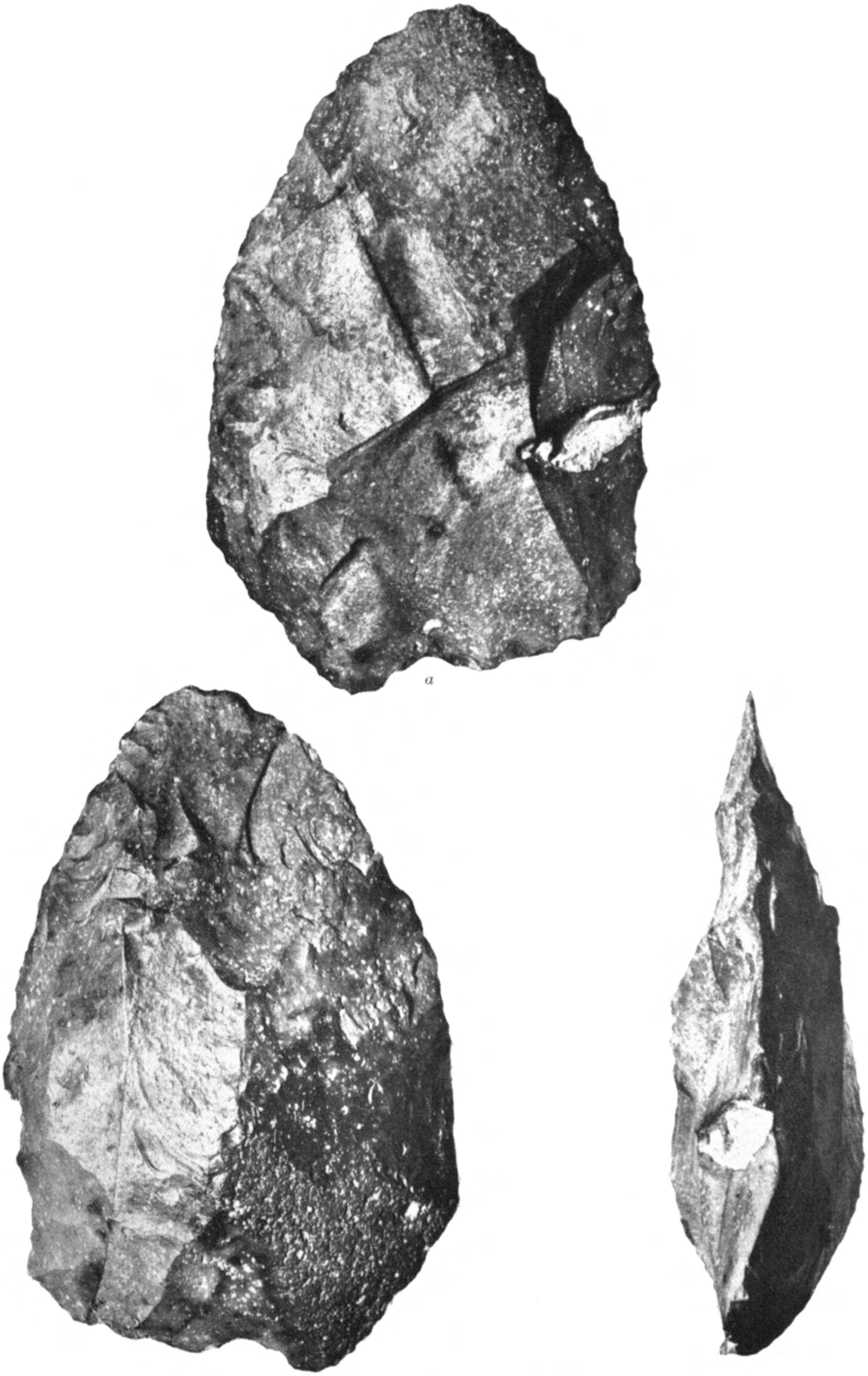
19

c

20

19.—A roughly made point from 50-foot gravels at Kena, on southwest flank of Kena Hill. *20.*—Point of plano-convex type from 50-foot gravels at Kena, on southwest flank of Kena Hill.

