SOME REMARKS ON INTERRELATING ENVIRONMENTAL CHANGES AND ECOLOGICAL, SOCIO-ECONOMIC PROBLEMS IN THE GRADUAL DEVELOPMENT OF THE EARLY EGYPTIAN INUNDATION CULTURE

"When the Nile overflows, the whole country is converted into a sea, and the towns, which alone remain above water, look like the islands of the Aegean."

Herodot

In memory of J.J. Clère, M. Malinine, G. Posener and J. Vandier.

par Michael ATZLER

Résumé

La culture égyptienne de l’inondation constitue un type spécial de ce qu’on appelle les cultures hydrauliques. Des changements écologiques et environnementaux de grande portée - voire radicaux - dus à certaines conditions spécifiques et répétées, menèrent vers la fin du Pléistocène et le début de l’Holocène à des développements culturels qui, peu à peu, aboutirent aussi à des changements socio-économiques. Ce fait n’est pas exclusif à la vallée du Nil. Le développement de la civilisation égyptienne et d’autres cultures n’est devenu possible qu’après l’existence d’une composante agricole permettant une production suffisante de denrées alimentaires. Ainsi l’économie rurale et la production de denrées alimentaires formèrent une nouvelle base d’existence avec la conséquence logique d’une accumulation des biens, et, par là, une extension et une intensification de l’inégalité économique et sociale. Ce fait a rendu possible la formation de nouvelles relations socio-économiques. Mais la formation des premières hautes cultures ne s’explique pas seulement par une intensification de la composante agricole à l’intérieur d’économies complexes; d’autres facteurs doivent avoir eu leur influence. La nécessité d’une coopération permanente, guidée et intensive, d’un nombre représentatif de membres d’une société à de grandes entreprises constitue un des critères décisifs pour la formation des premières grandes civilisations, pas seulement dans la vallée du Nil.

Abstract

The Egyptian inundation culture was a special kind of the so-called hydraulic cultures. Gradual cultural developments with socio-economic changes took place under the special conditions of repeated far-reaching and drastic environmental and ecological changes during late Pleistocene and early Holocene times, not only in the Nile valley. The development of the Egyptian and other early high civilizations was only possible after the development of agriculture providing a sufficient surplus in food. Agriculture and the production of (staple) food represented a new existence basis with effects on the accumulation of goods and the extension and intensification of economic and social inequality, therewith opening the possibility of new socio-economic relationships. But the development of the early high civilizations cannot be explained solely through the intensification of the agricultural component within a complex economy, other factors must have entered into play. The necessity of a permanent, supervised, intensive cooperation among a representative number of members within a society in great socially relevant enterprises formed one decisive criterium for the development of early high civilizations, not only in Egypt.
The Egyptian inundation culture uses the natural inundation of the Nile on its relatively narrow floodplain, and in its developed stage, dams, canals, basins etc. The Egyptian inundation culture was, as such, "technically" different from, for instance, the Mesopotamian artificial canal irrigation culture, which used water from the low river level in summer, well after the flood season, and distributed it with the help of a sophisticated and extensive canal system over large areas even further removed from the river bed. Several early high civilizations developed in regions where food production was directly dependent upon permanent, supervised, intensive social cooperation, for instance in hydraulic enterprises.

What took shape early on in Egypt was not only a high civilization, but also an extended empire which already encompassed the whole highly productive ecological area of the northern region of the river Nile (in contrast, for instance, to early developments in Mesopotamia). This suggests an early connection between ecological, economic, and political factors in this developing process. But numerous questions concerning this development are disputed, many due to the fact that the material available renders it often difficult to provide definite proof in detail. Therefore, in the present state of our knowledge, any consideration of these early developments can only be a survey of our ignorance and a reasoned essay in speculation from a broader context, and a paper of this length cannot claim to be exhaustive.

The early Egyptian high civilization is, because of the specific environmental conditions in the Nile valley, an inundation culture. Therefore, the resources of the limited/circumscribed floodplains of the Nile-levee-river-system formed the economic basis of this high civilization. These comparatively narrow floodplains are marked by natural levees, rising several meters above the seasonally inundated alluvial plains. The floodplains normally have a quarter-egg-shape with the lowest areas distant from the river; there are, of course, local topographical differences.

Some of the principle questions are necessarily: Did working under the specific ecological and economic conditions of the Egyptian inundation landscape influence the development of the early high civilization in the Nile valley? Did, therefore, specific ecological and environmental conditions influence the development of the socio-economic relationships?

The answer to these questions should already be found in the Nile valley itself, since there exist considerable ecological and environmental differences between the Nile delta and the connecting Nile valley which differently influenced the separate developments in the two areas.

The typical Egyptian inundation economy is dependent upon the levee-river-regime of the Nile and its floodings. Therefore, it depends on environmental relationships in the different catchment areas of the Nile-system between about 3 degrees south and 15 degrees north.


2 See for the problem: "Der Ägyptologe andererseits, der zu einem wesentlichen Teil des Quellenmaterials, besonders zu den Textzeugnissen, allein den vollen Zugang hat, stellt sich gewöhnlich die Frage nach einem

Kausalzusammenhang zwischen Bewässerung und Entstehung bestimmter Eigenarten der altägyptischen Hochkultur im angegebenen Sinn überhaupt nicht" (Schenkel: 1978,13).


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After the floodwater recedes, an irrigated and naturally fertilized post-flood landscape offers optimal possibilities for utilization. 6

Several processes took place during the last 30,000 years:
1/ intensification of resource utilization;
2/ plant (habitat) manipulation and the gradual development of agriculture and food production;
3/ gradual development of complex societies.

Therefore, the development of the early high civilizations can only be understood if we consider this long lasting process and not only "several 100 years before 3000 B.C". It should also be noted, that in different areas a slowly intensified agricultural component and food production developed, but this led only in some particular areas to the formation of early high civilizations. Therefore, also other factors must have entered into play. In spite of all the yet unanswered questions over exogenous and endogenous factors, developments, influences, etc. the gradual formation of the Egyptian high civilization formed, like other early high civilizations, an early "high time" in the far-reaching process of an intensive cultural development with socio-economic changes from late Pleistocene times onward. 7 Contributing to this development was also the interrelating effect of the exchange and adoption of new experiences, practices etc. 8

This cultural development process with its socio-economic changes took place under the conditions of far-reaching and drastic environmental and ecological changes during late Pleistocene and early Holocene times. Therefore, there existed during the late Pleistocene and early Holocene a complex system of differing environmental, ecological, and socio-economic developments which had, at least in part, mutual influence. These problems can hardly be approached in any other way than through an "interrelating representation", as problematic as such attempts may be in the light of modern scientific work and the flood of relevant literature. At the same time, the drastic environmental changes involved here pose the much disputed question regarding the influence of environmental changes on socio-economic developments 9. Since the late Pleistocene, the changing environmental and ecological relationships coincided with culturally better developed and more numerous human groups, which now had greater influence than ever before on determining further cultural developments 10.

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The development during late Pleistocene and early Holocene times was also influenced by changes in the orbital elements. Any change in the orbital elements that fix the irradiation patterns also causes climatic change. The control factor prevailing at higher latitudes is the obliquity, and for lower latitudes the eccentricity and precession dates. These changes in the orbital elements have, interconnected with atmosphere, hydrosphere, cryosphere, lithosphere, biomass, albedo and other factors, caused far-reaching environmental changes for several 100,000 years. The environmental changes could be influenced additionally by zonal and local events. In this paper the environmental changes of the last >30,000 years, which also determined the catchment areas of the Nile-system, are particularly relevant. The changing orbital patterns can be relatively precisely calculated and provide a comparatively certain time scale, independent of all the problems of “redatings” in radiometric and other technical dating techniques.

Moreover, there are in several places of the Nile valley multi-layered deposits from late Pleistocene and early Holocene times, which mirror the overlapping environmental changes.

The episodes of Nile alluviation and downcutting certainly have a climatic status and are, therefore, also linked with environmental developments through orbital changes, despite the complexity involved in these problems (see above), and the particular complexity of variables affecting the river system of the Nile. In addition, there are detailed stratigraphic studies of remarkable sedimentary sequences in the Nile valley from Pleistocene and Holocene times including numerous fossil as well as varied archaeological remains which can clarify the lithostratigraphical and chronological complexity and help to reconstruct the environments and physical conditions. The available time scale of orbital changes (see above) together with archaeological, radiometric, and other technical dating of materials provides, in spite of the now often disputed results of “dating techniques” and “redating” (see below), a certain chronological control and an opportunity to place the different materials in an at least relative chronological order.

Therefore, within the Nile valley we have in late Pleistocene and early Holocene times a complexity of different materials, which mirror, at least in fragments, orbital and environmental changes as well as ecological and socio-economic developments. The following phases in the region of the Nile and its catchment areas in the last >30,000 years are to be distinguished:

- ecologically favorable phases at about >and< 32,000 B.P. and >and< 10,000 B.P.
- ecologically problematic times during the cold phase, about >and< 20,000 B.P. and the following post-cold phase until about <13,000 B.P.

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Phase >and< 32,000 B.P.: 17

The seasonal cycle of the increasing amount of summer insolation in the low latitudes of the northern hemisphere and the decrease of insolation in winter caused rising precipitation over low latitude north-east Africa and, therefore, also an increase in the Nile-system. Isotopic data from Sahara groundwater and enlarged lake levels in tropical and extratropical Africa indicate a moister period. This formed in lower latitudes the last “pluvial” before the glacial phase 18.

The expanded Nile-system with its stronger Ethiopian floods on an enlarged floodplain with ponded floodplain margins and accelerated wadi activity caused better environmental and ecological conditions in the Nile valley 19.

From the phase >and< 32,000 B.P. material, partly with cultural debris, is preserved for instance in Khor Adindan, Ballana, Wadi Or, Arminna, Khor Hamra, Wadi Kubbaniya, Kom Ombo etc. Pond areas were used by the inhabitants. The greater part of the material is today lost or buried because of material transport, which include all possible cultural remains. The material shows nilotic, aeolian, and wadi activity. This rest-material is directly overlaid by material of the cold-phase and post-cold phase 20.

This period of better environmental and ecological conditions in the Nile valley was followed, gradually and temporarily overlapping, by the increasingly deteriorating ecological conditions of the cold-post-cold phases. With the commencement of these phases the ecological difficulties for the population started (again).

Cold-post-cold phases: 21

The cold phase >and< 20,000 B.P., with its high point at about 18,000 B.P., was determined (for further factors see above) by corresponding orbit constellations, which had a far-reaching effect, more intensive in higher latitudes than in lower ones 22. The effects of the cold phase reached the different areas at different times and with varying intensity 23. During the time of greatest ice volume, world sea-level was about +/-100m lower than today. Mediterranean sea-level was about +/-100-120m lower and the Nile-delta lay deeper and reached farther out into the Mediterranean sea than today 24. This lowering of the sea-level had an influence on the denudation basis of the Nile. This had no impact on the gradient and the floodplain of the Nile in Nubia and Upper Egypt, but further downstream, and is therefore also responsible for the fact that most of the material of the cold and the post-cold phases in the more northern parts of Egypt are

17 To this phase belongs, at least partly, for example, material from the formations called Korosko Upper Member, Neonile Beta, cf. Butzer-Hansen: 1968; Wendorf: 1968; Butzer in Williams-Faure: 1980; Said: 1990, 1993.


19 Even if not to the same degree as during the phase >and< 10,000 B.P., cf. Atzler: 1986.


21 To these phases belongs, for instance, also material from the formations called: Ballana, Sahaba, Masmas, Malki Member, Ineiba Lower Formation, Darau Member, Gebel Silsila Formation, Neonile Gamma, cf. Butzer-Hansen: 1968; Wendorf: 1968; Butzer in Williams-Faure: 1980; Said: 1990, 1993.


today buried under later materials or otherwise lost. The lowering of the sea-level caused an increase in continentality which was also responsible for general aridity. Global moisture transport diminished due to widespread lower sea-surface temperatures. The mean glacial ITCZ lay further south than at present. The midlatitude westerlies have been shifted equatorward several degrees latitudinally relative to today and caused precipitation in north African (especially mountainous) regions. The south-west monsoon had been largely suppressed, which also caused dryer conditions in far-reaching parts of Africa. In the Ethiopian highlands snowfall and glaciation reduced the amount of vegetational cover. This caused extensive erosion of material during thawing and rains and, therefore, an increase in the amount of debris and also a coarser sediment load in the runoff and in the river-beds. These sediments were also deposited in a Nile valley already filled to a certain degree with accumulated sediments from the phase >and< 32,000 B.P. (see above), and so began a further slow filling of the Nile valley. The precipitation in the catchment area of the White Nile was reduced at the same time. This caused a reduced low-water level in the Nile and, therefore, also a reduced material exchange. The differences between high-flood and low-water levels were pronounced. But the remains of numerous fish, hippo, cattle, hartebeest, and cultural material in the Upper Egyptian Nile valley and Nubia show that even this further reduced Nile-system functioned the whole year-round at least to the extent that the river never became completely dry and that surficial water was always available.

Material from the cold-post-cold phases is preserved in the Nile valley, but the remaining material is only a fraction of the material once existing, the greater part having been lost. There are now several areas in the Nile valley with signs of intensified use of resources, grinding and sickle stones, for example at:

Tushka

Site 8905: The site consists of more than a hundred distinct hearth areas. Several hearths may have been used at the same time, but the numerous hearths represent the repeated use of the site by small groups. The sites are located next to the pond area, one of the ponds seems to have been "manipulated" by the people. This area was often inundated, and therefore, occupation was "normally" only seasonally possible.

These intensively inundated ponds and pond-areas, which hitherto have generally been ignored, deserve special attention because they

27 It is often suggested that the White Nile even stopped flowing into the Egyptian Nile, cf. for the problem Williams-Adamson: 1974; Williams-Faure: 1980; Atzler: 1985.


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provided important resource areas for hunter-gatherer and later became of decisive importance in the gradual development of an agricultural component in the complex economy 31.

The stone tools were predominantly microlithic. The numerous fish remains 32 show that fishing belonged to the economic activities on the sites. Several hearths also contained numerous broken mammal bone fragments, particularly from Bos primigenius, but also from gazelle, hartebeest, hippo, and hyena. Numerous grinding stones, showing traces of extensive wear 33, and lunates 34, several with lustrous edges 35, were found together with a large Gramineae, perhaps a species of Triticum, and flag smut fungus, a disease of wheats 36. Sample WSU-315 on charcoal from Locality C yielded a date of 12,550 B.C. (14,500 B.P. +/-300) 37. Because the Sahaba formation is "closely related to the occupation at site 8905" 38, this material should belong to the later part of the post-cold phase which ended about <13,000 B.P.

Therefore, we find sites near pond areas at Tushka which date from the later part of the post-cold phase. They show hunting and fishing activities, as usual in pond areas. But here were also found numerous grinding stones, their grinding surfaces heavily worn and resharpened, lunates with lustrous edges, i.e. sickle blades with glossy sheen, a species of large Gramineae possibly Triticum (wheat or a progenitor, wheat-like Gramineae), and a type of fungus that grows on wheat. Hence, also the processing of cereal-like Gramineae seems to have had economic importance at Tushka 39.

Wadi Kubbaniya

Site E-78-2, A, B: Areas A and B represent two different concentrations of lithic artifacts, about 10m apart next to the pond area. The artifact distribution of area A was about 35m x 30m and contained several hearths, two bone concentrations, and a cache of chert cores and debitage, ca. 1m in diameter. Occupation seems to have been repeated. Three large lower grinding stones and 3 hand stones were found, also mammal bones (hartebeest, gazelle, wild cattle), fish, birds, and Unio 40. In area B several cultural horizons within thin lenses of silt with lithic artifacts, burned areas, and fossil bones were found. Three lower grinding stones and 3

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31 Cf. Atzler: 1985, see also below.

