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The Holocene Occupation of the Eastern Sahara: Regional Chronologies and Supra-regional Developments in four Areas of the Absolute Desert

Abstract

The following paper examines the climatic and cultural changes that occurred in the Eastern Sahara during the Holocene. The evidence is given from different areas of the absolute desert located on the Abu Muhariq Plateau (Djara), in the Abu Ballas scarp-land (Eastpans) in the Great Sand Sea (Regenfeld) and in the Gilf Kebir (Wadi el Bakht, Wadi el Akhdar). Each area has also yielded an independent sequence of occupation patterns during the Holocene wet phase based on numerous ^{14}C-dates from archaeological sites. Although the wider frame of climatic and environmental settings as well as the predominant cultural innovations was similar in all studied regions, the archaeological phenomena and thereby identified cultural processes were often quite different. Pottery played an important role during the entire period of occupation in the Gilf Kebir and is therefore the most important cultural marker in this area. The Regenfeld area yielded only a small amount of ceramic finds from the later occupation phase, whereas the Djara region showed 'aceramic' settlement units. Plant utilisation apparently increased in all areas during the mid-Holocene period. Up to now, we have not observed the introduction of livestock before the 6th millennium BC[1] (calibrated), while at the inner Great Sand Sea remains of domesticated animals are lacking.

Keywords: Holocene, Eastern Sahara, climate, prehistory, chronology, ^{14}C, domestication, stone tools, pottery.

Introduction

In the Eastern Sahara, the climatic and cultural development over the last 10000 years has essentially been reconstructed from the evidence carried out in the oases, the Nile Valley, and other favoured areas which are characterised by a permanent ground water supply. In contrary, this article will give an overall view of the current state of our knowledge about the Holocene occupation in the areas of Egypt's absolute Western and Libyan desert.

Fieldwork was performed between 1995 and 2000 in four different areas by a team of archaeologists, botanists, zoologists and geographers. The work has been carried out within the frame of the Cologne's ACACIA project which was mainly initiated by Rudolph Kuper. The general goal of this large scale research centre is the relation between the development of human activity and environmental setting in arid climate. Although ACACIA includes a number of different subprojects in southern and northern Africa, the interdisciplinary approach is the essential proposal.

The ACACIA expedition of 1998 was the onset of intensive surveys of the rich mid-Holocene sites and in the cave of Djara **[Fig. 1**, 2**]**, Abu Muhariq

1 All ^{14}C dates are mentioned in the text as calibrated dates in BC. The dates are calculated by *2-D Dispersion Calibration Program Version Cologne 2001* of *CALPAL (Cologne Radiocarbon Calibration & Palaeoclimate Research Package)* by B. Weninger, Radiocarbon Laboratory, University of Cologne. Uncalibrated BP dates of the areas investigated by ACACIA are listed in the **Table 1** (see p. 110f.).

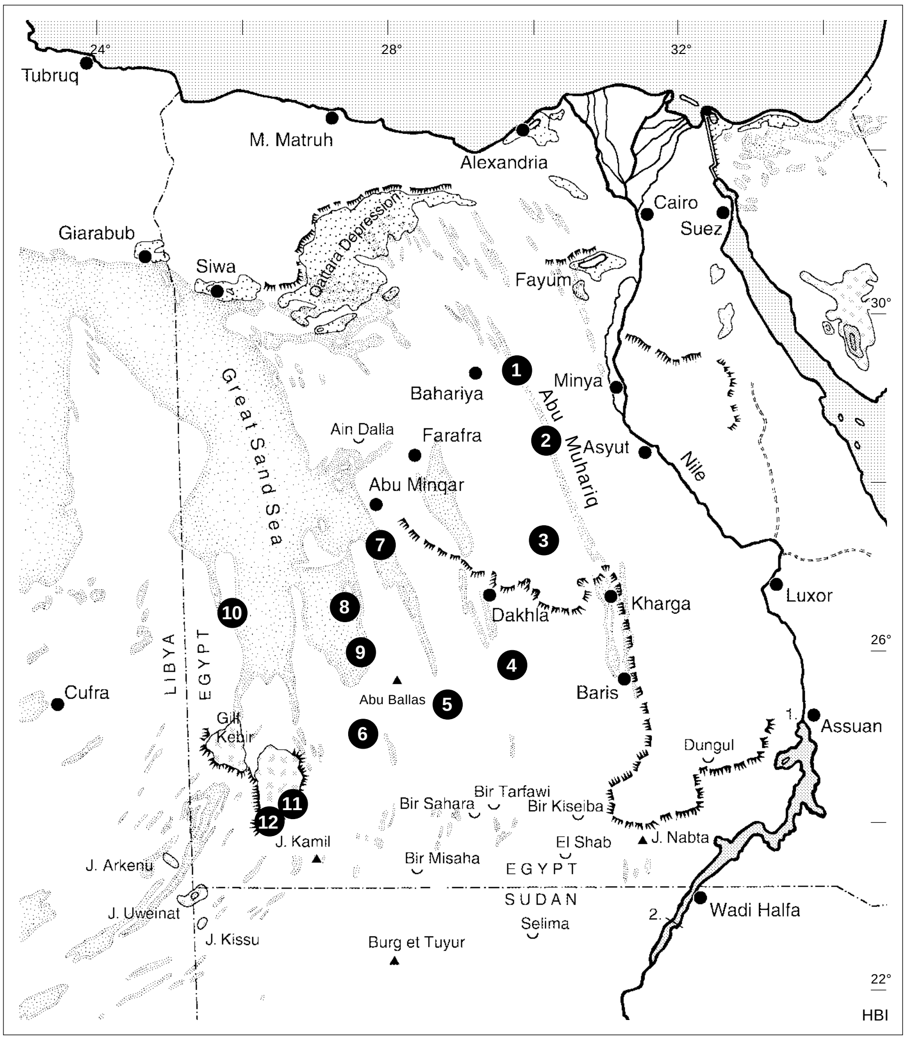

Fig. 1 Map showing the regions and local areas (*in italics*) mentioned in the text:

ABU MUHARIQ PLATEAU
1 *Seton Hill*
2 *Djara*
3 *Abu Gerara*

ABU BALLAS SCARP-LAND
4 *Eastpans*
5 *Mudpans*
6 *Westpans*

GREAT SAND SEA
7 *Abu Minqar*
8 *Regenfeld* (northern sites)
9 *Regenfeld* (southern sites)
10 *Glass Area*

GILF KEBIR
11 *Wadi el Bakht*
12 *Wadi el Akhdar*

Plateau, which was re-discovered in 1990 and briefly examined in 1993.

The playa sites of Eastpans **[Fig. 1**, 4**]** lie on the lower level of the eastern Abu Ballas scarp-land. During the 1995/96 and 1996 campaigns two large and a number of smaller sites were surveyed. They yielded data from the Epipalaeolithic and the beginning of the mid-Holocene as well as from the end of the Holocene wet phase. In 1996 and 1997 two campaigns yielded remains of numerous occupations in the Regenfeld area **[Fig. 1**, 8+9**]**, Great Sand Sea, among these several from the early Holocene or Epipalaeolithic.

Finally, the field-work of the Cologne's B.O.S. (*Besiedlungsgeschichte der Ost-Sahara*) project begun in the early eighties in Wadi el Bakht and Wadi el Akhdar **[Fig. 1**, 11+12**]**, Gilf Kebir, and was continued by ACACIA in 1999 and 2000. Whereas B.O.S. essentially focused on the sites in the wadis, the recent survey concentrated on the surrounding plateau sites.

In each local area the environmental and cultural development from the re-occupation in the early Holocene to the drying of the desert in the mid-Holocene has roughly been reconstructed, supported by numerous radiocarbon dates.

With very few absolute dates available so far, the Wadi el Bakht sites must be dated largely through comparison with more securely dated assemblages. As for relative dating, the best sequence for the southerly Western Desert is that based on work done by the *Combined Prehistoric Expedition* (CPE) in Nabta Playa and Bir Kiseiba, termed as Early, Middle, and Late Neolithic (WENDORF et al., eds., 1984). However, in the lack of evidence for the essential Neolithic traits as food production or at least a pastoral component we do not use the term 'Neolithic'. Although pottery production can roughly be subsumed as one of the Neolithic elements, it is by no means proven to be diagnostic. An 'aceramic' Neolithic as well as the use of a forager's pottery seems to be quite frequent in North Africa, similar to other kinds of multi-component subsistence strategies. In the following the early Holocene development is generally defined as 'Epipalaeolithic', which covers a widely uniform industry all over the regions. The mid-Holocene period is characterised by a diversification of cultural phenomena, both regional differences (concerning the lithics and the ceramics) and chronological shifting of the first appearance of pottery and new subsistence strategies. This points to the problem that units defining supra-regional horizons are less usable. Terms such as 'Ceramic', 'Neolithic' or 'Pastoral' distinguish archaeological horizons, independent of their absolute dating which is shifting from one region to another.

Consequently, we have need to establish more neutral terms to define the different periods of the sequences, and these will be named after the localities of the areas, except the area of Eastpans. There, a complete sequence has yet not been reconstructed, because both relative and absolute dates presently cover only short periods of time. In addition, not all the sites have been dated by ^{14}C-analysis, nor do the artefacts closely resemble the more securely dated industries elsewhere in the Eastern Sahara.

Although each sequence yielded an individual picture, the data will be used to develop generalised tendencies. Two cultural aspects are especially important in reconstructing the supra-regional developments: the introduction of pottery and livestock.

The Djara area (Abu Muhariq Plateau)

The Holocene sites of Djara **[Fig. 2]** are situated in a well defined area of 10 km by 5 km, located in between the Nile Valley and the Egyptian oases Bahariya, Farafra, Kharga and Dakhla, in the middle of the Abu Muhariq Plateau **[Fig. 1]**.

This region is particularly favoured by a hydrological system, which among other things led to the agglomeration of archaeological sites.

Djara was first mentioned by the German explorer Gerhard ROHLFS (1875: 59f.), who carried out an interdisciplinary expedition into the Western Desert. On Christmas Eve 1873 he made a rest near a spacious dripstone cave decorated with rock engravings (KUPER 1996. CLASSEN et al. 2001), which was called Djara.

The fieldwork, carried out by the ACACIA project since 1998 in this region, is still in progress. Until today 24 radiocarbon dates are available for the whole Abu Muhariq Plateau including Seton Hill, Djara, and Abu Gerara **[Fig. 1**, 1-3**]** (21 dates belong to sites of the Djara region). An early

Fig. 2 Djara 90/1.

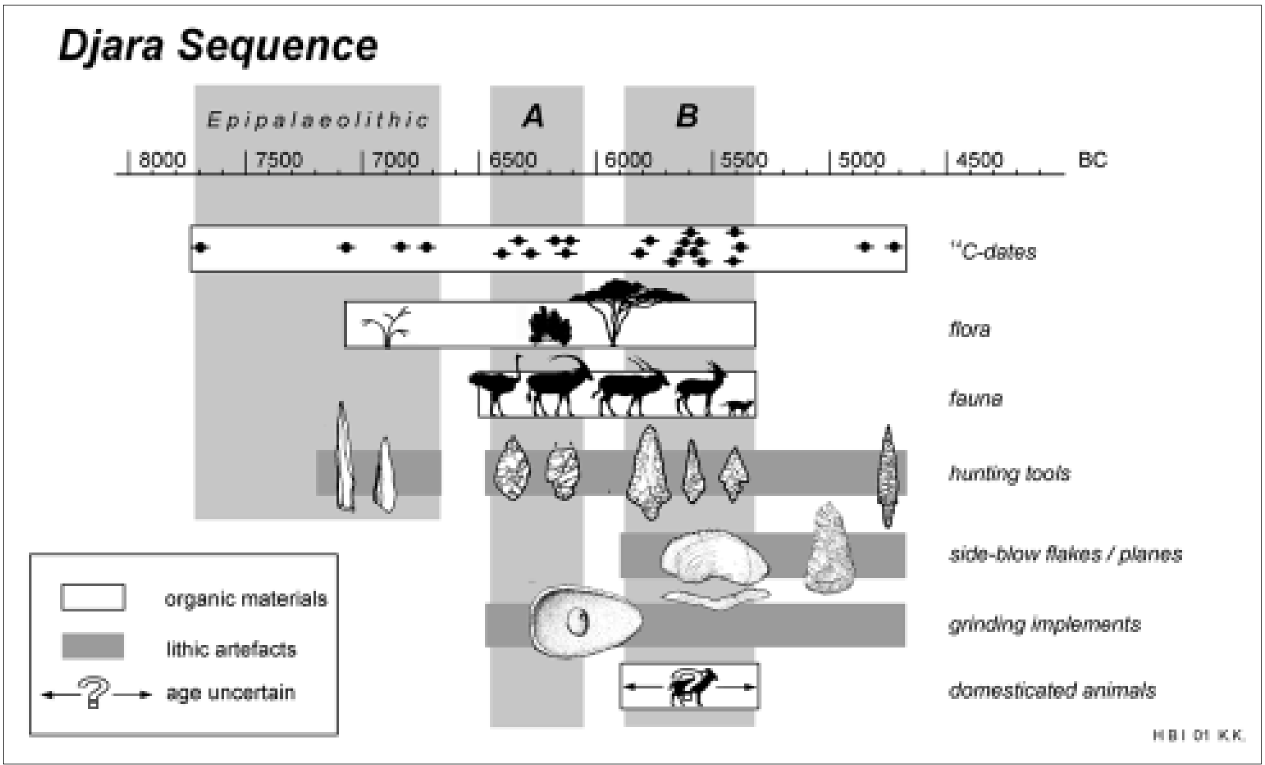

Fig. 3 The Djara sequence.

Holocene and a mid-Holocene occupation are distinguishable. The bulk of dates fall into the mid-Holocene, which can be separated into two distinct units, labelled as Djara A and Djara B **[Fig. 3]**.

Early Holocene occupation (ca. 7700-6700 BC)

Evidence for an early Holocene or Epipalaeolithic occupation of the Djara area are sparse. At the moment less than 5 % of all sites examined on the Abu Muhariq Plateau belong to this period. The predominant site type consists of single hearths with only a few, mostly broken stone tools or flakes. Probably they were used only for a short while as night camps or as short-term hunting camps.

The oldest indication for a human occupation is a charcoal sample taken from a hearthmound (*steinplatz*) (KN-4423: 7701 ± 110 BC). Artefacts were not associated with this feature at all.

Two samples of ostrich eggshell, taken from the surface of site Djara 90/1, provide early Holocene ^{14}C-dates (UtC-9460: 6839 ± 131 BC; KN-4422: 6721 ± 171 BC) for the artefacts in the nearer surrounding, which comprise lithic tools like notched and strangulated blades (TIXIER 1963: type 76), truncated bladelets (type 80) as well as backed elements. Above that, the assemblage of site Djara 98/20-3 consists of backed points with a straight back (TIXIER 1963: type 45) as well as elongated scalene triangles with one very short truncation (type 95) and can be classified as Epipalaeolithic **[Fig. 4,14-19]**. Until now radiocarbon dates are not available for this feature.