PLATE XXVIII



a

b 21 *c*

21.—Acheulean coup-de-poing, plano-convex, from 50-foot gravels west of Suhag

PLATE XXIX

23

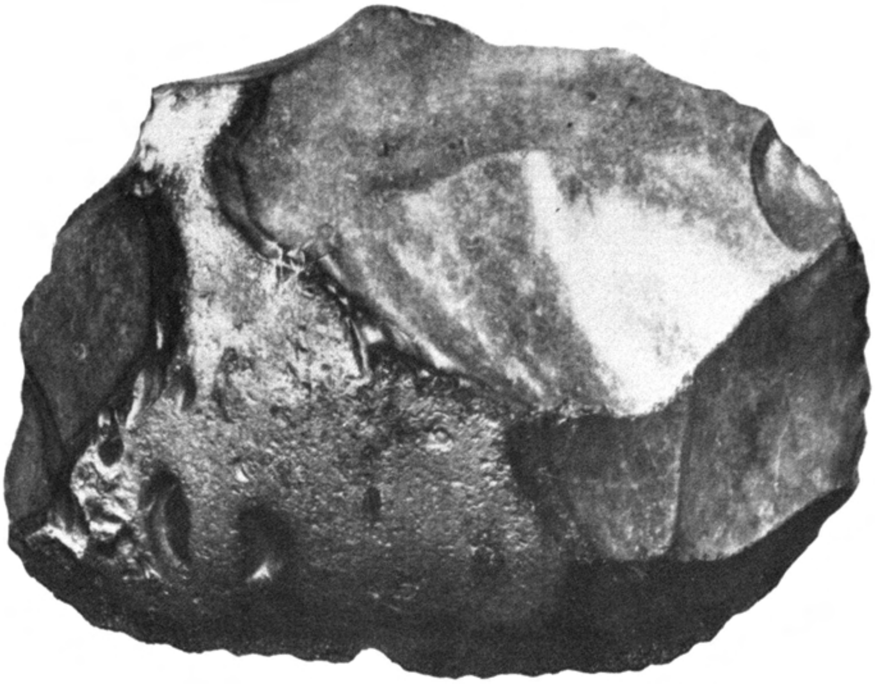
22

22.—Acheulean ovate implement from 50-foot gravels at foot of detached Eocene hill south of Oases Railway, about 3 miles from edge of desert. *23.*—Small coup-de-poing, of bilateral symmetry, from surface in Abydos bay, about 10 miles north of Abydos, at foot of travertine scarp.

a

b 24 *c*

24.—Plano-convex coup-de-poing, of Acheulean type, the underside a flake surface, from surface of 300-foot Nile gravel near ez-Zawa>idah south of Ballas.



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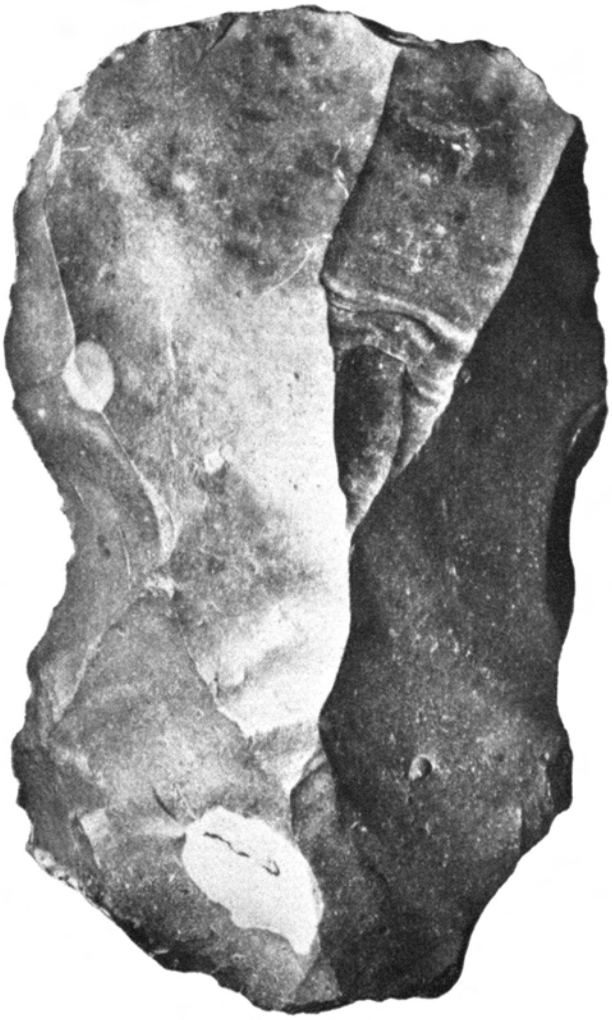
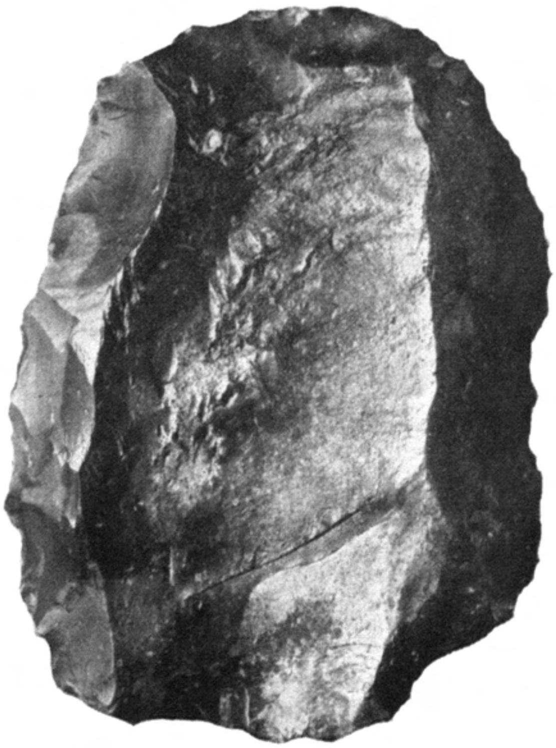