32 Mostly skull and foreward parts of the skeleton, especially at Locality D, Wendendorf: 1968, 933.

33 Locality A: 2 hand stones; B: 7; C: 1 milling stone; D: 1 milling stone, 5 hand stones; E: 2 milling stones, 1 hand stone; F: 1 hand stone, 1 milling stone.

34 Locality A: 8; B: 10; C: 77; D: 220; E: 41; F: 84; G: 28.

35 "The lustrous edged pieces... The pattern of wear, together with occasional traces of adhesive still evident, suggest that they were mounted by inserting the thick edge at a slight angle into some sort of shaft (probably of wood) and held in place with pitch or other adhesive", Wendendorf-Schild in Harlan-deWet-Stemler: 1976, 276-277.


37 **Several dates for the Qadan were obtained from Tushka, including 14,500 B.P. +/-300 years (WSU-315) and 2350 B.P. +/-300 years (WSU-415a), both on charcoal. The first may be too old, and the second is obviously much too recent"**, Wendendorf-Schild in Wendendorf-Schild-Close: 1989, 815.

38 Wendendorf: 1968, 940.

39 "One of the most interesting components of all three lithic groups at Site 8905 is the grinding stones and lunates with lustrous edges which occur at several localities in unquestionable association both with the cemented inter-dune pond deposits... These artifacts indicate an economic activity... and one which was ultimately of the greatest significance to man in the development of food production", Wendendorf: 1968, 941, 864-5; cf. also Harris in Reed: 1977.

40 Cf. Kobusiewicz-Banks in Wendendorf-Schild-Close: 1980, 55-75, fig. 4.2.
hand stones were recovered. The fauna consisted mostly of fish, with rare mammal remains. The hearths gave 2 radiocarbon dates of 19,100 B.P. +/-2130 (SMU-1401) and 16,540 B.P. +/-1160 (SMU-1400) 41.

Site E-78-3: The dense irregular surficial scatter had a diameter of about 35m with several deflated hearths. There were also several clusters of bones and one of shells, especially fish bones were numerous (130,280 pieces). The surface around the site was littered with fossilized remains of roots and trunks of Tamarisk trees and roots and stems of large grasses (Phragmites). 27 upper and lower grinding stones were found on the surface. Test excavations showed artifacts, bones, charcoal, and several overlaying cultural layers. In the excavation more hand and lower grinding stones (about 67) were also recovered 42. Many of the grinding stones show signs of reshaping and resharpening. The site was located in the vicinity of the pond-area, often inundated during the peak of the flood 43 and reoccupied several times, maybe already a short time before the peak of the flood, but especially after the recession of the floodwaters. A majority of identifiable bones are of fish 44 but Bos, hartebeest, gazelle, hare, and bird (water birds, now winter visitors) were also present. The identified edible plant remains are mostly tubers of the purple nut-grass, Cyperus rotundus, tubers of club-rush, Scirpus, and fragments of dom palm, Hyphaene thebaica. Cyperus tubers would have begun to grow after the flood began to recede, ready for harvesting by early October. Tuber production would have continued for months, but by December or January the tubers would start to mature and to need more processing, for instance with grinding stones, before consumption. Thus the edible remains of animals and plants suggest primary occupation after the flood began to recede 45. Several radiocarbon dates are available: between about 18,700 and 17,400 B.P. 46.

Site E-78-4: On an area of about 30m in diameter were found lithic material, several caches of raw material, numerous hearths, bones, and grinding implements. At the 1978 season at least 16 lower grinding stones, 22 hand stones, several purposes”, Roubet in Wendorf-Schild-Close: 1989, 473, 481, 482.

41 “The large standard deviations limit the usefulness of these dates, but it may be noted that the standard errors overlap between 17,000 and 17,700 B.P., which is the approximate time range indicated by the stratigraphic evidence”, Wendorf in Wendorf-Schild-Close: 1989, 527, 524-535; cf. Hietala in Wendorf-Schild-Close: 1989, 749, Table 42.4.

42 Layers 18+: 4 fragments of hand stones and 3 fragments of lower grinding stones; Layers 20-22: 2 complete hand stones, 5 fragments of hand stones, 1 pestle, 1 lower grinding stone, 11 fragments from lower grinding stones, a fragment of a mortar, and 18 fragments of unclassifiable grinding stones; Layers 22-23: 2 fragments of possible hand stones, 2 fragments of lower grinding stones, 8 fragments of unclassifiable grinding stones; Layers 23-24: 1 fragment of a probable hand stone, a fragment of a hand stone, 10 fragments of unclassifiable grinding stones. "The Kubbaniyan occupations of Site E-78-3... yielded 27 lower grinding stones and 28 handstones and pounders" (24 handstones... 13 pounders, 2 chisels, both combined with pounders). "...Almost all of them were used for only one purpose -grinding- but two of them seem to have been multifunctional: piece no. 4 apparently was used as an anvil or as a slab for cutting, and piece no. 6 seems to have been both a lower grinding stone and a handstone... If we consider the morphology of the passive (lower) grinding stones... then they must have been used for..."


44 A majority of the catfish are of medium size and may have been caught when the flood was receding.


and 2 pestles were found. Season 1981-1984: 2 pestles, 13 hand stones, 3 fragments of lower grinding stones were found. Test excavations showed distinct cultural layers and lenses which may represent different short-term occupations. There were also several fishhooks, gorges, and 31 ostrich eggshell beads. Next to a fire place two large mortars were situated. At the site fish, mammal bones (hippo, wild cattle, hartebeest, gazelle), bird (today winter visitors), and shellfish were found. The site was located in the vicinity of the pond-area, often inundated during the peak of the flood, and reoccupied several times, perhaps already a short time before the peak of the flood, but especially after the recession of the floodwaters. The available dates are between 19,060 (AA-224A) and 17,100 (SMU-623) B.P. Plant remains from the excavation include Acacia, Tamarisk, Salsola baryosma. The deposits of the site contained also a mat of plant casts and tree trunks. The edible plants consist of tubers of purple nut grass (Cyperus), fruit mesocarp fragments of the dom palm (Hyphaene), and an immature receptacle of water lily (Nymphaeaceae).

From E-78-4 Horizon 1 several cereal grains and an inflorescence fragment were recovered, the majority (apparently) from the buried hearth in M/4 around 0,40-0,60m under the surface. There were apparently 4 or 5 grains found. These discoveries "challenged some of our previous assumptions" and affect fundamental questions of resource-use intensification, plant (habitat) manipulation, and the early development of an agricultural component in the Nile valley.

"This discovery, however, should come as no surprise to those who are familiar with recent work on the prehistory of the Nile Valley".

47 The number of grinding stones actually found on the sites was apparently even higher than what was published in the reports: "Site E-78-3 and E-78-4, for instance, contained a number of milling-stone and handstone fragments that were not recorded. Milling-stone fragments were generally ignored because complete examples of this type were quite common", Banks in Wendorf-Schild-Close: 1980, 240.

48 "Some of the beads show traces of red staining, and numerous pieces of ochre have also been found, some of them associated with the hearths. Ochre occurs as an allochthonous element in the local Nubia Sandstone, and some of the grinding stones may also have been used for grinding ochre, as is suggested by the presence of red staining on a few of them", Wieckowska in Wendorf-Schild-Close: 1989, 586.

49 "Study of the microenvironment setting and lithology of the site suggests that the occupations were seasonal and that two major factors determined the patterning: the Nile flood, which occurred in autumn, and the location of the site near a seasonal body of water...The birds also indicate that the camp was used mainly during the late autumn and post-flood periods, and perhaps in winter", Wieckowska in Wendorf-Schild-Close: 1989, 585.

50 "The radiocarbon dates place the multiple occupations of Site E-78-4 between about 17,900 (excluding AA-224A) and 17,100 B.P., although the large standard deviations of most of the dates make the extreme measurements somewhat unreliable", Wieckowska in Wendorf-Schild-Close: 1989, 583.


52 Cf. Wieckowska-Banks in Wendorf-Schild-Close: 1980, 121-125, fig. 6.2, 6.5, 6.6; Wendorf-Schild in Krzyzaniak-Kobusiewicz: 1984, 121-123, fig. 4, 5; Wendorf-Schild-Close: 1989, 6; but cf. also the remarkable statement of Stemler-Falk in Krzyzaniak-Kobusiewicz: 1984, 135: "Since the sample in which the grains were found was a composite we do not know exactly where in the depositional layers of site 4 the plant material occurred".


The majority of these grains were found 0.40-0.60 m deep in an archaeological context with no evidence of contamination or disturbance by later materials, the overlying sediments and bedding lines were unbroken.

Several radiocarbon dates are available for the material from the archaeological context; two dates from the hearth in Horizon 1, M/4: 17,670 B.P. +/- 250 years (SMU-616) on charcoal; 17,380 B.P. +/- 1,340 years (SMU-617) on humates extracted from the SMU-616 sample. A date "from randomly collected charcoal fragments found 20-30 cm below Horizon 1 is 17,100 B.P. +/- 540 years (SMU-623)."

The radiometric dating of the cereal grains did not provide the expected results:

"Since the above was written there have been important new developments concerning the cereals found at Wadi Kubbaniya, which strongly indicate that they were not associated with the Late Paleolithic occupations, but are more recent in age. This conclusion is based on the age-determinations of the actual grains, using the recently developed linear accelerator radiocarbon counter at the University of Arizona in Tucson. Four of the grains found in 1978, and two others found in 1981 were dated, together with three pieces of wood charcoal. The cereals dated as follows: 1. 820 B.P. +/- 500 years (C-299), 2. 1090 B.P. +/- 500 years (C-298), 3. 2400 +/- 0.05x modern (C-448A), 4. 2670 B.P. +/- 220 years (C-447), 5. 1300 +/- 0.05x modern (C-449), 6. 4850 B.P. +/- 150 years (C-450A). The wood charcoal dated: 7. 17,450 B.P. +/- 100 years (C-297), 8. 18,020 B.P. +/- 525 years (C-450B), 9. 19,060 B.P. +/- 1000 years (C-446A). The postmodern dates of two of the seeds and the wide range in ages of the others indicate contamination by radioactive carbon-14 tracers. Analysis of the residue of the glue used to mount the seeds indicates that this is the source of the contamination: it gave a radiocarbon reading of 40x modern."

But the "glue contamination" of these grains apparently took place before the first radiometric dating, therefore, an accurate radiometric dating of these grains seems never to have been possible.


57 "The recovery of three grains of barley... and an inflorescence fragment and grain of einkorn wheat... raises a number of fundamental questions... First, let us state there can be no question concerning the association of the grains with the occupation at Site E-78-4. The botanical samples were collected by hand from the exposed face of the stratigraphic trench at that site, and most (not all?) of the pieces came from in or near the buried hearth exposed in the trench. There is no evidence of contamination by later materials and the nature of the deposits is such that contamination would be easily detected if it had occurred. Neither intrusive pits nor animal-burrows were observed", Wendorf-Schild-Close: 1980, 272; cf. also Wendorf-Schild in Krzyzaniak-Kobusiewicz: 1984, 117-123; Wendorf-Schild-Close: 1980: 121-125, fig. 6, 5, 148-9, 271-276, 1989, 6.

58 Or "from just below the surface", Wendorf-Schild in Krzyzaniak-Kobusiewicz: 1984, 123.


60 Wendorf-Schild in Krzyzaniak-Kobusiewicz: 1984, 126; "Two other barley seeds, both found in 1981, have been analyzed using electron spin resonance spectroscopy, a newly developed technique to determine the highest temperature to which an object has been subjected. These analyses indicated a temperature of only some 150°C for the Kubbaniya specimens, which is too low to cause the charring required if the seeds were to survive through millennia of seasonal flooding. The fact that they had not been charred suggested that these two barley seeds were not truly associated with the Late Paleolithic site where we found them", Wendorf-Schild in Krzyzaniak-Kobusiewicz: 1984, 126; cf. also Wendorf-Schild-Close: 1986, 1, 1989, 8, Table 28.13: Level a, hearth: 239% +/- 5% modern, AA-226, 75; level a, hearth: 133% +/- 5% modern, AA-227, 75; level a, hearth: 2670 B.P. +/- 250, AA-225, 75; level a: 4850 B.P. +/- 200, AA-228, 75.

61 What about a "specimen No. 6" which had remained with Dr. Hadidi in Cairo? Wendorf-Schild in Krzyzaniak-Kobusiewicz: 1984, 126. But in any case, these grains show after the various "travels and treatments" now a rather curious
There are now a multitude of different reports and statements about Wadi Kubbaniya. The excavators, corresponding to the results of radiometric and other new technical dating techniques are finally convinced that all of the "grains" they found do not belong to the cultural material in which they were recovered: "The work at Wadi Kubbaniya has dramatically enhanced our knowledge of the Late Palaeolithic in the Nile Valley. The problem of the precocious early use of cereals and other Near Eastern plants has been resolved, and the Nilotic Late Palaeolithic may now be seen as not very different from contemporary developments in adjacent areas" 62.

At Site E-78-4 were recovered: numerous upper ("handstones") and lower ("grinding slabs") grinding stones and mortars used for the processing of potentially different materials 63. There were not numerous sickles, but at Level f/g a retouched edge with "sickle sheen" on both faces 64 was found. Sickle sheen is produced by repeated use in cutting grain or similar flexible plants containing silicia 65.

The reports on the archaeological context and stratigraphy of the finding of at least some of the cereal grains seem to be unequivocal. If the majority of the cereal grains from Horizon 1 was found in connection with the buried hearth in M/4 the questions remains as to how "much younger, modern, post modern" grains could have got 0,40-0,60m beneath the surface in an archaeological context without evidence of contamination and later disturbance? Therefore, a modest question, sine ira et studio, in memory of my teacher in archaeology, the late R. Heidenreich 66, isn't that which the excavators proposed as a "final decision" in fact in favor of radiometric dating techniques? But an exact radiometric dating of these 4 or 5 grains was apparently never possible because of "glue contamination" (see above for the problem).

Until now, there exists only an apparently unequivocal archaeological context and stratigraphy of the finding of (some of) the grains and, therefore, also the possibility that cereal grains may have been used in Wadi Kubbaniya about 20,000 B.P., even if there is no "final proof" because "glue contamination" prevented the radiometric dating of the grains.

There is, hitherto, no "final proof" for these problems in Wadi Kubbaniya, hence, we could simply remember a statement of the late H.Kees (transmitted by the late S.Morenz): "Überlassen wir besser der Zukunft die definitive Lösung der Fragen, über die wir heute nur zu streiten vermächten, es vermeidet viel Ungemach". I am not trying here to convince anyone, one can only convince oneself 67.

63 The chemical analysis of "some" of the grinding stones, cf. Jones in Wendorf-Schild-Close: 1989, 260-266. shows that material high in cellulosis and low in protein was processed, these characteristics do not apply to seeds, but fit the tubers found; some grinding stones were also used for pigment processing, see above; for the problems of grinding stones see also below.
65 Cf. Curwen: 1935; Semenov: 1964; see also below.
66 And not simply because I belong to those people who based their publications on the unequivocal archaeological reports and earlier statements about Wadi Kubbaniya; cf. also for instance Fagan: 1983; Stemler-Falk in Krzyzaniak-Kobusiewicz: 1984.
The use of Gramineae for food in Wadi Kubbaniya should theoretically be no surprise because already for early hominids, much older than the people from Wadi Kubbaniya, one of the sources of food seems to have been the hard seeds of Gramineae of which none were found in the cultural debris over thousands of years. Furthermore, in the Levant, collection of barley was already being practiced around 19,000 B.P. 70:

"The recent discovery of numerous carbonized plant remains in Ohalo II, a 19,000 B.P. water-logged site in the Sea of Galilee... reinforces the interpretation (based on scanty remains, such as the 30,000 year old grain in Nahal Oren, a few pieces of wild barley in the Natufian at Hayonim Cave, etc.) that cereals were indeed present in the Levant. Statements based on the paucity or lack of plant remains due to problems of recovery and/or preservation are definitely misleading" 71.