Djara A unit (ca. 6400-6100 BC)

A significant change of the artefact assemblages and the settlement types can be established around 6400 BC for the Djara region. Large camp sites with dense artefact scatters on the surface are characteristic. Most of them yielded various activity zones, which emphasize that they were used over a longer time as temporary camp sites (KINDERMANN in press). During Djara A domestic

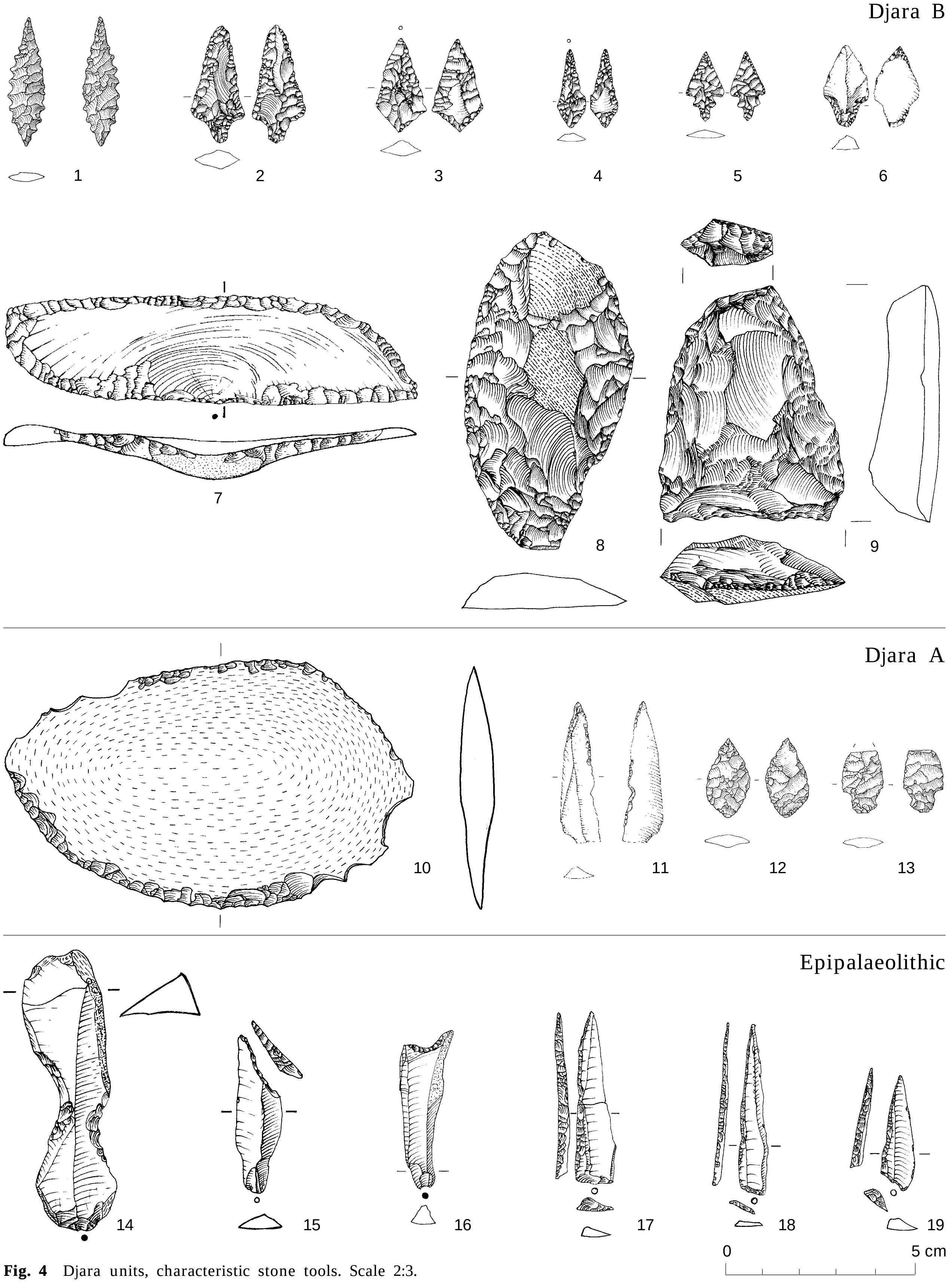

Fig. 4 Djara units, characteristic stone tools. Scale 2:3.
Djara B: 1-6 Points; 7 side-blow flake; 8 side scraper; 9 plane. – Djara A: 10 Side scaper; 11-13 points. – Epipalaeolithic: 14 strangulated blade; 15-16 truncated bladelets; 17-19 elongated scalene triangles.

activities are substantiated for the first time by grinding implements.

Site Djara 90/1-2, with two radiocarbon-dates around 6300 BC (KN-4602: 6409 ± 93 BC; KN-4603: 6280 ± 88 BC), is exemplary for this unit. Blades are the main blank products in the preceding early Holocene, which became less important in Djara A in favour of flakes, produced by a direct percussion. Stone tools like edge retouched or notched artefacts, facially retouched pieces, borers of TIXIER's type 12 (1963), simple end scrapers on flakes (type 1) and side scrapers on weathered flint sherds as well as facially and laterally retouched arrowheads are typical **[Fig. 4,10-13]**. Points with facial retouch appear for the first time in the region of Djara during the A unit (ca. 6400 BC) as it is also known from Eastpans around 6350 BC (see below) **[Fig. 4,12.13]**. The tool kit of this unit shows strong similarities with Bashendi A (ca. 6400-5700 BC) of the Dakhla Oasis (McDONALD 1991a: 43ff. 1992: 58ff. 1996. 1998a. 1998b).

Djara B unit (ca. 5800-5400 BC)

The number and size of archaeological sites increase during Djara B. Grinding stones are not so numerous as it is known from other sites like, Eastpans or Regenfeld, because good raw materials for grinders are absent on this Eocene limestone plateau.

Technological aspects, which already emerge in Djara A, like the common flakes produced by a direct percussion or the facial retouch, gain much more importance in Djara B. Stone implements were preferred to made out of flakes or weathered flint sherds during this unit. Djara B shares with Djara A such tool classes as edge retouched, notched and facially retouched artefacts, borers (TIXIER 1963: type 12), arrowheads and side scrapers. In the Djara B unit circular scrapers, sometimes bifacially retouched, are well known.

Side-blow flakes, which were also used as side scrapers (cf. CATON-THOMPSON 1952), appear for the first time during this chronological unit **[Fig. 4,7]**. Two reduction sequences of side-blow flakes could be refitted on the knapping-site Djara 90/1-6, dated by ^{14}C-dates around 5700 BC (UtC-9462: 5778 ± 48 BC; Erl-2859: 5608 ± 79 BC). A knapping experiment, done after an ACACIA campaign in 1998, pointed out a powerful direct hard-hammer percussion for the manufacturing process.

The predominant modification technique of Djara B is the facial retouch, which is frequent in all inventories. In many cases the facial retouch is executed very regularly, so separate retouch scars run parallel to each other on the surface of the artefacts (pressure flaking). This can be observed e.g. on the facially retouched arrowheads, which are the dominant tool type in the artefact assemblages of unit Djara B **[Fig. 4,1-5]**. A broad spectrum of different arrow points is obvious, unifacially and laterally retouched types – typical for unit Djara A – are less frequent during this period **[Fig. 4,6]**. Hollow based points, which are characteristic for the Fayum Neolithic (cf. CATON-THOMPSON & GARDNER 1934) and the Western Desert Oases (cf. CATON-THOMPSON 1952: pl. 99,14-16; 158. McDONALD 1992: fig. 3a) are absent in Djara.

Three bifacially retouched arrowheads and one side scraper were found in situ in a hearth, which yield radiocarbon dates around 5500 BC (HD-16311: 5679 ± 38 BC; KN-4601: 5407 ± 61 BC) **[Fig. 4,2.4.5.8]**. Over and above that splintered pieces and facially retouched planes **[Fig. 4,9]** are the typical tool types. Bifacially retouched knives can be seen as characteristic for this mid-Holocene unit; they were observed only in assemblages dated as Djara B.

Typological likeness is obvious between Djara B and the late Bashendi A (ca. 6400-5700 BC) as well as the early Bashendi B (ca. 5450 BC) of the Dakhla Oasis (McDONALD 1991a: 43ff. 1992: 58ff. 1996. 1998a. 1998b); also with the Neolithic assemblages of Kharga (CATON-THOMPSON 1952) and Farafra (BARICH & HASSAN 1988).

Numerous shells of the Nile mollusc *Aspatharia rubens* were excavated in Djara 90/1 and demonstrate contacts to the Nile Valley.

The archaeological sites of Abu Gerara **[Fig. 1, 3]**, southern region of the Abu Muhariq Plateau, show all in all stronger parallels to the oases, located more southerly, as to the archaeological region of Djara (RIEMER in press b). Ground celts and undecorated pottery are documented for the Bashendi unit of Dakhla as well as for Abu Gerara but they are unknown in Djara.

Mid-Holocene climate and environment

For the whole mid-Holocene (Djara A and Djara B) the flora, adapted to an arid climate, was all in all confirmed by the archaeobotanical investigations for the Djara region. The charcoal samples (analysed by St. Nussbaum) predominantly showed a vegetation adapted to arid conditions, like *Acacia* and *Tamarix*. Furthermore the identification of different Capparaceae-species points to the fact that water was episodically available and that the environmental conditions were better, as is known for the Regenfeld area. Carbonised fruits of *Anastatica hierochuntica* were observed in the charcoals of cave site Djara 90/1-3. Under current climatic conditions *Anastatica hierochuntica* only occurs on the more elevated and cooler plains of the Gilf Kebir Plateau and at the Mediterranen seashore. These incidences give a hint for a probably winter rain influenced Djara region during the mid-Holocene. On the other hand the species of Capparaceae could be interpreted as a move forward of the summer rain belt, which would support the hypothesis that both rain regimes possibly overlap in the area of Djara (pers. comm. St. Nussbaum).

The archaeozoological analysis (H. Berke and N. Pöllath) shows a fauna also predominant only under dry conditions. The inventories contain nearly exclusively wild forms such as various gazelle species, e.g. *Gazella dorcas*, *G. leptoceros*, *G. dama*, antelopes like *Oryx gazella dammah* and *Addax nasomaculatus*, furthermore *Carakal carakal* as well as *Struthio camelus* (BERKE 2001).

The precipitation in the mid-Holocene was presumably per annum never higher than 100 mm and would have supported only seasonal populations with the rare and only episodic exception showing more favourable condition under nevertheless sparse vegetation (NEUMANN 1989a. 1989b). For Djara A and Djara B a generally arid environment with short humid intermediate stages can be reconstructed. The playa-profiles of this region demonstrate alternating layers between sandy sediments (drier periods) and homogeneous clay deposits (more humid periods) (pers. comm. O. Bubenzer).

After 5400 BC a clear break is visible in the sequence of radiocarbon dates **[Fig. 3]**. Two single samples, taken from hearthmounds (Seton Hill 99/8; Djara 90/1-12), date later around 4800 BC (Erl-2871: 4719 ± 121 BC; Erl-2861: 4869 ± 96 BC) and verify only sporadic human activities, whose climatic significance is not foreseeable at the moment.

The once more drying trend of the desert in the mid-Holocene probably became noticeable already around 5400 BC on the Abu Muhariq Plateau. During this time Djara seemed to be no longer attractive for humans.

Subsistence strategies

Evidence for the reconstruction of the subsistence of Djara A and Djara B are sparse. For the early Holocene occupation (until 6700 BC) a hunter-gather subsistence is plausible. The faunal assemblage consist of wild animals and hunting weapons, which are dominant in the stone artefact inventories, like backed retouch implements.

Around 6400 BC a clear change in the way of life occurred with mid-Holocene Djara A. Facially and laterally retouched arrowheads took place of backed retouched insets. Combined with this development the blade industry got less important for the blank production.

This significant change is also visible in the increased appearance of grinding implements after 6400 BC (Djara A). While there is no evidence for cultivated cereals in the Djara region as well as in the Eastern Sahara, it seems plausible that wild grasses and seeds were ground. Together with this change the number and size of the archaeological sites increased enormously. It can be seen as an indicator for a longer stay and a more intensive exploitation. A sedentary settlement is not conceivable for the whole Abu Muhariq Plateau because permanent water resources are missing. The ecological conditions in the mid-Holocene appear satisfactory enough for a nomadic usage. Game hunting was an important factor for the subsistence during all chronological units. Hitherto one bone fragment of a domesticated sheep (*Ovis ammon*, fragment of proximal Radius) was found in a mid-Holocene surface concentration of site Djara 90/1, which is associated to Djara B artefacts (BERKE 2001).

The Eastpans area (Abu Ballas scarp-land)

Two playa basins within the eastern Abu Ballas scarp-land were discovered by the German photographer Rudolf René Gebhardt. The depressions are situated about 150 km east of Abu Ballas and 100 km south of Dakhla Oasis, both produced large multi-occupation sites, which were named as Eastpans 95/1 and 95/2 **[Fig. 5]**. In addition, a number of smaller sites in the vicinity have been surveyed, of which one has been excavated, but no further concentration of prehistoric sites of comparable extend could be observed. The sites were first visited by an ACACIA team in December 1995, excavations and detailed surface collections took place during two campaigns in the beginning and autumn of 1996.

Epipalaeolithic (until ca. 6600 BC)

From the Epipalaeolithic **[Fig. 6]**, only two excavated assemblages have been examined from the area of Eastpans. Some 3 km to the south of 95/1 an isolated Epipalaeolithic site (96/6) was discovered on a fossil dune. It contained two surface scatters including 22 cores and 76 retouched stone artefacts. The most common tool types are edge-retouched or notched blades (in total ca. 70 %). Elongated scalene triangles are less frequent (14 %), followed by multiple burins (7 %). Varieties of flint are dominating the raw materials, followed by silicified sandstone and quartz. An available date from ostrich eggshell beads gave an age about 7400 BC (KN-5223). This date fits into the pattern of similar Epipalaeolithic sites from the surrounding regions such as the Masara A unit in Dakhla Oasis, dated between 8000 and 7600 BC (McDONALD 1991b: 90ff.), or B.O.S. sites in the Abu Minqar and Ain Dalla regions at the northeastern fringe of the Great Sand Sea between 7600 BC (85/26: KN-3726) and 7300 BC (85/28-1: KN-3836; KN-3968; 85/28-2: KN-3882). On site Glass Area 81/61 (= “Willmann's Camp”) such an assemblage is dated about 7600 BC (KN-3102) and in Regenfeld about 7300 BC (Regenfeld unit C). Among the stone tools, we found two upper grinders and a number of fragments of lower grinders. This site occurred as an argument that grinders were sporadically used in the Epipalaeolithic, however, high amounts of grinding stones have been observed only on 'post-Epipalaeolithic' sites.