26

27

25.—Early Mousterian core, from gravels of 30-foot terrace at ez-Zawaʾidah. *26.*—Early Mousterian flake, from gravels of 30-foot terrace midway between Bir Arras and el-Haita, Wadi Kena. *27.*—Early Mousterian flake, waterworn, from surface of 30-foot terrace south of Oases Railway (found near No. 22).

PLATE XXXII



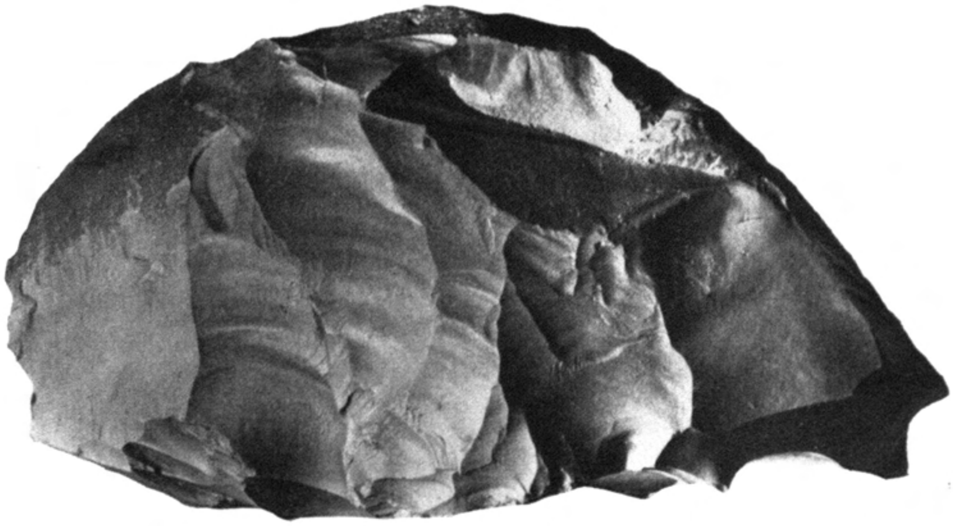
29

28

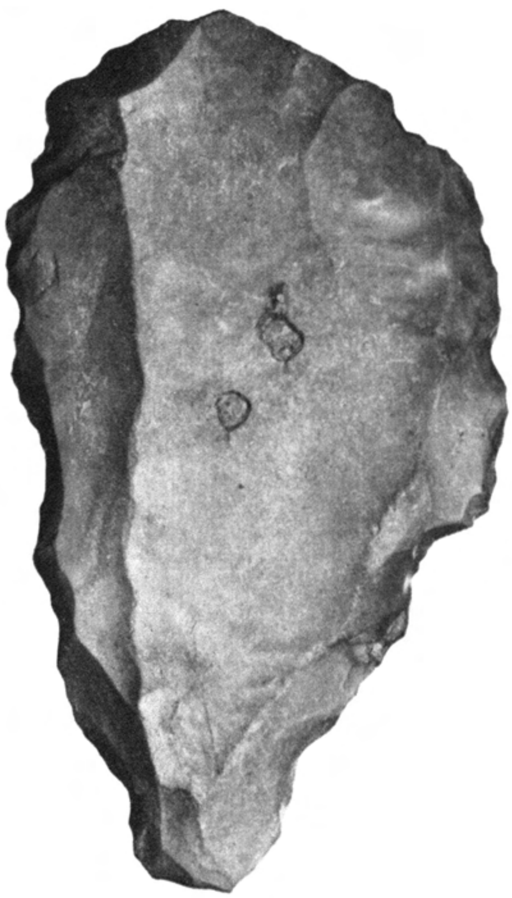
29

28.—Early Mousterian flake from 30-foot gravels near mouth of Wadi Serai, southeast of Kena. *29.*—Mousterian core from surface of 30-foot terrace west of Suhag (to contrast with No. 25).