Therefore, a possible human use of cereal grains in Wadi Kubbaniya +/-20,000 B.P. would not be different from contemporary cereal use in adjacent areas of the Levant, and wild barley could have been available in greater quantities in the more northern Nile valley and the delta at least during the cold phase (see below). Modern stands of wild barley were discovered by Hadidi in several wadis west of Alexandria 72.

Site E-78-7: There was no trace of occupation on the surface. The cultural debris was found in trenches. Trench 6 and 9 yielded numerous artifacts, among them also fragmentary hand-stones 73. The site was situated next to the pond area. The yellow sandy silt (= layer 11) is believed to have formed in seasonal ponds 74. The buried artifact scatter was very intensive. From the trenches also faunal remains (ca. 1600 pieces) from hartebeest, wild cattle, bird, fish (104 bones of Clarias sp.), and gazelle were recovered. In trench 6 a date of 17,850 B.P. +/-200 (SMU-592) from small pieces of charcoal was found 75, a date from trench 8 gave: 17,130 B.P. +/-200 76.

Site E-78-10: The site was a deflated surface scatter, roughly triangular in shape, and next to the pond area. The surface was littered with fire-cracked rocks, artifacts, shells, bones and 3 hearths. Two intact and one broken hand stone were found 77. The excavators date the site about 12,500 B.P. 78.

73 "The possibility cannot be dismissed that milling-stones were present but undetected at Site E-78-7", Banks in Wendorf-Schild-Close: 1980, 226.

74 "It seems likely that the site could not have been occupied during the annual flood period, or for a considerable period thereafter, but once the water-table had fallen and the floodplain was dry, then it would have been available for use", Wendorf-Schild-Close: 1980, 153, 176.


78 "Stratigraphically, Site E-78-10 represents the latest Late Palaeolithic occupation of Wadi Kubbaniya", Wendorf-Schild-Close: 1980, 217, cf. also 226-227; "An extensive, but completely deflated, Qadan concentration, Site E-78-10" is to be dated "around 12,500 B.P.", Wendorf-Hill in Wendorf-Schild-Close: 1989, 695, 679-696.
Site E-81-1: The site, with dimensions of about 20m x 15m, consisted of an irregular oval cluster of lithic artifacts, fossil bones, fire-cracked rocks, and grinding stones. The site was located in the vicinity of the pond-area, often inundated during the peak of the flood 79, and reoccupied several times. The site yielded 8 large lower grinding stones, or fragments thereof, and 2 fragments of mortars 80 on the surface. Several fragments of lower grinding stones were also recovered from the excavation. Two hand stones, 10 fragments, and a pair of pestles were found on the surface, 2 hand stones were found during the excavation 81. The remains of fish (93.5%), birds (mostly water birds), and mammals (hartebeest, wild cattle, gazelle) were recovered. Several casts of roots and stems of the large reed Phragmites were found, also edible remains of purple nut-grass, Cyperus rotundus, club-rush, Scirpus, seeds of probable chamomiles, a Tribulus fruit, and a fern rhizome. Ten radiocarbon dates between 18,350 B.P. +/-290 (SMU-1463, charcoal) and 17,210 B.P. +/-160 (AA-2039, Cyperus tuber) are available 82.

Site E-81-3: The site, with dimensions of about 14m x 10m, consisted of a small oval surface scatter of lithic artifacts, fossil bones, 3 hearths, and 4 pits. Four distinct horizons were recovered, within lenses of silt and covered by aeolian sand. The site was located in the vicinity of the pond-area and reoccupied several times. The site yielded 17,395 lithic artifacts, three handstones 83, and a fragment of a possible milling stone. Fish and bird bones were also recovered. There are two radiocarbon dates: 18,120 B.P. +/- 670 years (SMU-1036, charcoal, pits G2-F2 and H2-H3), and 18,360 B.P. +/-790 years (SMU-1129, charcoal, cultural layer) 84.

Site E-81-4: The site, with dimensions of about 20m x 15m, consisted of an irregular oval cluster of lithic artifacts, fossil bones, and fire-cracked rock. The site was located in the vicinity of the pond-area. The remains of fish (99%), birds, and mammals were recovered. Several hearths were found. The site yielded 14,361 lithic artifacts, and also 4 fragments of hand stones and one milling stone. Two radiocarbon dates are available: 18,440 B.P. +/-690 (SMU-1131, charcoal, lower cultural layer), and 20,690 B.P. +/-280 (SMU-1037, charcoal, 0-20cm) 85.

Site E-81-5: The site was a small scatter of lithic artifacts with shells. Other artifacts and 3 lower grinding stones lay about 10-20m away. A stratigraphic trench (78/1) yielded a fragment of a hand stone. A date on Unio from sands of a beach is available: 12,430 B.P. +/-100 (SMU-1032) 86.

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81 “The grinding stones were presumably left at the site from one season of occupation until the next”, Close in Wendorf-Schild-Close: 1989, 517.

82 “The radiocarbon dates suggest a general date for the site of about 18,000 B.P.”, Close in Wendorf-Schild-Close: 1989, 522, 490-523.

83 One is stained red from possible pigment grinding.

84 “The conflicting dates have very large standard errors, and it seems likely that the true age of the Fakhurian-related sites (E-81-3, E-81-4, E-82-3) is between >21,000 and 19,500 B.P.” Wendorf-Schild-Close: 1986, 41-42; cf. also Banks in Wendorf-Schild-Close: 1989, 303-320; Wendorf-Schild in Wendorf-Schild-Close: 1989, 790.

85 “The first date is comparable with that from E-81-3... it is probably too young. The second is much older and is the oldest date for the Late Paleolithic in Wadi Kubbanyia”, Banks in Wendorf-Schild-Close: 1989, 334; See also n. 84; cf. also Banks in Wendorf-Schild-Close: 1989, 321-335; Wendorf-Schild in Wendorf-Schild-Close: 1986, 42-45, 1989, 790; Haas in Wendorf-Schild-Close: 1989, 276.

Site E-81-6: The site, with dimensions of about 17m in diameter, consisted of a long, roughly oval cluster of lithic artifacts and fossil bones. The site was located in the vicinity of the pond-area often inundated during the peak of the flood. The remains of gastropods, fish (several thousand), two pieces of ostrich eggshell, and one mammalian bone (probably hartebeest) were recovered. The site yielded also 4 hand stones and 4 milling stones. Four other milling stones were noted 20-40m south of the site. Several radiocarbon dates on charcoal from the excavations, between 20 and 30cm below the surface, are available: 18,010 B.P. +/-340 (SMU-1033, charcoal, 20-30cm; "which is regarded as too recent"), 19,340 B.P. +/-370 (SMU-1033, charcoal, 20-30cm).

Site E-82-1, E-82-1a, b, c, E-82-2: These sites, not far from the living sites, were special workshops for the manufacture of grinding stones.

This again shows the importance of grinding equipment for the people of Wadi Kubbaniya, the more so because grinding stones had been reused and resharpened several times and not simply discarded after use.

Site E-82-3: The site, with dimensions of about 30m x 25m, consisted of a roughly oval cluster of lithic artifacts, fossil bones, and fire-cracked rock. The site was located in the vicinity of the pond-area. The remains of gastropods, fish (very numerous), birds, and mammals (hare, Felis, wild cattle, hartebeest, gazelle) were recovered. Several hearths were found. The site yielded also 3 hand stones and a sandstone flake from a grinding stone. One milling stone lay about 30m away from the site. Two radiocarbon dates are available: 19,810 B.P. +/-310 (SMU-1136, charcoal, 0-20cm) for the upper occupation lens, and 18,250 B.P. +/-290 (SMU-591, charcoal) from Trench 78/3 south of E-82-3.

Site E-83-2: The site was excavated after findings in the test pit 6. The site was (often) seasonally inundated and shows interdigitating silts and dune sands. The quantity of artifacts indicates repeated occupation of the area. In the excavations were also found 5 fragments of hand stones. One fragment of a hand stone was recovered from the surface of Site E-83-2. Some faunal remains were collected: fish, mammals (for instance, wild cattle), gastropods, and hartebeest. A date on charcoal is available: 16,500 B.P. +/-370 (SMU-1221).

Site E-84-1: The site, with dimensions of about 14m x 12m, consisted of a roughly oval cluster of lithic artifacts, bones, burned stone and several grinding stones. The site shows two separate Paleolithic components, one Kubbaniyan-related and one Sebilian component. The site was located in the vicinity of the pond-area often inundated during the peak of the flood and reoccupied several times. The remains of gastropods, fish (predominant), and mammalian bones (wild cattle, gazelle) were recovered. The site was dated by the excavators about 19,000 B.P., but is probably younger.

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87 "On the northern edge of a small deflational basin".
89 One with stains of pigment.
94 "An estimate for the age of the Sebilian component at E-84-1 can be based on its stratigraphic position relative to both the Kubbaniyan component and the lithological units near the site and on the age of the Sebilian elsewhere in the Valley... The Sebilian site of Gebel Silsila-2B-1 has two radiocarbon dates of 13,610 and 13,120 B.P. (Butzer-Hansen 1968: 114, 136). Other Sebian sites in Upper Egypt have an estimated age of 12,500 B.P. (Wendorf-Schild 1976: 287). Paulissen and Vermeersch, reviewing
Site E-84-2: The small site was located next to a small pond. The excavations yielded bones of fish and gastropods, also fragments from a lower grinding stone and a possible hand stone. The site was occupied "between 15,500 and 16,000 B.P."95.

The surface of the dune area was also littered with small clusters of artifacts, fire-cracked rocks, fossil bones and grinding stones, often from short-term occupations96. Grinding stones were also found in test-pits97.

The material available from Wadi Kubbaniya hitherto points to the intensified use of resources, certainly tubers, but also of other edible plants98. The excavators also suggest that there were more edible plants available than were actually found. Some of the material could not be screened99. Human coprolites include "club-rush and chamomile seeds and grass(?)-stem fragments"100, but they are from young children only and, therefore, may be only partly representative of the diet of the adult population during occupation of the site. The people at Wadi Kubbaniya seem to have intensified the use of their food resources, but there did not yet exist anything on the level of the later "food production". Upper and lower grinding stones are numerous and seem to increase with time. The food processed with these stones was certainly often plant tubers. Mature Cyperus tubers should be processed to rid them of toxins and break up the fibers. This processing may include grinding, roasting and boiling. Breaking up the fibers could be done with wooden tools, like wooden mortars, or with grinding stones. Chemical analysis of the surfaces of at least some of the grinding stones from Wadi Kubbaniya indicate that the stones had been used for processing material high in celluloses, including carbohydrates and fiber, and low in protein. These characteristics do not apply to seeds, but do fit the tubers also found at Wadi Kubbaniya101.

**Kom Ombo**


98 See above. "The floral remains include ten varieties of tubers and soft vegetable tissues, of which nut-grass tubers were the most common, followed by club-rush and fern and seven other varieties of soft tissue and organs not yet identified. The collection also includes the charred remains of fruiting structures, of which 11 varieties have been identified with some probability. Most of these seeds are of chamomile, asparagus, club-rush, aniseed, and water lily. There are also fruits of dom


numerous sites in the Kom Ombo Plain. Several disturbed and undisturbed sites with numerous grinding stones were found in connection with the Gebel Silsila Formation of the post-cold phase, in Kom Ombo dated about 17,000 - <13,000 B.P. Numerous sites were found on the surface in connection with the Sebil Channel\(^{102}\). The stone artifacts show backed points, often with basal truncation, trapezoids, lunates, and numerous upper and lower grinding stones. Shell (primarily Unio and Corbicula), mammal bones, and fish remains were found on these sites on successive flood beaches of the Sebil Channel. The Sebil Channel area seemed to be a seasonal pond-area\(^{103}\) during the Channel-B period \(^{104}\). located next to the pond area and contained different fauna and flora remains, also numerous cereal-like Gramineae\(^{108}\). Backed flakes and retouched pieces show extensive “sickle sheen”, some of these artifacts were possibly attached to a wooden sickle\(^{109}\).

Wendorf-Schild: 1976, 65; a radiocarbon date possibly from the brush fire: “evidence of extensive fire along the Nile valley in Upper Egypt in the thirteenth millenium B.P. (Wendorf-Schild: 1976: 8) may relate to early intensive utilization of grain collected from stands of wild grass selectively favoured by accidental or deliberate burning”, Harris in Reed: 1977, 185.

\(^{102}\) Scattered through the pond sediments were low frequencies of a large-grass, cereal-type pollen grain. These cereal-type grains suddenly became numerous (around 10-15% of the total pollen) near the top of the sequence. Dr. Dabrowski tentatively identified the large cereal-like pollen as barley, Wendorf-Schild: 1976, 72-74; cf. also Harris in Reed: 1977. The identification of these Gramineae as barley was only “tentative”, and especially in light of the problems in Wadi Kubbaniya, this find is now again disputed. “Some mention must be made here of the pollen recovered from the pond sediments at the Isna sites. In 1967-68, a preliminary study by M. J. Dabrowski, a palynologist in the Polish Academy of Science, identified occasional “cereal-type” pollen grains, which became suddenly more common near the top of the sequence... These cereal-type pollens were identified by Dabrowski as probably barley, which contributed to the development of the now-abandoned hypothesis that cereals were grown along the Nile during the Late Paleolithic. A final report on the pollen analysis has not been completed, but it is likely that the pollen grains were those of a large grass rather than of barley. Several species of grass are known in East Africa, which produce large cereal-type pollen grains, and it is possible that they were present at Isna”, Wendorf-Schild in Wendorf-Schild-Close: 1989, 817.

\(^{103}\) “Pans” in duricrust Ca/Sa-horizons at Gebel Silsila and Khor el-Sil, Butzer-Hansen: 1968, 178-179, fig. 4-3.


\(^{105}\) Cf. Wendorf-Schild: 1976, fig. 15-17.

\(^{106}\) Cf. Wendorf-Schild: 1976, fig. 49.

\(^{107}\) “A very thin layer of carbonaceous sand just above this sandy silt and below the overlying diatomaceous layer gave a radiocarbon date of 10,740 BC +/-240 (12,690 B.P. +/-240 I-3421).”

\(^{108}\) Scattered through the pond sediments were low frequencies of a large-grass, cereal-type pollen grain. These cereal-type grains suddenly became numerous (around 10-15% of the total pollen) near the top of the sequence. Dr. Dabrowski tentatively identified the large cereal-like pollen as barley, Wendorf-Schild: 1976, 72-74; cf. also Harris in Reed: 1977. The identification of these Gramineae as barley was only “tentative”, and especially in light of the problems in Wadi Kubbaniya, this find is now again disputed. “Some mention must be made here of the pollen recovered from the pond sediments at the Isna sites. In 1967-68, a preliminary study by M. J. Dabrowski, a palynologist in the Polish Academy of Science, identified occasional “cereal-type” pollen grains, which became suddenly more common near the top of the sequence... These cereal-type pollens were identified by Dabrowski as probably barley, which contributed to the development of the now-abandoned hypothesis that cereals were grown along the Nile during the Late Paleolithic. A final report on the pollen analysis has not been completed, but it is likely that the pollen grains were those of a large grass rather than of barley. Several species of grass are known in East Africa, which produce large cereal-type pollen grains, and it is possible that they were present at Isna”, Wendorf-Schild in Wendorf-Schild-Close: 1989, 817.