A dense Epipalaeolithic artefact scatter was found among the surface concentrations on the basin margins of site 95/1. A small area of 11 m^2 (95/1-2) was excavated. The collection of the surface assemblage and the excavation of the subsurface material revealed an unusual arrangement of features and artefacts. Beneath the scarce remainders of a hearth or a shallow pit two anvils from silicified sandstone and a depot of 12 nuclei in different stages of preparation from quartz-pebbles were found. The ensemble of approxi-

Fig. 5 Eastpans 95/2.

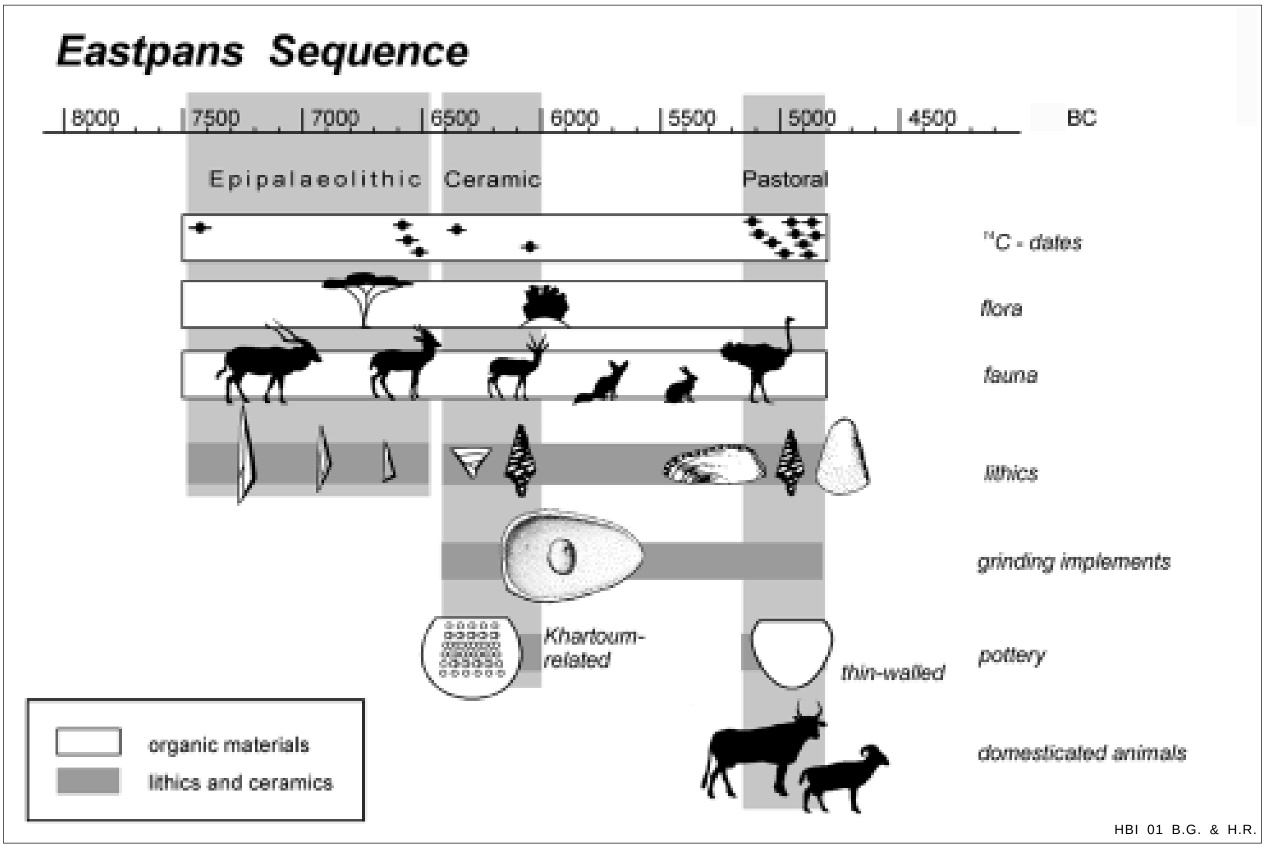

Fig. 6 The Eastpans sequence.

mately 1800 artefacts is dominated by bladelets, backed bladelets, geometric microliths, microburins and the waste of stone artefact production **[Fig. 7,15-20]**. Only few macrolithic stone tools were found – some large edge-retouched blades and flakes, one scraper, one bec and one burin. 40 % of the artefacts were made of flint, which have been brought here from the Abu Muhariq Plateau north of Dakhla Oasis, but some 30 % were made from quartz. Veins of quartz can be found within the sandstone-formations only a few kilometres away from the site but we didn't find any sources of pebbles until now. Only a few artefacts, mostly edge-retouched large blades, consist of local silicified sandstone, very few consist of petrified wood or desert glass. The raw materials of the stone artefacts show connections of the Epipalaeolithic occupants to the regions some 100 km to the north (flint) and about 400 km to the Glass Area of the western Great Sand Sea (!). In respect of the great distances between the primary sources and the sites of Eastpans, the raw materials underline the high mobility of the Epipalaeolithic groups.

The ensemble of the microliths, with dominance of elongated scalene triangles in combination with some short scalene triangles and one asymmetrical trapeze, hint to an age due to the Early Neolithic of Nabta type (CPE-chronology, Nabta Playa E-75-6 dated around 7000 BC, BANKS 1984: 61ff. WENDORF & SCHILD 1984: 7). Among the ostrich eggshell artefacts of 95/1-2 there is one sherd with an incised ladder decoration. An interesting parallel can be found on the B.O.S. site 85/5-4 in the Sitra-Hatiet close to the Oasis of Siwa (CZIESLA 1993: 188ff.). Here several sherds of a water-container with a very similar decoration were found within an Epipalaeolithic assemblage. This site is dated around 7000 BC by radiocarbon measurements (KN-3754; KN-3756). On the eastern fringes of the Great Sand Sea there are several sites in the area of Abu Minqar. The

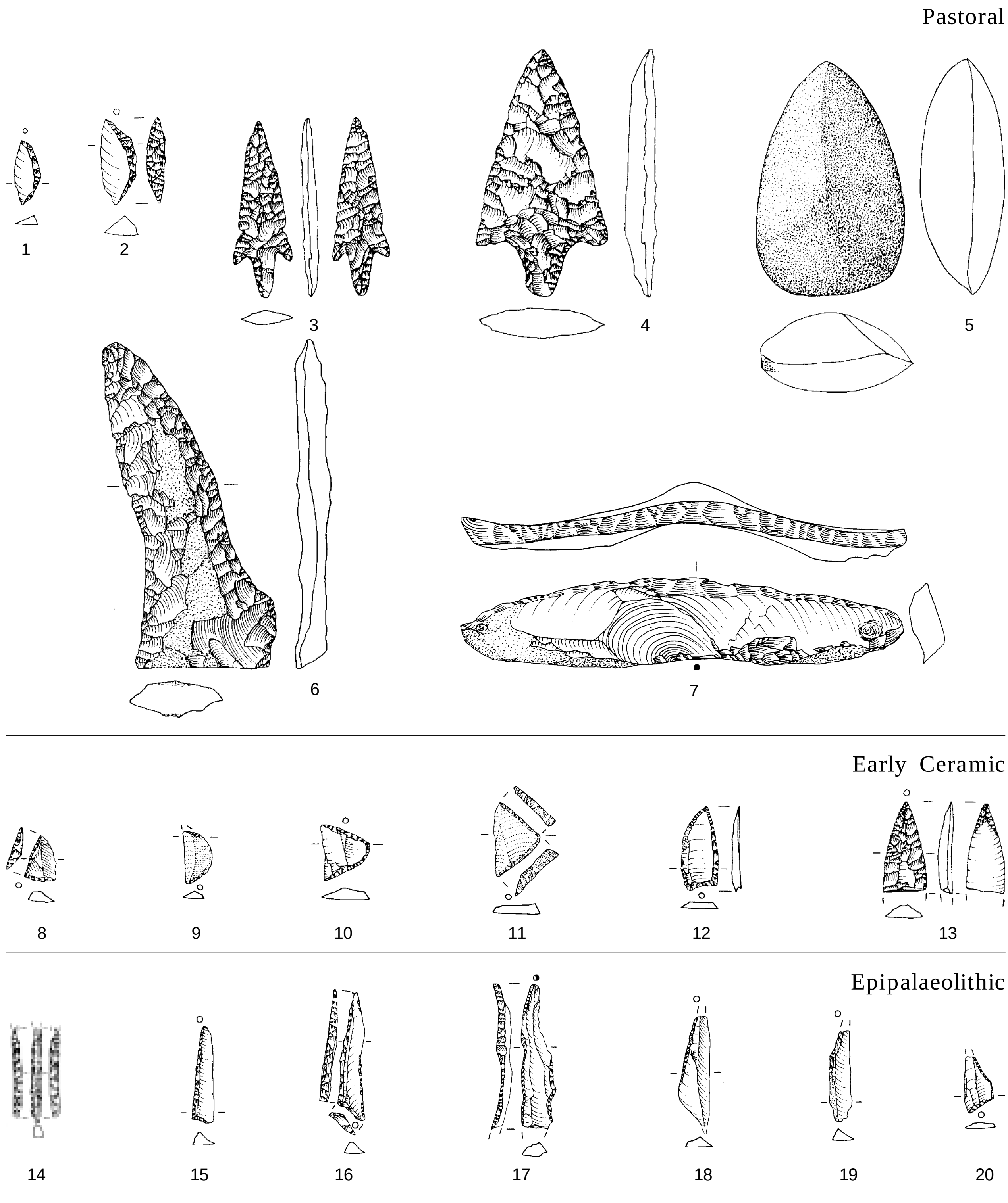

Fig. 7 Eastpans units, characteristic stone tools. Scale 2:3.
Eastpans 95/2 (Pastoral): 1.2 Segments; 3.4 points; 5 plane; 6 knife; 7 side-blow flake. – Early Ceramic (Eastpans 95/1-1): 8-12 Triangles/trapezes; 13 leaf-shaped bifacial point. – Epipalaeolithic (Eastpans 95/1): 14 needle-shaped perforator; 15-20 elongated scalene triangles and backed points.

extend settlement area of the B.O.S. site "Lobo"(= Abu Minqar 81/55) yielded many concentrations of stone- and ostrich eggshell-artefacts. The excavation 81/55-5, with mixed assemblages, date around 6800 BC (KN-3724; KN-3357) and 6300 BC (KN-3552). With the older date, elongated scalene triangles, microburins, edge-retouched and notched soft-hammered blades and ostrich eggshells with the same decoration are associated (KLEES 1990).

There was no charcoal from 95/1-2, which could be used for radiocarbon analysis. The bones were poorly preserved. The survey (by H. Berke) yielded *Oryx gazella dammah* and *Gazella dorcas/ leptoceros*.

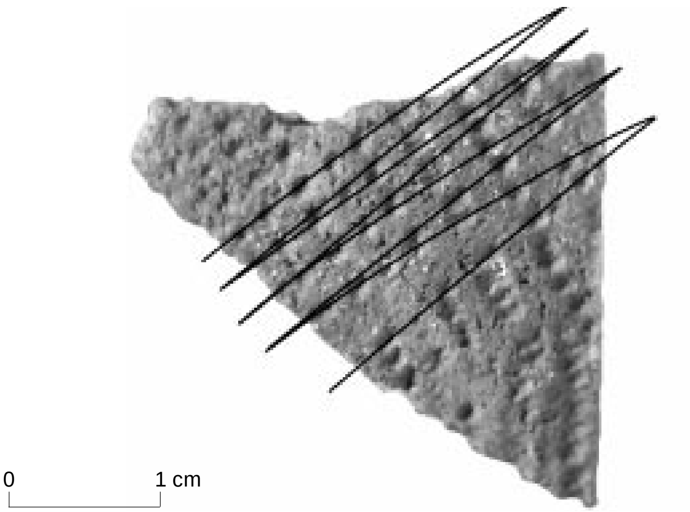

Fig. 8 Eastpans 95/1: Khartoum-related potsherd with packed dotted zigzag motif (about 7500 bp). Lines indicating the rocker technique. Scale 2:1.

Epipalaeolithic-Ceramic / 'Middle Neolithic' transition (ca. 6700-6300 BC)

Close to the western shore of the depression in 95/1 we were lucky to detect a stratigraphy with an early ceramic occupation overlying a horizon with artefacts dating to the end of the Epipalaeolithic period. Both units were brought to light in two different excavation trenches. The lower, Epipalaeolithic, part of the sequence is radiocarbon-dated with three dates around 6700-6500 BC (UtC-5623; UtC-5459; UtC-5582). The small Epipalaeolithic assemblage of the trench contains 13 retouched tools, unfortunately no backed element or microlith, but a needle-shaped perforator **[Fig. 7,14]** and several soft-hammered edge-retouched and notched blades and flakes. Most artefacts were made from flint, which originates from the Abu Muhariq Plateau north of Dakhla Oasis, or local quartz, and a few pieces of local silicified sandstone. Comparable stone tools as the needle-shaped perforator and the notched blades stem from the Early Neolithic of the CPE sites E-80-1 C in Bir Kiseiba (CLOSE 1984: 278ff.) and E-75-6 in Nabta Playa (BANKS 1984: 90ff.) dated around 7000 BC. Due to the assemblages of the early Middle Neolithic of Nabta and Bir Kiseiba, artefacts are distributed on the surface and within 10 cm below of 95/1-1. They contained potsherds with packed dotted zigzag motif **[Fig. 8]** and some hundred stone artefacts. The latter consist of waste from the artefact-production and a number of stone tools. There are grinding stones, edge-retouched blades and flakes, scaled pieces, one retouched piece from tabular silicified sandstone and one relatively large polished tool-fragment which was possibly been a celt of some sort. Striking is the variety of arrowheads and geometric microliths **[Fig. 7,8-13]**: two unifacially leaf-shaped points, one edge-retouched point with a hollow base, one triangle-point with straight base-retouch, one segment, and different transversal arrowheads in form of one symmetrical trapeze and two equilateral triangles. The rare blades of the upper layer at 95/1-1 differ significantly from the underlying late Epipalaeolithic artefacts in their knapping-attributes: Like all other artefacts from this assemblage they are all hard-hammered pieces. The majority of the artefacts are made from local quartz, however most of the tools are of flint, silicified sandstone or chalcedony whose origin is still unclear. This assemblage is dated around 6350 BC (UtC-5585), only slightly younger than the Epipalaeolithic material below.

B.O.S. site Abu Minqar 81/55-5 produced mixed ensembles which were dated around 6800 BC (KN-3724, KN-3357) and 6300 BC (KN-3552). With the younger date, bifacially retouched leaf-shaped arrowheads, small and only edge-retouched arrowheads with short stem, transversal arrowheads in form of trapezes and probably most of the scaled pieces can be associated (KLEES 1990).

