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The natural conditions for Pre- and Early Dynastic settlement in the Western Nile Delta around Tell el-Fara'in, Buto

Palaeogeographical investigations of the late Quaternary development of the Nile Delta have been intensified during the last few years. This research, however, which was occasionally connected with archaeological surveys and excavations, focused on the eastern Delta (Sneh *et al.* 1986; Coutellier and Stanley 1987; Stanley 1988; van Wesemael and Dirksz 1986; Sewuster and van Wesemael 1987; de Wit and van Stralen 1988; de Wit, this volume), whereas the western part was rather neglected. Especially the knowledge of the younger geological history of the region south of Lake Burullus is incomplete. Only few data are available from the widely scattered borings described by Fourteau (1915) and Attia (1954); they merely allow for a general outline of the late Quaternary stratigraphic sequence.

In order to add to the fragmentary information on the late Pleistocene and Holocene evolution of this part of the Delta, palaeogeographical research has been carried out in the area of Tell el-Fara'in (Andres and Wunderlich 1986; Wunderlich 1988; 1989). The research project was made possible by a grant from the Stiftung Volkswagenwerk, FRG. It chiefly aimed at the detection of the environmental conditions at different times, changes in the deltaic fluvial system and fluctuations of the sea level and the coastline.

The results of those studies were also to contribute to the recent investigations of the German Archaeological Institute, Cairo at Tell el-Fara'in (von der Way 1984; 1985; 1986; 1987; 1988; 1989) which showed that at the site of ancient Buto settlement started during the Predynastic period and there are different cultural layers up to the Early Dynastic and Dynastic periods (von der Way 1989; Schmidt, this volume). The archaeological findings raised questions about