\(^{109}\) “A series of artifacts, mostly naturally backed flakes and a few retouched pieces, from Site E-71-K14, Area A and C, and E-71- K15 show extensive traces of lustrous edges of the type known as sickle sheen... it is obvious that the naturally backed pieces were used in the hand without hafting... The pieces with parallel striation and the sheen developed along the entire edge were possibly
In the Isna area intensively used grinding stones and numerous “sickle” stones occur\textsuperscript{110}. For the time being the question must be left open as to whether or not barley existed in Isna. But found together on the occupational area in Isna were numerous grinding stones, numerous sickle stones with extensive sickle sheen, and “cereal-type Gramineae grains” in ponds. The use of these numerous grinding and sickle stones here demonstrates that silica-containing “Gramineae” were repeatedly cut and used, and not only possibly “tubers” or the like processed. These cereal-like Gramineae were found in ponds where these Gramineae do not grow naturally in great quantities, because these ponds were inundated during the flood for at least several weeks (about 6) or months depending on location\textsuperscript{111}. Therefore, there remains little other possibility but to conclude that in Isna perhaps different sorts of plants were used and processed, but also cereal-like Gramineae were sown in ponds and cut in greater quantities with sickles and then probably processed on grinding stones.

Developments during the cold-post-cold phases

The cold-post-cold phases formed a period of far-reaching ecological and environmental problems of long duration (over 10,000 years), following the ecologically more favorable times (at least in lower latitudes, for instance in regions around the Nile valley) of the phase >and< 32,000 B.P. (see above). The problems slowly increased also as a result of the rising summer-insolation and its warming effect (see above), and peaked between +/-15,000-13,000 B.P. The Nile-system was also diminished (see above).

On several sites in the Nile valley grinding stones were recovered, often in connection with sickle stones, and sometimes also with cereal-like Gramineae (for details see above), which hint at an intensified resource utilization\textsuperscript{112}.

In the Levant cereals and legumes have been exploited (at least) since 20,000 B.P., and stone grinding and pounding tools were also used since (at least) about 20,000 B.P.\textsuperscript{113}. Cereal and legume cultivation is suggested for the Natufians, about <12,800 B.P.\textsuperscript{114}. Agriculture

\textsuperscript{110} Cf. Wendorf-Schild: 1976, 86-87; “One of the surprising features of the Isnan sites is the absence of fish remains. Unlike the previous occupants of this area, these hunted only large mammals. The decline in fishing as a source of food may be related to the appearance of the new food resource represented by ground grain. The associated pollen strongly suggests that this grain was possibly barley”, Wendorf-Schild: 1976, 291. “The settlements are also several times larger than any of the previous Paleolithic communities... These data suggest a sudden demographic explosion accompanied by significant changes in the economic base... the Isnan sites contain grinding stones, some with deeply worn basins, and numerous blades and flakes with pronounced lustrous edges, indistinguishable from sickle sheen found on Neolithic sickles... Lustrous edges occur on up to 15 percent of all tools found in situ at these Isnan sites. This remarkably high frequency suggests a significant emphasis on the reaping of grain... Dr. Dabrowski also suggested that the sudden fluorescence of the cereal-type pollen may indicate the rapid introduction of the grains through human activity and recalls the changes in pollen spectra which occurred in northern Europe at the beginning of the Neolithic”, Wendorf-Schild in Harlan-deWet-Stemler: 1976, 279-282; cf. Wendorf-Schild in Krzyzaniak-Kobusiewicz: 1984, 117-118.

\textsuperscript{111} Cf. Atzler: 1985, 123-4.

\textsuperscript{112} Cf. also Harris in Reed: 1977.


seems to have spread within fertile areas of the Levant since >10,000 B.P.\textsuperscript{115}.

Obviously, there were similarities in the development in the Levant and in the Nile valley: use of Gramineae with special tools (at least) during the cold-post-cold phases. In the Levant, some regions yielded naturally great quantities of Gramineae growing on rainfall. But in the Nile valley there existed naturally denser Gramineae stands growing on rainfall only in the northern part during the cold phase. Whether dense stands of Gramineae growing on rainfall occurred during the cold phase also as far south as the region of Wadi Kubboniya is difficult to decide with certainty. But these denser Gramineae stands could not grow naturally in pond-areas which were inundated over long periods in Wadi Kubboniya or elsewhere. Already during the post-cold phase these dense stands retreated with the rains into some areas of the Nile delta (see below), and then great quantities of Gramineae were no longer naturally available in most parts of the Nile valley. Hence the intensified use of Gramineae in the greater part of the Nile valley during (at least) the post-cold phase seems only to become possible with Gramineae habitat manipulation and sowing on the floodplains in ponds after the retreat of the floodwaters.

Special tools: grinding, sickle stones, and mortars seem to occur in the Nile valley primarily on sites next to pond-areas and were hitherto not found on other sites. This vicinity indicates a most important seasonal utilization of specific resources at specific locations: "ponds". The ponds and pond regions, which up to now have been largely ignored, represented very important post-flood areas for fishing, hunting, collecting, and later also "planting" into the most productive ponds in arid landscapes which played a decisive role and also determined the further agricultural development in the inundation landscape\textsuperscript{116}. Post flood agricultural use for "planting" was primarily the use of natural and later manipulated "ponds" (see below).

"Processing/ grinding" stones and mortars can be used for the processing of potentially different materials. The metate (grinding-slab) seem to be "the earliest implement which we have that tells us that man was beginning to focus on grinding plant materials, and in this case on hard-seeded plants such as grasses. An early origin for this tool and a worldwide diffusion seem indicated, though our data are miserably deficient due to archaeological ignoring of this highly significant piece of equipment"\textsuperscript{117}.

"Grinding" stones were not a new invention during the cold-post-cold phases, but already known from earlier times\textsuperscript{118}. Carter\textsuperscript{119} mentions in his "Time scale of domestication": first grinding-slabs (metates) in the Old World about 40,000 B.P., first metates in the New World about 100,000 B.P. Kraybill\textsuperscript{120} also emphasizes that: "The earliest lower stones used for grinding have been recovered from Florisbad, South Africa, from levels dated at 49,000 B.P. Handstones occur in Mousterian undated levels in Spain and France and in dated levels in Russia as early as 44,000 B.P. and at 33,000 B.P. at Olieboomspoort Cave, South Africa. Grinding stones, not yet described as upper or lower, were reported at Bushman Rock Shelter at 46,000 B.P... Of interest is the appearance of grinding

\textsuperscript{116} Pond use can be shown in Wadi Kubboniya for the phase >and< 32,000 B.P.; cf. Atzler: 1985; for fishing cf. Van Neer: 1994.

\textsuperscript{117} Carter in Reed: 1977, 92.

\textsuperscript{118} Several "nutting stones" were found in early horizons at Olduvai Gorge; cf. Leakey: 1971.

\textsuperscript{119} In Reed: 1977, 93.

\textsuperscript{120} In Reed: 1977, 512-513.
behavior first in regions of steppe and grassland.

But grinding stones were not the only equipment for processing seeds and other material: "evidence from the Old World for treatment of seeds by pounding prior to grinding suggests that the pounding operation was antecedent to grinding for many wild seeds. Tools used for pounding seeds and other foods by some technologically simple societies of the Old World include tools which have been described in the literature as spheroids, stone balls, subspheroids, cuboids, and polyhedrons. Their presence in the archaeological record has a long history in Africa where they occur as early as 1.8 million years ago at DK, an occupation floor in lower Bed I at Olduvai Gorge, and as late as the Later Stone Age". Stones with flat or concave surfaces with small pits were also found in Middle Palaeolithic context at Bir Tafawa. Therefore, processing of food by pounding and grinding with special tools has a long tradition. Generally, grinding stones may have been used for a variety of purposes including, for example, pulverizing pigment, cracking nuts, grinding roots, tubers, and other fruit and materials - but also for Gramineae.

The true cereals belong to the grass family, Gramineae. Preferably, hard Gramineae seeds should somehow be "processed" before consumption. But processing in wooden mortars and then cooking would already be sufficient to prepare Gramineae for food. Harvesting Gramineae is also feasible without tools, for example by handpicking or shaking, beating the ripened seeds into baskets. Therefore, the processing of Gramineae must not necessarily leave any signs in the archaeological records, especially on earlier sites, and so Gramineae could also have been harvested on sites where no "sickle or grinding stones" etc. were found.

Gloss or sheen on sickle blades is produced by repeated use in cutting grass or similar flexible materials containing silica. This can, of course, be produced by repeated cutting of different silica-containing materials and not only by "harvesting cereals". This sheen also occurs on later Neolithic sickle blades in Egypt and elsewhere.

Certainly a variety of food resources were used, and not all of the species have necessarily remained in the cultural debris.

Wild barley, tolerant of heat and drought, was naturally distributed in Cyrenaica and Sinai. During the cold phase, the midlatitude westerlies shifted equatorward several degrees latitudinally relative to today and caused precipitation in north African regions and in the "northern" Nile valley as well. The majority of material from the cold-post-cold phases in the northern part of the Nile valley is lost today (see above) and, consequently, little or nothing will ever be "proven". Hence it can only be presumed that the wild barley of the Sinai, at least at this time, was continuous with that of Cyrenaica.

121 Kraybill in Reed: 1977, 494, with more examples.
122 Cf. Wendorf-Close-Schild: 1987; Wendorf-Schild-Close: 1993, 571: "The continued importance of denticulates, and the presence in BT-14 of grinding-stones, suggest the collection and processing of plant-foods", dates for BT-14 >and< 100,000 B.P. Table 38.4: "Stone balls occurred only at BS-11... Their significance remains enigmatic", Wendorf-Schild-Close: 1993, 570, but see Kraybill in Reed: 1977, 494.
“wild barley must have been present in the Nile delta, if not further upstream”\(^{129}\).

This barley and other Gramineae could grow seasonally on (winter) rainfall and/or wadi activity primarily outside the floodplains. But outside the seasonally intensive inundated floodplains Gramineae could grow, with sufficient rains etc., also in much denser stands and would have been available in greater quantities for human use. Already during the post-cold phase the midlatitude westerlies were slowly retreating northward also causing ecological change in the northern Nile valley\(^{130}\). With the rains, the naturally denser stands of Gramineae outside the floodplains also receded slowly northward into parts of the Nile delta\(^{131}\) and disappeared in other regions of the Nile valley. Gramineae could grow naturally only in small stands in random areas of the floodplains in a gradually expanding part of the Nile valley already during the post-cold phase. Greater quantities of Gramineae were no longer naturally available in these parts of the Nile valley and could only be obtained by manipulated Gramineae habitat, i.e. sowing of Gramineae seeds on the post-floodplains in ponds after receding of the floodwaters\(^{132}\). Therefore, the increasing numbers of sickle blades found on several sites in the Nile valley during the cold-post-cold phases\(^{133}\) could in this context point to the growing importance of Gramineae use and the gradual increasing manipulation of Gramineae habitat, sowing- harvesting etc., and the use of sickles to harvest Gramineae only seems to be “practical” if there are dense stands and greater quantities available\(^{134}\).

Particularly the preservation of comparatively small grains in an open site requires a set of unusual circumstances\(^{135}\). “Grains” left behind after occupation could easily have been eaten by animals, fungus etc. or simply disintegrate; or even when covered with dirt, could have been destroyed during week-long submergence in flood-waters; or, in random areas of the floodplain which were not “submerged” for more than a couple of days, germinated after the flood. Hence, the preservation of grains in the Nile valley requires a set of unusual circumstances, and it seems to be rather optimistic to hope to find cereals on every site where they once existed\(^{136}\). Already for early hominids, one of the sources of food seems to have been the hard seeds of Gramineae\(^{137}\), of which none were found in the cultural debris over thousands of years.

Here again the principal question of “preservation” comes into play. There will only be “proof” after finding corresponding materials on the spot\(^{138}\).

\(^{129}\) Harlan in Reed: 1977, 360.


\(^{131}\) Which can hardly be proven archaeologically because environmental changes, in sea level, river gradient, siltation, material transport etc., material from the Nile delta is only partly available prior to about 8000 B.P., cf. Holmes: 1993; Stanley-Warne: 1993; for modern stands of wild barley in several wadis west of Alexandria, cf. Wendorf-Schild-Close: 1980, 275.


\(^{133}\) In Wadi Kubbania only one was found, but in later sites more, see above.

\(^{134}\) Cf. Reed: 1977.

\(^{135}\) “Aeolian deposition is often quite erratic, and under the conditions described, alluviation is also generally a very slow process. Organic remains were hence probably not covered rapidly enough to prevent all surface and subsurface weathering”, Gautier-Van Neer in Wendorf-Schild-Close: 1989, 138. “In attempting any reconstruction of diet, therefore, we must remember that small charred seeds deposited loose on the site... may have been lost during excavation or may have turned to dust during the intervening seventeen millenia”, Hillman-Madeyska-Hather in Wendorf-Schild-Close: 1989, 164.

\(^{136}\) Cf. also Bar-Yosef-Belfer-Cohen in Gebauer-Price: 1992, 32.


\(^{138}\) Cf. for these problems also for instance Gabel: 1960; Shaw in Harlan-deWet-Stemler: 1976;
but because of the material preservation problems, it will often be impossible to “finally prove” anything 139.

Consequently, there often remains little else than to assume “possibilities” - or to abandon the whole problem. The process of forming judgment on the basis of incomplete information is, therefore, for historians a most familiar activity140.

The preservation of numerous mature tubers from Wadi Kubbaniya (see above) was the result of “roasting” and so at least accidental “charring” during the multi-staged (roasting, grinding, leaching ?) process of their preparation as food might have occurred. “Charring” seems to be essential for preservation of vegetable matter141.

Cereal-like grains were not “roasted” for consumption and supposedly only cooked, or baked as flour, after grinding; therefore, the chance of finding grains accidentally “charred” is “minimal”142.

The possibility that grain could be preserved on early sites is, in consideration of these circumstances, minimal. Thus, finding “grains” today in open excavation sites several thousand years old will be an unusual stroke of luck and will, under “normal conditions”, occur only seldom.

The occurrence of grinding and sickle stones with sickle sheen together on the same site is, of course, no “proof” for the use of “cereal-like grains”, as long as there are no such grains found (see above). But the occurrence of grinding and sickle stones on sites next to pond-areas shows that not only grinding, but also cutting silicia-containing plants, like Gramineae, played a prominent role in the “processes involved” on these sites. Because cereal-like grains are preserved on an open site only under special conditions (see above), there is a strong likelihood that such grains were used on some sites where none are preserved, and Gramineae use is even possible on sites without any special stone tools (see above). There is, therefore, support for the old hypothesis: that cereal-like Gramineae were used on sites where grinding and sickle stones with sickle sheen were found together, whatever other materials were also used and processed, and may be better preserved than “grass-grains”143. This supposition will


140 “As mentioned above, we cannot reasonably limit ourselves to ideas that are archaeologically testable”, Reed: 1977, 544; cf. also Binford: 1989.

141 “remarkable is the fact that the remains are dominated by charred fragments of soft vegetable foods”, Hillman-Madeyska-Hather in Wendorf-Schild-Close: 1989, 162; “in charred assemblages, foods preserved by roasting in the embers are likely to be overrepresented, while those eaten boiled or raw are likely to be underrepresented or entirely lacking”, Hillman-Madeyska-Hather in Wendorf-Schild-Close: 1989, 205.

142 The hulls of wild einkorn, emmer, and barley are tightly held to the seeds, therefore, threshing is not exactly easy, cf. Harlan: 1967; Helbaek: 1969; the separation of the grains from the husks can of course be facilitated by drying and roasting, cf. Harlan: 1967, but “roasting” the harvested grain is not, in this context, a “necessary precondition” for processing these grains for food; (drying or) pounding, for example in a (wood or stone) mortar, as it was done prior to grinding until Roman times, cf. Moritz: 1958, and is practiced till now in several countries, cf. Harlan: 1967, would already separate the grains from their hulls without any “roasting”.

