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ENVIRONMENT AND HUMAN ECOLOGY IN EGYPT
DURING PREDYNASTIC AND EARLY DYNASTIC TIMES[1]

BY

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The oldest known agricultural settlements of Africa were situated in northern Egypt, at Merimde and on the shores of Lake Moeris in the Fayum Depression. Radiocarbon datings gave an approximative value of 6500 years before the present for the Fayum 'A' culture, and it may be assumed that agriculture in the Nile Valley began about 5000 B. C. During the seven millenia that have passed since these first primary village farming communities were established, Man has coped with his environment to secure an existence for himself and his kind. The problems he has faced were at all times manifold : technical and biological problems related to methods of cultivation proper, engineering methods to secure irrigation, drainage and a successful economization of the water resources available, and lastly, the shielding of his fields against the encroachment of the desert and then, under pressure of expanding populations, the enlargement of the cultivable land at the cost of the desert.

Just as the fellahin of to-day use one composite term *gebel* to express « desert», whether a desert mountain, a rolling desert plain, or whether simply sand or stone is meant, so also it appears that the ancient Egyptians used the determinative signifying « mountains», which was equivalent to « foreign». Even to this day the fellahin speak of the *gebel* with an undertone of resentment, which is identical to the hostility of their

[1] Part of the contents of this paper were presented as a Faculty Lecture in Geography and Anthropology at the University of Oxford, June 4, 1959.

forebears to the sterility and latent enmity of the desert. In this sense the ancient Egyptians were the first conscious and recorded «men against the desert», to use the modern catchword, one of the first nations to contrast the fecundity of the water and the soil to the barreness of the desert. The philosophical expression of a conscious realization of this duality of life and death, side by side, and mutually interchangeable, are the fertility cults centered about the rites of Isis and Osiris in Egypt or of Inanna and Dumuzi in Mesopotamia. The very persistance of these practices, which cannot be merely regarded as symbolical or commemorative in nature, underlines the constancy of the struggle between man and the desert, even after mastery over the techniques of water control had once been achieved.

This then is the essence of human subsistence in the arid zone, that the natural forces of the positive and of the negative environment are continually subject to transformation. Sand, as water, is seldom still. It is this changing picture of water resources—be it exotic Nile flow, or local rainfall (Hassân Awad 1959)—and the changing face of the desert environment that we wish to sketch here in its main outlines in as far as they have effected the transition from food-collecting to food-producing economies and the first phases of agricultural settlement in the Nile Valley. A part of the material employed has been presented in detail in connection with earlier investigations already (K. W. Butzer 1958*a*, 1959*c*), to which reference may be made. It remains inevitable however, that repetition will occur, but it is hoped that the reader will overlook these in favour of a more digestible and illustrative sketch.

A. THE NATURAL-HISTORICAL BACKGROUND

1. The natural geographical Habitat of the Nile Floodplain

It is widely realized to-day that the germs of the Egyptian civilisation were the product of a fruitful contact between an endemic Final Palaeolithic hunting and fishing folk on the one hand, and new cultural and ethnic groups originating from the area of the Fertile Crescent on the other [1]. These appear to have brought the basic ideas of plant and animal domestication with them. Once primary agricultural communities are admitted, the geographer must cooperate with the prehistorian to answer the question : *where* could these farming villages develop? This poses a second question, *how* did the Nile Valley look before Man converted the natural to a cultural landscape? Did the earliest agriculturalists have to confront a complex of uninviting papyrus swamps, such as in the Sudd area of the Upper Nile? If this were so, civilized Man could only attack the marshes and jungles of the Valley from a base position on the desert edge, gradually draining the land and eking out a precarious existence until technical supremacy over the environment had been achieved. Or could Early Man settle at will in the Valley from the very beginning?

The Nile Valley as a natural Floodplain.

Like so many rivers of the world the Nile moves across its own alluvial floodplain north of Aswan, a sedimentary plain which has been deposited by the river in the course of repeated seasonal flooding. After the rainy season has begun in Ethiopia the river begins to rise and leaves the low water bed it has incised in the plain. The coarser and heavier load is deposited first of all, immediately on the river banks where the current is strongest. In the case of the Nile these coarser sediments are fine or middle-grained sands which are deposited as natural *levees* along the border of the river. However the velocity of the waters rapidly diminishes as the flood spreads out over the plain, so that the transporting ability is equally rapidly reduced.

The relative composition of the suspended matter transported by the Nile is as follows (Simaika 1953) :

30 % fine sand	0.02-0.2 mm in diameter
40 % silt	0.002-0.02 mm
30 % clay	less than 0.002 mm

[1] A similar fusion of autochtonous Egyptian and of Near Eastern elements preceded the second phase of Egyptian civilization, the Islamic culture.

Simaika was able to observe that the fine sands are mainly transported at a height of 80 cm above the river bed, whereas silt and clay are suspended uniformly throughout the waters. This implies that the fine sand is deposited immediately on the banks of the low water bed whereas the finer, suspended aggregate is deposited over the whole plain. In other words deposition becomes less and less from the river banks to the borders of the valley, and the steep levees built up along the river fall off desertwards with a very gentle slope, generally 2 to 3 m on a distance of several kilometers. Such lower situated *basins* form the greater part of the alluvial plain.

After the flood waters have begun to recede, the levees are immediately left high and dry, while the low-lying basins remain inundated for a longer time. Occasionally the lowest sections harbour perennial waters (marshes or lakes = back-swamps). Similarly the groundwater table is quite deep under the levees during low water, whereas it may even lie above the surface in the lowest parts of the basins. This simple picture of a natural flood plain can still be found to-day in African rivers such as the Chari, Logone or Okavango, where no age-old cultural landscape obliterates many of the characteristic features such as in the modern Nile Valley.

Generally speaking the model of river-levee-basin is complicated by river bifurcations or cut-off meanders. Since sedimentation is strongest on the actual river bed and its immediate borders, this bed is built up considerably faster than the basin country. As a result the bed will sooner or later lie higher than the basins and with the next flood the river will break out of its course with resulting bifurcation or shift of bed. In this way the numerous islands, giving even the modern Nile a braided appearance, come into being. But the old levees remain, even if the river bed has changed. The end result is a complicated network of river arms, islands, ox-bow lakes, new or abandoned levees, marshy hollows and seasonally inundated alluvial basins.

In the Delta, water and sediments are able to spread out over an area twice or three times that of the valley proper, as there are no lateral hindrances as in the limestone gorge of the Nile south of Cairo. Furthermore a large part of the load, as well as the waters, are carried out to sea. As a consequence the river gradient decreases strongly from 1 : 7000 at the apex to 1 : 19,000 in the northern reaches of the delta. The waters are distributed over countless branches and distributories reducing the gradient and current even further, so that the heavier matter is no longer transported. The levees are appreciably lower and smaller, the basins so low that they may at times deteriorate to perennial swamps or larger lakes. The latter are characteristic for the mouth of the delta, going over into brackish lagoons. These lagoons are cut off from the sea by sand and silt bars built up as barriers by the westerly coastal current.

How does this picture compare with the Sudd basin of the Bahr el Ghazal? Firstly the Sudd basin is not characterized by a high and low water regime, as the waters are exclusively from the region of the Central African lakes. As a result the flooded area is perennially inundated, with a corresponding vegetation and morphology. Secondly the Sudd basin is characterized by a great depth and extent of Pleistocene lacustrine deposits. It is irrelevant for our purpose whether this Lake Sudd had an outlet or not. Important is that the present Sudd basin represents a former lake reduced to a vast marsh. This marsh is continuing to fill up with organic and inorganic sediments, and so the well-known floating marsh islands, the papyrus swamps and the like have come to be characteristic. But neither levees nor seasonally flooded basins occur, and this is the decisive distinguishing mark between the natural floodplain of the Nile in Egypt c. 5000 B. C. and the former Lake Sudd basin reduced to the Bahr el Ghazal swamps of to-day. The wholly erroneous analogy of the primeval Nile to the Sudd swamps was unfortunately sanctioned by numerous geographers, and came to be an axiom in the Egyptological literature. The first to point out this serious misconception was Siegfried Passarge, writing in 1940. However his basic study remained inaccessible in Egypt due to the war, and as a result this noted geographer has not received the credit he has deserved.

From the preceding discussion it was obvious that the extent of perennial swamps and lakes in the Valley was small, almost unimportant, even in early settlement times. The greater part of the plain consisted of seasonally flooded basins as to-day. Yet how perfectly absurd is the idea of the alluvium being uninhabitable to-day! And just as inviting or uninviting as to-day was the picture of the plain some seven millenia ago. The levees were at all times inviting to settlement, being inundated for only very short periods of several days at the peak of the flood. It seems quite likely that the greater part of the modern villages, standing several meters above the plain on their own cultural debris since centuries or millenia, were originally built on active or abandoned river levees. From the very beginning Man could build his abode upon the levees or upon the desert edge, and after the floods had receded, throw his crop seeds upon the wet mud of the basin floors or graze his cattle and other herds upon the lush vegetation of grass, herbs, brush and young shoots. When the water rose again the harvest had been gathered in and the livestock could pasture upon the levees or on the desert margins of the alluvium.

Theoretically these ecological assets would not be so optimal in the delta of the river. However in the case of the Nile providence had provided an equalizing asset : the *turtlebacks*. During the late Upper Pleistocene degradation of the Nile steep channels were incised in the older deposits of fine or coarse fluviatile sands once deposited by the lowermost Nile during periods of high Mediterranean sea-level. The last, Würm-age regression of the Mediterranean appears to have taken place so quickly that the lower Nile had little energy for lateral erosion. As a result large remnants of the older Pleistocene sediments were preserved between the various Nile arms of the Delta. These are to-day known as turtle-backs, which occur at the head and in the central, eastern part of the Delta, particularly extensive being those northwest and again southeast of Benha. One such «sand island» even to-day achieves 13 m above the alluvium. It is noticeable that the recent mud layers are thin on the peripheries, and generally speaking their surface goes over into the alluvium with a very gentle slope. As a result it can be assumed that their present areal extent is very much smaller than it was seven millenia ago. The accumulation of Nile mud and Man's agricultural activities have greatly reduced the turtle-backs in size. This can be most easily appreciated from the air, where it is possible to see a large ring of lighter coloured fields surrounding the turtle-backs. This is due to the admixture of sand and silt due to continuing extension of alluvium and cultivated land.

Even to-day there are countless such sand islands occurring between the Nile branches over an area of almost 5000 square kilometres in approximately the rectangle Cairo-el Quantara-el Simbillawein-Khatatba. This area would have been optimal for human settlement : where the deepest basin lands would normally occur, there were patches of dry desert. Even if the levees were smaller, settlements could be made on the margins of the sand islands. So there was cultivable land and dry land, but little or no marsh zone at all. This is supported by the fact that only one of numerous borings in the central or southern delta, namely at Shinraq, struck lacustrine as opposed to fluviatile deposits. To these assets can be further added that the location behind the Nile arms provided defense against enemies and protected the herds and fields against desert marauders. In review then, the Delta, in particular its southern and eastern parts, was also accessible and inviting to human settlements from the very beginning. The question of alluvium and sea in the northern half of the Delta will be discussed further below.

Some Consideration on the Location of Predynastic Settlement.