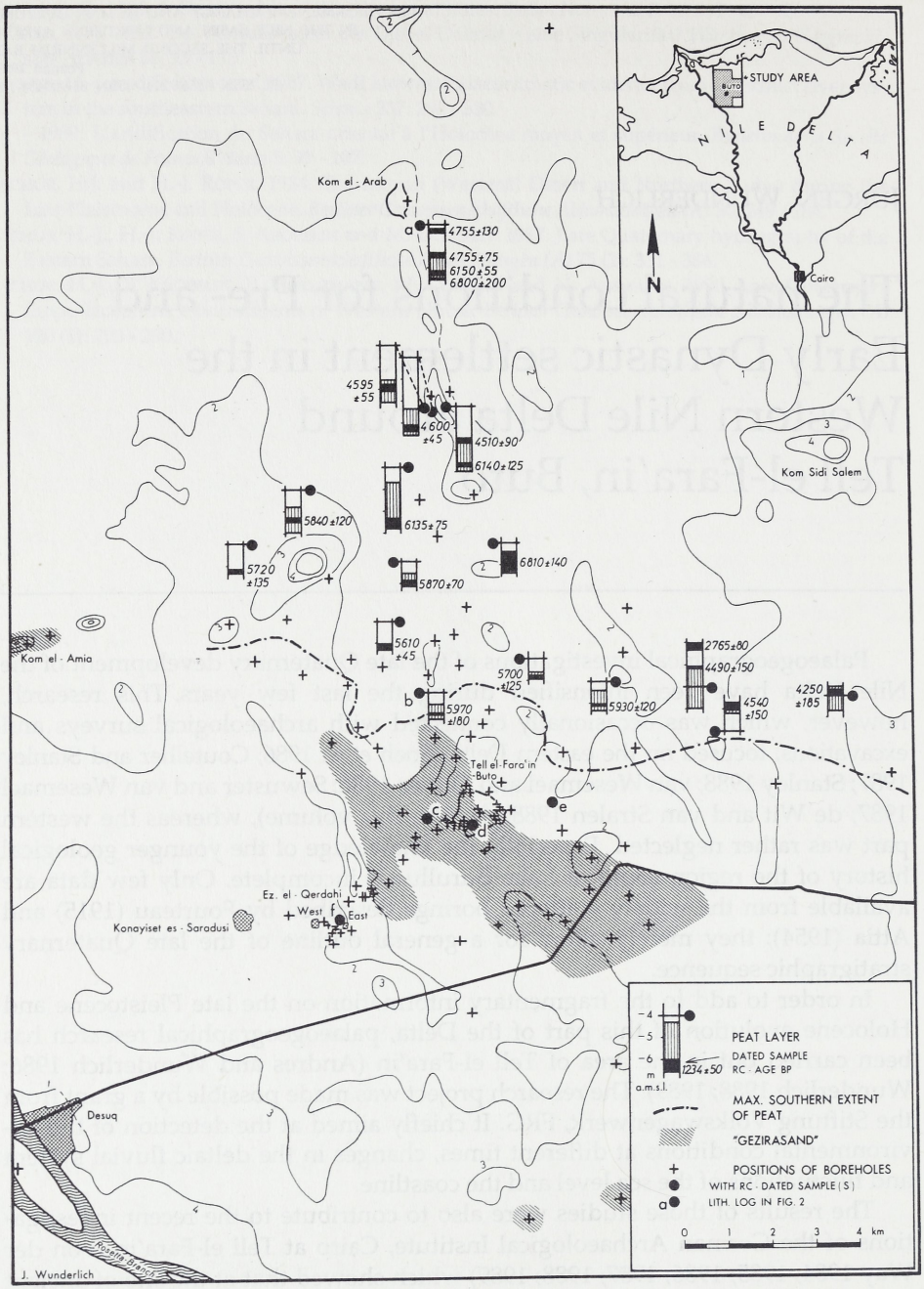

Fig. 1. Map of the study area showing location of the borings and several results discussed in the text.

the natural conditions facing early man in this region as well as about the function of the settlement and its relation to ancient Nile branches or to the coast. Furthermore, it was of great interest whether other settlements of an equivalent age, which are now buried below Nile sediments, existed close to Buto. All these archaeologically relevant problems are not to be solved without any detailed information on the subsurface structure.

The study area (Fig. 1) around Tell el-Fara'in extends from the southern border of Lake Burullus for nearly 30 km to the south, its southwestern corner just touching the Rosetta branch; from west to east it is about 20 km wide. It includes different geomorphological units: the northern part is covered by the brackish Lake Burullus and the adjacent vast plains of bare soil and salt marsh with low ridges and seasonally flooded saltpans; adjoining to the south there is the highly cultivated and irrigated floodplain with a dense network of canals and drains; it also contains different morphological features, *i.e.* ridges or small mounds.

As the most valuable information could be expected from studying the subsurface, boring and subsequent analyses of taken sediment samples, including radiocarbon dating, were concentrated upon. Two different drilling equipments were used: an auger of the Edelman type and a motor-driven gouge auger with a gouge of 1 m in length and 3 cm in diameter. More than 150 drillings to depths of 15 m maximum and an average depth of about 9 m have been carried out in the working area (Fig. 1). They were concentrated around Tell el-Fara'in. The stratigraphic records provided from borings were partly completed by geoelectric soundings. Beside of own measurements a lot of soundings were carried out by Prof. Gamili, Dept. of Geology, Mansoura University, Egypt. As far as possible, the fieldwork was supported and completed by digital processing and interpretation of Landsat MSS and TM data as well as by studying topographic maps of different years. The latter research methods allowed for the detection of possible courses of abandoned Nile distributaries and other features like subdeltas, former lakes and small mounds, which are mostly Tells or Koms (Wunderlich 1988: Fig. 2).

This paper focuses on the results of the borings and the laboratory analyses. They indicate that the subsurface conditions inside the study area – especially close to Tell el-Fara'in – are highly complex. Nevertheless, a general outline of the upper sedimentary sequence can be drawn. In Fig. 2 it is illustrated by lithologic logs being typical for different parts of the working area.

Normally the upper few meters of the sediment column are made of floodplain deposits. This well known Nile mud mainly consists of dark brown or in the lower sections (below actual mean sea level) of dark grey clay, silt and silty clay. The sediments are locally interrupted by loamy or sandy intercalations, reflecting the shifting of Nile distributaries or changes in their discharge and sedimentation pattern. Nodules of FeMn and $CaCO_3$ as well as molluscs are recorded. The content of the organic matter varies around 8% of weight.

To the north of the working area peat or highly organic muds underlie the rather homogeneous clay and silt mostly below –4 m actual mean sea level (Fig.