143 See above; and it has long been known that a number of blades from most sites could also have been used for “cutting grasses”, cf. for instance Hoffman: 1991; for denticulates from Middle Palaeolithic context: “The function of Middle Paleolithic denticulates has not been established, but their consistent association with lakeshores and swampy deposits suggests activities related to the exploitation and processing of plants, perhaps both aquatic and terrestrial. If this inference is correct, then plant-processing was a major activity at Middle Paleolithic localities in these depressions; unfortunately, this cannot be tested by use-wear
perhaps be wrong for some sites and right for others, and there is, as shown by the hopeless experiences of generations of archaeologists, hitherto not even the slightest chance to “avoid” these “material uncertainties”\(^{144}\). But we should at least leave the questions open for future solution, as we are not able to decide “definitely” at present.

Here one more supposition could be mentioned: sickle stones with sickle sheen seem to become more numerous during the cold-post-cold phases. In Wadi Kubbaniya there is up to now only one reported sickle stone, on later sites more, and often many more (see above). Perhaps this only results from the inadequate material preservation, but maybe there was in fact gradually more “grain” used during the cold-post-cold phases. Numerous sickles on a site indicate that species “harvested by cutting” were used in greater quantity, and not just tubers etc.\(^{145}\).

Grinding stones together with sickle blades with glossy sheen and “cereal-type grasses”, for instance Gramineae with the “strong possibility that they may have been a species of Triticum”\(^{146}\), or “a large-grass cereal-type pollen grain, barley?”\(^{147}\), found at the same occupation area show that cereal-like Gramineae were also items worked with these stone tools, whatever other materials may also have been processed with them\(^{148}\).

Therefore, “some time” during the cold-post-cold phases also cereal-like Gramineae were seasonally cut and processed in the Nile valley, at least, on sites next to the pond-area\(^{149}\). But the gradually intensified use of “cereal-like grains” in the cold-post-cold phases would not yet represent a kind of “food production” as defined in later times\(^{150}\), but only indicate the slow\(^{151}\) development of “sowing-harvesting” of “cereal-like Gramineae” (see also below), as well as, for instance, tuber-processing etc., as only one factor out of several in the complex economy of the time.

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\(^{144}\) The essential argument for the use of grain, however, is the fact that the grinding stones occur together with sickle blades... the association of the two together is strong presumptive evidence for a functional relationship, and most likely such function is in the reaping and processing of grain. The presence of large grass cells, pollen and fungi in the associated deposits is further evidence”, Wendorf: 1968, 944; “It is not surprising... to discover that several Final Paleolithic groups in the Nile Valley also were intimately involved in the initial steps which may have led to food production, either there or elsewhere. The evidence for such involvement consists of: 1. Numerous grinding stones and lustrous-edged pieces (probably sickles) from several late Paleolithic sites... confidently dated well before 10,000 B.C., and as early as 12,500 B.C.; 2. Biological data which confirm the presence along the Nile Valley at this time of a graminea suitable for exploitation... 3. A significant but short-lived demographic change in at least one area which closely coincides with the initial appearance there of the grinding stones and sickle blades”, Wendorf-Schild in Harlan-deWet-Stemler: 1976, 270-271.


\(^{146}\) Also spores of wheat flag smut fungus were found on the site, cf. Tushka. see above.

\(^{147}\) Becoming numerous near the top of the sequence, cf. Isna, see above.


\(^{150}\) Cf. for example Childe: 1936, 1987.

\(^{151}\) At least during the post-cold phase, see above.
But the presence of lunates and other blades with sickle sheen also raises the question as to whether sickles could be used to reap wild grain. Flannery (1965) has suggested that wild grasses could not be efficiently harvested with sickles because wild grass has a brittle rachis which disintegrates when touched, scattering the seeds as a mechanism for dispersal under natural conditions. Domestic grains have rough rachises, so that the grain stays in the stalk when cut and must be removed by threshing. According to Flannery, the use of sickles would indicate that the grain had already undergone some selection by planting and harvesting. Harlan (1967), however, has emphasized that sickles may also be used to reap wild grain as long it is still slightly green. Whatever the historical truth may be, the use of different special tools at least suggests the intensification of the use of these resources, and the use of sickles to cut harvest only seems “practical” if there are dense stands and greater quantities available\(^\text{152}\).

Considerations of agricultural origins have been influenced especially by the concept of the “revolutionary” nature of agriculture and the “center of origin” idea\(^\text{153}\). It would be worth noting in this connection that manipulation of wild plant habitat and growth frequently occurred among hunter-gatherers by means of transport, propagation, fire, irrigation, sowing etc.\(^\text{154}\). The population of the Nile valley during the cold-post-cold phases could have been familiar with such procedures. In the Nile valley, the manipulation of plant habitat, sowing-harvesting, propagation, casual cultivation, protocultivation\(^\text{155}\) etc. was a slow process (see above).

The hitherto prevailing concept is that the planting of “grain” first occurred in the upland areas of the “Fertile Crescent” of Iraq, Iran, and Levantine sites\(^\text{156}\) where the modern wild relatives of wheat and barley grow today\(^\text{157}\). But also in the Nile valley, where barley supposedly grew naturally in denser stands during the cold phase (see above), the intensification and diversification of the use of resources led to the sowing and harvesting of “cereal-like Gramineae” in ponds\(^\text{158}\).

But if cereal-like Gramineae were needed in greater quantities in the Nile valley after the cold phase (see above), they must have been sown by men on the floodplains in seasonally inundated ponds. But this means an intentional change in habitat and growing season of these plants: from Gramineae growing on (winter) rains and/ or wadi activity outside the intensively inundated floodplains, to Gramineae deliberately sown in seasonally inundated ponds after the flood, and therewith at another time and in a habitat where these plants could not grow naturally in dense stands\(^\text{159}\).

There is also no reason why the initial development of “ground grain” should be

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\(^{152}\) Cf. Reed: 1977.


\(^{157}\) Cf. above, cf. also Helbaek: 1959.

\(^{158}\) See above; for Isna cf. Wendorf-Schild in Harlan-deWet-Stemler: 1976, 282.

restricted only to wheat and barley. Therefore, the successfully domesticated species of wheat and barley could have grown "naturally" in different areas, (at least barley) during the cold phase probably also in the northern Nile valley (see above), and/or also be "introduced" by "cultural exchange" into some of the areas where they occur in later times and now. Different wild "grasses" are even now harvested for food in Africa, and Jardin (1967) lists over sixty species of grasses harvested within recent years. The loss of the greater part of the material in the Nile valley (see above) excludes, hitherto, all definite conclusions for this area.

Whatever "evidence" the future might bring, we will never be sure of a "final proof" for the "first occurrence" of the exploitation of ground grain as a source of food, and to know "where" in fact this occurred (see above). This is also because we do not know all the different places where wild relatives of whatever "usable grasses" might have grown and where, only for instance, the wild relatives of wheat and barley originally occurred. The widespread environmental changes during the last >30,000 years underscores the possibility that also wild wheat and barley had distributions, at least at some periods, somewhat different from those of today, and in the Nile valley such "grasses" could "grow" during the whole time of changing environmental conditions of the last >30,000 years (see above for conditions).

The available evidence allows one to suppose that cereal-like Gramineae were used in the Nile valley during the cold-post-cold phases. The appearance of numerous special tools during the cold-post-cold phases shows that the corresponding development had already reached a "somewhat advanced state". To what extent the various plant species contributed to the diet over the seasons of the year, is also a yet unanswered question.

Occurring at sites near pond-areas is evidence of the use of upper and lower grinding stones, sickle stones with sickle sheen, and cereal-like Gramineae. But at other sites only grinding and sickle stones were found (see above). At the sites without cereal finds it is still unclear as to what was treated with these tools (see above), but since they were found near pond areas, the processing of pond products is also probable. In any case, these finds suggest an

160 "Our present understanding would hold that neither individual crops nor agricultural systems must necessarily originate in narrowly restricted geographic areas or centers. For our purpose, a more useful concept would be that of a temporarily long, geographically widespread, and biologically intimate relationship between plants and man out of which domestication can proceed almost anywhere in temperate or tropical zones", Harlan-deWet-Stemler: 1976, 4; cf. also Childe: 1987, 22.

Vavilov: 1926, suggested, that Ethiopia was the area where wheat and barley were first domesticated; Chevalier: 1938, Porteres: 1951, and Murdock: 1959, claimed centers for domesticates in West Africa; cf. for the problem also for instance Harlan-deWet-Stemler: 1976; Reed: 1977; Ebret: 1979; "L'agriculture est apparue à 9-10 et peut-être même 12 endroits différents dans l'ancien monde et à 2-3 endroits dans le Nouveau Monde", Bairoch: 1985, 129.


163 Even when some grinding stones show staining, it should be kept in mind, that these tools could also be used for several purposes: "grinding equipment is assumed to have been used to grind pigment... The lack of ochre on some of the handstones and grinding slabs suggest that they were not used for that activity alone, nor does the ethnographic evidence support such an assumption", Kraybill in Reed: 1977, 514; "The problem is to determine, if possible, the predominant earliest use, for ethnological studies show that metates are used primarily for preparing vegetable foods and secondarily for all other purposes; this is true among the seed gatherers as well as the agriculturists. If we were to judge the past by the present, we would have to conclude that metates were primarily for grinding seeds... Traces of pigment last. Traces of food, except under most unusual conditions, could not be expected to do so... Grinding of grain tends to polish the stones. Grinding of clays formed by breakdown of granite scratches the stone because quartz crystals are commonly included in the clay. Pigment grinding should often scratch the stone and also leave a
intensive use of seasonal resources especially in the pond-areas during this environmentally problematic time\textsuperscript{164}. What is most crucial in subsistence decisions is perception\textsuperscript{165}. Now, besides the traditional form of hunting and fishing, a new use of the pond-areas occurred as manifested by the discovery of special tools and, at some sites, different plant remains. But the use of the pond-areas could, according to local peculiarities, also show local and seasonal differences so that not every site must show the same materials. The absence of grinding stones on sites next to the pond-area with only mammal and fish remains could\textsuperscript{166} indicate that plants, for instance tubers or Gramineae etc., were not processed because they were not eaten during the time of occupation, or because, for example, tubers were eaten before they reached maturity and required processing.

Grinding stones were, at least according to what we know today, found mostly in sites next to the pond-area. This suggests that they were activity-specific, which means food resources were exploited during the time when the corresponding plants were (most) available. Gramineae, but also mature tubers\textsuperscript{167}, which need processing before consumption, could potentially be stored for later consumption, if kept dry. Dry season or low water sites closer to the river bed have been mostly destroyed by later events of the river-system and, therefore, are not (or hardly) preserved today. Therefore, it is impossible to decide if grinding stones were also used there, or if, for example, the people returned when necessary to the natural tuber habitat during the dry season in order to dig out the now older tubers which must be processed for consumption. The settlement system involved the reuse of seasonal key areas corresponding to the differently available seasonal resources. Tubers grow in seasonally inundated regions, and their digging up will improve the natural growth, but people, like recent hunting and gathering populations, must not over-exploit the tuber or other resources, endangering their future availability. Therefore, also tuber and other resources could not be used without intentionally incomplete harvesting and “use-interruptions”, which again hints at the repeated and not constant use of the same sites\textsuperscript{168}.

The intensified use of different plant and animal resources located within a few kilometers of the Nile valley between river and “desert” would also comprise a restricted mobility of the groups, especially under deteriorating population-resource relationships. The sites had to be moved only a few kilometers corresponding to the seasonal inundation\textsuperscript{169}.

\textsuperscript{164} For the possibility of competition/"ambush" (?) between groups cf. Wendorf: 1968; Clark in Harlan-deWet-Stemler: 1976; Reed: 1977; Wendorf-Schild-Close: 1986.

\textsuperscript{165} Cf. Found: 1971.

\textsuperscript{166} At least at the time when grinding stones were known from nearby contemporary sites.

\textsuperscript{167} \textit{Cyperus esculentus} was used also later and has been recovered from Predynastic and Dynastic times in Egypt, cf. Täckholm-Drar: 1950; Darby-Ghalioungui-Grivetti: 1977.


\textsuperscript{169} See for instance above, Wadi Kubbaniya; Bar-Yosef-Belfer-Cohen: 1989, have calculated an optimum exploitation territory for a group of hunter-gatherers within the Mediterranean vegetation belt of 300-500 km\textsuperscript{2}, which means, theoretically, an area of about between 17 x 17 km and 22 x 22 km.
This "is" of course not "sedentism" but means a restricted movement in circumscribed catchment areas, also intensified by the "increased population from immigration" into the Nile valley during the ecologically problemtic times of the cold-post-cold phases and again after <7000 B.P.\textsuperscript{171} This restricted movement in comparatively narrow circumscribed catchment areas could cause ecologic-economic-social "consequences" (see below) which would, inter alia, also reinforce attempts for resource use intensification and diversification. Resource use intensification was already accomplished during the cold-post-cold problem phases in the Nile valley by intensified Gramineae use (see above). But a long-lasting intensified Gramineae use was only possible in the Nile valley, after the cold phase (see above), with the gradual increase of "sowing-harvesting" of Gramineae in pond areas (see above). Therefore, the restricted movement in comparatively narrow circumscribed catchment areas could have reciprocally supported the gradual processes of plant habitat manipulation, sowing-harvesting, propagation, casual cultivation, proto-cultivation etc., which means at least the "preconditions" of a gradual development of an agricultural component in the complex economy.

Cereal-like Gramineae will not grow naturally in great quantities in regions of the floodplain which are inundated for about 6 weeks or longer and, therefore, naturally occur only in small stands in random habitat, but not "densely in ponds" (see above). Therefore, these Gramineae will not be available in greater numbers in such natural habitat and would not be usable in great quantities even over a short period. Only by the "manipulation of habitat", in other words, the sowing of cereal-like grasses in intensively watered (and thereby also naturally fertilized) areas of the floodplain, and as the evidence demonstrates, especially in pond areas, after the recession of the flood waters, could an intensified use and propagation of cereal-like Gramineae be accomplished (see above). Such use of pond areas presupposes human manipulation through "post-flood sowing" in habitats which were not natural for these plants. This in turn presupposes the existence of accumulated experience and experimentation\textsuperscript{172}. But this emerging use of cereal-like grasses could have had varying significance for the different groups of the Nile valley, also depending on the locally different resources available.

Because it can be assumed that various activities performed with grinding stones could have been carried out at an earlier time with wooden utensils\textsuperscript{173}, a comparison of the level of intensification of resource use is not easily possible.

The cold-post-cold phases formed a problematic time lasting thousands of years, therefore, it is to be assumed, that this was also a time in which recurring stimuli for intensified and diversified plant, fish, mammal, bird etc. resource use, a willingness for increased efforts, the innovative use of accumulated experiences, and the adoption of new methods etc. were also existing\textsuperscript{174}. The worsening of the environmental conditions after the ecologically more favorable phase >and< 32,000 B.P.\textsuperscript{175} evoked reactions

\textsuperscript{172} Cf. Reed: 1977.

\textsuperscript{173} Till now the wooden mortar with pestle is one of the most universal pieces of equipment for processing plant food in Africa.


\textsuperscript{175} See above; and such far-reaching environmental changes can not simply be designated a
from the people and caused wandering into ecologically more favorable regions, probably also to the Nile valley (see above), which would further aggravate the population-resource relationships there. The normal response of hunter-gatherers to such stress would be emigration out of the area or a shift toward a broader spectrum pattern of procurement of resources. Emigration out of the Nile valley was hardly feasible under the widespread environmental circumstances. During the cold-post-cold phases, the groups in the Nile valley used a broad spectrum of resources in their complex economies (see above). But this was obviously not sufficient to solve the problems. Intensified use of several resources and exploitation of accumulated experiences with potentially usable species had to be included. This is demonstrated by the increased appearance of grinding and sickle stones and Gramineae next to pond-areas. Under the prevailing circumstances, groups must have striven to intensify and diversify methods for food procurement.