A brief survey of the location of the known predynastic settlements in Egypt shows that all known town or village-sites are preserved exclusively on the edge of the desert, so Merimde, Maadi, Badari, Mahasna, Abydos, Nagada, Armant and Hierakonpolis. Cemeteries have been neglected, their very existence at localities without settlement traces however presupposes the existence of villages now buried under the alluvium. The question then is : were all settlements in pre-mid-Gerzean (Nagada II) times located on the desert edge, or must we assume towns and villages in the valley itself?

The Mesolithic sites of Egypt, generally grouped under the microlithic Helwan culture, are limited to Helwan, Omari and Laqeita Wells. Almost equally modest and localized are the finds of the preceding sub-microlithic Epi-Levallois III industry. As far as we can judge from their cultural remains, these folk can be classified as terminal food-gatherers in the sense of Braidwood and Reed (1958). These authors have attempted to give broad estimates of population density for cultures of various economic character from modern analogies. In this way they offer a suggestion of 5 inhabitants per 100 square kilometers for such specialized collector groups. Even if the estimate is several hundred per cent «off», it does give a qualitative idea of the distribution of population to be expected. The present cultivable land in riveraine Egypt amounts to some 23,500 km². In prehistoric times this area may have been very approximately 16,500 km²—deducting 5000 km² for lakes, lagoons and backswamps in the Delta (see below), 1000 km² for subsequent land reclaimal in the Fayum and 1000 km² for subsequent areal expansion of alluvium in the Valley. Admitting the inhabitants were generally specialized collectors one would get *a total population in the order of 1000 inhabitants for the Nile Valley and Delta about 5000 B. C.* This is pitifully little, but does explain something about the extremely scarce and modest finds of the later pre-Neolithic industries.

Some five centuries later we know of the existence of Merimde and Fayum 'A', and a little later, the first upper Egyptian cultures at Tasa and Badari. The former have been classified as late Neolithic by previous authors, the Badarian is already Chalcolithic, i. e. copper was known and employed. These were primary village-farming communities as regards their economic level, a class for which Braidwood and Reed estimate some 1000 inhabitants per 100 km². One can argue about the extent of primary agricultural villages in Merimdan times, but no one can contest that farming villages were characteristic during the Gerzean period. On this basis we can estimate *a total population in the order of 100,000-200,000 for the second half of the fourth millenium B. C.* Even if we take the lower figure as applicable, a tremendous expansion of the population can be assumed for the 5th and 4th millenia, something characteristic of food-producing as opposed to food-collecting cultures. How then do the settlement traces of Predynastic times compare with this theoretical estimate of total population?

Merimde had an area of about 180,000 m² (map in H. Junker 1932) with cultural debris attaining an average depth of 2 m. This necessitates a dense settlement, of not too short duration. At Maadi over 6000 m² of settlement area had been exposed by 1936, the rubble being 20-100 m thick (Menghin and Amer 1932, 1936). J. Garstang (1903) gives a map section of 7100 m² for Mahasna, W. Kaiser reassessing this area at 10,000 m². The remains form only a thin veneer however, and it is hazardous to estimate the true size of the former settlement. Hemamieh North Spur (Badari) was only 200 m², with an average sebakh depth of 150-180 cm (Brunton and Caton-Thompson 1928, p. 69). T. E. Peet (1914) gives a value of 700 m² for Gerzean Abydos, the debris attaining 1 m thickness. For Nagada (South Town) this value is 15,000 m² according to the map of Petrie and Quibell (1896), with a depth of 1-60 cm. Kaiser (1959) reassesses this area as 50,000 m² on the basis of a new examination. In 1939 (Mond and Myers) the excavated part of predynastic Armant had amounted to 716 m². Predynastic Hierakonpolis was the largest Upper Egyptian settlement. A new 1 : 15,000 topographic-geologic map has been constructed by the writer and Dr. Kaiser (1959), but it is difficult to give a definite areal figure. Settlement remains, probably of one central town and many subsidiary villages, cover a total area of 1,000,000 m², but in the author's opinion, it is better to employ the areal extent of the more dense debris. This amounts to 50,800 m² after our survey in 1958. These then are the areal estimates of the prehistoric setlements, as far as we can suggest them at the moment.

The matter of actual associated populations is exceedingly difficult, but we may again attempt to give a partial answer. A. Badawy (1954, p. 13-27) has presented a fine study of Predynastic architecture in Egypt. Shelters or huts were sunk into the ground, walls of straw or reeds lining the sides of the hollows. These wattlework constructions were carried up above the ground level and coated with plaster. The oval or circular plan gradually was superceded by a rectangular one, and more durable materials such as wood or stone were later employed. At Hierakonpolis the writer could study these building forms in detail. The pits dug out usually amounted to 1 or more meters deep, with as area averaging 7 to 15 m². Generally the density of such dwellings was little more than 1 hut per 65 m². Interestingly Braidwood and Reed obtain 25 houses for Neolithic Jarmo using a similar argument. They further assume 6 inhabitants per dwelling. This seems logical considering the size and family numbers of rural houses in the Near East to-day.

On this basis of approximation we would obtain a population of some 16,000 for Merimde, of at least 600 for Maadi, 20 for Badari, no more than 1000 for Mahasna, 105 for Abydos, at least 1500 for Nagada, at least 110 for Armant, some 4700 or at most 10,000 for Hierakonpolis.

As a first consideration it is obvious that Merimde was not the first and not the only Neolithic settlement in Lower Egypt. Even if our estimate is too generous, one must assume numerous farming villages in the Delta area some 6000 years ago. A functioning economy is hardly conceivable without them. Yet no single trace of another settlement occurs on the desert flanks of the Delta. This implies these other villages must have been situated in the southern half of the Delta, where they are now buried under many meters of silt. It is curious why Merimde remains the only town of Neolithic date, uniquely situated outside of the Delta. At the same time however Merimde confirms our argument that *village farming communities have flourished in the adjacent parts of the Delta,* between the protecting branches of the river Nile, *since the beginning of food-producing economy in Egypt some 7000 years ago.*

A second consideration, weakened by the two hypothetical arguments upon which it is based, is however at least worthy of mention. Namely that the known Gerzean settlements of Upper Egypt only suppose a contemporary population of at best 20,000 inhabitants. It was shown that settlement was possible upon the alluvium from the start, and it has been mentioned that more cemeteries of Nagada-II age occur on the desert edge, than we know corresponding villages. Yet it is not necessary that Predynastic Man only interred his dead on the desert, yes, there may also have been cemeteries on the plain as well. In other words, even *at the beginning of the Gerzean period no more than half of the population of the Nile Valley lived on the edge of the desert.* In the centuries when Hierakonpolis and Nagada flourished upon the low desert there were already countless villages on the levees and other elevations of the Nile floodplain. Naturally such settlements may have in part been situated on the edge of the desert, only to be buried by alluvium at a later date. This may well have been the case in Middle Egypt (cf. Kaiser and Butzer 1959). But it was not the rule.

Württemb. Certain is only the fact that the wild date *Phoenix sylvestris* has been found in the Upper Pleistocene deposits of the Kharga Oasis (see Täckholm and Drar II, p. 204 seq.). The well-known «Nagada-plant», represented on Gerzean decorated pottery, has turned out to be the abyssinian banana *Ensete edule* Horan.

The characteristic elements of the marsh vegetation were lotus and papyrus, both of which are no longer native to the Egyptian Nile. The papyrus rush of the ancient Egyptians belongs to the Cyperaceae (*Cyperus papyrus* L.), growing a 3-5 m long stem, limited however to quiet, shallow water (36-62 cm deep) in river inlets, on lake margins or in backswamps. Both the Egyptian lotus *Nymphaea lotus* L. and the blue lotus *Nymphaea coerula* Savig. were represented in ancient Egypt. Further species of note were *Cyperus esculentus* L.; common reed, *Phragmites communis* L.; and stemmy plants like *Juncus acutus* L., *J. arabicus* Adams and sedge, *Arundo donax* L.

However a systematic review of the endemic plants does not give a picture of the natural vegetation. Each element has to be grouped into associations forming individual vegetation types. Without pollen-analysis it is only possible to provide analogies derived from the principles of plant geography and plant ecology. So for example S. Passarge (1940) was able to observe a natural succession of vegetation in little-settled areas near the Delta lagoons. In the lowest basin-hollows reed swamps, on the heavy soil of the basins thorn brush. The latter is seasonally inundated, after which grass and herbs cover the ground. Thirdly bush and brush develop on the natural levees, the soil being hidden under grass and herbaceous plants after occasional flooding. The latter picture could be amplified by Passarge's observations carried out in the Kalahari and Central Africa, where Man has not depleted the vegetation in search of firewood. In these areas there is treegrowth upon the natural levees, made possible by groundwater available throughout the year. And in this sense groves of sycomores thrive upon the elevated locations of human settlement in the Nile floodplain even to-day.

In review then the ancient Egyptian floodplain landscape was dominated by *three vegetation complexes : in the areally limited back-swamps an association of papyrus, lotus, sedge and reeds; in the seasonally inundated alluvial flates*

The natural Vegetation of the Floodplain.

In order to reconstruct the natural vegetation of the alluvial plain it is prerequisite to know the floral elements of the vegetation associations and the terrain of the countryside. The former can be determined by pollen-analysis, macro-remains from geological deposits, and above all archaeological finds in tombs and from excavations. Pollen-analysis has unfortunately not yet been applied widely in the arid zone, also not in Egypt [1]. However thanks to an unequalled collection of plant and tree remains from Predynastic and earlier Dynastic times, supplemented by tomb reliefs and other works, as well as the testimony of classic authors, the *elements* of the primeval vegetation of the Nile Valley are well known to-day. The systematic study of the former vegetation was successfully inaugurated by that great botanist Georg Schweinfurth in 1884, and thanks to the many-volumed 'Flora of Egypt' (since 1941) by Vivi Laurent-Täckholm in collaboration with Mohammed Drar, we now know more about the Egyptian vegetation in Predynastic and historical times than of any other area not yet investigated by means of pollen-analysis.

The characteristic indigenous trees of Egypt are beyond doubt the Nile acacia (*Acacia arabica* var. *nilotica* Delile) and tamarisk (*Tamarix nilotica, T. articulata*). The first species is still represented by well over 20 varieties in the floodplain and the wadis of the Eastern Desert to-day. The tamarisk is already known from Upper Pleistocene deposits in Wadi Qena and from younger deposits in the valley. The mediterranean species sycomore (*Ficus sycomorus* L.) is probably also an autochtonous form, so also the Egyptian willow (*Salix safsaf* Forsk.). Of further interest in this connection are *Zizyphus spina Christi* Desfont., *Balanites aegyptiaca* Del., *Mimusops schimperi* Hochstett, *Ceratonia siliqua,* etc.

On the other hand it is difficult to estimate the natural status of the immediate forebears of the cultivated palms as *Phoenix dactylifera* L. (date palm), *Hyphaene thebaica* Mart. (dum palm) and *Medemia argun*

[1] A so-called peat sample from the Delta was submitted to the Palynological Laboratory in Stockholm recently, but was found to contain no pollen (kind communication of G. Erdtmann).