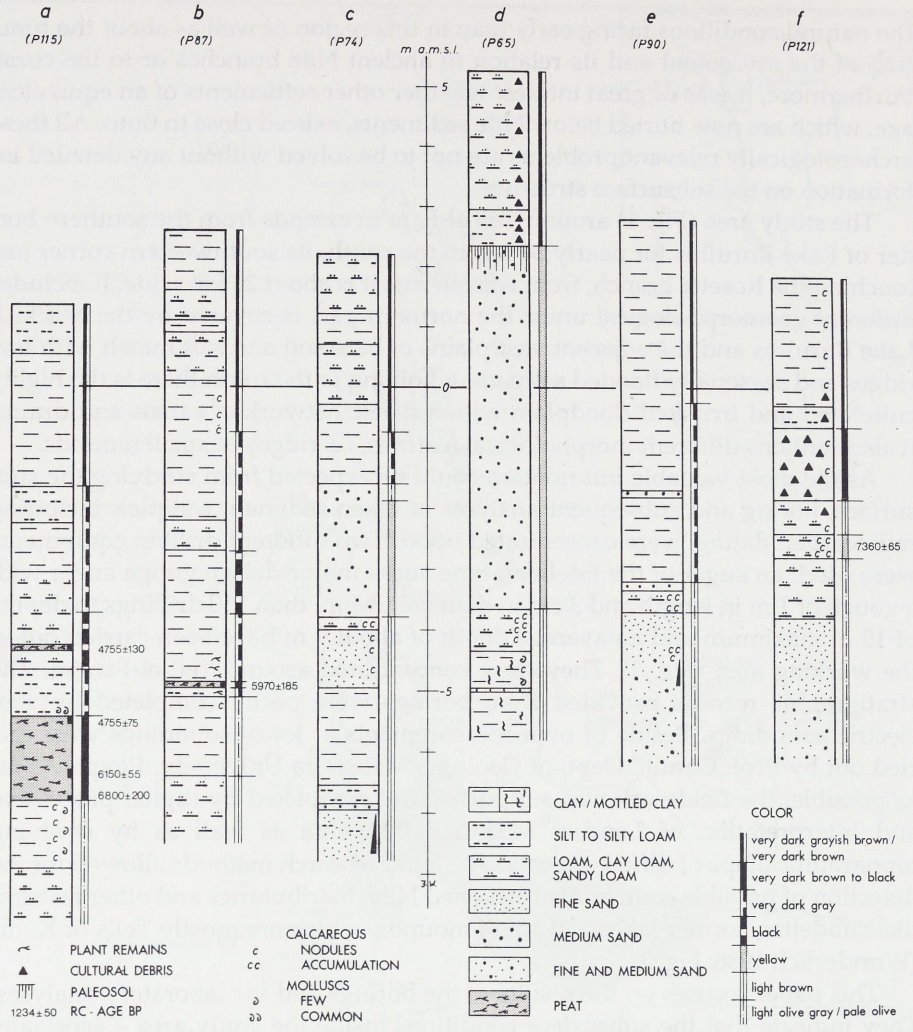

Fig. 2. Lithologic logs (a - f) of selected borings showing characteristic sedimentological sequences from different parts of the study area. For the locations of the borings see Fig. 1.

2: a, b). Their thickness decreases in a southward direction from more than 1 m to about 10 cm and they completely disappear south of the line shown in Fig. 1. The content of organic material varies from approximately 75% of weight (peat) to about 15% of weight (organic mud) finding an expression in the very dark brown or black color. This remarkable sediment layer obviously represents a former southward advance of the marsh- and lagoon-belt near the coast. It was proved by abundant molluscs on top of the peat indicating a brackish environment.

Several samples of the organic material were radiocarbon dated. The C-14-datings were carried out by the Institut für Umweltphysik, Universität Heidelberg, FRG. The C-14-ages as well as the spatial distribution and the level of the dated samples are depicted in Fig. 1. They show that in the northern part of the working area the top of the peat layer is about 4,500 radiocarbon-years old, whereas the bottom is older than 6,500 B.P. According to Pearson *et al.* (1986) this fits with a range from nearly 3,000 to 6,000 cal. B.C. The thin organic layers further south yielded C-14-ages of about 5,800 B.P. This corresponds to a calibrated age of about 4,500 cal. B.C. (after Pearson *et al.* 1986; for the complete dates including lab-numbers *cf.* Wunderlich 1989). The C-14-ages indicate that to the north of Buto the maximum southern extent of the lagoon- and marsh-environment was reached shortly after 6,000 B.P. Subsequently, sedimentation of Nile mud prevailed and the southern border of peat development was pushed to the north.