As to the decorated pottery of Eastpans 95/1, the B.O.S. site of Mudpans 85/56 (KUPER 1993: 217. 1995: 129), some 150 km to the northwest, yielded similar potsherds covered with a packed dotted zigzag motif. Radiocarbon dates on charcoal samples point to an age between 6500 and 6350 BC. In both cases – Mudpans and Eastpans – the pottery is of a standard type, usually well fired and with a dense texture of angular or gently rounded quartz temper. While the ceramics of both sites show a standard picture, the large site of "Willmann's Camp" (= B.O.S. site Glass Area 81/61) at the western margins of the Great Sand Sea about 400 km to the northwest has produced predominantly dotted zigzag decoration combined with organic and shale tempered fabrics diverging from the tradition mentioned above (KUPER 1988: 132ff. 1995: 128f.). The dotted zigzag motif is common within the Khartoum complex of Nubia. Ceramic with impressed decoration over the entire exterior of the vessel, the preference of quartz as raw material for flaking stone artefacts, the described arrowheads and microliths and polished celts are common in the Middle Neolithic assemblages of the Gebel el Nabta and Bir Kiseiba regions in southern Egypt, which are dated between 6700 and 6300 BC (WENDORF & SCHILD 1984: 415ff.). McDONALD (1992: 58ff.) has noticed "several small sherds with punctuate or impressed designs" on the Bashendi A site 275 (ca. 6600 and 5900 BC) from the Southeast Basin of Dakhla (McDONALD 1991a: 45). Additionally Siegbert Eickelkamp (pers. comm.) found similar sherds at the eastern Abu Tartur foothills and on the top of the plateau. There are also some sherds with "comb-impressed decoration" from Ain Raml, Farafra area (HASSAN et al. 2001: 38).

The faunal remains from 95/1-1 were studied by Hubert BERKE (2001: 242). Only hunting game could be identified: *Gazella dorcas*, *G. leptoceros*, *Addax nasomaculatus*, and *Lepus capensis*. Almost all bones came from the upper part of the stratigraphy.

Pastoral/'Late Neolithic' (ca. 5100 BC)

At the southwestern border of the 95/2 basin a concentration of bones and ceramics were discovered during the 1995 survey. In January 1996 a surface of 27 m^2 was excavated, eleven hearths of different sizes and one *steinplatz* (hearthmound) were observed.

The sediment was excavated approximately 5 cm deep. Here the number of finds decreased noticeably. The smaller features with ash and/or charcoal had disappeared, and three new small concentrations of ash and charcoal came to light. These three belong to an earlier occupation phase after which playa floated over the surface. Six features could be dated via radiocarbon analysis. These dates are all of similar age between 5100 and 4950 BC. Statistically all of them are contemporaneous, although a stratigraphic ordering of the features is possible.

Most of the stone artefacts concentrated around, and within, the largest hearth "location 1". The excavation brought approximately 1200 stone artefacts to light, most of them made from eighth different flint-variants originating from the Abu Muhariq Plateau, and local silicified sandstone and local quartz. Only few objects were made of chalcedony and petrified wood, some pieces were of sandstone and one upper grinder were made from granite. The assemblage is dominated by the waste of stone knapping. Most of the artefacts are very small, nearly 50 % smaller than 15 mm. There are only very few bladelets, microburins are absent. Only 3 % of the artefacts are tools, most of them geometric microliths, among them 14 segments **[Fig. 7,1.2]** and four trapezes. As bladelets and microburins are missing, it is likely that small flakes were used as blanks for the microliths. Only a few larger tools were found: two end and one

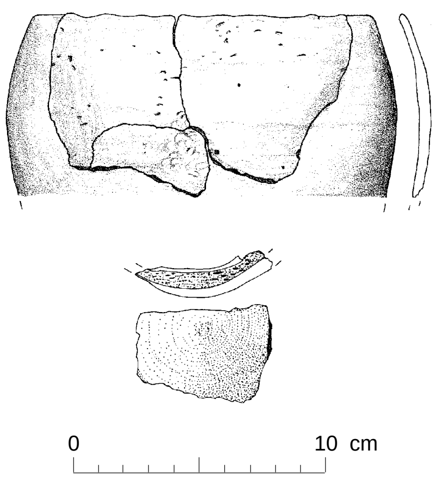

Fig. 9 Eastpans 95/2: undecorated thin-walled pot (about 6000 bp). Scale 1:3.

side scraper, one large perforator, one bifacially retouched point **[Fig. 7,3]** and one side scraper on a side-blow flake **[Fig. 7,7]**. A number of artefacts was collected from the surrounding surface, among them a large bifacial point, a polished celt and other bifacially retouched items **[Fig. 7,4-6]**.

The occurrence of side-blow flakes and planes can be used as markers for the Late Bashendi A / Bashendi B unit (McDONALD 1990. 1991a. 1992. 1998b). This is underlined by the assemblages of the Djara B unit.

A high amount of undecorated potsherds of a thin-walled silty fine fabric with small shapes were collected from the excavation and surrounding area **[Fig. 9]**. The paste had been tempered either with sand and grass-seeds visible from the black voids or with sand and fine shale; some were tempered only with sand.

As to the dating of the pottery of 95/2-1, undecorated thin-walled fabrics are known from Dakhla Oasis, related to the Bashendi B unit (HOPE 1999: 239). Parallels are also found in the collections of the Abu Gerara survey between Djara and Dakhla (RIEMER in press b). There an age parallel to the Djara B unit is proposed by similarities of the stone tool assemblage. The region of Gebel Kamil south of the Gilf Kebir (B.O.S. site Gebel Kamil 83/28-1) also produced similar pottery.

Here a flake-dominated assemblage of stone artefacts with segments mainly produced from quartz was excavated. Unfortunately, the radiocarbon dates of ostrich eggshell of about 3500 BC (KN-3974; KN-3975) must be regarded as far too young. A similar undecorated thin-walled and well polished ceramic are reported from site E-76-7 in Kharga Oasis (WENDORF & SCHILD 1980). The stone artefacts of the assemblage, which is dated around 4800 BC, consists mainly of hard-hammered retouched flakes and blades, perforators and scrapers. Within the Late Neolithic of Wadi el-Akhdar there are some assemblages with similar microliths but a different stone technology and a much younger dates (B.O.S. site 81/4 dated around 4700 BC: SCHÖN 1996a: 584ff. B.O.S. site 80/7-2 around 4500 BC: SCHÖN 1996a: 318ff.). Small thin-walled vessels from these sites are comparable to the pottery from 95/2-1.

From the largest hearth "location 1" come most of the botanical remains which have been analysed by Hala Barakat (BARAKAT & EL-DIN FAHMY 1999: 36ff.). Beneath *Acacia* and *Ziziphus* a variety of wild grasses and cereals have been identified. Barakat reconstructs a relatively moist environment with a dense grass vegetation which was used by the inhabitants of 95/2 as a staple foodsource and for animal fodder. Faunal remains were found throughout the whole excavation but were best preserved in "location 1" and "location 2" (*steinplatz*). In addition to the rests of hunting game such as *Gazella dorcas*, *Addax nasomaculatus*, and *Lepus capensis*, Hubert BERKE (2001: 243; Abb. 4) identified remains of *Canis* sp. and domesticated sheep (*Ovis ammon*) and cattle (*Bos taurus*). However, wild animals play the major role and indicate therefore a multi-resource subsistence, combining herding, hunting and gathering.

Fig. 10 Eastpans 95/2: burial.

It is likely that the place was used several times within a shorter period because of the relative stratigraphy of the features and the short distances between them. Although no hut could be detected, it seems clear that the spot was used as cooking area where different kinds of food processing took place. South of the excavation there is a large field covered with *steinplätze* (hearth-mounds). One of them (95/2-5) was dated by ^{14}C to around 5200 BC. The well preserved large structure showed an unusual pitch black filling with little charcoal and a lot of oily wood tar. It is possible that on this spot tar was processed for particular purposes.

Unfortunately, the attempt to radiocarbon date the only burial found so far (95/2-2) **[Fig. 10]** was not successful, the bones lacked sufficient collagen. The study of the skeleton by J.E. Molto indicate that the burial is that of a man of about 50 years. Offerings were not observed, except for a concentrated brown substance, and bone fragments of Phalanx III of a gazelle (determination by H. Berke) below the skeleton, inside the grave pit.

Predynastic or Early Dynastic Phase (around 3000 BC)

In the vicinity of the mentioned sites a number of small concentrations of pottery have been discovered which fall into the period after the desert had developed. Not far from 95/2 a small concentration of sherds with basketry impressions was discovered. They are similar to those of the Sheikh Muftah unit in Dakhla Oasis (TANGRI 1991. HOPE 1999: 221). Moreover, three locations produced remains of the Pre-/Early Dynastic Clayton rings, including a single rock (95/3) with two ceramic caches in situ (RIEMER & KUPER 2000: 93f.).

Settlement pattern

The distribution of the sites shows a different system of land-use during the early Holocene in comparison with the later units. Eastpans 95/1 and 95/2, although both site-scatters in playa basins, have a different geomorphology if looked at in detail. These differences must be taken into account when discussing the differences in the prehistoric occupation of both areas. At 95/1 the basin stretches northward to the foothills of a low escarpment, whereas the western and southern shores of the hollow are softly rising slopes. To the east the depression shows a wide sandy plain. The prehistoric sites lie on a terrace at the western shore of this basin. The main concentration with prehistoric remains is to be found within an area of 500 to 350 m. Westward of this main accumulation is a second concentration of features and finds which lie in a circle 300 m in diameter around an area nearly void of remains. The sites in the western area can mainly be dated to the Epipalaeolithic, whereas the sites closer to the basin-shore are younger – 'Middle' or 'Late Neolithic'.

In 95/2, some 4 km west, the situation is remarkably different. Here we found a shallow basin of approximately 800 by 800 m with well defined edges. The prehistoric remains are distributed in four distinct concentrations of features and finds. Most of the datable artefacts can be related to 'Late Neolithic' activities. Only a few single objects can be associated with the Epipalaeolithic and only one feature can, until now, be firmly dated by radiocarbon analysis into the Ceramic or 'Middle Neolithic'. It is probable that older remains are still hidden within the playa at the upper parts of the basin-shore.

Contacts and movement

For all occupation units of Eastpans the raw material of the stone artefacts as well as the ceramics show a wide spun network of relations. Connections mainly to the Abu Muhariq Plateau in the north and for the Epipalaeolithic site 95/1-2, to the Glass Area in northwest across the Great Sand Sea, are visible through the raw materials of the stone artefacts. During the later units the connections to the oases in the north still existed. With regard to the ceramics, there is evidence for relations to the southern regions in Nubia for the time around 6500 BC. For the 'Late Neolithic' phase around 6000 BC and probably in later times, we can detect connections to the oases in the north, as well as to the southwest into the Gilf Kebir and Gebel Kamil region.

Summary

Until now we can report little but there is very interesting evidence from Eastpans about 100 km south of Dakhla Oasis. Only few sites and features in the region have up until now been examined, and we are far from establishing a whole occupation-sequence. The occupations fixed by radiocarbon dates fall into phases which are poorly dated in the adjoining surveyed areas of the ACACIA project and those where colleagues are researching in Dakhla Oasis to the north or Nabta Playa / Bir Kiseiba to the south. We are still confronting the terminological dilemma by using the term 'Neolithic', without having any hard facts for a pastoral way of life before 5100 BC. Eastpans 95 / 2-1, the first Neolithic complex in this respect, was excavated and yielded domesticated cattle and sheep as well as a concentration of several hearths. The term 'Epipalaeolithic' for small scatters with predominantly backed elements and an expressive soft-hammered blade- / bladelet-technology is also insufficient because it describes a certain style of living which could have been only a part of a more complex and 'Neolithic' subsistence strategy – but this has to be confirmed by much more data than is available now. Both playa-basins of Eastpans as well as few smaller playas in the vicinity can be seen as comparable favourable regions throughout the early and the mid-Holocene. Here we registered a concentration of settlement-activities on the shores of moist depressions where water would have been available at the surface after sufficient rainfalls. Nevertheless, as the data says, people mainly survived by gathering grass-seeds and hunting wild animals throughout the whole occupation-sequence.

The Regenfeld area (Great Sand Sea)

Holocene sites were explored during the B.O.S. mission at the eastern (Abu Minqar) and western margins (Glass Area) of the Great Sand Sea (KUPER 1981. 1988: 132ff. KLEES 1989a. 1989b). Most sites mentioned here are situated in the inner Great Sand Sea. They are located at the edge of a playa basin **[Figs. 1**, 8; **11]**, about 50 km northwest of the small stone pyramid of Regenfeld, which was built by the German explorer Gerhard ROHLFS in 1874 (1875: 161ff.). At present, 17 radiocarbon dates are available for the Regenfeld area covering the Holocene wet phase **[Fig. 12]**.

Regenfeld A-C units (ca. 8700-6900 BC)

It has been suggested that the human occupation of the rather dry Eastern Sahara began by about 9500 bp (ca. 8800-8700 BC) (KRÖPELIN 1993), when the rains moved into the desert. This is confirmed by a camp fire from the site Regenfeld 96 / 1 with charcoal and ostrich eggshells which has a radiocarbon date of 8652 ± 90 BC (KN-4973). Unfortunately, significant artefacts are not related to this feature.

Fig. 11 Regenfeld 96 / 1.