—forming the greater part of the floodplain—*low scrub with a lush grass and shrub vegetation; on the ridges and hillocks marking ancient and actual levee banks, groves of acacias, tamarisk and sycomore.* The latter served as an area of permanent settlement, growing in height with silt, dust and debris according to the rise of the floodplain, upon which Man and his flocks found refuge during the flood season. The greatest part of the plain formed an ideal land for Man to sow his crops and graze his beasts. The backswamps were very limited in size and did not hamper cultivation until population pressure forced their drainage. Before this these marshes formed a reservoir of game. The process of swamp reclaimal was not, as is widely supposed, the major activity of Man in Predynastic and Old Kingdom times. The persistance of fishing parties, fowling excursions and spear hunts in the back-swamps of the Nile floodplain until the close of the New Kingdom documents their existence into late Ramessid times. Until the 20. Dyn. there are few inscriptions referring to swamp drainage which compares strikingly with innumerable references to irrigation in its various forms.

Recently H. Larsen (1957) has suggested that the existence of the *Ensete edule,* apparently in great number, presupposes a dominantly swamp or jungle-like character of the Nile vegetation in Gerzean times. He bases himself further upon the supposed 20 m aggradation phase at Maadi. We have already indicated elsewhere (Butzer 1958*b,* p. 67; 1959*c,* p. 26-27) that the silts struck by the Maadi and Turah bores and trenches were not Nilotic but Middle Palaeolithic. The heavy mineral statistics do not show an appreciable difference from those of the Sebilian silts. With relative frequencies of some 24 % iron ores, 37 % amphiboles 24 % pyroxenes, 9 % epidotes etc. it seems of value to draw attention to Shukri's (1952) samples from Aswan or Kom Ombo. The so-called final Palaeolithic implements reported but unpublished from the base of one silt section need to be typologically analyzed, and even then, one must count with the possibility that this mud was seasonally viscous at one time or other—a feature known to have occasioned Neolithic pottery sherds into indisputably secondary positions elsewhere in Egypt. The reason for our doubts in this matter are simple. In the course of extensive and intensive geological examinations on the low desert on both banks of the Nile we were unable to find a trace of Nilotic silt primarily deposited above the present level of the alluvium. Only in the Nile-Fayum and Merimde areas could, apart from the Sebilian silts of southern Egypt, the well-known Upper Pleistocene silts in 5-8 m or more be observed. Under these circumstances it does not seem feasible that a Holocene aggradation phase to almost + 20 m should leave no traces other than in the Maadi-Turah area. The latter sections are surely deserving of a closer investigation. The botanical aspects building themselves up around this concept are of course wholly hypothetical, as the *Ensete* could thrive at will in the backswamps and possibly also on the alluvial flats. Certainly its frequency as pottery motive is due to its economic rather than to its numerical importance. The tree stumps of the low desert in Upper Egypt will be referred to further below. Summarizing we do not see any convincing reasons for assuming a + 20 m Nile aggradation in Neolithic times, although it is not improbable that the flood levels were relatively (but not absolutely) higher than to-day. This is supported by the evidence from Mesolithic Khartum where A. J. Arkell (1949, p. 109-110) has given good reasons for a Blue Nile flood level exceeding that of the present by 4 m. But we are unable to follow his argument in a later publication (1953, p. 8), in which this figure is raised to 10 m. *Higher floods would not change the picture of the floodplain* however. The stronger the floods, the greater the load, and the faster the deposition. The levees would grow correspondingly quicker and higher, adapting themselves in a new hydrological equilibrium.

Alluviation as a Function of variable Nile Flood Volume and Mediterranean Sea-Level.

During the later Gerzean period the last settlements on the desert edge were abandoned in favour of townsites on the alluvium. So for example Mahasna and Armant break off quite suddenly in late Gerzean times, while Hierakonpolis was shifted to a site 500 m further east, within the cultivated land. Since the historical unification of Upper and Lower Egypt agricultural settlements have been confined to the alluvial plain. It is therefore of interest to investigate the extent of Nile mud deposition at the onset of local agricultural and the rate of sedimentation in succeeding millenia. This is a matter of vertical and of horizontal alluviation.

The present mean depth of the alluvial fill of Nilotic silt has been estimated at 11.2 m for the northern Delta, 8.5 m for the southern Delta, 9.7 m for the stretch Cairo-Minya, 8.5 m Minya-Qena, and 6.7 m Qena-Aswan (J. Ball 1939, p. 163). This modern mud overlies an earlier Holocene filling of sand, silt and fine gravel which apparently aggraded to level out the deep valley eroded by the Nile in Epi-Levallois III times (Butzer 1959*b*, 1959*c*). This lower Nilotic bed attains a depth of 2-5 m at el Matana, 3-7 m at Luxor, 12 m at Qena, 6 m at Balyana, 2.5 m at Tahta and 10.5 m at Asyut (see Sandford 1934, p. 103-104; Fig. 25). Whether this coarser Nile load represents an influx of local wadi material in Holocene times or whether it merely consists of older Nile deposits subjected to lateral erosion after the transition from vertical incision to aggradation, is not easy to say. At any rate the matter would be well worth investigating.

Just precisely when accumulation changed over from coarser to finer materials, and the typical silt-mud deposition began, can only be guessed at until better means of dating are available. Theoretically one could reason—if the subrecent annual deposition of 1.03 mm of mud could be extrapolated—that silt accumulation began about 7600 B. C. in the northern and 4600 B. C. in the southern part of the valley. This would be logical as a gradual response to a rising Mediterranean sea-level in Postglacial times, first noticeable in the Delta and then progressing slowly upstream. This is a bold but illustrative approach. In point of fact however, the rate of mud sedimentation will hardly have been uniform. For, it would be presumptious to assume that neither the Blue Nile flood volume nor the Mediterranean sea-level (as base level of erosion) had fluctuated in the course of the last seven millenia.

The archaeological literature on the topic of this rate of sedimentation is of a summary and next to useless character, so for example the figure of 10 cm mud accumulation per century quoted by Sir Flinders Petrie. In another publication (Butzer 1959*c*, p. 24-27) we have discussed this subject in detail and it does seem probable that 1) *60 % of the*

Nilotic mud had been deposited before the 1. Dyn. (c. 2850 B. C.), 2) *mud deposition was quite limited between about 1960 and 900 B. C.* and, 3) *some 20-25 % of the Nilotic silts have been deposited since about 500 B. C.* These empirical figures can be theoretically explained in terms of the two natural factors governing deposition : flood load and sea-level. From Mesolithic Khartum (Arkell 1949, p. 109-110) it is known that the Blue Nile flood volume was considerably greater c. 4000 B. C., probably a result of greater moisture in Ethiopia at this time as well. This would certainly effect the Egyptian Nile. Then in Old Kingdom times there are historical documents that the flood level let off steadily (unpublished study by H. W. Helck), whereas repeated famines due to weak floods are repeatedly reported from the years c. 2100-1900 B.C. (cf. evidence in Butzer 1959*c*, p. 67-69). In New Kingdom and late Dynastic times records of exceptionally high floods become frequent, and the testimony of Herodotus (450 B. C.) and of Roman authors in the 1. century shows that « strong floods » achieved 9.54 m as a rule, which is 50-100 cm higher than was the case in Islamic times. The historical evidence of long-term trends of Nile volume seems to fit in with the picture of actual deposition.

The problem of Mediterranean sea-levels in Postglacial time has been treated by the writer (1958*b*, p. 38-39) and D. Hafemann (1959). The salient features are a low stand at -100 m during the maximum of the Würm regression (c. 20,000 B. C.) ; a rise of over 50 m between 9000 and 4000 B. C. ; a stand at + 4 m, lasting several centuries, c. 3500 B. C. ; a drop to a longer halt at + 2 m, c. 2000-1000 B. C. ; a drop to well below sea-level attaining at least -2.5 m 400 B. C., rising to -2.0 m in the 1. century A. D. and regaining its present value in early Islamic time. Over fifty years ago attention was drawn to the effect that the Delta towns and particularly Abuqir are 2.6 m lower, relative to the sea, than they were in classical times. From this a subsidence of 2-3 m was deduced for the Maryut and the Delta, attributed to a compaction of the looser Delta sediments. In view of the unequivocal evidence from all over the Mediterranean, Hafemann (1959) concludes that there was a true eustatic rise in sea-level amounting to 2.5 m between 500 B. C. and 500 A. D. This puts a question mark beside the Holocene Delta-subsidence theory. The matter can be amplified by a study of the profiles of the younger (Abusir and Gebel Maryut) offshore bars extending from Alamein to the Maryut (Butzer 1959*d*). These Upper and Middle Pleistocene barrier bars do not show any distinct sag towards the north-east, as should be evident if subsidence had occurred in the Maryut. Instead there is a sharp discontinuity in level at the longitude of Mex, after which the Abusir bar jumps abruptly back to a higher level and continues undisturbed to the site of ancient Canopus. This can, in view of the absence of any visible faults, not be attributed to graben-faulting or the like, but would appear to have an exogenic origin. The present elevation of the Delta cities would then seem to be an eustatic and not a tectonic feature.

Rising sea-levels before 3000 and again after 500 B. C. would favour aggradation in the Nile Valley, whereas the regressive tendency between 3000 and 500 would have a reverse effect. This once again fits in with the empirical evidence.

How then does this matter of sea-level fluctuations effect the ancient topography of the Delta coastline? Since the Nilotic mud of the northern Delta averages only 11 m, none of the present land surface will have been submerged before the Mediterranean had risen to at least -11 mm. s. l. According to radiocarbon dates of the Postglacial eustatic rise in ocean level, the Mediterranean can be estimated to have achieved this level 5500 B. C. But we saw that mud deposition should have began before 7600 B. C. in the far north, and that, accepting a uniform rate of deposition, 2 m of silt would have been laid down by 5500, i. e. deposition and rising sea-level could to a large measure be expected to balance each other off for at least another millenium. At any rate the popular concept of a Nile Delta deposited and pushed seaward only in Holocene times after a period of Late Glacial—Early Holocene immersion does not appear applicable. The Delta existed in at last its present dimensions since at least the last interglacial period, only to loose ground in Post-glacial times until after the maximum sea-level at + 4 m had been abandoned.

Only after sea-level rose to above that of the present were the Nile waters dammed back behind the lagoons. Only then was a larger part of the northern Delta submerged. The extent of marine or brack-water inundation can be acertained from a study of the existing boreprofiles from the Delta. From profiles given by Fourtau (1915) and others in the Geological Museum, Cairo, we can list following details :

Kafr el Dawar.......	7.5 m	silt and sandy clay on brackish clay.
Rosetta............	10.5 m	silt on 19 m brackish clay, overlying marine sand.
Baltim............	1 m	silt overlying 3.7 m marine sand.
Khasha...........	6.4 m	silt and clay upon 0.8 m brackish clay.
Masraf Omum......	4.5 m	silt overlying 5 m brackish clay intercalated with 0.5 m coarse sand.
Basandila..........	1 m	silt overlying 4 m brackish clay.
Damietta..........	11 m	silt and clay overlying 7 m brackish clay.
Manzala...........	14.8 m	silt and clay over 5 m brackish clay intercalated by 1 m clay, overlying 1 m marine sand.
Matariya..........	20 m	silt over 1.5 m brackish clay, overlying marine sand.
Port Said.........	6 m	brackish clay (recent) over 6.1 m clayey sand and clay, overlying 6 m marine sand.