To the south of the peat deposits a characteristic sand layer was detected below the upper clay- and silt-sequence (Fig. 2c). The numerous sediment borings in the vicinity of Tell-el-Fara'in allowed us to delineate the extent of this sand deposit with some reliability. As shown in Fig. 1 it is restricted to a sharply defined area. Similar sands were also recorded at some other places, but due to long distances between the boreholes they could not be associated with the sandsheet around Tell el-Fara'in.

The layer of yellow and greenish grey sand is normally 1 or 2 m in thickness. It increases to more than 6 m below the ruins of Tell el-Fara'in, where it appears at the base of the cultural horizons (Fig. 2d). Presumably Predynastic people found this sand hill overtopping the surrounding floodplain like an island. In the eastern Delta those sandy elevations are called *gezira*. Thus the sand forming this characteristic layer will be termed *gezirasand*. This does neither mean anything about its age and origin nor its belonging to any stratigraphic formation.

Various investigations were carried out in order to derive information about the environmental conditions leading to the deposition of the *gezirasand*. Grain-size analyses of several samples proved that more than 50%, occasionally more than 60% of weight are made of medium sand which consists mainly of quartz. Fair sorting and a skewness of about 0.9 as well as majority of subangular to subrounded, well polished sandgrains indicate that the sand has been deposited in a fluvial system. Additional information provided studies of the grain-morphology using a Scanning Electron Microscope (it was carried out by Dr. Igel, Mayence). They also gave evidence that the *gezirasand* is mainly a fluvial deposit, but there are some clues that it was redeposited by wind.

In the course of the excavation carried out by the German Archaeological Institute Cairo at Buto several cuts were dug down to the surface of the *gezira*. They gave an insight into the upper stratum of the sand body. It became evident that the top of the *gezira* is highly disturbed by bioturbation and therefore no sedimentary structures are visible. However, it was found that below the sand surface the soil profile of a cambisol type had developed before the place was occupied by man. Formation of this paleosol presumes adequate climatic condi-

tions with sufficient rainfall and it indicates that the mound was covered by more or less dense vegetation.

A lot of drillings gave evidence that the *gezirasand* at and around Tell el-Fara'in as well as adjacent fine grained deposits (Fig. 2e) and the peat overlie a sediment sequence, which obviously differs in composition and color from the sediments above (Fig. 2a - f). The surface of this sequence was recorded at about –4 m a.m.s.l. The sediments mainly consist of stiff mottled clay, silt, fine grained micaceous sand or even medium to coarse sand. They are chiefly of light greenish-grey or light brown colour. These non-marine facies are complex not only in their vertical but also in their horizontal succession.

The characteristic stratigraphic unit is usually capped by a thin loamy and often highly calcareous layer. The nodular or poorly consolidated accumulations of $CaCO_3$ are typical for a calcic soil horizon which frequently develops near to the surface under semi-arid conditions due to precipitation of calcium carbonate by descending water. Two samples taken from this horizon at Buto and about 2 km southwest of Tell el-Fara'in yielded radiocarbon-ages of 13,000 ± 600 B.P. (HD 12511 - 11987) and 14,315 ± 285 B.P. (HD 12510 - 11973) (these dates were provided by the Institut für Umweltphysik, Universität Heidelberg, FRG. They are corrected to 85% of the recent C-14-activity). As C-14-dates of soil carbonates are rather uncertain because of possible contamination, these ages can only be regarded as an approximation for the development of the paleosol. Nevertheless the calcareous layer indicates that during the period of soil formation an extensive area must have been free from inundation caused by the annual Nile flood, before the overlying sediments were accumulated.