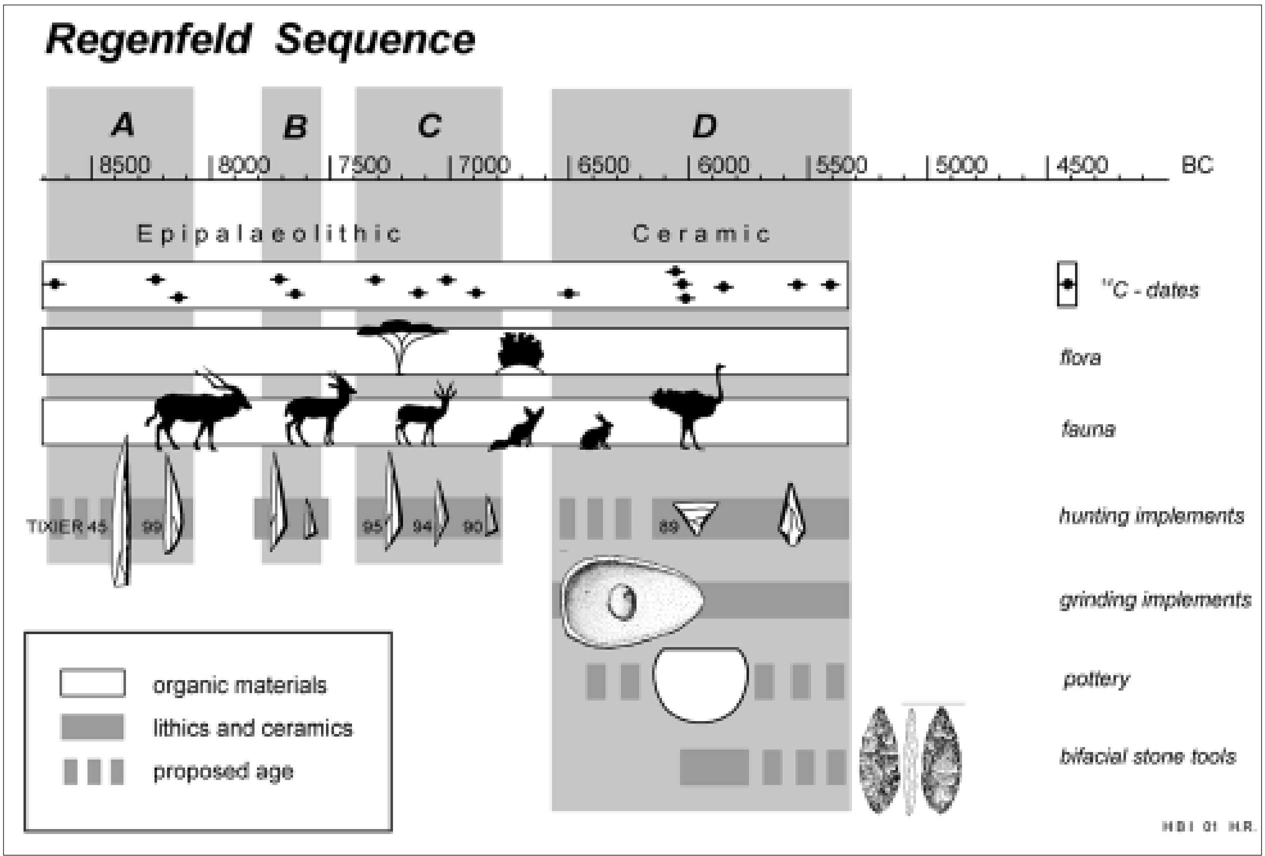

Fig. 12 The Regenfeld sequence.

The early Holocene or Epipalaeolithic of Regenfeld was grouped into three chronological units indicated by different lithic tool-kits. The Regenfeld A unit, featuring the oldest complex, was documented by two isolated surface scatters of site 96/20. The predominant tools were elongated backed points with straight or arched backs (TIXIER 1963: types 45 and 99) **[Fig. 13,23-28]**. Two ^{14}C-dates place the assemblages at about 8200 BC (UtC-7191; UtC-7192).

The Regenfeld B unit is dominated by elongated scalene triangles **[Fig. 13,17-22]**. The differences in size and shape of the tools essentially increased. Two excavations (96/1-1 and 96/1-7) yielded radiocarbon dates of 7714 ± 82 BC (UtC-6534) and 7645 ± 72 BC (KN-5053). Elongated trapezes may characterise a rare variant of the backed bladelets **[Fig. 13,14.15]**. Parallels to these trapezes are scarce among the assemblages from the Eastern Sahara. A number of trapezes are documented on site Westpans 85/52 dating to 7850 BC (KUPER 1993: 214). In contrast to Regenfeld 96/1-7, Westpans 85/52 showed a predominance of backed points (HAHN 1988) which are rather common in the Regenfeld A unit.

So far the Regenfeld C unit has been placed by four ^{14}C-dates between ca. 7300 and 6900 BC (UtC-7186; UtC-7187; UtC-5581; UtC-7188). The sites contain elongated triangles and other backed bladelets **[Fig. 13,7-13]** as well as a new macrolithic blade component. Continuously notched or strangulated blades are the most characteristic macrolithic tool type from Regenfeld C **[Fig. 14]**.

The Regenfeld sequence coincides roughly with the chronological sequence of the CPE with the characteristic lithics of the El Adam-, El Ghorab- and El Nabta-Early Neolithic (WENDORF & SCHILD 1984: 409ff. 1994. 1998. CLOSE 1992). However, with regard to the introduction of pottery and domestic animals, the Early Neolithic of Bir Kiseiba and Nabta Playa might be quite different to the Epipalaeolithic of Regenfeld. Distinct similarities

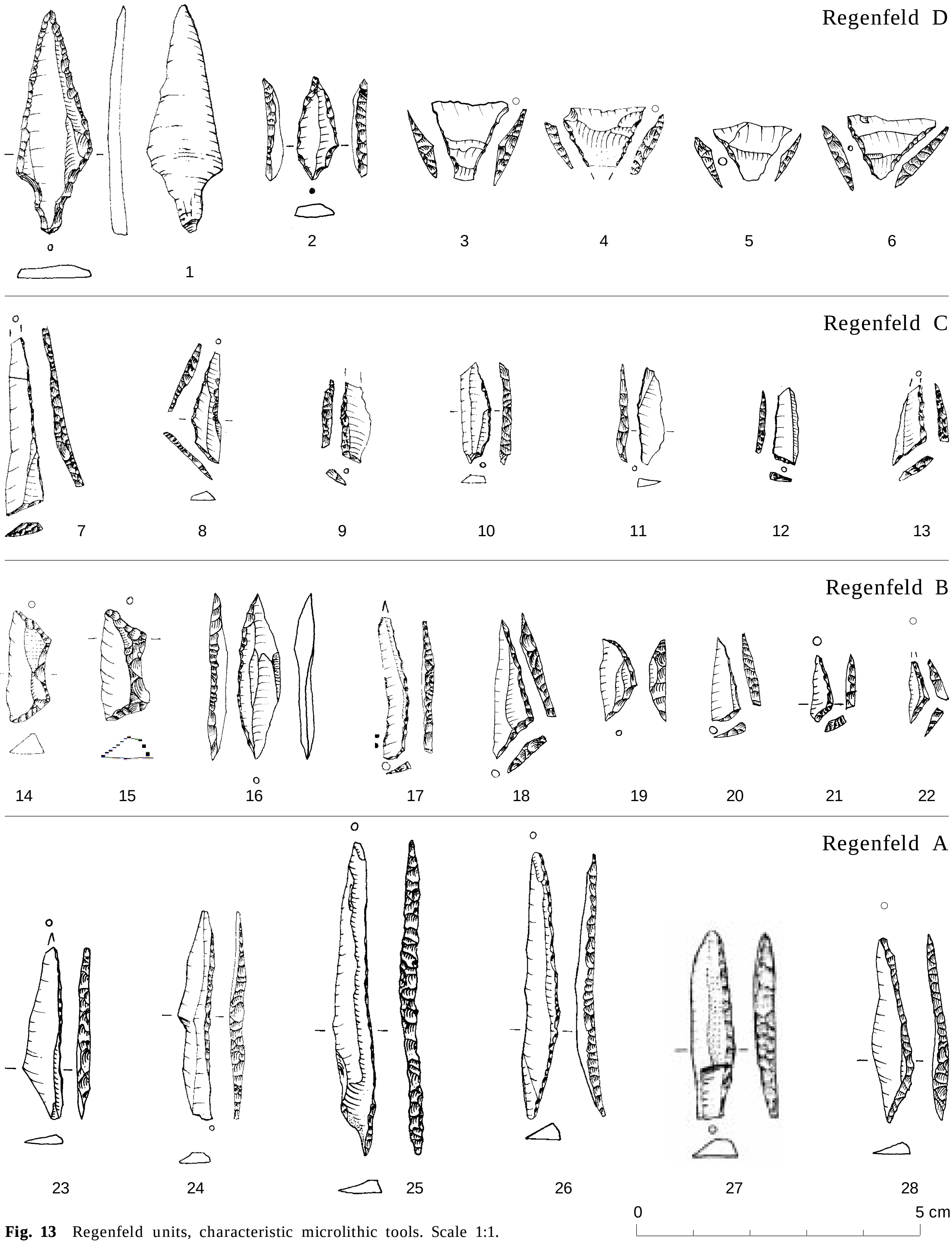

Fig. 13 Regenfeld units, characteristic microlithic tools. Scale 1:1.
Regenfeld D: 1.2 Tanged points; 3-6 transversal arrowheads. – Regenfeld C: 7-13 Elongated scalene triangles. – Regenfeld B: 14.15 Elongated notched trapezes; 16 backed point; 17-22 Elongated scalene triangles. – Regenfeld A: 23-28 Backed points.

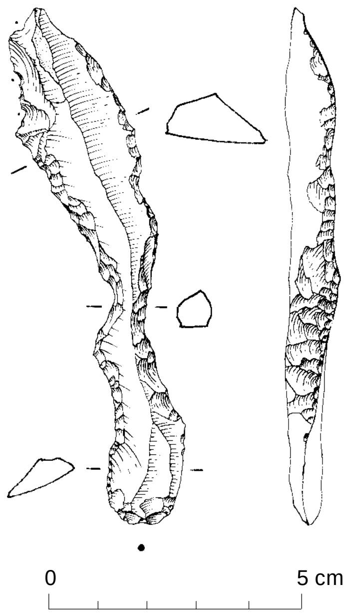

Fig. 14 Regenfeld C unit: notched or strangulated blade. Scale 2:3.

to the Regenfeld B and C units are present in the microlithic assemblages of the Elkab Epipalaeolithic (VERMEERSCH 1984) and partially in the assemblages of the Masara units of the Dakhla Oasis (McDONALD 1991b: 99).

Regenfeld D unit (ca. 6500-5400 BC)

As there is no specific marker in the material culture, which may have led us to further diversification, the phase between the end of the Epipalaeolithic and the drying of the desert, which is roughly associated with the mid-Holocene, is currently summed up as the Regenfeld D unit. The data base concerning the beginning of the Regenfeld D unit is very small. It might be worth while adding some information from the neighbouring areas, in particular, from Mudpans and Eastpans (Abu Ballas scarp-land). There the change of inventories after the Epipalaeolithic has been fixed by ^{14}C-dates to around 6600/6500 BC. In Eastpans 95/1 the youngest Epipalaeolithic event dates to 6600 BC. The onset of the following unit characterised by pottery, transverse arrowheads and facially retouched points falls at about 6500-6350 BC in Mudpans (KUPER 1993. 1995) and around 6350 BC in Eastpans (see above). A date of 6493 ± 75 BC (KN-3983) from site Regenfeld 87/2 coincides with this early Regenfeld D period. A series of ^{14}C-dates clusters in the second half of the unit, ca. 6050-5400 BC. Among the lithic tools are transverse arrowheads **[Fig. 13,3-6]**, borers, splintered pieces and elements with lateral retouch. Tanged points and bifacially modified artefacts are present in low percentage on site 96/19 **[Fig. 13,1.2]**. Flakes and blades with large platforms dominated the blank production. One of the most important characteristics is that grinding stones were essentially more frequent in the Regenfeld D unit. It might indicate a change of the subsistence strategy towards a predominant gathering of wild cereals.

Moreover the average extension and the diversity of camp sites increased in the Regenfeld D unit. The large sites include a wide range of activities and dense artefact scatters. They were predominantly located at large playa basins.

At the moment, the full significance of pottery in the inner Great Sand Sea is difficult to understand. Decorated fabrics are unknown from the Regenfeld sites and the undecorated type occurs at only one site, Regenfeld 96/1 cluster 4, dated to 6052 ± 53 BC (UtC-7190). These sherds (RIEMER 2000), tempered with very coarse angular quartz grains, are different from those of other sites. In the wider vicinity of the southern Great Sand Sea, the oldest pottery that has been discovered on locations along the Abu Ballas escarpment in Mudpans 85/56 (KUPER 1993: 217. 1995: 129) and Eastpans 95/1. It is attributed to the beginning of the Regenfeld D unit (see above).

The undecorated pottery occur in various fabrics from numerous sites. Although the earliest dated potsherds came from the same excavation unit in Mudpans 85/56 (as the mentioned decorated ware), undecorated pottery appeared throughout the whole mid-Holocene.

In the faunal assemblages all identified bones belong to wild animals, not only in the Epipalaeolithic but also in the Regenfeld D unit. Remains of domesticated cattle or small livestock have not been observed. Only one possible remain of domestic cattle was recorded at the site of Regenfeld 96/15 (RIEMER in press a). This bone is a mandible fragment from a large bovid. Morphological details, especially the dorsal edge of the Diasthema point towards *Bos taurus*, but the determination is not certain (H. Berke, confirmed by A. Gautier). Further bone remains have been collected during an excavation in 2000 and will help to clear the picture. Associated ostrich egg-shells have been dated to 5553 ± 49 BC (UtC-7185).

The inner Great Sand Sea is relatively void of archaeological remains from the periods after the development of the desert. The only exception are two sites featuring the Predynastic or Early Dynastic Clayton rings (RIEMER & KUPER 2000). The one is located at the western part of the Sand Sea, another one on the rocky hill of Regenfeld 96/15.

Climate and environment

The excavations and surface collections of the Regenfeld sites have yielded evidence for a characteristic arid fauna and flora during the Holocene wet phase (RIEMER in press a). The examination of charcoals from camp fires and hearthmounds (*steinplätze*) conducted by B. Eichhorn and St. Nussbaum, contained remains of *Acacia* and *Tamarix*.

The fauna (surveyed by H. Berke) consists almost entirely of ostrich (*Struthio camelus*), hare (*Lepus capensis*), fennek (*Fennecus cerda*), gazelles (*Gazella leptoceros*, *G. dorcas*) and antilope or large gazelle (*Addax nasomaculatus/Gazella dama*). Small gazelles dominated the fauna, whilst *A. nasomaculatus/G. dama* is less frequent. These species do not need water. Other desert-adapted forms such as oryx (*Oryx gazella dammah*) or hartebeest (*Alcelaphus buselaphus*), which only rarely need to drink, were not observed. This indicates the arid conditions of the Egyptian Sahara with an estimated precipitation which never exceeded 50 mm in the early Holocene, and 100 mm in the mid-Holocene (NEUMANN 1989a: 142. 1989b: 113), combined with the less favoured plain relief of the Sand Sea. Environmental differences between Regenfeld and the southerly site of Mudpans near the Abu Ballas scarp are clearly visible. In Mudpans dama gazelle and oryx were very numerous and semi-arid intrusions (eg. giraffe, elephant) were present in a small number (VAN NEER & UERPMANN 1989: 327f.).

As to the environmental development, the chronological chart for Regenfeld indicates that the spectra of species, did not change significantly from the early to the mid-Holocene. However, sedimentological evidence from the Holocene layers of the fossil dune of 96/1 probably suggests a moderate change between ca. 7200 and 5850 BC towards more favourable conditions indicated by a decrease of eolian sand deposition.