These are the only profiles known to us recording marine or lagoonal conditions of deposition. The brackish clay is obviously a lagoonal deposit of the type forming in the brackish Delta lakes of to-day. These profiles then delimit the extent of the maximal Flandrian Transgression c. 3500 or 4000 B. C. Contrary to our above supposition, it is interesting to note that none of the brackish clays or marine sands overlie typical Nilotic silt! Where tapped the basal sediments consist of clayey sand, sandy clay, clay or coarse sand. Except for the latter Pleistocene material, the base complex is similar to the early Holocene filling of the buried Epi-Levallois III channel of the Nile. This may provide a clue that *the actual silt phase of the Holocene Nile did not begin before 4/5,000* B. C.

Employing the limit of the above profiles to those without traces of marine or brackwater sedimentation, and extrapolating on the basis of the contours it is possible to give an approximation of the coastline and the extent of brackwater lagoons for the time of maximal Holocene transgression (Fig. 1). Interestingly no marine sediments occur in the Maryut whereas only one of five bores reached brackwater sediments.

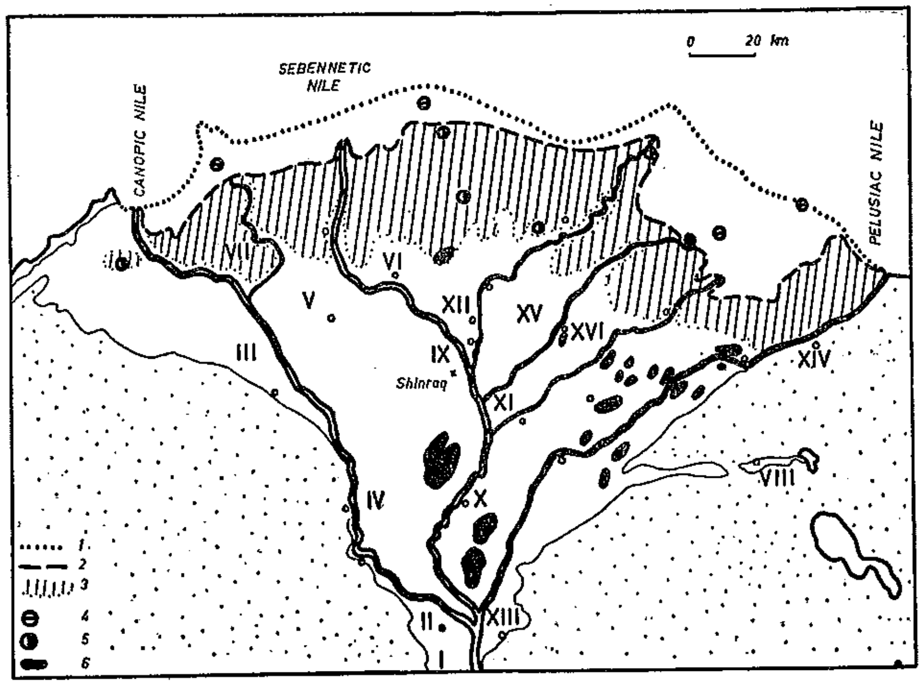

FIG. 1.—*The Delta in Predynastic and early historical Times.* 1 = moderncoastline, 2 = coastline c. 4000-3000 B. C., 3 = extent of brackish lagoons c. 4000-3000 B. C., 4 = borings with Nilotic mud over brackish clay and marine sands, 5 = borings with Nilotic mud upon brackish clay, 6 = turtle-backs. Desert dotted. River courses and names after description of Herodotus (modified after J. Ball 1942), older Delta cities indicated by open circles (generally after J. A. Wilson 1955). Lower Egyptian nomes in 1900 B. C. located by Roman numerals : I. Memphis, II. Letopolis, III. Kom el Hisn, IV. Terenuthis, V. Sais, VI. Xois, VII. Metelis, VIII. Pithom (Tjeku), IX. Busiris, X. Athribis, XI. Leontopolis, XII. Sebennytos, XIII. Heliopolis, XIV. Sile (Tjaru), XV. Hermopolis (NW Mendes), XVI. Mendes. These names are identical with the leading cities (already indicated with exception of Metelis and Hermopolis).

This must imply that a Nile arm, possibly the Canobic of Herodotus, embouched immediately east of the peninsula of Abuqir, thus preventing marine flooding. It is interesting that *even with a Mediterranean level at*

+ 4 m the open sea only covered about the area of the present Delta lakes Edku, Burullus and Manzala, without the adjoining marsh zone. Lagoonal conditions were definitely limited to the south by the present 3 m contour. Employment of further bores would inevitably add more detail to Fig. 1, but it is unlikely that the overall picture might change much. If then we compare our present knowledge of the coastal topography of the Nile Delta in late prehistoric times with that of the Tigris-Euphrates, it is significant that Lees and Falcon (1951) also reject the theory of recent delta-building and extension. However these authors ignore the eustatic hypothesis and attempt to explain everything by tectonic agencies, although there is only very indirect evidence of this at their disposal. Bore profiles through the alluvium of the area immediately upstream of Basra would be of great value in future assessment of the matter.

It is dificult to employ the bore profiles of the Nile Delta to estimate the former extent of the perennial swamps. It is significant however that only one bore at Shinraq struck lacustrine shells of *Limnaea* and *Planorbis,* as opposed to fluviatile species (Fourtau 1915). The map Fig. 1 has been completed by including the Nile topography as described by Herodotus (c. 450 B. C.), modified after the interpretation of J. Ball (1942, p. 24-28). This will at least give a better approximation of the true topography in Predynastic times. Although Herodotus claims the present Rosetta and Damietta mouths were artificial, it should be pointed out that a bore at Shiribin on the Damietta arm, situated at 3 mm. s. l., struck 10 m silt over 20 m sandy fluviatile deposits! These thick river sediments rest on coarse Pleistocene sands.

Fig. 1 also includes the location of the 16 Lower Egyptian nomes at the time of Sesostris I (1971-1930 B. C.). It is amusing that all are situated on « dry» ground, excepting Metelis (VII). This nome is however strikingly called the Harpoon Nome. Finally the location of the Delta cities, whose existence is documented before Late Dynastic times (after J. A. Wilson 1955), has been indicated. As Wilson points out, almost all of these lie above the present 6 m contour. The exceptions have, in part, carried epiphets such as « swamp-island» or « sand-island» (H. Kees 1954, p. 11, 108-109), which suggests these were situated on levee banks (Buto, Behdet) or turtle-backs (Imet, Tanis).

Bearing in mind that the recent Mediterranean regression achieved its lowest point c. 500 B. C., it is possible to interpret the colonisation of the northern Delta in Late Dynastic and Ptolemaic times *physically* as a response to natural marsh drainage and northward extension of the land surface. According to Makhzumi the present Delta lakes were only created in 961 A. D. (Shafei 1952) by marine transgression, probably in the course of the rise in sea-level since the 2nd century A. D.

2. Geological Deposits, Fauna and Vegetation of the Desert Zone during the Neolithic Subpluvial.

Geological Indications of Precipitation during Neolithic and Chalcolithic Times.

The existence of post-Pleistocene moist spells in arid regions is gradually becoming commonplace knowledge, although such climatic fluctuations can, of course, not be compared with the Pluvial phases of the Pleistocene. Geologically not of great importance, their ecological significance cannot be too greatly stressed however. What then is the geological evidence from Egypt speaking for greater precipitation in Neolithic times? Admittedly this evidence is minute and detailed, and of a specialized character. But it is nevertheless there and deserving of a comprehensive review.

The excavations at Merimde (Junker 1940) exposed a thin but fairly continuous gravel horizon above the first Neolithic settlement layers. These pebbles were apparently of appreciable size and suggest a period of sheetflooding after appreciable rainfall. On an experimental basis G. Knetsch (1954) has observed that present day spates on the low desert at Giza attain little energy for transport of all but fine sand. In the absence of any wadi (there are only small rills in the desert surface) at Merimde, widespread gravel transport in Neolithic times does *mean* something. At Maadi Amer and Huzayyin (1952) were able to indicate deposition of coarse gravel and sand at the mouth of Wadi Digla in early and post-Gerzean times. Rushdi Said (1953) has investigated recent transport and incision in this wadi, showing that vertical erosion is characteristic to-day. Again two bores near Helwan (cf. Fourtau 1915) indicate considerable wadi activity, namely a 6 m bed of sand and gravel contemporary with the basal alluvium.

Passing out of the zone of present-day rainfall to the Fayum (long-year mean less than 10 mm), Sandford and Arkell (1929, p. 60-61) described a section at Ezbet George with 1 m of fluviatile rubble containing Predynastic flints, overlying mud of the 18 m pre-Neolithic Fayum lake. These sediments were deposited in a now nonexistent surface drainage channel. An interesting sequence can be gleaned from the publications of Brunton and Caton-Thompson (1928, p. 73-76) from Badari :

a) 60 cm Gerzean cultural debris.
b) Up to 27 cm clean, unconsolidated scree.
c) 30 cm Amratian-Gerzean hearth deposit.
d) 15 cm Amratian deposit.
e) 15 cm Badarian cultural deposit.
f) Up to 30 cm limestone scree cemented to a resistant breccia, probably during the period of Badarian settlement.
g) Limestone debris with Badarian pottery sherds.

From the unconsolidated character of layer *b*) it can be deduced that maximum moisture occurred before 3500 B. C., and was apparently concentrated c. 4000 B. C., as the formation of such a breccia (see Pl. 1) requires appreciable atmospheric moisture (present annual mean 4 mm !). The last archaeological site with palaeoclimatic implications is Armant (Mond and Myers 1937, p. 7-8), where S. A. Huzayyin recognized a 1.6 m thick, finegrained wadi deposit under 12 Dyn. graves and upon Badarian pottery. This material was laid down by a now-disappeared streamlet over a long period, as a large tree was able to grow during the process of alluviation.

To-day only the larger and intermediate wadis of the Eastern Desert south of about the latitude of Helwan, are able to transport rubble, gravel and sand over longer distances. Such deposits are easy to recognize due to their poor sortment of finer and coarser material, and their irregular stratification. Generally speaking modern spates act erosively and lead to vertical incision, with transport limited to sand in the immediate drainage channel. The latter applies to almost all wadis of the Western Desert south of about Meidum, and to the smaller wadis of the east bank, not possessing larger catchment areas or appreciable gradient momentum. It seems safe to say that the above features—definitely dated archaeologically—verify the existence of a subpluvial phase somewhere between 5000 and 2350 B. C. It also helps to date a part of the wadi activity of uncertain age which has eroded and redeposited the Upper Pleistocene deposits in Middle Egypt. Here the small east bank wadis have generally removed all traces of Würm pluvial terraces, building up large fans on the low desert (Map 1, *Qw* in Butzer 1959*a*). Obviously a good part of this work will however still belong to the Pleistocene, in particular the Epi-Levallois II moist interval. Similarly the finely stratified local deposit of clayey sands and fine limestone debris between Matahra el Sharqiya and Beni Hassan may still have enjoyed some sedimentation as late as early Holocene time (Butzer 1959*a*, 1959*c*). Being quite unconsolidated it cannot be of Lower Pleistocene or even Pliocene age, otherwise erosion would long have removed it at this highly exposed locality. We believe it to be a large fan deposited by numerous smaller wadis in sheetfloods—although this is no more than a hypothesis. There are only hellenistic and islamic remains on the surface, which leaves the possibility open that some deposition persisted to a later date.