Hunter-gatherers normally try to maintain an equilibrium with the resources of their environment by limiting the population to levels below maximum carrying capacity\textsuperscript{176}, but this does not imply a lack of correlation between population, immigration, diminishing resources, and intensified and diversified methods for food procurement under long-lasting and far-reaching deterioration of environmental and ecological conditions which forced people to “concentrate” in ecological niches, like the Nile valley, without a chance for emigration. This kind of “relationship”, widespread disturbances of former equilibria of hunter-gatherer subsistence systems, may also provide an answer to the question of the gradual development of intensified and diversified means of resource exploitation and further developments in the direction of plant habitat manipulation, “sowing-harvesting”, and finally agriculture, expressed (also) by Binford: “The question to be asked is not why agriculture and food-storage techniques were not developed everywhere, but why they were developed at all”\textsuperscript{177}.

This intensified and diversified use of resources first took place in a conventional seasonal way and included different species. The human manipulation of species and their habitat, sowing-harvesting etc. appeared to play a role only gradually\textsuperscript{178}. The beginnings of an accumulated knowledge adequate to realize the connections between “seed and fruit”\textsuperscript{179}, and the


\textsuperscript{178} “It seems most realistic therefore to envision the process of human adaptation in the late Pleistocene as forming a continuum of selective exploitation, intervention, near-cultivation and quasi domestication. Somewhere in this continuum the first act of deliberate cultivation must have occurred, without fanfare, or important consequences, or awareness that anything new had been done. The contemporaries of the pioneer among all cultivators were surely as aware as he or she that seeds sprout and planted cuttings become new plants. Accidental planting and subsequent utilization must already have occurred numberless times. The only new aspect of the situation was the element of deliberation, the decision to plant a seed or cutting with the intention of using the result”, Bronson in Reed: 1977, 28-29.

\textsuperscript{179}“The capacities of our not-so-remote ancestors to observe and reason… to recognize what happens when seeds are planted, a phenomenon which was probably quite familiar to the Neanderthals and their predecessors”, Pfeiffer in Harlan-deWet-Stemler: 1976, 24.

theoretically unsatisfactory “deus ex machina of climatic change”, Flannery in Ucko-Dimbleby: 1969, 75-76.

attempts at human application of such knowledge and the slowly developing human manipulation of species and their habitat which could gradually and then later regularly be practiced, cannot be fixed for the present and may reach back much further than is often hitherto assumed. What is involved here is a process with setbacks and interruptions, but only with sufficiently accumulated experience is the successful application of any species manipulation possible. Only gradually did the initial efforts which led to an early “sowing/planting” and “proto-cultivation” occur and did not yet represent “food production”, which developed much later.

Under the special environmental conditions in the Nile valley this meant at the same time, that “sowing” must correspond to the special conditions of the Nile post-flood inundation landscape. This also included a change from Gramineae naturally growing on (winter) rains outside the intensively inundated floodplains to Gramineae sown after the flood in autumn in ponds. Therefore, there must also have been an independent (at least a further) development in the Nile valley itself.

The type of cultural remains which can be found on the sites depends not only upon the phases during which these sites were used but also on the location of the sites and, therefore, can be quite different. Corresponding to the locally differing geographical circumstances in the Nile valley there existed differences in the lay-out of pond areas and the floodplains and, therefore, not every site could be used in the same way and must not comprise the entire range of usage (see above). Some of the sites, moreover, were located on the edge of the floodplain and were only occupied during the peak of the flood. It should not be surprising that sites on the edge of the floodplain or at low water levels or other areas of the Nile valley did not cover the whole range of hunting, fishing, and use of wild and later “sown” species in the same way, with the same frequency or at all.

Moreover, during the seasonal cycles of flooding the groups changed sites, wandering to low-water and flood-free locations. This system of wandering had an influence on the accumulated cultural material. Larger permanent

180 “With a world occupied by collectors who had developed an intensive and pragmatic interest in wild plants and their properties, I believe that, inevitably, some would have begun to develop the techniques for food production. We have, at least, nicely documented instances at Tamaulipas and Tehuacan (MacNeish 1958, 1964) of societies depending chiefly on wild plants and the slow appearance of cultigen after cultigen while wild plants continued to make up the bulk of diet. Jarmo, Deh Luran, and other sites in the Old World also show a combination of wild and domesticated plants of similar species, but these sites are evidently sloydially more developed toward agriculture than the earlier levels of the Middle American sites”, Coldwell in Reed: 1977, 79.

181 “Even if we reject the almost unprovable possibility of a Pleistocene origin for casual plant tending, we must still account for the fact that full-scale dependence on agriculture lags a surprising distance behind the known beginnings of cultivation”, Bronson in Reed: 1977, 32.

182 See above; cf. for Wadi Kubbaniya: “the settlements occupied at the maximum of the flood are not preserved: they were, beyond the reach of Nilotic sediments and so have been destroyed by deflation”, Wendorf-Schild in Wendorf-Schild-Close: 1989, 801; cf. also Vermeersch: 1994; Van Neer: 1994.

183 Cf. for instance sites in El Kab, Vermeersch: 1970, 1978, 1994; the Makhdama sites near Qena between about 13,380 B.P. +/-770 (1-3940) and 12,060 B.P. +/-280 (GrN-12029) with fish (most abundant), mammals, mollusks, birds, a shell of the gastropod Engina medicaria indicating contact with the Red Sea; “The Makhdama sites are thus situated on a safe place as close as possible to the inundated area and on the contact between extreme environments”, Vermeersch-Paulissen-Van Neer in Krzyzaniak-Kobusiewicz: 1989, 108, 87-114; cf. also Close: 1988.

settlements did not yet exist and it is, therefore, not surprising to find evidence of different activities at seasonally different sites (see above); but only by considering the materials from several sites together can an impression of the year-round activities of the groups be provided. Also as a result of this wandering system\textsuperscript{185} a certain form of an early "resource using behavior" persisted in the presence of (and in spite of) possible "sowing and harvesting". The special processing tools found in pond-areas show that a considerable part of the plant species used were also processed there. How much of this processed food was also consumed on the spot or stored for later use is difficult to judge\textsuperscript{186}.

This may also indicate that early forms of planting existed in conjunction with other activities such as food-gathering, hunting, and fishing. The harvested plants formed only a (seasonally variable?) part of the whole diet. But the possibility of storing food raises the questions of the intensity of harvesting and storing food, in spite of the site-wanderings (possibly only) in comparatively circumscribed catchment areas (see above) enforced by the flood season. If the harvesting and the storage of food was practised at a certain intensity it could already have socio-economic consequences\textsuperscript{187}.

The phase >and< 32,000 B.P. and the long lasting problem period of the cold-post-cold phases were apparently of decisive importance for further cultural developments. But the material preservation problems (see above) exclude a more detailed representation of these important developments during this hitherto little known and often neglected era, and we cannot "insist" that the accidentally preserved material is representative for all (possibly also different) developments in the whole Nile valley. These factors must be considered in assessing the circumstances of the time. In spite of all the uncertainties as to details, it can be assumed that the slow accumulation of experiences over long periods and the gradual development of new practices which were feasible within a continuously functioning environment were important factors in the developmental process. An optimal operating of the innovations could be slowly developed and adopted\textsuperscript{188} and could also be incorporated, step by step, into the cultural complex of the groups. Alongside this was the possibility for culture exchange which could also offer new methods of problem solving\textsuperscript{189}.

\textbf{Phase >and< 10,000 B.P.}

The phase >and< 10,000 B.P.\textsuperscript{190} started in the Nile valley with the so-called "Wild Nile".

\textsuperscript{185} For the problem of the restricted movement in comparatively narrow circumscribed catchment areas, see above.

\textsuperscript{186} At least a part of the "grain"-harvest had to be stored for later sowing, for the problem of food storage, cf. Reed: 1977; Wendorf-Schild-Close: 1989, see also below.

\textsuperscript{187} "Storing hunter-gatherer societies exhibit three characteristics -sendentism, a high population density, and the development of socioeconomic inequalities- which have been considered typical of agricultural societies and possible only with an agricultural way of life. Furthermore, their economic cycle -massive harvest and intensive storage of a seasonal resource- is the same as that of societies based on the cultivation of cereals. The difference between storing hunter-gathers and agriculturalists lies in whether the staple food species are wild or domesticated- this proves to be only a minor difference, since it does not affect the main aspect of society... The conclusion to be drawn is that it is certainly not the presence of agriculture or its absence which is the relevant factor when dealing with such societies, but rather the presence or absence of an economy with intensive storage as its cornerstone", Testart: 1982, 530.

\textsuperscript{188} Maybe some groups in special ecological niches sometimes "resisted".


\textsuperscript{190} To this phase belongs, for instance, also material from the formations called: Arminna Member,
The high floods of the "Wild Nile" met a Nile valley choked with old materials and this accounts for the elevated rest sediments which can be found today. These events started about <13,000 B.P.\textsuperscript{191}. 

During the phase >and< 10,000 B.P. the amount of solar radiation reaching the earth was up to 7% greater in summer and about 7% less in winter across lower and higher latitudes of both hemispheres. Although the average annual solar radiation was close to the modern value, the seasonal radiation differences were significantly increased. This, coupled with sea-surface temperatures close to those of today, caused the intensification of the Northern Hemisphere summer monsoon, widespread precipitation, enlarged lake levels over the African-Eurasian area, and an increase in the Nile-levee-riversystem\textsuperscript{192}. The precipitation increased, depending upon location, between 20%-100%, as shown by lake-level records, alluvial records, pollen records etc. The palynological analysis shows that at least parts of the Sahara and especially mountainous regions were covered by a Mediterranean type of woodland vegetation and other flora. People with domesticated cattle and "grains" became distributed throughout and around the Sahara during this phase\textsuperscript{193}. 

Existing parallel to the intensified Nile-system, at least in the more southerly areas of the Nile valley, were higher summer temperatures, precipitation and greater wadi activity\textsuperscript{194}. Winters were colder than today, resulting in less evaporation. The intensification of the Nile-system with higher flood and low-water levels gave rise to the formation of an extended levee-river-system with enlarged floodplains. With this also began an increased material transport in the Nile valley removing the greater part of the old material with all its potential cultural debris and partly transporting it to the Mediterranean sea\textsuperscript{195}.

Sites from the phase >and< 10,000 B.P. with grinding equipment, for example at:

**Wadi Halfa**

Site ANE-1: The site was located more than 2 kilometers from the Nile, next to the old pond-area. In the cultural debris also fragmentary mammal bones (hartebeest, Equus, gazelle, Hippopotamus, antelope) and fish remains were recovered. There were 132 lunes and several


\textsuperscript{194} Evidence of wadi activity can be found in, for example, Wadi Or, Sample 192, 207, 200, 199; from the Kom Ombo Area, Sample 300, 399, 22, 79, 128 etc., cf. Butzer-Hansen: 1968.

bedrock grinding areas found in and near the occupation. The grinding areas were saucer-shaped depressions in the sandstone rock. Several grinding stones occurred, mostly in fragments. One nearly round specimen is about 100mm in diameter and 40mm thick at the center and shows a convex grinding surface.

The site is dated at approximately 10,000 to 8000 B.C. and could, therefore, belong to the phase >and< 10,000 B.P.\textsuperscript{196}

Site Dibeira West 1 (DIW 1): The site lies on an elongated mound, dimensions 350 x 90m, built of silt and fluvial sands. Thirteen concentrations of artifacts, bones (especially from mammals), charcoal, and burned stone were scattered over the mound. The most elevated concentration (A) is situated at ca. 135m, the lowest one (B) at 133-132m. Each concentration is considered as a separate seasonal encampment of people who returned to the area. Hunting large savanna mammals, but not fishing, seemed to be important during the season represented by the sites. Several grinding stones, lunates and a few bladelets with sickle sheen were found. Charcoal from a cultural layer yielded a date of 7440 B.C. +/-189 years (WSU-175). The site is now dated ca.10,600 B.P.\textsuperscript{197}

Site Dibeira West 51 (DIW 51): The site lies on a regressive beach at ca. 129-132m. An area of about 95 x 35m was covered with a large quantity of burned stone and artifacts. The archaeological material occurs in the alternating sand and silt layers. Several grinding stone fragments were found. A number of ostrich eggshell fragments and beads were discovered in the trenches. Charcoal from a cultural layer dated ca. 8900 B.P. (SMU-582) and 5750 B.C +/-120 years (WSU-176)\textsuperscript{198}

\textbf{El Kilh}

Several sites lie on the west bank of the Nile about 16km north of Edfu on the footslope of a small conical hill. The sites are situated only about 5-7m above the modern floodplain next to the pond-area of their time.

Site E-71-P5: The site was situated at the edge of an extensive area of silt and fluvial sand on a recessional beach. Numerous Unio shells and artifacts were littering the surface. Some mammal (Bos primigenius, hartebeest) and fish bones were recovered in the trenches. Several intensively used grinding stones occurred and many of the chipped tools have lustrous edges. A sample of Unio shell from the site dated 9610 B.C. +/-180 years (11,560 B.P. I-3760)\textsuperscript{199}

In addition to sites with evidence of grinding and sickle stone (with "sheen") use, there are others on which such tools have not been found, for instance in El Kab. On the east bank of the Nile, across from El Kilh at the brick enclosure of El Kab, Vermeersch has recorded nilotic sediments, which he called El Kab Formation. Several neighbouring sites and occupation layers with a microlithic blade complex composed of backed bladelets,


\textsuperscript{199} Cf. Wendorf-Schild: 1976, 37-40, 303; Wendorf-Schild in Wendorf-Schild-Close: 1989, 817; "The lithic assemblages at this site have a number of similarities with the earlier Isnan industry, and indeed, this assemblage may be a later phase of that industry. Ground grain was also still an important source of food because several extensively worn grinding stones and lustrous-edged pieces were present; but fish-absent from the earlier Isnan communities- also occurs, together with bones from large savanna-type animals such as Bos and hartebeest", Wendorf-Schild in Harlan-deWet-Stemler: 1976, 283.
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microburins, and a few geometrics (including also lunates) were found. The material yielded dates between ca. 8010 B.P. and 7930 B.P.\textsuperscript{200}.

During the phase \(>\text{and}< 10,000 \text{ B.P.} \) more favorable ecological conditions caused a gradual relaxation of the population-resource relationship, also in the ecological niches which were up to that time comparatively densely populated, for example in the Nile valley. This also triggered a wandering process from these former niches into new areas, hitherto unused.

The high level of the so-called “Wild Nile” did not decisively hamper the development in the Nile valley, as is assumed\textsuperscript{201}. At the beginning of the phase \(>\text{and}< 10,000 \text{ B.P.} \) the more intensive floods met a Nile valley choked with old material so that the sediments of this intensified Nile-system, called Wild Nile, can be found in comparatively highly elevated and protected areas (see above). Therefore, at the time of the so-called Wild Nile a rather different topography than today existed. Hence the notion of an inundated “narrow channel and valley trough” catastrophically destroying life and resources or greatly reducing formerly available resources is hardly realistic for the entire valley. The levee-river-system became adjusted to the (once again, see above phase 32,000 B.P.) intensified Nile-system of the phase \(>\text{and}< 10,000 \text{ B.P.} \). High floods inundated a now correspondingly expanding and extended floodplain including wadi areas (as floods did in Wadi Kubbanya in previous times, see above). This caused, as is usual during phases of intensified Nile floods, a greater usable surface. Also existing in many parts of the valley was a larger floodplain border area creating more living space during the flood.