Wadi el Bakht/Wadi el Akhdar (Gilf Kebir)

Archaeological sites in the Gilf Kebir were recorded in several areas, e.g. like in Wadi Sora, Wadi Wassa, Wadi Firaq or Contrast Wadi as well

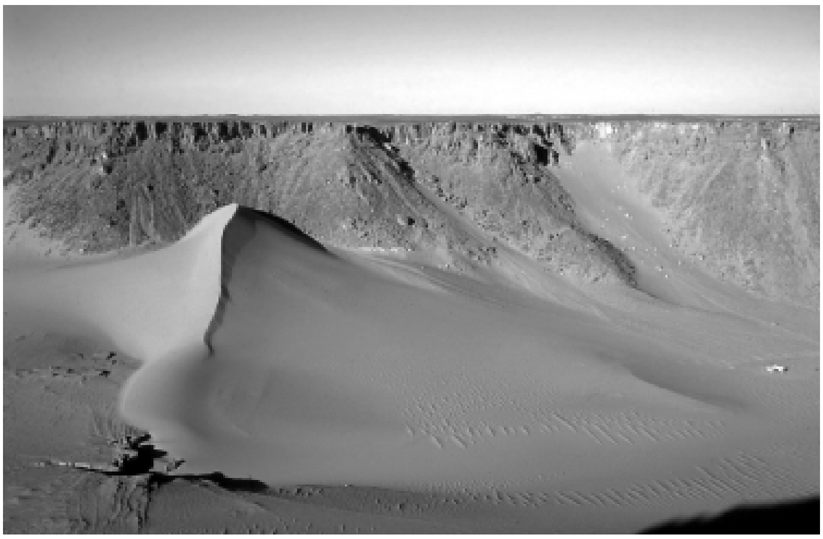

Fig. 15 Wadi el Bakht playa and dune.

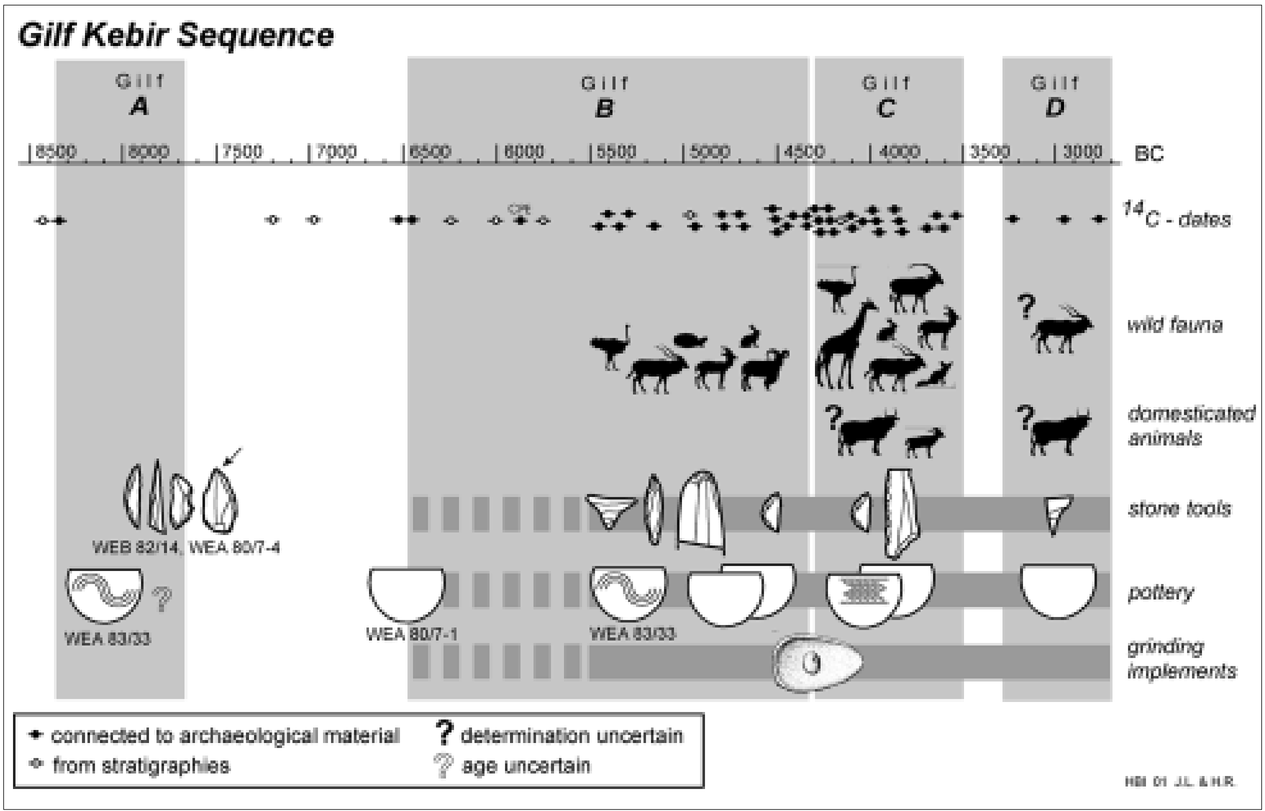

Fig. 16 The Gilf Kebir sequence including the Wadi el Akhdar and Wadi el Bakht.

as some scattered sites on the plateau itself. However, the major inventories come from extended excavations and surveys in the Wadi el Bakht (WEB) **[Fig. 15]** and Wadi el Akhdar (WEA) (KUPER 1981. LINSTÄDTER 1999). In this paper, their regional chronologies will for the first time be combined to form a basic chronology of the whole Gilf Kebir Plateau area.

B.O.S. fieldwork in both wadis started in the early eighties of the last century. The excavations conducted in the Wadi el Akhdar were subject of the Ph.D. thesis of Werner SCHÖN (1996a). In the Wadi el Bakht single sites were examined in two Master theses (HALLIER 1996. LINSTÄDTER 1998). The remaining material from the Wadi el Bakht is still being worked on, and fieldwork is still being undertaken. In the last two years, this fieldwork has focused on human activities in the wadi itself in relation to the surrounding plateau as well as the plains east of the Gilf Kebir (LINSTÄDTER in press).

In total about 50 ^{14}C-dates are available from the Gilf Kebir area **[Fig. 16]**. Except for two recent dates from ceramics from the site WEA 83/33 discussed below, all radiocarbon dates from the Wadi el Akhdar are presented in SCHÖN (1996a: Tab. 17). Half of the data from the Wadi el Bakht come from a large playa profile (WEB 82/13) and is not yet directly connected to archaeological material (KRÖPELIN 1989). The other Wadi el Bakht dates come from excavations of 'Neolithic' sites of different age close to the profile. A single date comes from an atelier site on the Wadi el Bakht plateau, excavated in 2000. Based on these data and inventories, the 'Neolithic' occupation can be divided into four units (Gilf A to Gilf D).

Gilf A unit (starting from 8100 BC)

In analogy to the resettlement of the Great Sand Sea, the first ^{14}C-data of this phase are from the middle of the 9th millennium BC. However, the earliest date of 8383 ± 293 BC (KN-2879, SCHÖN 1996a: tab. 17) from layer G of the profile WEA 80/7 is not linked to any archaeological inventory.

The only date from this unit connected with artefact material (UtC-6536: 8310 ± 61 BC), comes from wavy line pottery from the site WEA 83/33. In order to avoid destroying one of the rare decorated pieces, an undecorated fragment of the same ware was dated (SCHÖN 1996a: pl. 107,7). Due to the unexpected high age of this sherd, it was decided to date a further (this time decorated) piece, which rendered an age of only 5338 ± 71 BC (UtC-8219). Therefore the question of the earliest occurring of wavy line pottery in the Gilf Kebir remains open.

On the same site WEA 83/33, as well as the site WEA 80/7-4, Epipalaeolithic microliths such as elongated triangles, backed points, other backed microliths and burins based on blades, as known from numerous inventories of the Eastern Sahara, were found. The excavator Werner SCHÖN (1996a: 357) compared types of the site WEA 80/7-4 with finds from different sites of the Combined Prehistoric Expedition (CPE), predominantly dating between the middle and the second half of the 8th millennium BC. According to these microlith forms the early date of 8383 ± 293 BC (KN-2879, SCHÖN 1996a: tab.17) can serve as a reference point for the onset of human settlement in the early Holocene.

The Wadi el Bakht finds (WEB 82/14) were extracted from mixed inventories on the basis of typological features **[Fig. 17,42-48]**. A special type of notched trapeze **[Fig. 17,42]** is also documented for two sites situated outside of the Gilf Kebir (i.e. Westpans 85/82 and Regenfeld 96/1) linked with data around 7700 BC.

Gilf B unit (ca. 6500-4300 BC)

Two ^{14}C-dates connected with archaeological material come from the middle of the 7th millennium BC. They are situated in the layer D of the profile WEA 80/7-1. Apart from some stone artefacts, numerous sherds of an undecorated vessel of 37 cm diameter were found (SCHÖN 1996a: pl. 10,1). Schön assigns it to the Middle Neolithic of the CPE. Thus the beginning of the phase Gilf B can (comparable to the sites of Westpans and Regenfeld D) be fixed around 6500 BC. After the data from layer D (see above), there are for a following 1000 years, no further ^{14}C-dates connected to archaeological material. These appear again around 5500 BC. In total, 10 inventories of the Wadi el Akhdar and the Wadi el Bakht are assigned to the phase Gilf B, both from single and multiple phase sites. The number of inventories is evenly distributed among the two wadis, but an extension of the sites and the amount of artefact material lead to the assumption that the Wadi el Bakht was the main settlement area. However, this impression might be influenced by conditions of preservation, since in the Wadi el Akhdar erosion is more pronounced.

Pottery is represented on almost all sites of unit Gilf B, however not as numerous and well-preserved as in the following phase Gilf C. Different ceramic types are distinguishable. On the site WEB 82/21, mineral as well as organically tempered ware and mixtures have been described (LINSTÄDTER 1998). All types have certain features in common, such as the absence of ornaments (with the exception of edge notches) **[Fig. 17,38-40]**, an average wall thickness of 8 mm, a simple surface treatment and a not very hard firing. The only decorated and directly dated sherd of this phase is the mentioned wavy line piece of WEA 83/33.

The spectrum of stone tools in the Gilf B unit is very broad **[Fig. 17,19-37]**. Besides a number of tools based on relatively large blanks such as endscrapers, most tools are based on small blanks which come from a standardised production of small blades and long-narrow flakes. A reduction sequence was reconstructed for the blank production of site WEB 82/21 (LINSTÄDTER 1998. 1999). Its general validity for the Gilf B unit is still to be verified. The spectrum of small tools is dominated by microliths such as segments, trapezes, triangles and no-geometrical forms. Drills (*mèches de foret* and others), splintered as well as edge-modified pieces (both notched and denticulated) complete the Gilf B tool kit.

Gilf C unit (ca. 4300-3500 BC)

This unit, lasting almost 1000 years, is well-documented in the Wadi el Akhdar. SCHÖN (1996a. 1996b) describes it as the “main settlement phase” of the Late Neolithic or “Jüngeres Spätneolithikum”. In total, 16 inventories from both

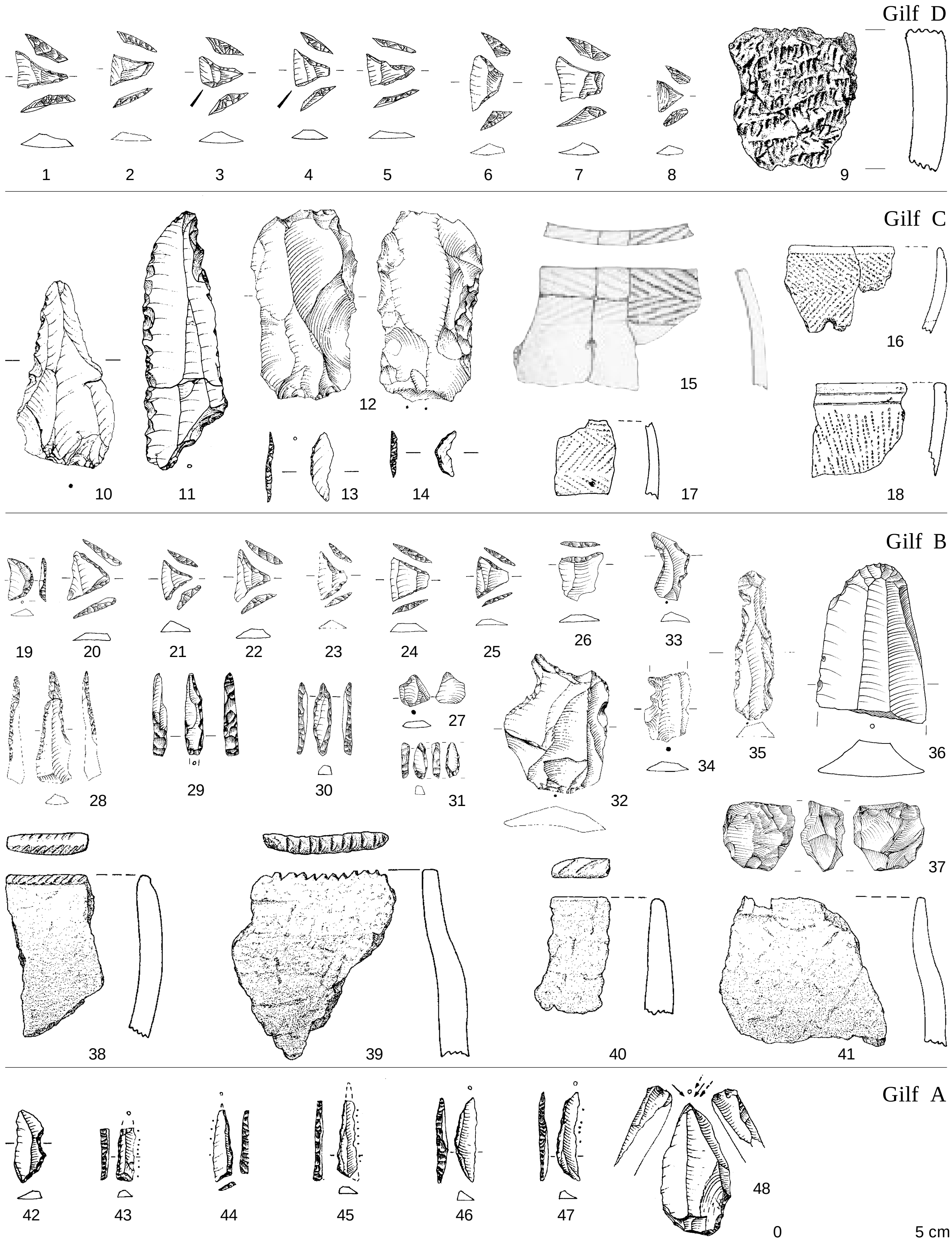

Fig. 17 The Gilf units, characteristic artefacts. Scale 1:2.
Gilf D: 1-8 Triangles and trapezes; 9 ceramic. – Gilf C: 10-12 Retouched pieces; 13-14 lunates; 15-18 ceramics. – Gilf B: 19 Lunate; 20-22 triangles; 23-25 trapezes; 26 truncated piece; 27 microburin; 28-32 borers; 33 notched piece, 34 denticulated piece; 35 edge retouched piece; 36 end scraper; 37 splintered piece; 38-41 ceramics. – Gilf A: 42 Notched trapeze; 43-45 elongated scalene triangles; 46.47 backed points; 48 burin.

wadis can be assigned to this phase. At the end of Gilf C, finds are restricted to the Wadi el Bakht. This is due to the fact that the barrier dune presumably lasted longer than that of the Wadi el Akhdar (KRÖPELIN 1989) and the termination of human settlement, meaning the end of the Gilf C unit, is connected in both valleys with the collapse of the barrier dunes. In contrast to easily recognisable end, the beginning of this phase is not so pronounced, as there was no prior abandonment of settlement. This fact, as well as a large time gap between it and layer D of WEA 80/7-1 caused W. Schön to assign the inventories of the 5th millennium BC, to the Late Neolithic. However, their difference to the material of the main settlement phase is emphasised by calling them "Älteres Spätneolithikum" or "early phase of the Late Neolithic" (SCHÖN 1996a. 1996b). With respect to the observation that numerous features (such as the undecorated ceramic, the blade production and the high proportion of microliths) are similar to Gilf B, the inventories of the "Älteres Spätneolithikum" *sensu* SCHÖN (1996a) are re-assigned here to Gilf B. Thus the border line between Gilf B and Gilf C has to be drawn around 4300 BC. Archaeologically, it is clearly visible in the transition from excavated to surface material at the site WEA 81/4 (SCHÖN 1996a: 557ff.). The unit Gilf C is characterised by a pottery, which is well-fired, usually mineral tempered and thin-walled **[Fig. 17,15-18]**. It carries incised lines or impressed ornaments. Comb impressions are most frequent, such as the so-called herringbone motif.