Of interest to this topic is lastly the evidence in favour of a period of warm climate, the Postglacial thermal maximum. F. W. Braestrup (1947) has called attention to such tropical relicts as the water plant *Pistia stratiotes,* Degen's toad *Bufo vittatus,* the fish *Gymnarchus niloticus,* the Basilisk chamaeleon, several tropical snakes and mollusca in the Delta or in the Fayum. Braestrup believes these tropical forms are relicts of a warmer period, only able to survive in their more favourable micro-habitat. In this connection it would be relevant to mention the weak layer of rubefaction (5 cm) evident on the 1.5 m (Epi-Levallois II?) terrace of a wadi immediately south of Deir Tasa (Butzer 1959*a*). This zone of red weathering indicates a short and moderate interval of warm, moist climate following the last Upper Pleistocene development of a brown soil, under cool-moist conditions. One could implicitly infer a Neolithic date for this. However the 1.5 m terraces in Upper Egypt do not seem to have been effected, possibly the subpluvial was appreciably weaker so far south. In retrospect then, the geological evidence of greater moisture during the chronological equivalent of the Atlantic phase is no longer a matter of individual idiosyncrasy as far as Egypt is concerned.

From the southern Sahara there is also considerable evidence of similar tenor : there are indications of greater water action in the Libyan Desert wadis during Neolithic times ; on the Sudan margins of the Sahara there are numerous clay deposits of former rainwater pools as well as freshwater mollusca where no life exists to-day (Sandford 1936) ; in the Khor Abu Anga, emptying into the Nile below Khartum, a red-brown sandy clay with the large land snail *Limicolaria flammata* was deposited in 'mesolithic' times (A. J. Arkell 1949*b*, p. 7) ; several faunal and floral elements from Mesolithic Khartum, not responsive to a riveraine environment, require a considerably higher precipitation (Arkell 1949*a*, p. 109-110) ; at Shaheinab nearby the occupational material of the site seems to be distributed throughout a gravel bed of the Wadi Shush (Arkell 1953, p. 7). The evidence from the Western Sahara is also manifold.

The close of the Neolithic subpluvial was also recorded by geological deposits in Egypt. It appears that aeolian activity took on an important character, such as had already been the case before 5000 B. C. (1959*b*), in later Old Kingdom times. Sand dunes invaded the Nile Valley in western Middle Egypt, probably covering a 175 km stretch of former alluvium to a depth of 0.5 to 3.5 km by many meters of sand (see Fig. 2, Pl. 4). It is probable that this invasion was facilitated by weaker Nile sedimentation and an eastward retreat of the Bahr Jusef (Butzer 1959*b*, 1959*c*, p. 69-71). A precise date for the onset of this aeolian deposition upon Nilotic silts cannot be obtained from the profiles in question at Tuna el Gebel or Dalga.

However there are indirect indications elsewhere. So at Hierakonpolis in Upper Egypt where a Predynastic cemetery in the Sebilian silts was denuded by later wind action, which removed up to 2 m of fairly resistant silt, exposing the burials. This material was laid down, together with sand, upon a part of the Gerzean settlement in the lee of the cemetery (Pl. 3) (Butzer 1959*b*, Kaiser and Butzer 1959). Again there are interesting features at the site of the German-Swiss excavations of the

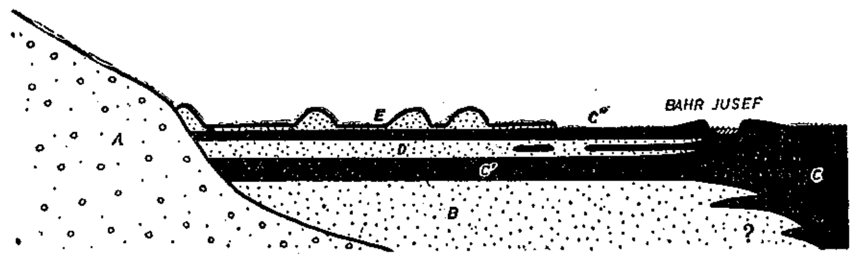

Fig. 2.—*Conventionalized Section of the Marginal Valley Dunes between Tuna el Gebel and Dalga.* A = Pleistocene gravels, B = Older Dunes, c. 2350-500 B. C., C = Nilotic silt, C′ of Graeco-Roman age, C″ of Islamic age; D = Lower Younger Dunes of Byzantine to Islamic age, locally intercalated by silt, E = Upper Younger Dunes (subrecent).

sun temple of Userkaf at Abusir (c. 2480 B. C.). Dr. Kaiser and Dr. Haeny have informed the writer that the walled street joining the valley temple and the actual Re temple high up on the desert was apparently subject to sand accumulation already shortly after completion. To prevent this or to facilitate removal of the sand from a smaller crossection, a dividing wall was built in the Talweg, which was thereby reduced to less than half its original width. Even thereafter the sand seems to have gained the upper hand fairly quickly, or the construction could not have withstood the vicissitudes of time so well. Similarly the base of the Re temple was fortunately already hidden from the view of Ramessid masons by aeolian depoits. It may well be that the admonitions of Ipuwer (9. Dyn. 7, c. 2100 B. C.) refer to the drastic effects of the invading sands—and receding floods— when he says «Upper Egypt has become a desert» (II, 11).

The autochtonous mammalian Fauna of Egypt during the Predynastic Period.

In a previous publication the author (Butzer 1959*c*, p. 36-43) has tried to present a picture of the larger mammalian fauna of Egypt in

Neolithic times. For this purpose a survey of the osteological material and the Predynastic and early historic representations—pottery decorations, stone palettes, ivory carvings, drawing of various sorts and tomb reliefs—were employed. The systematic zoological picture can be formulated as follows :

A. *Ungulatae :*

1. *Artiodactyla ruminantia.*

Camelidae.	*Camelus dromedarius* L.
Cervidae.	*Dama schaeferi* Hilz.
Giraffidae.	*Giraffa camelopardalis* L.
Bovidae.	
Hippotraginnae.	*Oryx algazel* Pall.
	Addax nasomaculatus Blainv.
Bubalinae.	*Bubalis buselaphus* Pall.
Antilopinae.	*Gazella dorcas* L.
	Gazella dorcas isabella Gray.
	Gazella leptoceros loderi Thos.
	Lithocranius walleri Thos.
Ammotragus.	*Ammotragus lervia* Pall.
Capra.	*Capra ibex nubiana* F. Cuv.
Bovinae.	*Bos primigenius* L.
	Bubalus lelwel.
	Bubalus aff. *caffer* Sparmann.

2. *Proboscidia.*

Elephantidae.	*Loxodonta africana* Blbch.

3. *Perissodactyla.*

Equidae.	*Equus asinus africanus* Fitz.
Rhinocerotidae.	*Diceros bicornis* L.
	Ceratotherium simum Barch.

4. *Artiodactyla nonruminantia.*

Hippopotamidae.	*Hippopotamus amphibius* L.
Suidae.	*Sus scrofa* L.

B. *Carnivora* :

1. *Herpestoidea.*	*Felis leo* L.
	Felis pardus Schreb.
	Hyaena striata Zimm.
	Hyaena crocuta Zimm.
2. *Arcotoidea.*	*Canis aureus* L.
	Canis lupaster L.
	Canis vulpes L.

The rodents and smaller felines have been omitted, as their record is incomplete and their importance subordinate. Similarly we have not attempted to treat the domesticated animals, which have been adequately studied by J. Boessneck (1953).

It is apparent that this list refers in the main to the Nile Valley, where the evidence is manifold and varied. In the desert areas we are largely reduced to the matter of the rock-drawings. Summarizing from Butzer (1958*a*) we can regionally sum up as follows, listing the animals in order of numerical importance :

Eastern Desert. Wadi Matuli basin. Wadi el Atwain : Elephant, ibex, ostrich, giraffe, crocodile, gazelle, hippo, antilope; Wadi Rod Ayad; elephant, ibex, gazelle, giraffe, barbary sheep, ostrich and antilope; Wadis Zeidun and Manih : ostrich, ibex, elephant, giraffe, crocodile, antilope, hippo, lion, barbary sheep and gazelle.

These sites are situated 45 to 80 km away from the valley margins.

Wadi Kharit basin. Giraffe, ostrich, antilope, ibex, gazelle, elephant, rhinoceros.

Western Desert. Dakhla—Kharga. Giraffe, antilope, ostrich, ibex, gazelle, elephant and crocodile.

Gebel Uweinat. Ostrich, giraffe, oryx, addax, barbary sheep, ibex, gazelle and possibly fallow deer.

Gilf Kebir. Giraffe, ostrich, oryx, bubal and gazelle.

The question is, how far do these drawings give a true picture of the actual fauna at each locality. For both the Uweinat—Gilf Kebir and the Dakhla—Kharga groups it can be said with some certainty that we are dealing with autochtonous ethnic groups localized in each of these biozones. In each case the style is too individualistic and characteristic as that we are confronting rock-drawings and paintings of «itinerant artists». Similarly, for the oldest drawings of the Eastern Desert we can say that at least the «Earliest Hunters» of Hans Winkler (1938-1939) were strictly a desert folk, with no immediate access to the valley. To these belong the great majority of the elements of a savanna-type fauna : elephant, rhino, giraffe, and ostrich. On the other hand the boats, hippos and crocodiles are stylistically beyond doubt the work of Gerzean artists, who appear to have developed trade routes through the Wadi Hammamat. These «aquatic» factors are then no complication. They are the work of Nile dwellers, drawing scenes from the valley. As regards the other, numerous classic objections to the representative character of the rock-drawings, the reader is referred to Butzer (1958*a*, p. 35-36). In our opinion there is little reason to doubt their palaeozoological implications.

The existence of elephants and rhinoceros in the Eastern Dessert has led us to postulate a former rainfall of 100-150 mm in the more elevated Red Sea Hills, compared with 10 mm to-day (cf. Butzer 1958*a*). Similarly the existence of the giraffe in the Uweinat—Gilf Kebir may point to a former rainfall of some 50 mm for these hills, reflecting topography and relief (to-day some 20 mm). The elephants and giraffes from the oases may have had to thank their existence to the then-functioning mound-springs, so that it is better not to deduce anything on that count. As the writer has discussed with G. W. Murray, it may well be that the highlands of the present desert axis enjoyed the overlap of the summer and winter rainfall belts in Neolithic times. As Mr. Murray has expressed it, «This optimum zone would change abruptly and tragically to one of least rainfall so soon as the winter and summer rainfalls retreated northward and southward respectively.» This might help to explain the occurrence of elephant in the Red Sea Hills or Tibesti. The elephant needs abundant water and green fodder (to the equivalent of several hundred liters of water daily) throughout the year. In all evaluations of such evidence however, it is imperative to remember the paramount effect of topography and relief in a hyperarid area (K. S. Sandford).