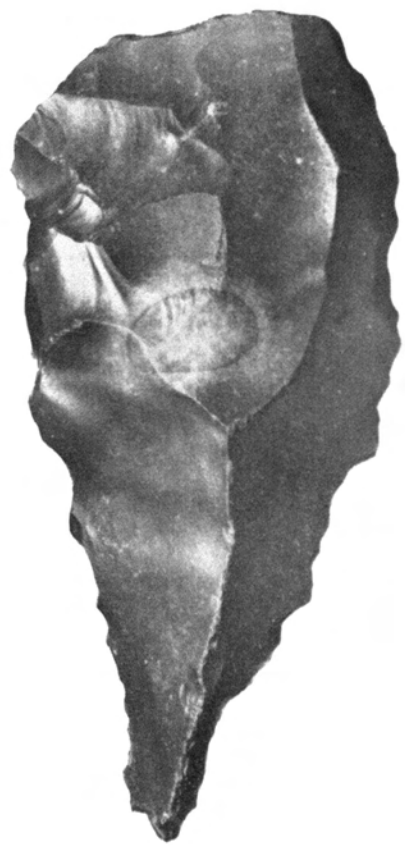
PLATE XXXIII



30



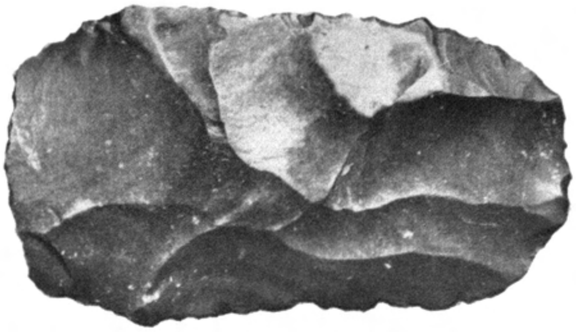
31



32

30.—Mousterian core of type probably associated with 30-foot terrace, from 10- to 15-foot gravels near Nakadah.
31–32.—Mousterian flakes, of type later than that of 30-foot terrace but coarse, from 10- to 15-foot gravels near Nakadah.

PLATE XXXIV



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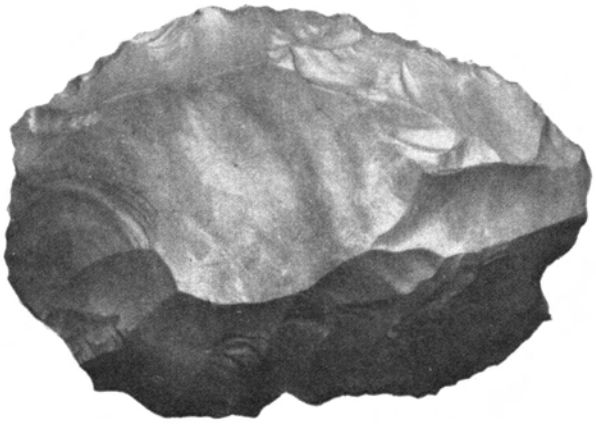
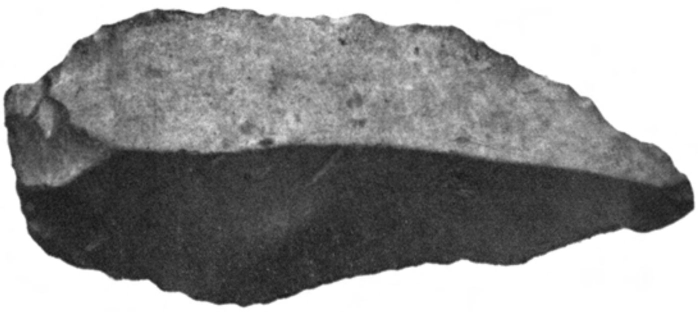


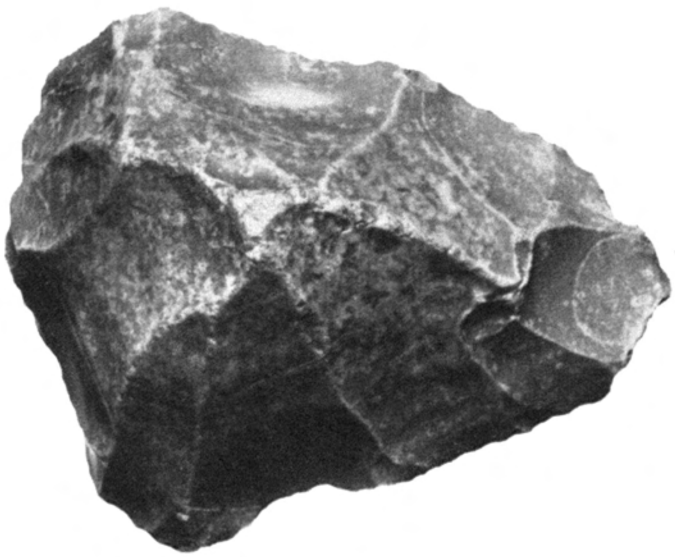
35



33

33.—Mousterian flake of type commonly found in the 10- to 15-foot gravels of Upper Egypt, from gravels near Nakadah. *34.*—Mousterian flake of type commonly found in the 10- to 15-foot gravels of Upper Egypt, from near Denderah. *35.*—Highest developmental stage of Mousterian flake found in 10- to 15-foot gravels of Upper Egypt, from el-Haita, Wadi Kena.