Stone inventories usually consist of large blanks manufactured with a less standardised and less costly technology. The tool spectrum is not diverse. Microliths (segments) are rare and manufactured in a way comparable to that of Gilf B **[Fig. 17,13.14]**. The other tools are predominantly of large, edge-modified blanks as well as unmodified blanks with use-retouch **[Fig. 17,10-12]**, completed by a few scrapers and drills.

Gilf D unit (3300-2700 BC)

Unit Gilf D is based on SCHÖN's (1996a. 1996b) "Jüngstes Spätneolithikum" or "youngest phase of the Late Neolithic", represented by the site WEA 80/14 (CZIESLA 1996). The most remarkable feature of this inventory is a high percentage of microliths, in particular asymmetrical transverse arrowheads, as well as a high amount of blades and long-narrow flakes. Due to the advanced aridification of the Eastern Sahara, doubts were raised concerning the accuracy of the late ^{14}C-data of WEA 80/14 (SCHÖN 1996a: tab. 17). According to CZIESLA (1996) who separates this inventory from the main settlement phase with respect to its different lithic material, preservation and position it will be presented here as an independent phase. During the last field trips in 1999 and 2000, a stone construction on the site WEB 99/51 was discovered and excavated approximately 1 km south of the middle reaches of the Wadi el Bakht. The small inventory rendered a certain number of asymmetrical transverse arrowheads **[Fig. 17, 1-8]** which resemble those from WEA 80/14. In the surrounding area a sherd was discovered for which no parallel exists. It is predominantly organically tempered, fragile and covered with impressions **[Fig. 17,9]**. However, its relation to the lithic inventory is uncertain.

Climate and environment

The arid climate which prevailed in the Eastern Sahara during the early and mid-Holocene was subject to considerable oscillations, although certain phases had a tendency to a more favourable semi-arid climate. The Gilf Kebir was a geomorphologically advantageous location because of its deep wadis and the existence of the already mentioned barrier dunes.

The climate of the Holocene is also reflected in the sediments of two profiles (WEA 80/7-1; WEB 82/13). The approximately 10 m high profile in the Wadi el Bakht (WEB 82/13) is of special importance because its alternating limnic and aeolic sediments permit conclusions on modifications of the landscape and the precipitation regime. For the first half of the Holocene (ca. 8800 to 4200 BC), the sediments give evidence for the short but heavy rains of a monsoon-controlled summer rain regime. For the time of 4300 to 3300 BC, the moment when the dam collapsed, the profile shows a thick pelite layer and aeolic sediments are absent (KRÖPELIN 1989). This speaks for a Mediterranean-controlled winter rain climate with drizzly, steady rains causing substantially less run-off. Thus the total amount of precipitation in the Gilf Kebir (estimated by Kröpelin for the Holocene wet phase as 100-150 mm / a) cannot directly correlated with the amount of available water (KRÖPELIN 1989).

Subsistence and land-use

For the Gilf A unit only stone artefacts and ceramics are present so far. When comparing the archaeological material of all contemporaneous sites of the B.O.S. / ACACIA and CPE study area, a hunter economy seems most probable. The same way of life is assumed for Gilf B unit, suggested by numerous arrowheads and bone remains of various wild animals. The occurrence of grinding stones suggests the use of wild grain. A remarkable change in the stone tool inventories and the first occurrence of ovicaprides is proven for Gilf C (WEB 82 / 15). From a surface collection of the CPE, 25 bones of domesticated cattle and remnants of sheep and goat have been identified (WENDORF & SCHILD 1980). A ^{14}C-date about 5800 BC (SMU-273: 6980 ± 80 bp) is given for the CPE finds. The occurrence of cattle was not verified by later expeditions. Because the date comes from fragments of ostrich eggshells from a surface collection, the connection of sample material and bone finds is doubtful. Because there is not a single bone of a domesticated animal in all Gilf B inventories and the fact that finds of the older units are very rare on the playa surface, the bones of domesticated species come most probably from phase Gilf C. Thus the earliest estimated beginning of a pastoral nomadic use of the Gilf Kebir falls to the middle of the 5th millennium.

For unit Gilf D it is extremely difficult to reconstruct the economic system. Some badly preserved bone fragments of large mammals have been preserved at WEA 80 / 14, one of them probably of domesticated cattle (CZIESLA 1996: 229).

Hardly any statement on landscape use in the Gilf Kebir was possible before the onset of ACACIA fieldwork, since archaeological investigations were concentrated on the rich sites in the valleys. During the campaigns of the years 1999 and 2000, the plains east the Gilf Kebir as well as the plateau around the Wadi el Bakht up to the Winkelwadi in the north were examined. An abundance of sites was documented and is still being analysed. First results indicate that the main settlement activities have been in the units Gilf B and Gilf C. Different site distributions and thus different land-use strategies could be determined. Settlement activities from the phase Gilf B are apparently concentrated – according to the original hypothesis – on the middle reaches of the Wadi el Bakht. Whilst some finds indicate a settlement of the eastern plains, the settlement on the plateau was limited to a few sites.

Unit Gilf C shows different patterns of settlement. Opposed to the few and small sites in the wadi, sites of this phase were scattered in the entire study area on the plateau. This leads to the impression that not the wadi, but the plateau itself was the actual habitat. Both the changing economy and / or the changing climate regime could be responsible for this remarkable shift in land-use activities.

Conclusion

The list of radiocarbon dates from the four mentioned desert regions, completed with numerous dates of neighbouring sites from the B.O.S. missions, helps to establish the wider chronology of the climatic and cultural change **[Fig. 18]**.

The beginning of the northwards shift of the summer rain belt and the occupation by hunter-gatherers seem to have been established in the mentioned regions not before 8800 / 8700 BC. While the re-occupation is indicated by dates from Wadi el Akhdar and Regenfeld, the early Holocene has been roughly reconstructed on the base of the Regenfeld dates. The Abu Muhariq Plateau has yet not yielded enough dates which would help to enlighten the very early occupation.

With regard to the climatic development during the Holocene wet phase, little is known about the shifting and interaction of the tropical summer rain and the Mediterranean winter rain belt. KRÖPELIN (1987) has suggested that moderate winter rains affected the upper playa deposits in the Wadi el Bakht and the long term occupation

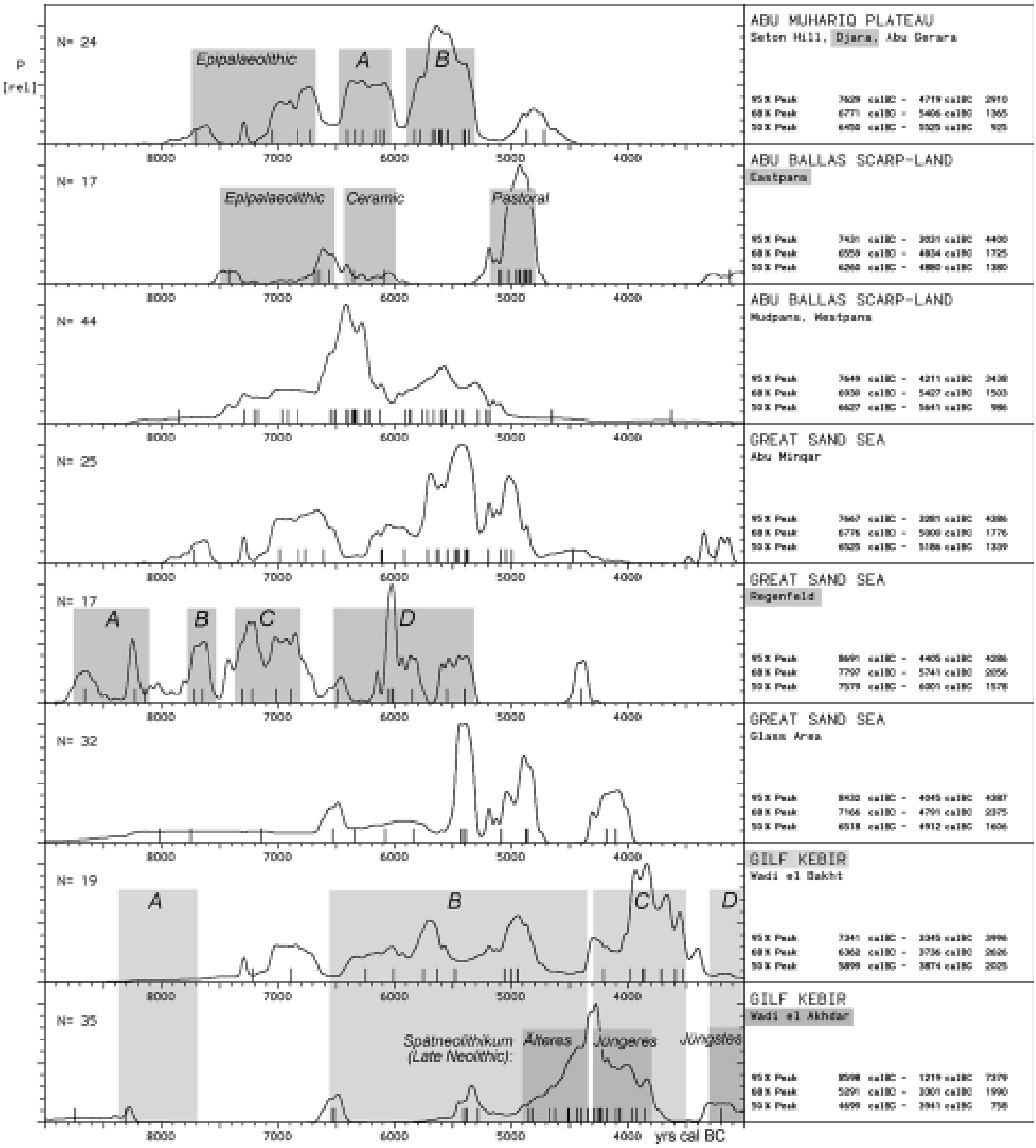

Fig. 18 Probability distributions of 213 calibrated ^{14}C-dates from desert areas mentioned in the text. The ticks on the cal scale represent the cal median values, calculated by fitting Gaussian curves to the cal distribution of the individual dates. The chronological units are shaded. Limits of the Late Neolithic ("Spätneolithikum") of Wadi el Akhdar by SCHÖN 1996. The individual dates of the areas investigated by ACACIA are listed in **Table 1** (see p. 110f.) including uncalibrated BP as well as calibrated BC. The dates are calculated and plotted by the *2-D Dispersion Calibration Program Version Cologne 2001 of CALPAL (Cologne Radiocarbon Calibration & Palaeoclimate Research Package)* by Bernhard Weninger, Radiocarbon Laboratory, University of Cologne.

Region Site	Material[1]	Archaeological feature	Lab.-No.	^{14}C-years by	$\delta^{13}C$ ($^{0}/_{00}$)	Age calBC[2]
A B U M U H A R I Q P L A T E A U						
Djara						
90/1	OES	surface	KN-4326	7260 ± 80	[3] -25.00	6119 ± 81
90/1	OES	surface	KN-4422	7820 ± 90	-7.10	6721 ± 171
90/1	Ch	surface	KN-4423	8620 ± 90	[3] -25.00	7701 ± 110
90/1-1	Ch	fireplace	KN-4601	6448 ± 69	[3] -25.00	5407 ± 61
90/1-1	Ch	fireplace	KN-4600	6685 ± 90	[3] -25.00	5600 ± 76
90/1-1	Ch	fireplace	HD-16313	6753 ± 53	-24.00	5659 ± 46
90/1-1	Ch	fireplace	HD-16311	6786 ± 49	-21.00	5679 ± 38
90/1-2	Ch	fireplace	KN-4603	7421 ± 74	[3] -25.00	6280 ± 88
90/1-2	Ch	fireplace	KN-4602	7588 ± 82	[3] -25.00	6409 ± 93
90/1-3	Ch	ashy layer[4]	Erl-2863	7303 ± 109	-24.47	6172 ± 119
90/1-3	Ch	ashy layer[4]	KIA-12422	8057 ± 59	-25.38	7049 ± 186
90/1-6	Ch	fireplace	Erl-2859	6696 ± 94	-25.85	5608 ± 79
90/1-6	Ch	fireplace	UtC-9462	6900 ± 50	-26.10	5778 ± 48
90/1-6	OES	fireplace	UtC-9460	7913 ± 43	-3.10	6839 ± 131
90/1-8	Ch	*steinplatz*	Erl-2860	6406 ± 105	-27.23	5363 ± 99
90/1-8	Ch	*steinplatz*	UtC-9463	6959 ± 46	-17.20	5827 ± 61
90/1-12	Ch	*steinplatz*	Erl-2861	5982 ± 78	-25.05	4869 ± 96
90/1-13	HA	*steinplatz*	Erl-2872	6713 ± 75	-25.76	5620 ± 69
90/1-13	Ch	*steinplatz*	Erl-2862	7215 ± 81	-25.84	6086 ± 86
98/20-1	OES	surface	UtC-9465	6430 ± 50	-7.00	5401 ± 54
98/20-3	Ch	*steinplatz*	UtC-9464	7500 ± 60	-26.60	6339 ± 70
Seton Hill						
99/8	HA	*steinplatz*	Erl-2871	5866 ± 98	-25.15	4719 ± 121
Abu Gerara						
98/5	OES	surface	UtC-9459	6597 ± 42	-4.00	5547 ± 50
99/28	OES	fireplace	Erl-2858	6605 ± 74	-7.40	5549 ± 60
A B U B A L L A S S C A R P - L A N D						
Eastpans						
95/1-1	Ch	top layer/surface	UtC-5585	7529 ± 48	-26.30	6356 ± 70
95/1-1	Ch	bottom layer	UtC-5623	7750 ± 150	[3]-25.00	6682 ± 210
95/1-1	Ch	bottom layer	UtC-5459	7752 ± 48	-26.60	6563 ± 59
95/1-1	Ch	bottom layer	UtC-5582	7820 ± 50	-25.80	6646 ± 79
95/2-1	Ch[5]	fireplace	UtC-5451	6170 ± 80	-28.00	5107 ± 118
95/2-1	Ch	fireplace	UtC-5749	6102 ± 46	-22.90	5026 ± 89
95/2-1	Ch	*steinplatz*	UtC-5752	6072 ± 36	-23.80	4960 ± 64
95/2-1	Ch	*steinplatz*	UtC-5751	6053 ± 36	-20.30	4935 ± 63
95/2-1	Ch	fireplace	UtC-5753	6041 ± 39	-23.50	4923 ± 63
95/2-1	Ch	fireplace	UtC-5755	6022 ± 37	-25.00	4897 ± 56
95/2-1	Ch	fireplace	UtC-5750	5998 ± 45	-23.60	4874 ± 61
95/2-1	Ch	fireplace	UtC-5754	5984 ± 36	-24.70	4859 ± 52
95/2-1	Ch	fireplace	UtC-5756	5958 ± 34	-25.30	4833 ± 54
95/2-3	Ch	fireplace	KN-5006	7213 ± 80	-25.04	6085 ± 86
95/2-5	Ch	*steinplatz*	UtC-5757	6133 ± 30	-22.70	5088 ± 91
95/3	PF	ceramic cache[6]	UtC-5940	4430 ± 80	-25.50	3124 ± 152
96/6	OES	surface	KN-5223	8350 ± 55	-0.89	7420 ± 76
G R E A T S A N D S E A						
Regenfeld						
87/2	OES	surface	KN-3983	7640 ± 80	-6.90	6494 ± 77
96/1	OES	surface cluster 4	UtC-7190	7186 ± 49	-3.80	6058 ± 61
96/1	Ch	fireplace	UtC-5581	8040 ± 50	-26.10	7016 ± 161
96/1	OES	fireplace	KN-4973	9388 ± 70	-0.88	8659 ± 99