Just as the actual geological evidence of greater rainfall points to several humps and sags in the precipitation curve, so does the fauna indicate a strong dry spell preceding the main Gerzean culture c. 3600 B. C. At this time elephant and giraffe were seriously decimated in both the Eastern Desert and in the valley. We have designated this as the *first faunal break* due to deteriorating climatic-ecologic conditions. The *second faunal break* can be localized between the 1. and 4. Dyn., i. e. c. 2850-2600 B.C. (Butzer 1958*a*, 1959*c*). During this period the elephant and giraffe, certainly also the rhinoceros, as well as the gerenuk gazelle, *Lithocranius walleri,* were locally extincted. The lion and the barbary sheep were severely decimated. This means that *the specific savanna fauna of Egypt had died out before the Pyramid Age*—due to a declining and fluctuating rainfall in the course of the gradual termination of the Neolithic subpluvial. The 4. and 5. Dyn. enjoyed the last rains of this moist interval as it seems, for a new trend is noticeable among the fauna between the close of the 4. and the beginning of the 12. Dyn. (c. 2480-1991 B. C.). During this time the desert gazelles replace the larger antilopes and the ibex as dominant element of the Egyptian fauna. The addax even seems to have become locally extincted in the Valley and in the Eastern Desert. So also the fallow deer *Dama schaeferi* Hilz. To illustrate this trend, as established from the analysis of 990 representations (omitting hippopotamus and smaller felines and rodents), Fig. 3 provides an approximate graph of the relative composition of the autochtonous mammalian fauna at various epochs. The 'second faunal break' is particularly striking, and a last transformation, characterized by final achievement of internal equilibrium, was closed off by the 12. Dyn. The following table illustrates the matter more precisely.

Each desert hunt scene of the classic 5. Dyn. tomb reliefs shows animals at large on the surface of the desert (Pl. 2). For the first time however the tomb of Mereruka (6. Dyn.) shows a hunt within a fenced enclosure. The terrain indicates desert country but the game was obviously kept and hunted in artificial reserves, which were replenished after the king or his courtiers had enjoyed the traditional sport. This fact is decisive in assessing the zoological implication of the odd thousand animal representations preserved on Predynastic art objects and Dynastic

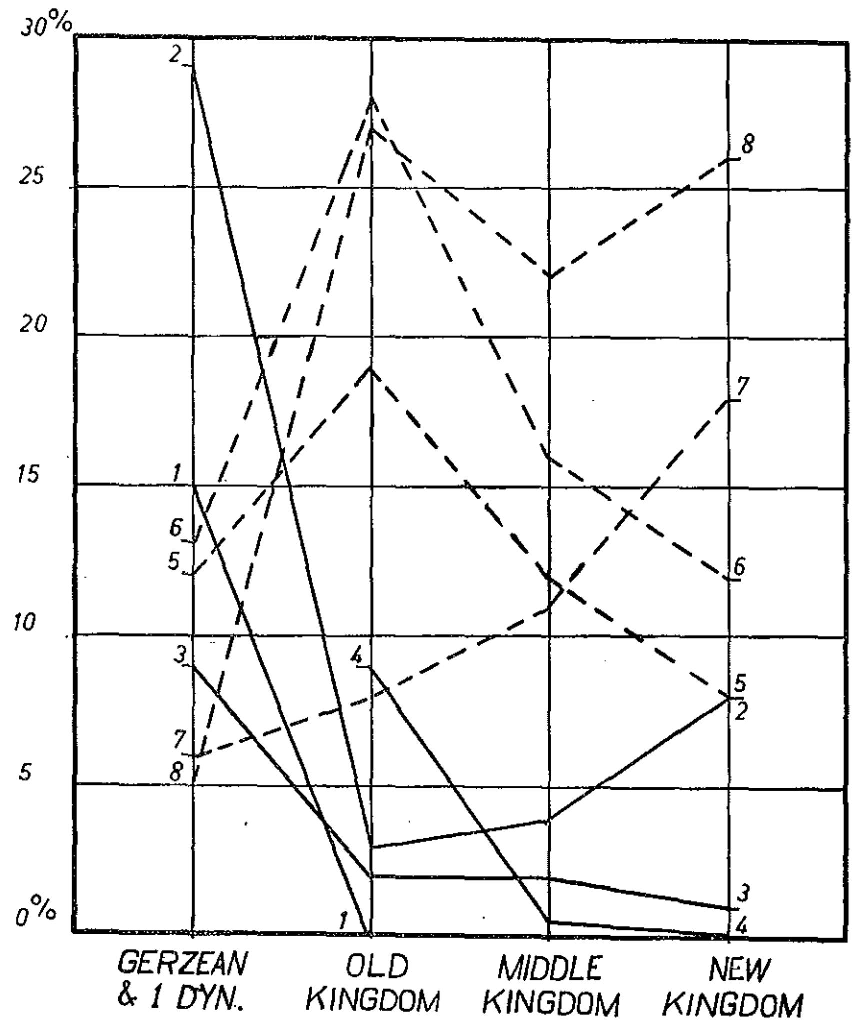

FIG. 3.—*Relative Composition of Animal Representations (in %) : the faunal Transformations of Egypt in Dynastic Times.* 1 = Rhinoceros, elephant and Giraffe, 2 = Felidae, 3 = Ammotragus, 4 = Addax, 5 = Ibex, 6 = Oryx, 7 = Bubalidae, 8 = Gazellae.

TABLE 1.—Animal Representations from the Nile Valley according to Dynasties (3500-1100 B. C.) after Butzer (1959*c*, p. 64)

	Total	Rhinoceros	Elephant	Giraffe	Felidae	Cervidae	Ammotragus	Addax	Ibex	Oryx	Bubal	Gazellae	Struthio	Others (1)
Gerzean/1.Dyn.	281	2	24	16	*81*	7	25	x (2)	32	*35*	17	14	2	26
4.Dyn........	53	—	—	—	1	2	—	5	*13*	*12*	5	10	—	5
5.Dyn........	199	—	—	—	6	5	3	14	35	*50*	18	*52*	1	15
6.Dyn........	128	—	—	—	2	1	3	14	20	*40*	4	*34*	1	8
11.Dyn........	72	—	—	—	2	3	2	1?	14	*18*	5	*24*	—	3
12.Dyn........	103	—	—	1?	6	9	2	—	14	18	*20*	*25*	2	7
18./20.Dyn....	154	—	—	—	12	5	2	—	12	17	27	*28*	13	20

reliefs and paintings. An explanation can be found from analysis of the New Kingdom drawings, where the proportion of desert hunt scenes is very low considering the prolific illustration of daily life as known from the first half of the 18. Dyn. Fishing and fowling in the Valley swamps or hunts upon hippopotamus and the Ur have instead received greater attention. The great number of ostrich representations also points in the same direction : *the larger mammalian fauna of the Nile Valley or its immediate vicinity had been widely exterminated by c. 2350 through human agency*. This does not alter the fact that the extermination of the savanna fauna in Egypt as a whole was climatically instigated. It is obvious to everyone that none of these animals could exist in the dry country to-day, whereas the galeria zone could, of course, without Man, still support them.

The animals depicted on 6. Dyn., Middle and New Kingdom reliefs *and paintings were chiefly drawn from the Red Sea Hills, southern Nubia or the steppe country of the Mediterranean littoral to be hunted in game parks and enclosures* (Butzer 1959*c*, p. 58-59, 66-67). Apart from such

(1) Includes *canidae*, hyaenas, wild ass, boar and *Bos primigenius*.

(2) Known from rock-drawings in Predynastic times.

especially popular game as ostrich or fallow deer, or symbolical hunts on lion, *the dynastic representations provide an invaluable record of the main faunal trends in Egypt as a whole.* Before the close of the subpluvial the main elements of the fauna were common to both the riverain zone and the desert highlands, after the close of the subpluvial the fauna was drawn solely from the highlands. So an essential continuity is preserved within the record.

The Vegetation of the Low Desert in late Prehistoric Times.

In view of the geological and zoological evidence of the Neolithic subpluvial one may ask whether then there is no botanical evidence, for, after all, the savanna fauna presupposes a certain amount of vegetation. This is also the case. There is considerable evidence of tree-growth on the low desert—naturally of a parkland character and limited to edaphically favoured localities—a condition substantiated by historical documentation on 5. Dyn. reliefs.

Between Khawalid and Deir Tasa (G. Brunton 1937, p. 67-68) reported tree roots in the low desert at many places. As far as can be guessed now, these were buried under scree or cultural debris. The trees included acacias or tamarisks with trunks up to 32 cm across and roots up to 4.5 m long. They can be dated from the Badarian to at latest the 4. Dyn. Since the lowest roots were found up to 12 m above the present flood-level, it is not warranted to suppose that moisture was derived from Nilotic groundwater or floodwater. Similarly at Armant (Mond and Myers 1937, p. 7-8). Here the former growth of sparsely set trees seems to have been mainly pre-Gerzean, while one tree thrived during the alluviation of a small wadi in Predynastic times—implying atmospheric moisture. The very fact that such a tree was not overly large, despite its long period of growth, indicates that we are dealing with desert vegetation. Species include *Ficus sycomorus* and *Acacia* sp. Acacias only require little moisture to establish themselves. After a few years it seems that the leaves can draw moisture from the air (M. Kassas, G. W. Murray) so as to be able to live without soil moisture for several years. For example the acacia bushes of the Eastern Desert bloom even in years without any rains (G. W. Murray). If we assume a rainfall of 50 mm for the hillier country for the period c. 5000-3000 B. C. (cf. Butzer 1958*a*, Map 3), it is thoroughly reasonable that a limited tree-growth, in the sense of an 'acacia desert grass' savanna (H. L. Schantz), was possible in topographically and edaphically selected areas.

This interpretation of the tree remains of the low desert is substantiated by the desert hunting scenes depicted on 8. and 6. Dyn. but no later reliefs. The tomb of Ptahhotep I at Saqqara (Davies 1900, I, 21) shows an irregular low desert terrain with sycomore and smaller bushes. Again the chamber of the annual seasons in the Re temple of Neussere (Schaefer 1942, p. 256), also 5. Dyn., shows a low desert landscape with two large sycomores and a small acacia (Pl. 2), along with a number of other plants which are also visible in Sahure (Borchardt 1913, II, 17) and Mereruka (Wilson and Allen 1938, p. 25). Some of these smaller shrubs are probably desert succulents, in part perhaps also halfagrass. Their size, admittedly a poor criterion on Egyptian drawings, never exceeds the height of the antilopes' knees (c. 40 cm), But the conventionalization and simplification of detail is so strong that Prof. (Mrs.) Täckholm does not believe a safe identification to be at all possible (personal communication). The youngest of such representations is what may be a bare acacia stem in a desert scene in the 6. Dyn. tomb of Zau at Deir el Gebrawi (Davies 1902, I, 11). Each of these representations indisputably refers to the desert as the irregular, bumpy terrain is amplified by dotting—indicating sand—and red colour. In other words *the low desert was not an all-out desert in Predynastic and earlier Old Kingdom times but harboured an acacia desert grass savanna vegetation.* This sparse growth of sycomore, acacia and tamarisk in an open parkland with grass tufts and desert shrubs was due to the infrequent but ecologically important rains characterizing the subpluvial. Just as the acacias of the Eastern Desert to-day, such copse would be concentrated near wadis or even in them, where ground moisture could carry over many months from the occasional spates. As a matter of interest inscriptions record that acacia wood for *shipbuilding* (!) was felled at Hatnub even in the 6. Dyn. (Breasted 1905, I, 233). The occasional acacia bushes of this area are hardly even worth the while for firewood to-day.