Now available, was a much greater potentially usable area after the flood than before, and pond-areas extended and formed also further away from the river. How intensively these areas were in fact used under these now more favorable conditions is another question. Grinding and sickle stones (with “sheen”) preserved from this time are scanty (see above). The intensified Nile-system now caused an increased material transport in the Nile valley removing the greater part of the existing material with all its potential cultural debris. Material from pond-areas is hardly preserved. Therefore, a definite judgement especially about the areas where grinding and sickle stones and “Gramineae” were intensively used (see above) is for the time being impossible. Furthermore, particularly in this long phase of more favorable ecological conditions, population growth is to be assumed, at least in some areas\textsuperscript{202}, this in turn altered the population-resource relationship once again in these areas.

In the Sahara and the Levant, a further developed agricultural component \(>\text{and}< 10,000 \text{ B.P.} \) can be seen\textsuperscript{203}.


\textsuperscript{201} “As apparently spectacular as the rise of protoagriculture in the late Palaeolithic Nile Valley was its precipitous decline. No one knows exactly why, but after about 10,500 B.C. the early sickle blades and grinding stones disappear, to be replaced throughout Egypt and Nubia by Epipalaeolithic hunting, fishing, and gathering peoples who used tiny, geometrically shaped stone tools... Based on evidence of truly massive Nile floods in the late Sahaba-Daraw period, F.Hassan has speculated that a prolonged series of such natural disasters would have discouraged the Nilotic peoples from continued reliance on grain foods that had to be cultivated in the dangerous and periodically scouried or buried bottomlands. Whether his explanation is sufficient or whether it places too much emphasis on catastrophic events cannot be told at present. For now... it is one of the few explanations based upon both geological and archaeological evidence”, Hoffman: 1991, 89-90; for “catastrophic changes” cf. also Close-Wendorf in Gebauer-Price: 1992.


The groups moving into the Eastern Sahara came at least partly from the Nile valley204. Stone grinding tools occur even on the earliest sites in the Eastern Sahara205 and there are now tens of thousands of grinding stones found in the Eastern Sahara206. If groups from the Nile valley could bring domesticated cattle and grinding equipment about 9500-8000 B.P. into the Eastern Sahara then ground food and domesticated cattle should have existed in the Nile valley before this time207.

204 “In the southern part of the desert, at least, they probably came from the east from the Nile Valley... We believe that even the first Holocene colonists of the desert brought domestic cattle with them, although this has not been universally accepted (Clutton-Brock 1989; Muzzolini 1989b; Smith 1984)”, Close-Wendorf in Gebauer-Price: 1992, 63-64.


207 “Early Neolithic sites in the southern part of the Eastern Sahara, even those with radiocarbon dates earlier than 9000 B.P., usually yield bones believed to be those of domestic cattle”, Close-Wendorf in Gebauer-Price: 1992, 69; “If the colonists of the Eastern Sahara came from the Nile Valley, bringing domestic cattle with them, then we might conclude that the actual process of domestication took place at the end of the Pleistocene or beginning of the Holocene in the Nile Valley. The wild progenitors of domestic cattle were present in the Valley (as they were not in the desert)... Alternatively and more probably, domestication may have occurred as part of the process of human expansion into the Sahara in the tenth millennium B.P.-a process which was at least made easier and perhaps even made possible by the presence of domestic animals... How the desert adaptation developed is unknown, but when we first see it the relationship between people and their cattle is already one of local symbiosis”, Close-Wendorf in Gebauer-Price: 1992, 67-68. If the ecological suppositions of Close-Wendorf are correct then “an origin of cattle domestication” was impossible in the southern Eastern Sahara during this time: “There was also the problem of surface water. Cattle are thirsty creatures and must drink every day if they are to thrive, or every other day if they are simply to survive. They would not occur naturally in an environment which, even generously estimated, had no more than 200mm of rainfall and which supported only hare, gazelle, and the occasionally oryx-all of them essentially non-drinkers. There was no permanent, standing water in the southern part of the Eastern Sahara during the Holocene... only ephemeral playa lakes. These would have filled during the summer rains, but then have stood dry for much of the year. During most of the seasons, the only way to obtain water would have been to dig wells. We may therefore reject the idea that the cattle found in this area in the Early Holocene could have been wild”, Close-Wendorf in Gebauer-Price: 1992, 67.

208 “Sheep or goat occur in Middle Neolithic context at Nabta (E-75-8) shortly after 7000 B.P. Caprovids were domesticated in southwestern Asia (sensu lato)... in the ninth millennium B.P.... Their wild ancestors are not known from North Africa,... so that any caprovids found here must be domesticates brought in by herders”, Close-Wendorf in Gebauer-Price: 1992, 69.

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sites in the Nile valley (see above), but the material preservation problems (see above) prevent a detailed assessment of the events in the Nile Valley (see above).

The practices of intensified and diversified resource utilization and the necessary knowledge of grinding and sickle stones and of “sowing and harvesting” Gramineae in pond areas were available in the Nile valley to be drawn on since the cold-post-cold phases (see above). To what extent this “know-how” was used under the improved ecological conditions must for the present remain an open question because of insufficient material preservation in the Nile valley. Sites in the Sahara show the slow increase of an agricultural component within the complex economy. Whether it is possible that this increasing agricultural component was accompanied by a gradual population growth, and whether this is the actual historical reality, cannot be proved at present. The question is also open as to if and when the availability of better adapted species for agricultural use, which may have been spread through cultural exchange, likewise played a role. In any case, various factors must have been involved leading to the gradual increase in the agricultural component. With the now extensive cultural exchange it can be assumed that “know-how” about the possibilities of a more developed agricultural component was also available in the area of the Nile valley, irrespective of which groups and how intensely these components were used, and of any possible corresponding differences in the ecologically differing areas.

Some developments after <7000 B.P.

The special environmental conditions of the phase >and< 10,000 B.P. (see above) then diminished, gradually and with local differences, from about <7000 B.P. and approached at around <4000 B.P. more modern values.

This renewed gradual decrease in the Nile system from about <7000 B.P. simultaneously caused a diminishment in the levee-river-system, in the extension of the floodplain, in the material transport etc. The number of preserved prehistoric sites significantly increased during this closing time of the phase >and< 10,000 B.P., also because from that time on, the former repeated drastic changes of the levee-river-system with its extensive material transport and exchange, aggregations and dissection etc. gradually ceased. This means that the number of preserved sites in the Nile valley also depends directly upon the incidence of material exchange in the levee-river-system, and so is for the most part also determined by extraneous circumstances. Material existing prior to <7000 B.P. is only partly preserved (see above). Because of environmental changes (in sea level, river gradient, silation etc.) material from the Nile delta is also only partly available prior to about <8000 B.P. These circumstances prevent the drawing up of chains of evidence which are otherwise possible for later times, in the first place because of the far greater material preservation. These peculiarities of material

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210 Or probable, according to some theories, cf. Reed: 1977.


212 “Agriculture generally spreads through the diffusion of ideas and products rather than people. In almost every case... farming is adopted by indigenous peoples rather than brought in by colonists... The exception to this pattern are... the expansion of cattle pastoralists into the Eastern Sahara”, Gebauer-Price: 1992, 8.


preservation are to be observed whenever conditions in the Nile valley are assessed 216.

The more numerous preserved sites of the later Prehistory after <7000 B.P. in the Nile valley 217, from the Fayyum 218, Merimde Beni Salame 219 and other Lower Egyptian sites, Badari, of the Naqada-period and the following so-called proto- and predynastic times in the Nile valley and Nile delta 220, show gradually increasing complex economies with clear evidence of a growing agricultural component and food production 221. Now existing are more and more permanent settlements with storage facilities, cemeteries, and gradually developing structured and complex societies 222. Because of the now improved material and preservation conditions (see above), a firmer evidence chain with greater amounts of cultural remains in different parts of the Nile valley is possible.

With the ending of the phase >and< 10,000 B.P. the ecological and environmental conditions began again to gradually worsen (see above). Slowly and with local differences, formerly occupied areas, for instance in the Sahara, had to be abandoned once again. Wanderings into ecologically favorable niches, as the river oasis of the Nile valley 223, resumed. Because of the possible population growth in several areas during the phase >and< 10,000 B.P. (see above) there may have been a considerable density of population, even in comparison to the cold-postcold phases (see above). The overlapping environmental conditions also affected the intensity of the Nile-system, worsening the ecological conditions in the circumscribed area of the Nile valley. The once mighty floodplains were again gradually reduced by the re-adjustment of the levee-river-system causing a corresponding reduction of usable areas. There recommenced, therefore, in several regions of the East-Sahara-Nile valley-Near Eastern area a problematic time, which must have once again


217 The “final appearance” of “neolithic sites” in Egypt, according to the hitherto preserved material, would be comparatively late in the Mediterranean region, cf. also: “A 7000 B.P. date for the fully neolithic in Spain and France fits well within the pattern now emerging in southern Italy and the Adriatic. As more full neolithic economy sites in southern Italy are dated, support grows for their age between 7500 and 7200 B.P.... This is further supported by evidence for full neolithic sites from the Dalmatian coast around 7200 B.P.... and from the southeastern Adriatic and Greece by 7500 B.P.”, Donahue in Gebauer-Price: 1992, 77; cf. also Clark: 1977; Renfrew: 1979; “Dans la Grece et au sud des Balkans (notamment en Bulgarie) les preuves sont nombreuses qui permettent de fixer vers 6500-6000 (B.C.) les debuts de l’agriculture”, Bairoch: 1985, 122.


led to attempts at intensified and diversified resource utilization. But in contrast to previous phases (see above) there was now accumulated knowledge available for methods and species for an intensified agricultural component and gradually growing food production at least through cultural exchange in the Sahara-Nile-Levant (and other) regions (see above). Agriculture spreads quickly in areas where groups occupy all of the habitable ecozones and emigration is hardly possible 224. Also in the Nile valley the evidence of a complex economy with an already advanced agricultural component gradually increases 225, but until now the necessary developments leading up to this cannot be shown with certainty for the Nile valley itself (see above). Here again the question remains as to whether this is the result of material preservation in the Nile valley and/or if exogenous factors played a role 226. In any case, a cultural exchange in the Levant-Nile-Sahara region during this ecologically problematic time existed 227. Hence, the question must remain open as to whether or not the development which can be shown for the Sahara (see above) and the Levant (see above) also occurred “exactly” at the same time and in the same way in the Nile valley. The domesticated cereals in the later Neolithic sites of Egypt are wheat and barley as in the so-called Fertile Crescent 228 and not primarily sorghum, millet etc. of “accepted African origin” 229; this however could be the result of a slow development and final selection under cultural exchange conditions 230.

**Pond problems**

In the course of the gradual worsening of the population-resource relationship, the intensification and diversification of resource use became again necessary, now by the increased production of storable Gramineae foods. In the Nile valley this was only possible through the intensified use of ponds (see above). The localization of sites next to the pond-areas had in early and later times economic significance. Also the later prehistoric sites were situated on elevated flood-free ground next to the pond areas 231.

The pond-areas were special areas of the floodplains in which agricultural use of the post-flood landscape was optimal 232. But the pond-areas performed only a fraction of the natural floodplains. Early sites with grinding equipment and Gramineae were, hitherto, found only next to the restricted pond areas 233. Only in the ponds could Gramineae/cereals be grown with the highest possible product quality. For example, the size of the grains was decisively influenced by the amount of natural “fertilization” from flood water sedimentation and by the amount of moisture preserved over longer periods in the ponds.


228 Cf. Harlan-deWet-Stemler: 1976; Zohary: 1986; see for the problem above.


230 And there is the still unanswered question of what sort of cereal-like grains were used early in the Nile valley, see above.


However, with any intensified use of ponds, problems also occur. Flood water with the highest possible sediment-load should inundate and "stand" for as long as possible at the highest possible water-column over the ground in order to provide optimum sedimentation of fine fertile materials and only then can guarantee the best natural fertilization, fecundity, and moisturization of the soil. But on the other hand, the more seasons a pond is inundated, the more the problems of salinization occur, especially through the "residual water" remaining in the ponds.

Moreover, the sowing should be completed within a relatively small time frame for an optimum yield. This means that the water should "disappear" from the used areas at a "certain time" to guarantee the optimal time for sowing, growing and ripening. Areas under water for too long become swampy or salty and are no longer usable 234.

The later occurring basin system solved these problems in a rational way (see below). The problem already existed in principle for the pond areas when they gradually became salinized through the oozing and evaporation of residual flood water which continued over a period of time excluding these areas from further growing of cereal-like Gramineae. These problems could only be solved, as in modern times, when the residual water could be drained off in time.

Here lies the weak point of the natural ponds and one of the reasons why individual ponds could only be used for a certain time until "salinization" occurred and the search for new ponds had to begin again or ponds were later possibly "worked over" or "dug". The problems of destruction, siltation, and the filling up of ponds and pond areas by wadi, aeolian, and nilotic activities etc. also arose. Although finding new ponds was hardly a problem in times of favorable population-resource ratios, difficulties emerged in periods of intensive pond use and during ecological problem times (see above).

So here again the solving of specific problems in a particular inundation landscape played a crucial role without which a corresponding resource-use intensification or an increasing agricultural component would not have been possible.

**Gradual development from ponds to basins**

Human manipulation of ponds seems to have occurred early 235. Because of material preservation, it is impossible to say for certain when human manipulation attempts at digging new ponds etc. first took place.

Basins could solve the problems of pond use (see above) in a rational way because they were constructed in such a way or surrounded by earthworks so that the flood water supply could be controlled and the optimum amount of sediment-rich flood water could be let in and out, thereby guaranteeing adequate fertilization and moisture content of the ground 236, and the "dangerous" residual water could be carried off before salinization started. In natural ponds, water drainage installations and canals are difficult to construct because they often cannot completely drain the ground of the pond due to insufficient elevation differences between the pond and the surrounding area.

The long tradition of using ponds, later also for the sowing of cereal-like Gramineae (see above), and the gradual solving of the pond problems through the installation of ponds/concavities with water conduction/canal/basins, demonstrates that the basins were a gradual

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235 A possible example from the time about >and< 14,500 B.P. from Tushka, Site 8905, cf. Wendorf: 1968, 886-897.

improvement over the former ponds. The basins are actually “ponds with canals”. These developmental tendencies are evident in the early pond use (see above) and later, basin use from dynastic times (see below). But the details of the early development of hydraulic enterprises cannot be proven because of the lack of material preservation 237, and it can be assumed that many different attempts in problem solving existed. Therefore, we can only grasp the beginning and ending points of a developmental continuum which was determined both by the problems of intensified food production and the socio-economic relationships in Egypt (and also in other hydraulic early high civilizations). Therefore, in spite of the range of possible details, the potential interpretations are still limited 238.

The development of the basins from the former ponds can also be deduced from the Egyptian script. The term read by the “Wörterbuch” “wrw” (WB I, 332, 10, 11, 334, 4) signifies “a concavity in the earth filled with water, pond” and also the “artificially constructed basin” (WB I, 332, 10; Meeks: 1977-79. Année Lex., 77.0969, 79.0719).

“Wrw” can be written since Pyr. with (Gardiner Grammar) N 36 “canal” (=“Teich o.ä., Pyr., M.R.” = WB I, 332, 11, and not simply “well”; Gardiner: N 36= “channel filled with water, later form as det. irrigated land N 23”).

“Wrw” can since Pyr. be written with N 41/42 ( “wrrw” = WB I, 334.4, N41/42 = a concavity in the earth filled with water, pool, pond; Gardiner: “well full of water, pool, marsh”).

“Wrw” can be written with N 36 and N 23 “(wrw, MR”, WB I, 332, 11, for N 36 and N 23 see above).