Drillings carried out about 4 km southwest of Buto led to the detection of a distinctive cultural layer (Fig. 2f) close to the villages of el-Qerdahi East and West (Wunderlich *et al.* 1989). It provided further valuable information not only on the sedimentological but also on the cultural history of the study area. Analysis of the cultural debris revealed that the typology of pottery and lithic material corresponds exclusively to that of the prehistoric Buto-Maadi culture (Wunderlich *et al.* 1989; Schmidt, this volume). The base of the characteristic layer was localized in depths of –0.8 to –1.9 m a.m.s.l. but occasionally sediments interspersed with cultural debris were recorded down to –2.4 m a.m.s.l. The maximum thickness of the horizon runs up to 1.5 m. The sharply confined layer is covered by very dark grey or brownish grey clay and silt and also at its base fine grained but light colored sediments were found. In some borings the latter are interrupted by a highly calcareous horizon at about –2.5 m a.m.s.l. The carbonates were radiocarbon dated to 7,360 ± 65 B.P. (HD 11561 - 11204). These dates were provided by the Institut für Umweltphysik, Universität Heidelberg, FRG. They are corrected to 85% of the recent C-14-activity. Below a depth of –3 to –3.5 m a.m.s.l. fine micaceous sand follows.

The level of the prehistoric horizon corresponds well with the findings at and close to Buto (von der Way 1985: 271; 1988). However, it is remarkable that at el-Qerdahi no Early Dynastic or later material was found. Furthermore it is an important fact that during the 4th millennium B.C. settlement was obviously not restricted to elevated *geziras*.

A great number of results from the fieldwork as well as the interpretation of maps, aerial photographs and satellite images allow us to model the Late Pleistocene and Holocene evolution of the area around Tell el-Fara'in. This model has also to consider the geology, palaeohydrology, palaeoclimatology and cultural history of the entire drainage basin of the Nile including the Delta itself, and the submarine Nile cone. The main features of the model are as follows.

Assuming that the two radiocarbon-ages of the calcic horizon at and close to Buto are correct, the sediments below this layer must have been deposited during the (Late?) Pleistocene. They are possibly identical with the "fine Nilotic sands" described by Butzer (1975: 1044) who correlates them with the Masmas and Gebel es-Silsila formation of Upper Egypt. During the major Wurm regression at about 18,000 B.P. these sediments were partly eroded. The vigorous incision concentrated on channels outside the working area. When sea level rose again, sediments were first accumulated in those deeply incised channels. Simultaneously, on the higher elevated areas a soil with a calcic horizon developed.

Later on, the landsurface was covered by the *gezirasand* but also by the peat to the north and the dark Nile mud further south. These different facies, however, are not contemporary. It can be supposed that the *gezirasand* was deposited first. The sand originated from an abandoned channel of a highly competent distributary, which had run to the west of Buto in a north-westward direction. During a mid-Holocene arid phase (Nicholson and Flohn 1980: 324) or even earlier the channel deposits were redeposited by wind, forming large dunes. Thus the *gezira* below the ruins of ancient Buto is not comparable with the *geziras* and "turtlebacks" of the eastern Delta. There, according to Butzer (1975) and others, the sand ridges are remnants of Pleistocene sand deposits, which were eroded during the last glacial maximum.

Reduced sedimentation as well as continuous rising of the sea level after the last Pleistocene regression and to some extent the downward trend of the Delta plain allowed for the southward advance of the lagoon- and marsh-belt close to the coast. Its southernmost position (Fig. 1) was reached shortly after 6,000 B.P. A decrease in sea-level rise, as supposed by many authors (Kidson 1986), enhanced by increasing accumulation of the fine grained Nile mud north of Tell el-Fara'in, caused a northward shift of the area of peat formation during the Neolithic wet phase. This was the period when a soil developed on top of the *gezira* and the sand was stabilized by more or less dense vegetation.

During the 4th millennium B.C. the increasing floodplain as well as the level of the annual Nile floods had not reached a level of –2.5 m a.m.s.l. Thus not only at Buto but also at el-Qerdahi and probably at different other places within the research area, Predynastic people found appropriate places for settlement. However, rising of the floodplain coupled with an increasing level of the Nile flood caused that the occupation of the site at el-Qerdahi ended prior to the Early Dynastic period. In contrast to this at Buto the high elevation of the *gezira* allowed for continuous settlement.

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