We have, in summary, reviewed the geological, zoological, botanical and historical evidence for the Predynastic and early Old Kingdom period and come to the conclusion that the epoch c. 5000-2350 B. C. was considerably moister than to-day [1]. It was not an outspoken pluvial phase, but a geological record does nevertheless exist. Maximum moisture had been achieved before the Nagada I (Amratian) period, and two very intense dry spells are attributed to the transition Nagada I/II (c. 3700 B. C.) and the 1.-3. Dyn. (2850-2600 B. C.). With the 5. Dyn. the rains had pretty well ceased and the beginning of the 6. Dyn. (c. 2350 B. C.) safely marks the final termination of the subpluvial. The vegetation, in as far as it was not eradicated by Man or his herds, was able to persist a little longer. In Fig. 4 we have attempted a—purely hypothetical—reconstruction of the ecologic zones as a function of rainfall and pasture for the optimal part of the subpluvial. On the basis of the rock-drawings (see Butzer 1958*a*, Map 3) and similar botanical evidence the ecologic zones have been sketched for the Sudan as well. So for example there are innumerable dead acacia stems west of Bir el Atrun, northern Darfur (Murray 1951). There is no certain dating, but in all probability these features are contemporary. Significantly the stumps, up to 30 or 40 cm in diameter are sparsely set at about 3 to 5 per acre, which infers an open savanna vegetation some 200 km further north than this vegetation type flourishes to-day.

This then is the picture of the Nile Valley and of the Egyptian deserts in Neolithic and Chalcolithic times which the natural-historical evidence can provide. Just as the floodplain habitat was of relevance to the earliest agricultural settlement and to the development of an agrarian economy as a whole, so the former vegetation of northwestern Egypt, the Eastern Desert, the Saharan highlands and the northern Sahel was

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[1] It seems unnecessary to mention that the Sahara is a natural and not a man-made desert; it is a function of the primary and secondary circulation of the atmosphere. A mere glance at the precipitation means—Alexandria 201 mm, Cairo 33 mm, Fayum 8 mm, Asyut 4 mm, Aswan 1 mm—should convince even the most sceptical desert optimist. Rich vegetation such as that of the Gebel Elba to-day is a matter of condensation moisture, mist-oases in the sense C. Troll, M. Kassas and M. Drar.

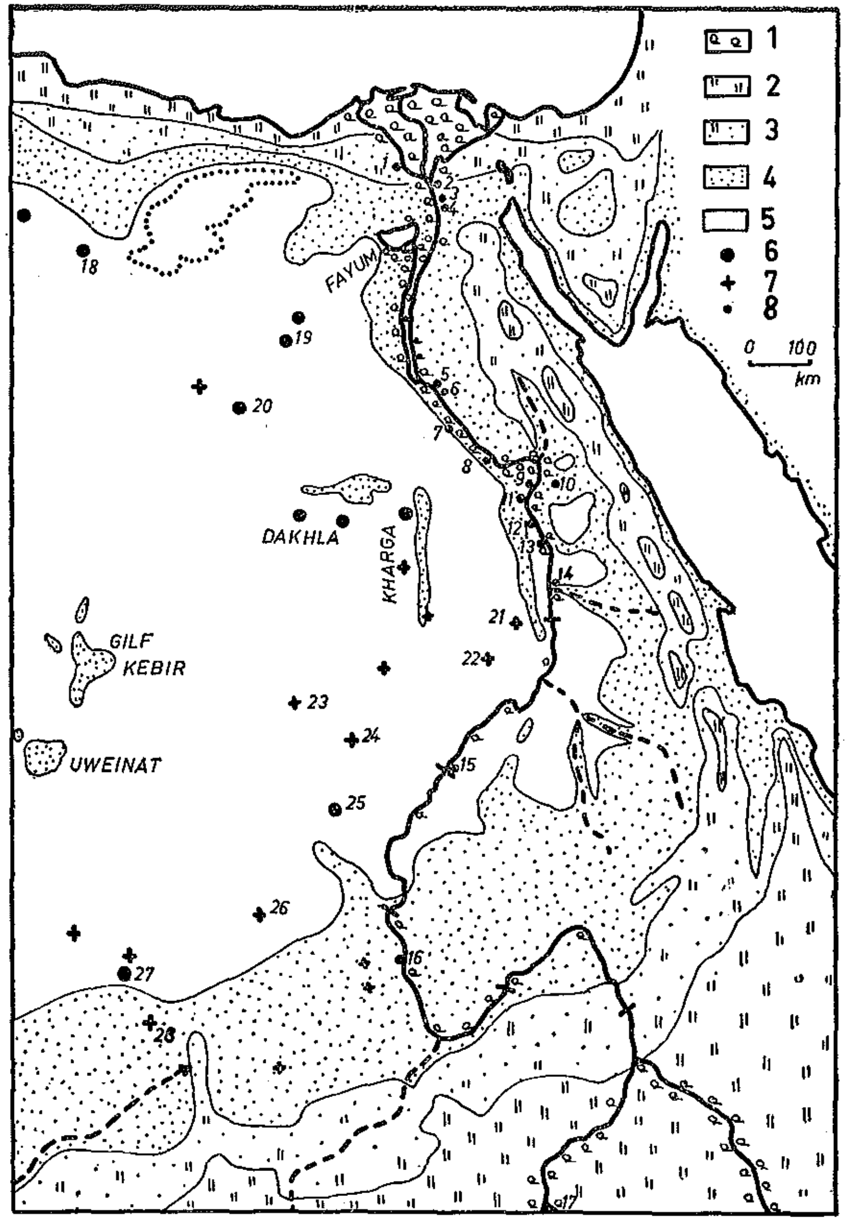

FIG. 4.—*Climatic-ecologic vegetational Zones in Egypt and the Sudan c.* 5000-3000 B. C. 1 = Galeria woodland, 2 = 'good' pasture with over 150 mm precipitation, 3 = 'moderate' pasture with c. 100-150 mm precipitation, 4 = pasture after rains, 50-100 mm precipitation, 5 = negligible pasture, less than 50 mm precipitation; 6 = larger oases, 7 = larger water places, 8 = prehistoric sites: 1 Merimde, 2 Heliopolis, 3 Maadi, 4 Helwan, 5 Deir Tasa, 6 Badari-Hemamieh, 7 Mahasna, 8 Abydos, 9 Nagada-Tukh, 10 Laqeita, 11 Armant, 12 Esna, 13 Edfu, 14 Kom Ombo, 15 Wadi Halfa, 16 Dongola, 17 Khartum, 18 Siwa, 19 Bahariya, 20 Farafra, 21 Kurkur, 22 Dungul, 23 Tarfawi, 24 el Sheb, 25 Selima, 26 Lagia, 27 Merga, 28 Bir el Atrun.

all-important to pastoral subsistence in those areas. To-day there are no nomads or pastoral folk on the Libyan Desert flanks of the Nile or in the Red Sea Hills north of about the Wadi Qena. But in late prehistoric times the Nile Valley was exposed to possible strife or invasion along the greater part of its course. This brings us to those problems of prehistorical or anthropological affinity which are intimately associated with the natural environment.

B. COMMENTS ON PREHISTORICAL AND ANTHROPOLOGICAL ASPECTS

During the dominance of the Middle Palaeolithic culture in north-eastern Africa, Man was able to settle over the greater part of the now-empty Sahara. Levalloiso-Mousterian artefacts have been collected from between the dunes of the Libyan sand sea, from the Libyan Plateau many miles away from the river as well as from the coast of the Red Sea. This is not surprising as this industry more or less corresponded to the main phase of the last great, Würm-age pluvial throughout the Near East. In relative contrast to this stands the distribution of the Upper (or Late) Palaeolithic industries, which are limited to the Mediterranean littoral or to the vicinity of wadis or rivers. This is strikingly the case in Egypt, where the Late Palaeolithic Epi-Levallois cultures, developing autochtonously from the late Upper Levalloisian, are so far not known outside of the Nile Valley. Of course it is not all too easy to distinguish surface finds of both stages, as the later product is simply characterized by a number of new innovations occurring side by side with the older.

Artefacts of the Epi-Levallois I (including the Lower Sebilian) are found in the silts overlying the late Levallois ('Mousterian') Nile gravels in Upper and Nubia, and on the shores of the + 28 m Fayum lake. Interestingly the Sebilian silts at Armant contain intercalations of aeolian sand (Sandford and Arkell 1933, p. 47), suggesting an arid local climate. Similarly the silts are not intercalated with local gravels at the mouth of Wadi Khuzam (Butzer 1959*a*), indicating little water action at the time. The Epi-Levallois II culture is generally distributed upon the silts of southern Egypt (Sandford and Arkell 1933), occurs in and upon wadi gravels in the Thebaid (Butzer 1959*a*), in suballuvial gravels in Middle Egypt (Sandford 1934) and along the shores of the + 22-23 m Fayum lake (Sandford and Arkell 1929). The 'sub-microlithic' implements of the Epi-Levallois III stage are confined to the silt banks of the Nile between Wadi Halfa and Ezna, sites such as Dibeira West, Kom Ombo, Sebil and near Edfu (Sandford and Arkell 1933, p. 79-80, 94; E. Vignard 1924). Probably also of Epi-Levallois affinity is the industry with double-ended and discoidal cores found at Abu Suwair (Wadi Tumilat) by S. A. Huzayyin (1952), possibly also the less apparent industry at Heliopolis which includes bifacial axes and reedged flakes—unfortunately not yet published with illustrations. Although wadi gravels were still deposited with unrolled Epi-Levallois II artefacts (Butzer 1959*a*), the last stages of that cultural evolution took place during a fully arid climate while the Nile was degrading in response to a marine regression. The Abu Suwair and Heliopolis industries presumably corresponded to a postpluvial moist spell indicated from elsewhere in the Near East (Butzer 1958*b*, p. 104 seq.).