38



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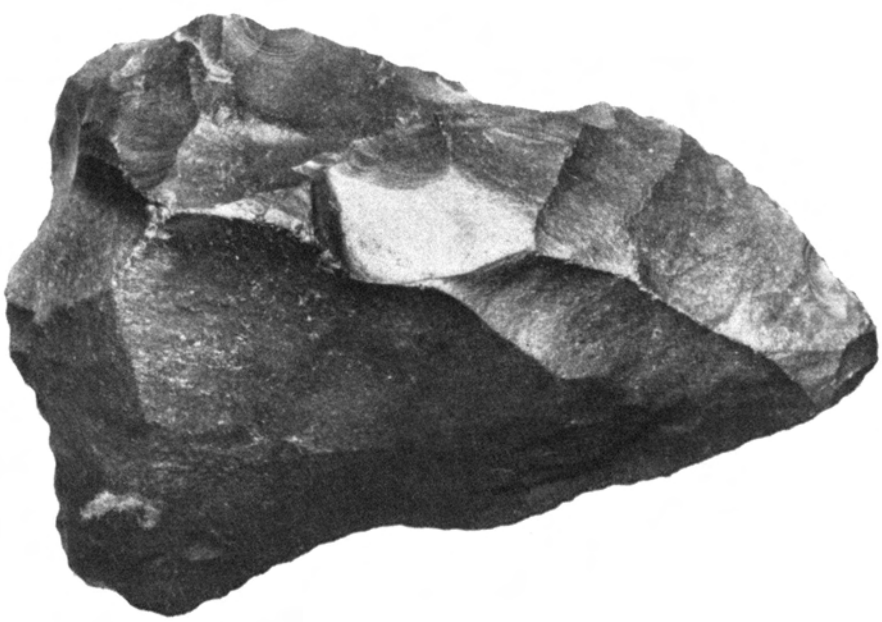
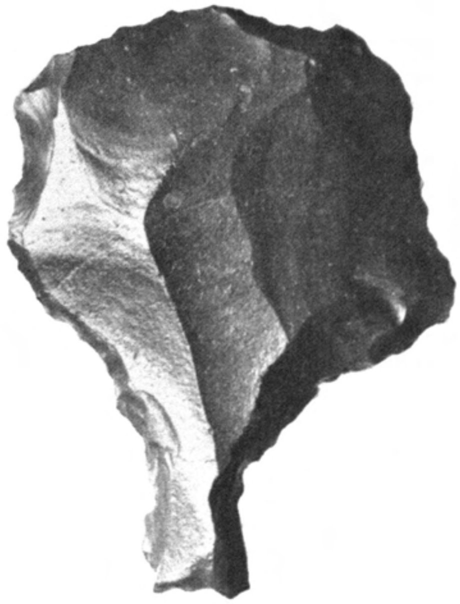


36

36.—Mousterian core from 10- to 15-foot gravels south of Oases Railway. *37.*—Mousterian core from wadi terrace about 5 miles southeast of position of No. 36. *38.*—Mousterian core from surface near desert edge west of Nagʿ Hammadi.

PLATE XXXVI

40



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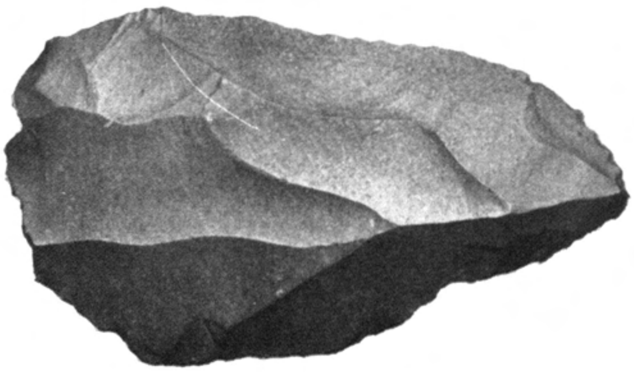