“Wrw” appears in the Pyramid Texts: Pyr. 1728a (M., N.) relating to the king: in.k.n.k wr.w (wrr.w= N.), "b.n.k m.r.w (wr.w and wrr.w with N 41, see above); or Pyr. 203a (W., N.) the king as: hrj tp wrw (wr= N.) m wrw.f (wrw with N 36, see above).

Therefore, the term “wrw”, which then can also mean “basin”, can signify already in the Old Kingdom “a concavity in the earth filled with water, pond”, which was or could be “equipped with manipulated water conduction, canal” (for the here often translated water-hole/ well with canal see below). This already demonstrates the gradual process from ponds to basins (see above). This shows that for the Egyptians the ponds and later basins were functionally similar and that the technical development was also expressed by “ponds with manipulated water conduction”, i.e. hydraulic enterprises. These “ponds with manipulated water conduction” could then also signify “artificially constructed basins” (see above) the more so since the later basins represented “further developed ponds” (see above). This “early” coincidental evidence preserved on stone material in pyramids confirms the existence of hydraulic enterprises on the floodplains, the “pond with manipulated water conduction, canal” (i.e. the basin), (at least) for the Old Kingdom 239.

In what time frame the gradual changeover from ponds to basins occurred, and how long manipulated ponds and artificially constructed basins were simultaneously in existence in different areas of the Egyptian Nile valley, must remain an open question 240. From cold-post-cold phases until dynastic times, there was only a long lasting, slow, sometimes interrupted (see

237 Cf. also Schenkel: 1978; see also below.


240 Cf. Atzler: 1981, for the problem of the “garden”-areas see below.
above) development from natural ponds to occasional manipulated ponds (see above) to more frequent pond manipulation and only "at the end" to artificial basins, with set-backs, local distinctions, and sometimes "coexistence," but not just an "invention". The gradual development from a pond to a basin enterprise could have been technically accomplished in different ways, for example, by equipping specially located and overworked natural concavities/ponds with hydraulic installations in such a way as to allow inundation and drainage of the residual water to be managed (for the problems involved see above). Using these more or less overworked "natural" concavities with water conduction mechanisms would have required only comparatively short canals and some dividing walls and dams 241. Different "practises" particularly in the "early stages" could have been performed simultaneously (see also above).

In Egypt with its comparatively narrow floodplain, in contrast to other areas, efforts for the utilization and manipulation of the floodplain could gradually be realized through comparatively simple measures, so that there was also no insurmountable innovation threshold. The Egyptian inundation economy was based primarily on the manipulated use of the restricted pond-areas (see above) on the inundated floodplain and not on the artificial irrigation outside the flood season (as for instance in Mesopotamia). But an extension of the restricted pond-areas on the floodplain could only be realised by artificial pond/ basin installations. The more ponds and (later) basins were artificially installed, the greater the percentage of the floodplain which was transformed into pond basin/ areas. But only the developed and expanded basin/ hydraulic enterprise system signified the transformation of the greater part of the floodplain into optimal agriculturally usable pond/ basin land. Optimal (Gramineae planting/) agriculture in the Nile valley and, for example, in (parts of) the Sahara (see below) depended on pond/ basin use. This is true even in modern times in Egypt.

In Egypt, irrigation by means of artificial water-lifting and transport especially played a role in the limited garden/ vegetable/ wine land 242. This garden land could be irrigated at certain locations outside the flood season by means of labour-intensive water lift and transport equipment. The water must have been taken from river-channels, canals, basins, and other accessible water reservoirs 243. The digging/installation of year-round water transporting canals improved certainly also the possibilities of the garden economy.

This gardening system could not, however, provide the necessary amount of primary food source/ cereals for the whole country. There must have existed a developed hydraulic enterprise guaranteeing the optimal production of staple food on the agriculturally usable inundated floodplains which would not have been feasible only with water scooped out of "water-holes, wells" etc. 244.

The modern "Hod Bimban" south of the Kom Ombo plain 245 may show how natural surface concavities/ponds and hydraulic enterprises could have been manipulated even in early times. The Hod Bimban is now a basin over 1 kilometer wide and several kilometers long. The dams of this basin are mostly formed


242 Cf. for Old Kingdom and following times, Klebs: 1915, 1922; Kees: 1958.

243 Urk. I, 212,5 also includes at least the use of garden land, see below; for the later "shaduf", cf. Davies: 1903, Pl. XXXII, 1933, I, 70-73, II, Pl. III; Klebs: 1934, 43 et sq.; Butzer: 1976; Kemp: 1989, fig. 2, 3.

244 The in this context often translated "well/water-hole with canal" would not have been a solution for the entire staple-(grain) food production of Egypt.

from the natural occurring but artificially elevated levees of the river Nile. To the west the basin adjoins the ascending floodplain margins. The floor of the basin is uneven and would only partly be a pond-area under natural conditions. One canal conducts the fresh inundation water in and later the residual water out of the basin. That means a basin is “constructed” here by using and extending a natural pond area, only slightly manipulated, and equipped with a canal. This can be one example of a hydraulic enterprise which was feasible even in the “early times” of Egyptian history.

In the Nile valley only a fraction of the naturally inundated floodplain consisted of ponds in pond-areas. Only these ponds could be used for optimal Gramineae “planting and growth” in the post flood landscape. Ponds could not be used long-term without manipulation (see above). The extension of the pond-areas on the floodplain was, especially under deteriorating environmental conditions, only feasible through further human manipulation: artificial “installations” of ponds or basins with concomitant enterprises. Therefore, under the special conditions of the Nile valley intensive (Gramineae) agriculture and production was only feasible through artificial inundation landscape manipulation, and the often assumed picture of a relatively small population which could have used abundant natural resources until dynastic times is apparently misleading. It is not possible that the whole spectrum of agricultural products, especially staple food like cereals, could have been produced for the whole country on the intensively irrigated garden land. This garden system could not have encompassed the whole range of agricultural production and hydraulic enterprises. Therefore, without hydraulic manipulation of the main pond/basin areas an intensive cereal production for a large population would not have been possible under the conditions of the Egyptian inundation landscape 246.

A gradual transition from ponds to basins with possible local variations could only be proven today by corresponding archaeological finds. But this can hardly be expected due to the material conditions of ponds, pond-areas, basins, canals etc. which are either concavities or piles of material consisting only of earthworks, stone, and some vegetable materials. Therefore, specific key fossils are not existing, and surface alterations and constant agricultural use of the same areas over thousands of years have largely destroyed all traces 247. Consequently, archaeological finds of manipulated ponds, early basins, canals, early river-levée-fixations, and corresponding earthworks etc. can hardly be expected.

Moreover, relevant written material, particularly the juristic files and local and central administrative lists and land registers once existing in large numbers throughout Egyptian history 248 are, with the exception of a few rests, mostly not preserved, especially from earlier dynastic times in comparison to later periods 249.

Here again it is only possible to judge the Egyptian inundation economy and its hydraulic enterprises within an interrelating context and

247 Ponds from earlier times are only preserved in areas which were no longer used due to ecological changes, see above.

248 Cf. for instance also Meeks: 1972.

249 In consideration to the preserved rests a huge amount of written files already existed in the Old Kingdom, cf. Posener-Krieger-de Cenival: 1968; Posener-Krieger: 1976, 1985; cf. also for instance the Uschebtis only existing from later times etc.; cf. also for comparison: at the Site of Bouqras at the Euphrates the “use of irrigation systems” is already assumed for PPNB times, <8500 B.P., cf. Byrd in Gebauer-Price: 1992; for the possibility of hydraulic enterprises “before 3000 B.C.” also compare the existence of “planned large-scale irrigation by means of canals” in the “proto-literate period” in Mesopotamia, cf. already Jacobsen, in Frankfort et alii: 1946, 128.
cannot be left to the chance of material preservation alone.

Throughout the whole "older" Egyptian history we have only sparse evidence for "hydraulic enterprises" in the written records.

From the Old Kingdom there is at least some evidence of hydraulic enterprises, some examples:

- "Wrw" = pond with manipulated water conduction, basin (Pyr. 203a, 1827a, see above);
- "dnj/dnj: i = "embanked land" (Pyr. 278c, for "dnj/dnj= abdämnen, mit r: gegen das Wasser; auch: (die Ufer) befestigen (mit m., Stein)", cf. WB V, 464, 575, "dnj = Damm als Feldergrenze", WB V, 465; for inundated land (without specification) cf. also Pyr. 1554a;
- opening of canals (cf. Pyr. 1102a);
- grg = found, establish (WB V, 186: "gründen, einrichten") with U 17/18, excavating a (corresponding to the sign rectangular) concavity filled with water, basin, this seems to refer to a rectangular garden-basin, but grg in relationship to the establishment of settlements and districts (WB V, 5, 10, Pyr. 1589, 1597, 1837, Urk. I, 4) refers certainly at least also to agriculture (cf. also "bassin d'irrigation", Yoyotte: 1962: RdE 14, 84; Aubert: 1975: Or 44, 7);
- a listing of different hydraulic enterprises appears in Urk. I, 212 251:

1: "It is the order of the majesty"; 5: "not should be counted canals, §-"water-bodies, areas with water-bodies" 252, dug out concavities filled with water253 water-lifting/ transport apparatus, sycomore/ trees254.

Long term usable areas can only be secured under the specific conditions of the Egyptian inundation landscape accompanied by attempts economy, see above, which formed "areas with a water-body", but § could also signify as t3 §, § wr for instance the Fayyum lake and other §-water-bodies, areas with water bodies, ponds, lakes etc., cf. also "wb: §" with agricultural connection, cf. Urk. IV, 1737, Yoyotte: 1959; Sauneron: 1959: Kemi 15, 34 et sq.; § can for instance also mean "bowl", cf. WB IV, 397-399.

253 With N 41/42 signifies "dug out", i.e. manipulated hydraulic enterprises, and it must stay open as to whether agriculturally usable ponds or only other concavities filled with water, pools "Wasserlöscher, Brunnen“ = WB IV, 567, for gardening (or something else, see below) are meant in this specific context. "Wrw" is not mentioned in Urk. I, 212, but only šd.wr with N 41/42 and this means according to "Egyptian definition" simply: "dug out concavities filled with water", and this information was sufficient for the Egyptian familiar with the circumstances in detail. The listing: Š.w, šd.wr, Šn.wt, Šw.wt may refer to gardening, but if the writer here meant "only gardening" with the whole listing is uncertain, particularly in light of our hitherto limited knowledge of the details of hydraulic enterprises, and the staple food for the members of the Pyramid complex was produced with agricultural instead of "garden" economy. But if all the staple food was delivered from outside to the Pyramid complex, or at least partly produced on land belonging to the Pyramid complex, is not certain and, therefore, it must stay open as to which "countable", i.e. "taxable", elements from the existing complex economy were addressed in this listing; for N 41/42 see also above: "wrw". If staple foods were indeed produced with the help of artificially "dug wells" this would hint at an even more developed form of hydraulic enterprises with, necessarily, a water-lifting/transport apparatus, also mentioned in the inscription, cf. Schenkel, 1978, 21-24, and this already in the Old Kingdom. But for the time being (see above) it would be better not to "overstretch" the evidence here.

254 Cf. for the problem also Kees: 1933; Goedicke: 1967; Fischer: 1973
at local and territorial river-levee-manipulation and fixation. The problem is to prevent the recurring natural shifting of the river bed due to sediment accumulation, high floods etc. 255. But attempts at a gradual fixation of the natural river-levees posed certain problems, which could only slowly be solved. In the Nile valley, river-levee fixation means the local damming of the main river in such a way that even at (least “normal”) peak flood the water cannot uncontrollably flood the areas used 256. A complete Nile-river-levee regulation (i.e. not just fixation) is only feasible with the help of a flood-trough to control the increase of the floodwater pressure 257. A river-levee regulation system of the Nile could only gradually be accomplished and required constant effort. But a locally limited river-levee fixation and the creation of closed/ dammed local inundation areas will not be confronted with the problems of increased floodwater pressure 258. In any case, such attempts at local river-levee fixation necessitated the construction of “overflow-openings”, later overflow-canals, which allowed the controlled inundation of the areas to be used 259.

Since the Old Kingdom, Nile flood level measurements have been recorded on the

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258 Willcocks: 1904, suggested that in Old Kingdom times only the left bank of the river was fixed and correspondingly used.


260 Such regular, precise measurements, besides important events like religious festivals, creation of statues of gods, warfare, taxation, etc., demonstrate that at least during times of a functioning central administration this data must have been of prime importance. But this data only assumes such significance when it can (at least also) be used for decision-making in an administrative economic context. Such use of flood level data is only feasible when corresponding hydraulic enterprises exist, in other words local river-levee-fixation, closed/ dammed local inundation areas, and hydraulic manipulation on the floodplain: “ponds with canals”, basins etc. (see above). Without all this, these measurements could not provide any reliable data for estimating local and overall inundation intensity, for reckoning the optimal time for hydraulic apparatus manipulation, for sowing, for tax assessment 261 etc. Under the permanently changing conditions of a natural floodplain, pond-areas etc. (see above), Nile flood level measurements could not have been used as reliable administrative criteria 262.

Domestication and agriculture do not inevitably lead to the formation of early high civilization, but domestication and agriculture can develop and maintain an artificial ecosystem in which the yield is far greater than the natural biomass-supply which can be used by humans. This is particularly true for landscapes in which the highest possible productivity for usable

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biomass is made accessible only through human manipulation, as for example, hydraulic enterprises. But high, permanent investment in usable areas in hydraulic cultures implies, at the same time, that these highly productive areas were always circumscribed and surrounded by other areas of less (or no) productivity. The enormous effort involved in maintaining such an artificial ecosystem is explained by the imbalance between population size and the "naturally" available resources without the above-mentioned investments. Agricultural investments increase the available resources, which allows the maintenance of a greater population size than naturally feasible. Therefore, these agricultural investments cannot be given up without dramatic consequences.

The above remarks may have shed some light on the multifaceted problems of an intensified agricultural use of the highly productive Egyptian floodplains requiring also a gradually increasing amount of social cooperation. Incipient intra-group competition over the use of circumscribed highly productive areas in the Nile Valley developed into interrelating forms of discussion, agreement and cooperation culminating in a comprehensive social cooperation within the Egyptian kingdom. The necessity for a permanent, supervised, intensive cooperation among a representative number of members within a society in great socially relevant enterprises formed one decisive criterium for the development of early high civilizations.

In Egypt the necessity for a comprehensive social cooperation primarily in hydraulic enterprises, to guarantee the staple food production under specific environmental conditions, led gradually to the development of the early high civilization. There existed a connection between the quality of social cooperation in the inundation (hydraulic) economy with a corresponding food production success. But the developed Egyptian inundation economy only worked with maximum efficiency under a sophisticated and competent central and local leadership. When this central-local administrative cooperation-system did not function then the whole system regressed to a level of inferior quality with corresponding repercussions.

Government functions in Egypt are multifaceted and include also leader functions in the inundation economy, a condition which was an important factor determining political relationships. But a maximum efficiency of the Egyptian inundation economy and a high cultural standard could only be achieved as long as the central-local administrative cooperation-system was permanently able to provide optimum local and central leadership decisions under the special ecological conditions of a temporally and gradually changing Nile-levee-river-inundation-system (see above). The numerous and different problems of central-local cooperation, leadership-decisions and changing ecological conditions can already be seen in Old Kingdom times. But the results of the "combination" of ecologically problematic times with insufficient social cooperation in the Egyptian inundation culture, especially non-

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266 Local functionary like hrj mw; 3 n mw; 3 n b'h etc.; cf. Endesfelder: 1979: ZÄS 106: 47-48; for local people working at local hydraulic enterprises cf. pAnast. II; 6.

functioning central leadership, are distinctly demonstrated for instance at the end of the Old Kingdom and during the Second Intermediate Period 268.

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