Region Site	Material[1]	Archaeological feature	Lab.-No.	^{14}C-years by	δ^{13}C	Age calBC[2]
96/1-1	Ch	pit/fireplace	KN-5053	8593 ± 70	[3] -25.00	7646 ± 74
96/1-2	Ch	layer 2/3[7]	UtC-7189	6978 ± 38	-25.70	5850 ± 56
96/1-2	Ch	layer 3[7]	UtC-7188	7965 ± 48	-25.90	6892 ± 124
96/1-2	OES	layer 3/4[7]	UtC-7187	8209 ± 43	-5.20	7223 ± 95
96/1-3	OES	surface	UtC-9466	5560 ± 50	-0.10	4402 ± 46
96/1-3	OES	butchering site	UtC-9441	6422 ± 41	-3.40	5399 ± 53
96/1-5	Ch	fireplace	UtC-7186	8261 ± 43	-23.90	7309 ± 112
96/1-7	OES	workshop	UtC-6534	8690 ± 50	-2.48	7720 ± 88
96/15	OES	stone circle	UtC-7185	6617 ± 46	-5.10	5553 ± 49
96/19	OES	surface	UtC-9458	7160 ± 50	-4.40	6013 ± 58
96/19	OES	surface	UtC-9461	7168 ± 45	-6.20	6027 ± 48
96/20	OES	surface cluster 2	UtC-7191	8990 ± 60	-1.30	8140 ± 111
96/20	OES	surface cluster 1	UtC-7192	5107 ± 118	-6.00	8226 ± 66
GILF KEBIR						
Wadi el Akhdar						
83/33	Po	surface[8]	UtC-6536	9080 ± 50	-20.00	8310 ± 61
83/33	Po	surface[9]	UtC-8219	6382 ± 46	-14.10	5380 ± 60
Wadi el Bakht						
82/13	HA	sample 1999[10]	Erl-2873	5407 ± 74	-22.95	4210 ± 106
82/13	Ch	sample E[10]	KN-3179	6080 ± 420	-	4951 ± 438
82/13	Ch	sample D[10]	KN-3097	6200 ± 1000	-	5002 ± 1071
82/13	HA	sample 1999[10]	Erl-2874	6871 ± 66	-22.76	5754 ± 65
82/13	Ch	sample 1999[10]	Erl-2868	7146 ± 99	-21.94	6009 ± 110
82/13	Ch	sample 1999[10]	Erl-2928	7407 ± 124	-24.94	6249 ± 129
82/13	Ch	sample B[10]	KN-3095	7980 ± 90	-	6894 ± 152
82/13	Ch	sample A[10]	KN-3096	8200 ± 500	-	7219 ± 604
82/15	Ch	sediment	KN-3079	5180 ± 60	-	3978 ± 98
82/15	Ch	fireplace	KN-3149	5070 ± 60	-	3861 ± 74
82/16	Ch	fireplace	KN-3098	4820 ± 60	-	3593 ± 68
82/18	Ch	fireplace	KN-3182	4880 ± 390	-	3594 ± 476
82/19	Ch	fireplace	KN-3184	4770 ± 130	-	3529 ± 142
82/21-1	OES	sediment	KN-3976	6050 ± 65	-2.10	4946 ± 92
82/21-2	Ch	sediment	KN-3410	6600 ± 300	-	5482 ± 299
82/22	Ch	pit	KN-3328	6150 ± 200	-	5061 ± 228
82/24	Ch	layer 1	KN-3591	5090 ± 60	-	3875 ± 71
82/24	Ch	fireplace	KN-4024	4920 ± 60	-24.30	3716 ± 58
99/53[11]	OES	surface	Erl-2864	6735 ± 82	-2.64	5635 ± 72

[1] Abbreviations: Ch = charcoal; OES = ostrich egg shell; HA = humic acid; PF = plant fibres; Po = potsherd

[2] Calculated by *2-D Dispersion Calibration Program Version Cologne 2001* of *CALPAL (Cologne Radiocarbon Calibration & Palaeoclimate Research Package)* by B. Weninger, Radiocarbon Laboratory, University of Cologne.

[3] Estimated value

[4] Dripstone cave

[5] Charred seed

[6] Clayton rings (RIEMER & KUPER 2000)

[7] Dune section

[8] SCHÖN 1996: 694; 701 Taf. 107.7

[9] SCHÖN 1996: 694; 701 Taf. 107.9

[10] Playa section (KRÖPELIN 1989: 229)

[11] Plateau site

Tab. 1 ^{14}C-dates of the areas investigated by ACACIA including dates from ACACIA, B.O.S., and other missions of the Heinrich-Barth-Institut. Dates of other areas formerly investigated by B.O.S. are not listed, except two new dates from the Wadi el Akhdar completing the dates mentioned by SCHÖN 1996.

of the Gilf Kebir after 5000 BC. The southern Great Sand Sea is probably more restricted to a summer rain influence (pers. comm. H. Besler), while the species in the archaeobotanical record of the mid-Holocene Djara A/B units show a rather Mediterranean trend.

In conclusion, it must be accepted that individual climatic archives which has yet been explored are worth for the local environmental conditions. With regard to the reconstruction of general climatic trends, however, there is a need for more reliable data and comparison of profiles from different regions.

The cultural chronologies of the three mentioned regions show an essential change from the early Holocene Epipalaeolithic to the following mid-Holocene period. It is clear from the numerous radiocarbon dates that the *Djara A – Regenfeld D – Gilf B – horizon* was well under way around 6400-6500 BC. These dates correlate well with those from excavations in other localities such as Nabta Playa, Bir Kiseiba, Dakhla or Farafra, where similar assemblages occur. Only the dates given both for the Haua Fteah Libico-Capsien and the Fayum Qarunian (Fayum B) culture suggest that the Epipalaeolithic ended somewhat later, ca. 6000 BC (McBURNEY 1967. KOZLOWSKI & GINTER 1989).

However, it is rather difficult to define the characteristics of the 'post-Epipalaeolithic' phase on a supra-regional scale. Apart from the economically based CPE sequence which deals with the 'Neolithic', or other regional sequences, including those we described above, there is a need for cultural markers and chronological sequences working supra-regionally. Therefore KUPER (1995: 130ff. 1996: 88) presented a system based on the introduction and change of pottery, subdivided into three major 'ceramic' units. In addition he noticed two different spheres of overlapping influences in Egypt: the very early Khartoum related pottery which is associated to the “Early Ceramic”, and the undecorated fabrics of the “Middle Ceramic”, which are suggested to have been originated from the Near East. In the most regions of the Sahara the introduction of pottery appears to be a major event and seems to be connected to other adjustments in the economic and social organisation. On the other hand ceramic is completely absent in Djara during the Holocene wet phase. Taking into account, that pots of Khartoum-style were found in Nabta Playa and Bir Kiseiba (BANKS 1980. WENDORF et al., eds., 1984: *passim*) from early Neolithic contexts while they appeared later in the northern desert regions and the oases (cf. McDONALD 1992, 58ff,). The introduction of pottery has strictly not been related with one supra-regional synchronic horizon but with boundaries that serve as time-markers in the most local areas.

The intensification of plant utilisation, indicated by the grinding implements, seems to be a phenomenon representing the cultural change after the Epipalaeolithic in the desert.

The lack of domesticated animals in Regenfeld is quite astonishing because earliest evidence for cattle and small livestock dates in most other regions to the 6th millennium BC (at the latest), and therefore, earlier than the onset of the depopulation of the deserts (BANKS 1984. WENDORF et al., eds., 1984. WENDORF et al. 1987. WENDORF & SCHILD 1994. GAUTIER 1987. McDONALD 1998a). The data from the desert regions between Dakhla and Gilf Kebir include two sites from the vicinity of the Sand Sea where domesticated animals were identified: Eastpans 95/1 (BERKE 2001), a semi-pastoral playa camp about 4900 BC, and Glass Area 81/61 (“Willmann's Camp”), where three sheep bone fragments occurred among wild faunal remains from a new surface collection (survey by N. Pöllath; cf. VAN NEER & UERPMANN 1989: 326). In any case remains of domesticated animals do not dominate the faunal assemblages. This, and the most common arrowheads, indicates that herding was not a major aspect of the economy in the desert areas. A few bone assemblages from the inner desert, including Regenfeld and Mudpans (VAN NEER & UERPMANN 1989: 327f.), did not yield domesticated animals. It is likely, that the scarcity of the rainfall, the inhospitable environmental conditions, and the large distances between water pools affected the herders who did not enter this inner desert area.

In any case domesticated animals and pastoralism have not been the onset of the cultural change, which became visible in the mid-Holocene.

The most assigned to lithic assemblages, dated to the mid-Holocene occupations, give evidence of a strictly flake-orientated tool production, replacing the elaborate blade and bladelet technology of the Epipalaeolithic. Moreover, the homogeneity of the Epipalaeolithic industries in North Africa was replaced by cultural complexity and regional variability, indicated by different lithic tool kits and strategies concerning the accommodation of raw materials and the production of tools. There is a great deal of similarities between the lithic assemblages from various sites of the Abu Muhariq plateau and the neighbouring oases of Dakhla and Farafra. Thus, the Abu Muhariq Plateau and the oases must be seen as one technocomplex, which features the tanged points, facially retouched knives, leafs, side-blow flakes, to name but a few. The assemblage of "Lobo" (= Abu Minqar 81/55) in the vicinity of the oases also contains facially retouched tools in higher quantities (KLEES 1989a. 1989b). Moreover, there are affinities with other northern regions both to the west in Siwa/Qattara (HASSAN 1976. HASSAN & GROSS 1987. CZIESLA 1993) and Haua Fteah (McBURNEY 1967), and to the east in the Fayum (CATON-THOMPSON & GARDNER 1934. KOZLOWSKI & GINTER 1989).

The sites of the Gilf Kebir are another facies, which were characterised by transverse arrowheads and other geometrics. Mudpans is also assigned to this facies, although it yield little intrusion of the northeastern facies (KUPER 1993). Apart from the lithics, especially the decorated pottery of Khartoum-style is closely associated to the Saharo-Sudanese Neolithic or Wavy-line horizon.

Regenfeld as well as Eastpans were characterised by lithic assemblages mixed by influences of both facies. The sites of lower Nubia as well as the Nabta/Bir Kiseiba region also yielded assemblages of both traditions.

As to the desert areas mentioned above, ceramics, livestock, grinding implements and new lithic technologies were the most important elements of the post-Epipalaeolithic period, however, not one element can be defined as a characteristic time marker exclusively.

The drop-off in the number of ^{14}C-dates just after 5400/5300 BC in many regions of the Western and Libyan Desert reflects the beginning of the drying trend towards hyper-arid conditions which led to the depopulation of the desert after 5000 BC. Small revivals of humid events may fall about 4900 BC and probably about 4400 BC visible from single occupation events in many regions. This drying of the desert might be a general trend in the Eastern Sahara, from the Abu Muhariq plateau to the Great Sand Sea. Apart from this, the Gilf Kebir indicates playa activities and a long term occupation which has been finished not before 3200 BC. Taking into consideration the mountainous relief of the plateau and the relative better conditions of the central Sahara which were presumably affected the Gilf Kebir, one can imagine the favoured conditions of this refuge.

Little remained from the Late Neolithic outside the Gilf Kebir and the oases. The thin-walled and burnished or gently polished pottery of Eastpans 95/1 (ca. 4900 BC) might be one of the elements, which mark the transition to the Late Neolithic. During this time, the drying up irreversibly stopped the episodic occupation of the desert by prehistoric dwellers. Apart of this, all mentioned regions (with the exception of the Gilf Kebir) yielded a number of sites which produced the so-called Clayton rings (RIEMER & KUPER 2000. GATTO in press). This pottery came from the late Predynastic or Early Dynastic. Two radiocarbon dates suggest an age about 3100/3200 BC. Taking into account that these artefacts date into a phase of hyper-arid conditions, it is surprising that the distribution of these pottery stretches from the oases regions to the west of the Great Sand Sea and the southern fringes of the Selima Sandsheet in northern Sudan. Although their function is still unclear, the Clayton rings reveal the use of desert routes during early historic times. The oscillations of the climate and growing desertification does obviously not cut off the old networks, but they probably became more concentrated on specific routes and regions. In any case, live based on the rare desert sources was no longer possible, but still changed into the mode of the caravans crossing the deserts. This might be initialised by the introduction of the domesticated ass.

Still, there is a lot of research to do – future work must show, how living conditions, subsistence strategies and life styles had changed through time in the different regions and how the Sahara wide networks between the inhabitants have been tied and cared for.

Acknowledgements

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