41

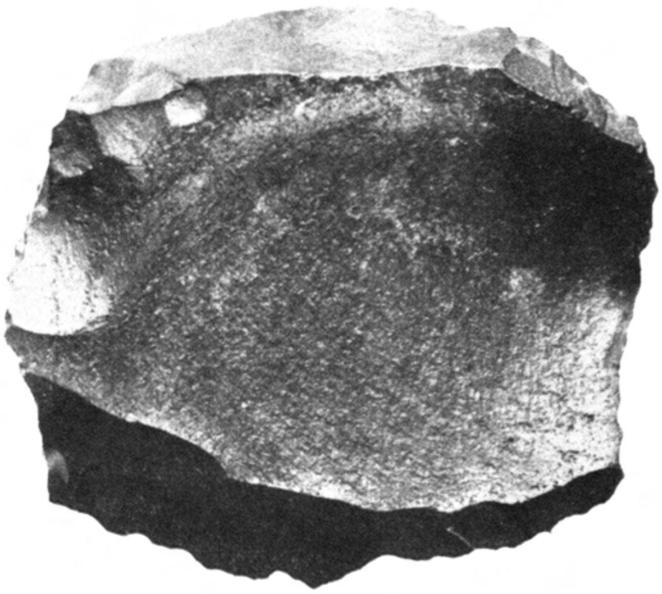
42

43

39.—Trimmed Mousterian flake from surface in Abydos bay near desert edge 15 miles north of Abydos. *40.*—Mousterian flake from surface of desert west of Nag< Hammadi. *41.*—Mousterian flake from surface of desert west of Suhag (to contrast with Nos. 33–35). *42–43.*—Mousterian flakes from gravels at Tunah el-Gebel.

PLATE XXXVII

45



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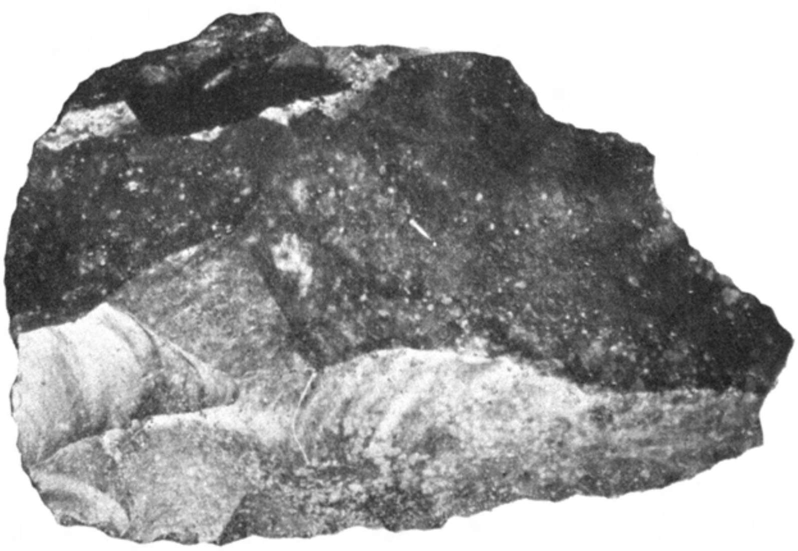
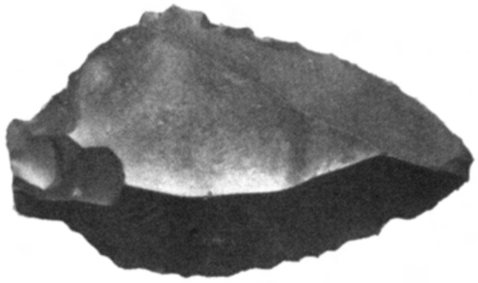


46

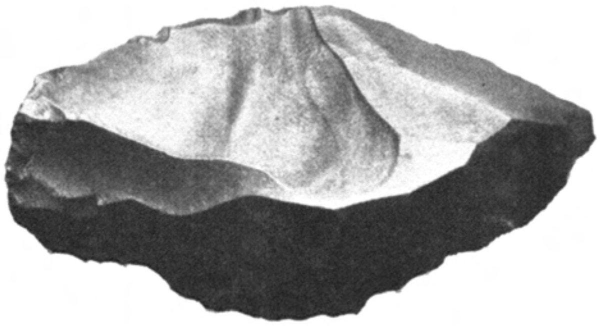
44–45.—Mousterian cores from gravels at Tunah el-Gebel. *46.*—Mousterian flake from gravels at Tunah el-Gebel