The so-called full microlithic facies grouped under the term Helwan culture, and seemingly representing the Upper Natufian, have been but incompletely studied and published so far. There is little doubt that they are chronologically Holocene and it may be justified to group them as 'Mesolithic' on considerable grounds. Best known are the finds at Helwan (Sandford 1934, p. 119-120), equally important are those of el Omari (F. Debono 1948) and Lateiqa Wells (Debono 1951). This is all we know at the moment. It seems then that the representatives of this culture were grouped on the immediate borders of the Nile or at other sources of perennial water, as were their predecessors of the Epi-Levallois III. It is implicit that the Epi-Levallois II is at least as old as the Würm maximum (c. 20,000 B. C.) on account of the corresponding cool-moist climate in Egypt (Butzer 1959*a*). This means that Man had been predominantly settled in the Valley since at least 25,000 B. C., exclusively so since perhaps 15,000 B. C. In other words *Man had moved into the riveraine zone some 10 to 20 millenia before the advent of the Neolithic.*

Yet authors like V. G. Childe (1929, p. 42, 46) speak of *postglacial* (?) desiccation as a motive to first settlement in the riveraine zone, out of which sprang the Neolithic culture : « Animals and man would be herded together round pools and wadis that were growing increasingly isolated by desert tracts and such enforced juxtaposition might almost of itself promote that sort of symbiosis between man and beast signified in the word domestication.» Or as Arnold J. Toynbee, following Childe, expresses the concept of climatic challenge (1935, I, p. 305), « When the grasslands overlooking the lower valley of the Nile turned into the Libyan Desert..., these heroic pioneers—inspired by audacity or desparation—plunged into the jungle-swamps of the valley-bottoms, never before penetrated by Man, which their dynamic was to turn into the Land of Egypt...» All that we can say to these genial hypotheses is, that at least ten thousand years of «juxtaposition» preceded actual incipient domestication in the Nile Valley, and that Man was living equally as long, apparently contented and undynamic, in that same supposedly uninhabitable zone before he finally embarked upon the road to civilization. Neither can we follow such arguments such as those of H. Frankfort (1956, p. 29), «... progressive desiccation marked the period from perhaps 7000 B. C. onwards ... making the valleys of the great rivers inhabitable. When meadows and shrub lands began to emerge from the swamps and mudflats along the river courses, man descended from the highlands.» Local desiccation does not effect the landscape of the floodplain of an exotic river such as the Nile, where meadows and shrub lands were characteristic on the natural levees and the only seasonally flooded alluvial flats from the very beginning. The almost classic phrase of Man's descent from the highlands is also trite and mythological. From the Lower Palaeolithic onward Man was at home upon the desert and beside the wadis and rivers. During drier phases he concentrated near the latter, so for example since the close of the Middle Palaeolithic as we saw. The common misunderstanding of human settlement «high up» on the Pleistocene terraces and his subsequent «descent» on to the alluvial flats implies a lack of basic information on the significance of river terraces, little more.

What then do we know about the transition Mesolithic/Neolithic in Egypt? In the main, that there is a great cultural gap between the terminal food-gatherers responsible for the microlithic Helwan industry and the autochtonous village farmers of late Neolithic Merimde. The cultural stages of «vegeculture» and «incipient agriculture», as Braidwood and Reed (1958) designate the mixed food-getting and specialized food-collecting transitions, are missing. This is of paramount weight in asessing the origin of the Egyptian Neolithic : we can safely assume a cultural infusion of some sort from the Fertile Crescent where this transition of cultures has been demonstrated. Until further evidence is available it remains a supposition however. Suffice it to say that Merimde appears well after the onset of the Neolithic subpluvial c. 5000 B.C. (at least two millenia later than the earliest farming communities in the Fertile Crescent) and that Late Glacial—Early Post-glacial aridity did not promote the transition from food-gathering to food-producing in any way, nor did it motivate Man to first settle in the riveraine zone or begin the process of (initially unnecessary) swamp-drainage. Late Pleistocene aridity only provided a latent means of enforced habitation of the ever-optimal zone of population concentration nearby to rivers or wadis—at least ten millenia before the beginnings of local agriculture.

Quite contrary to the desiccation or river-propinquity theory of Neolithic origins, desert settlement achieved a quite unknown density and importance just after the transition to food-producing. Innumerable Neolithic and especially Chalcolithic sites are still preserved along the desert margins of the Valley from Merimde to Upper Nubia, Still lacking systematic study are further the wealth of New Stone Age artefacts seemingly scattered over the desert surfaces of the greater part of Egypt. These do not only occur at oases such as the Gilf Kebir and Kharga but along the routes across the Libyan Desert. Apart from the stone industries are the rock-drawings of the Eastern Desert of Upper Egypt, the Wadi Kharit area of southeastern Egypt, the flanks of the Upper Egyptian Valley, the great oasis, and the plateaux of the Libyan Desert. Hans Winkler identified six ethnic groups on the basis of the rock pictures and drawings. Most important of these are : 1) the Earliest Hunters, contemporary to the Egyptian Neolithic and Amratian cultures and originally living in the desert areas of the south half of Egypt. They were hunters and little else, we have no evidence that they kept domesticated animals. So far we have no implements linked with them, and it may be that they had so-to-speak a Mesolithic rather than a Neolithic culture. It is widely assumed that the cultural impetus to rock-drawings originated in the northwestern Sahara, under influence of Mesolithic Spain. 2) The so-called autochtonous mountain dwellers, a cattle-herding folk appearing in Amratian times and probably the forebears of the hamitic Bidjarin of Upper Egypt. These settled in the hunting grounds of the Earliest Hunters and gradually seem to have absorbed these. 3) The Early Nile Dwellers, who seem to have been the major protagonists of the Gerzean culture, and are linked with the so-called Nagada boats. These people drew boats, hippos, and crocodiles in Wadi Hammamat, and it may be that they already carried out commerce and trade on the Red Sea routes.

Figuratively speaking there was apparently an explosion of population after c. 5000 B. C. paralleled by new settlement through the greater part of the Sahara. The latter is certainly not a matter of greater carrying-capacity of a food-producing economy. The explanation must be sought in a climatic amelioration, an interval of some rain throughout the more elevated areas of the Sahara with a differentiated relief and topography. This was realized already 30 years ago on the basis of the fauna of the petroglyphs.

The Late Palaeolithic and Mesolithic saw the desert Sahara next to uninhabited, with the advent of the first farming communities in the Nile Valley the desert highlands were repopulated by Man, who apparently followed the game inwards from the latitudinal fringes of the Great Desert. The 5th millenium saw a loosely affiliated cultural group of Early Hunters occupying the Saharan highlands from the Atlantic to the Red Sea. The fine naturalistic drawings of large dimensions are however not common to the Earliest Hunters of Upper Egypt and Uweinat. Possibly these formed a local group. The lack of drawings of the hunting culture on the southern and northeastern borders of the Sahara suggests the original cultural connexion was possible straight across the centre of the desert complex. However the minuter problems of the origins and ethnic classification of the ancient Saharan populations are not our matter, we are only concerned with the ecologic problems they pose (similarly so our discussion of these people in Butzer 1958*a*, p. 40-47).

The second group of desert folk, the cattle-nomads of Hamitic affinity, originated somewhere in the southeastern Sudan it seems, and spread northwards to the Red Sea Hills and to Uweinat, and northwest-wards through the Central Sahara to the Fezzan, Tassili, Hoggar, Air, Nigeria etc. One gets the impression of a radial expansion from the axis Ennedi—Tibesti—Tassili—Hoggar, which would seem ecologically feasible. This livestock-raising culture was able to flourish in the central Saharan hill country during the 4th and 3rd millenia. Whether these two great peoples were actually limited to the domain of the rock-drawings or whether the rock-drawings were limited to areas with suitable material (exposed, flat rock surfaces of some durability, yet not too hard) remains a puzzle. Interestingly the sites west of Luxor (see Winkler 1938-1939) are on limestone rock faces, so that not only sandstone was used. In a very broad way the limits of the rock-drawings do probably reflect ethnic lines to some extent. Fig. 5 gives a broad outline of the localization of these two peoples.

Besides these folk who left us a vivid record of their way of life there were of course others who left the mute surface finds of stone implements and pottery. From them we know of prehistoric agriculture in the Kharga and elsewhere in the Libyan Desert, so the querns and grinders from Uweinat. But until this scattered material is all gathered, particularly from the Red Sea Hills, and published, we can say little else than that numerous but unknown peoples inhabited the greater part of Egypt in Predynastic times. We need only refer to the nation of the Temehu Libyans who inhabited the oases during the Old Kingdom—all before the close of the Neolithic subpluvial. The termination of better climatic-ecologic conditions in the Sahara led to the evacuation of Tibesti, Uweinat, the Gilf Kebir and part of the Libyan oases well before the last millenium B. C., the historical repercussions being well known from Egypt in the 6. Dyn. for example. Desert neighbours play no part whatever for Upper Egypt during the New Kingdom, nomadic strife

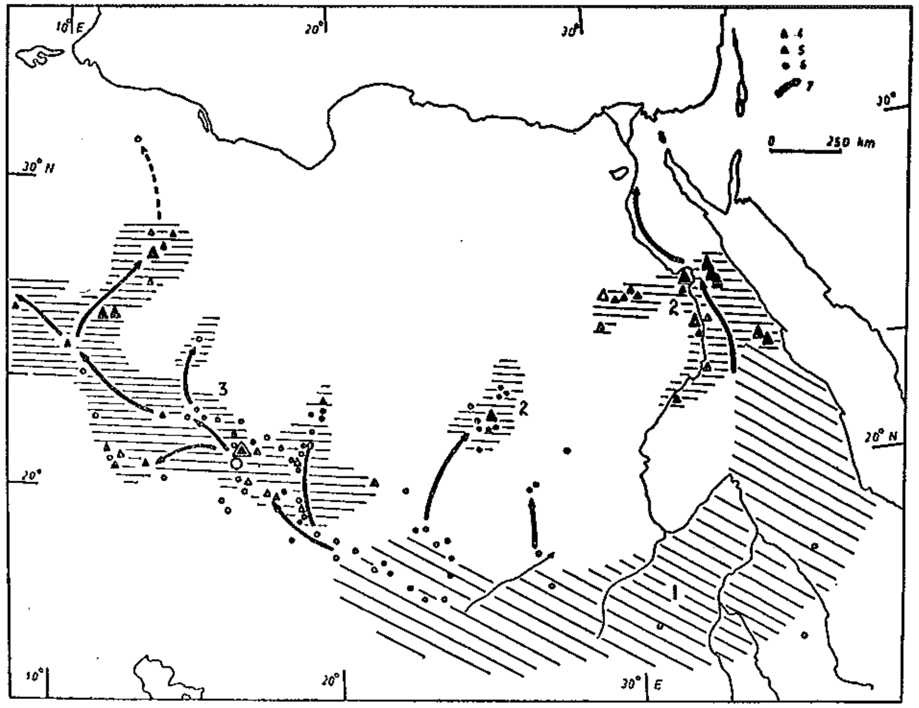

FIG. 5.—*Early Hunters and Cattle-nomads in the Sahara in Neolithic Times.* 1 = approximate extent of 'Hamitic' livestock-raising culture c. 4000 B. C. 2 = documented extent of the eastern Hunters at that time, 3 = domain of central group of Hunters, 4 = rock-drawings of Early Hunters, important centers shown by larger symbols, 5 = rock-drawings of the Early Hunters and Cattle-nomads, 6 = rock-drawings of the Cattle nomads; 7 = hypothetical routes followed by the expending Cattle-nomads in the 4th millenium B. C.

being limited to the steppe littoral of the Mediterranean. After the arrival of the camel the Blemmyan wars against Rome document the persistance of nomads only in the present lands of the Ababda, Beja and Bidjarin. Desert inhabitation and cultural intercommunication across and through the Sahara achieved a unique maximum in Neolithic times the course of the subpluvial c. 5000-2350.

The rather sudden and dramatic expansion of the food-producing Neolithic cultures—existing in the Fertile Crescent since at least 7000 B.C. across the Middle East, via Anatolia to southeastern Europe, through the Mediterranean, and over Egypt to the Sahara coincides remarkably well with the onset of moist conditions after 5000 B. C. One cannot help but believe that the same ecologic conditions enabling the savanna fauna to occupy the Saharan highlands facilitated and perhaps inspired Man's expansion over the great Empty Quarter and the spread of the numerous farming population throughout the arid zone of the Old World.

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