PLATE XXXVIII

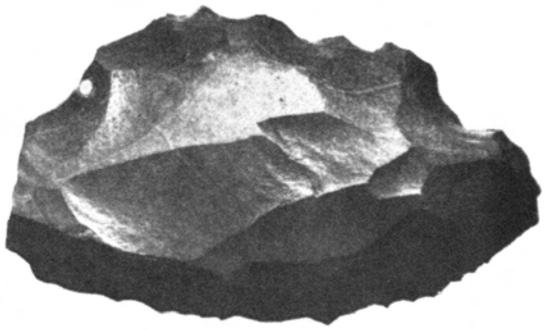
49



47



50



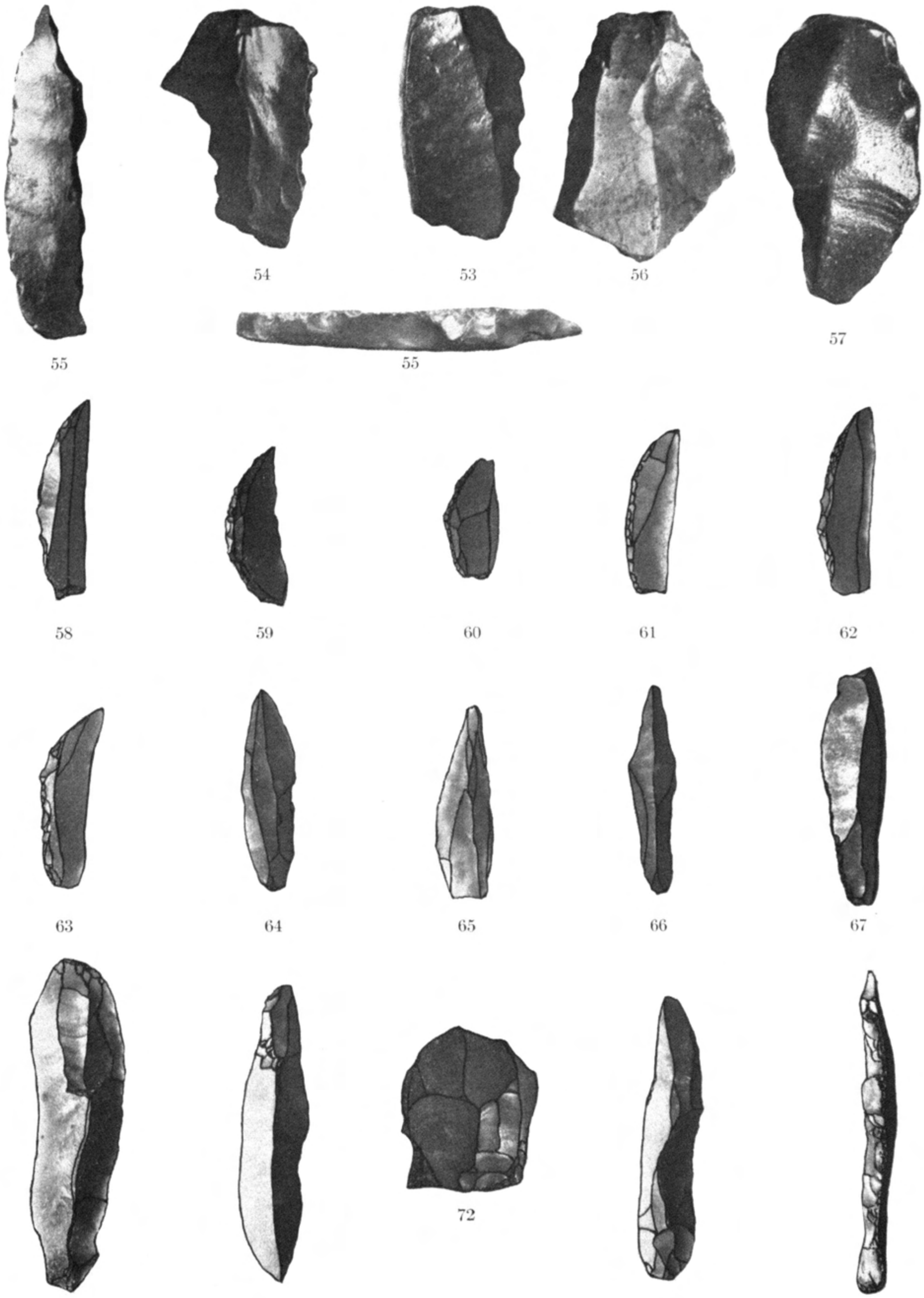
48

51

52

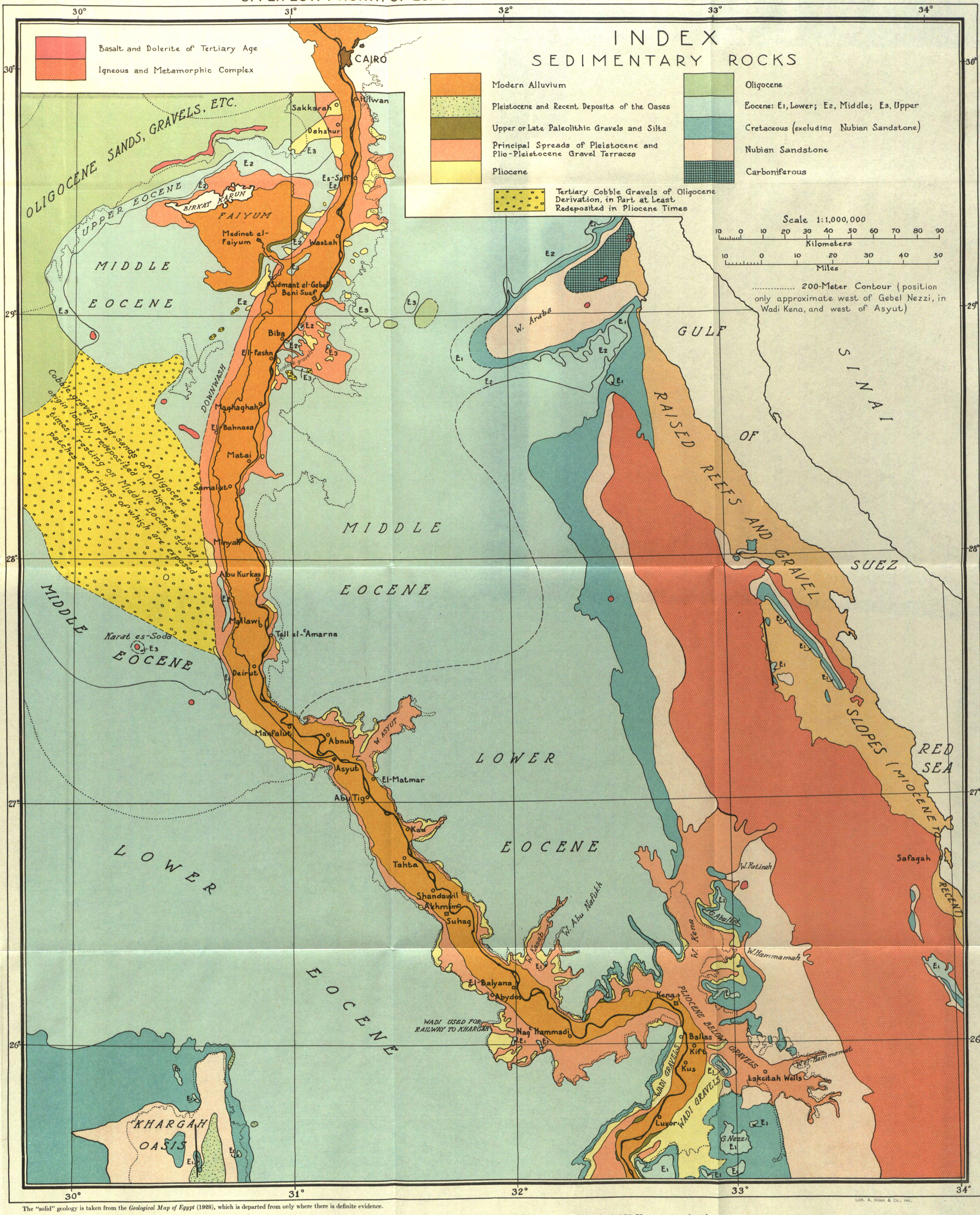
47–48.—Shouldered points from el-Haita. *49.*—Point from wadi floor near Nakadah. *50.*—Point from surface between Denderah and el-Marashdah. *51.*—Point from *sebakh* diggings on desert edge west of Nagʿ Hammadi. *52.*—Point from surface near ʿArab Miteir, east of Asyut.

PLATE XXXIX



53–56.—Flakes of Middle Sebilian type from suballuvial gravels near esh-Sheikh Timai. *57.*—Flake of Lower Sebilian type from gravels in river bed near el-Hibah. *58–72.*—Collection of implements from north side of Hilwan, between the railway and the path to ʿIzbah el-Waldah.

UPPER EGYPT NORTH OF LUXOR WITH MIDDLE EGYPT SOUTH OF HELWAN



The "solid" geology is taken from the *Geological Map of Egypt* (1928), which is departed from only where there is definite evidence.

For details of the Faiyum and the Nile-Faiyum divide see the folding map at the end of *OIP* X; an approximation only can be given on the present scale. Within the Faiyum the shore lines of known late and post-Mousterian age are marked along the eastern side of the basin. The rest of the deposits are shown in the color common to all other indications of Pleistocene beds on the map, undifferentiated.

Owing to the need for revision of supposed faults south of Hilwan to Maghaghah, these together with all the slip faults are omitted here.