

TO THE EUPHRATES  
AND BEYOND

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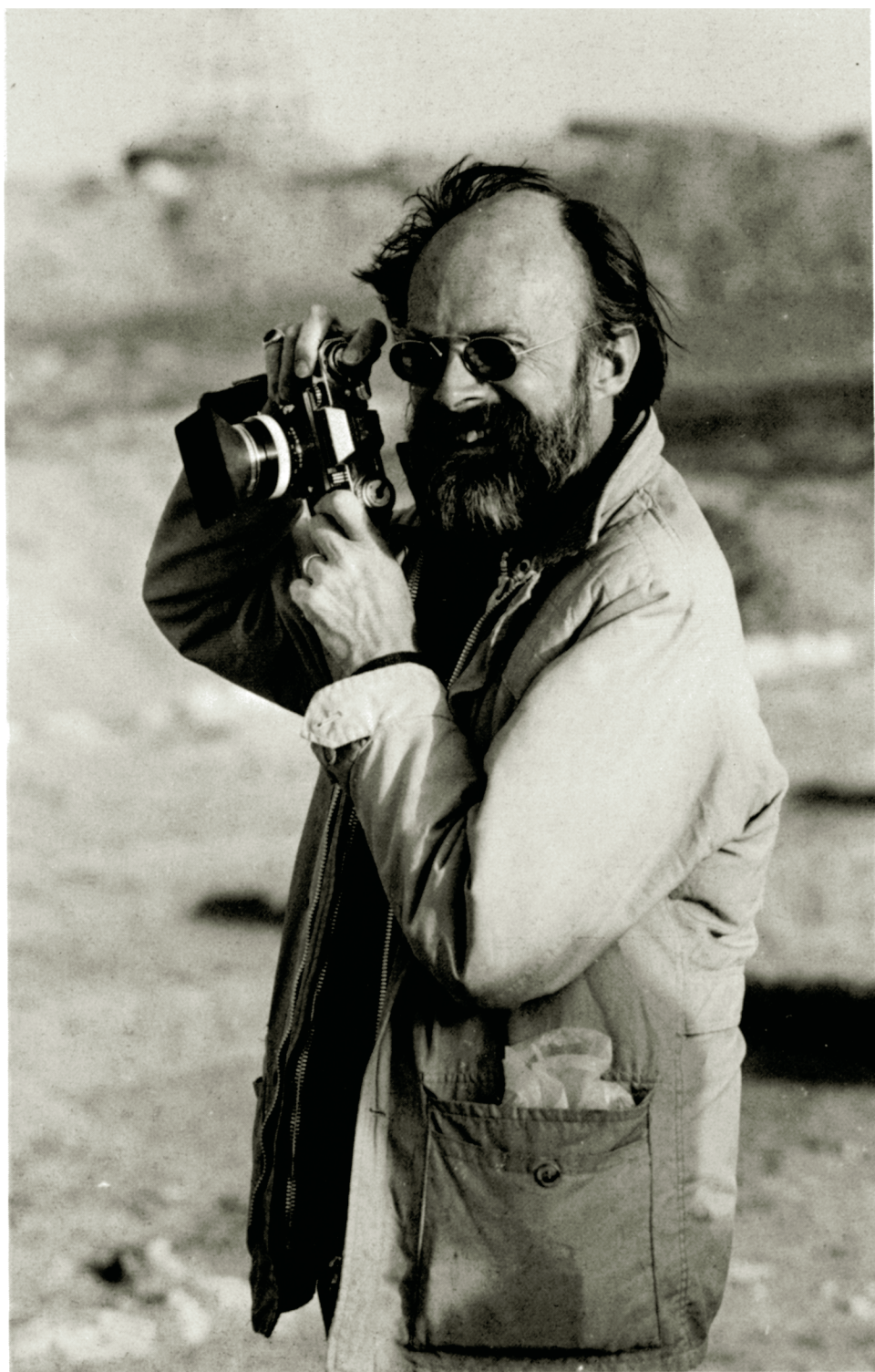
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# TO THE EUPHRATES AND BEYOND

*Archaeological studies in honour  
of Maurits N. van Loon*

*Edited by*

O.M.C.HAEX, H.H.CURVERS & P.M.M.G.AKKERMANS



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## Foreword

Planning this volume with studies in honour of Maurits N. Van Loon was a pleasant and challenging task. When we began to enumerate all the possible contributors for this celebratory volume, we realized that it would be impossible to include all his former and present colleagues, his students, and his many other friends. Forced by practical considerations to keep the size of the book within certain limits we have decided to restrict the number of contributors to his former students and collaborators in the field. We are painfully aware that this meant that some of Van Loon's very good friends could not be invited to participate, and we can only hope that they will forgive us.

The contributions in this volume are offered as a tribute to one of the most productive, versatile and stimulating Archaeologists today. So much is standard praise. Perhaps Maurits Van Loon's unique and overriding quality, however, is a determination to expand the archaeological discipline and to examine critically some of its most fundamental assumptions. Whether collaborating with biologists, pedologists or chemists he continues a vigorous, wide-ranging search for new methods of study and new areas of relevance. It is characteristic of the wide range of Van Loon's interests that the articles presented here cover such a variety of fields with a wide chronological and geographical range.

It is only fitting that the contributors to this volume all have been collaborators or former students of Dr. Van Loon and that the initiative in conceiving and editing it has remained entirely in their hands. Principal responsibility for initiating it rested with Odette Haex, Peter M.M.G. Akkermans and Hans H. Curvers. We wish to express our gratitude to the committee *Vrienden-cadeau Maurits van Loon* for the financial support in the genesis of this celebratory volume. Special thanks are expressed to the *Stichting Nederlands Museum voor Anthropologie en Praehistorie* (Amsterdam), and the *Allard Pierson Stichting* (Amsterdam).

Finally, the editors would like to thank Remko Jas who has helped to correct the first prints.



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# Notes on the prehistoric environment of the Syrian Djezireh

SYTZE BOTTEMA

*At that last stop we made, I asked one old fool who was leaning against a tree if he thought it was getting hotter, year by year. All he said was, 'It's always been hot skipper, since the day the world was made.' 'And what day might that be?', I asked him. 'In the Ice Age, as I heard tell.' That was his reply.*

Bryan Aldiss: *Helliconia Summer*

When one travels through the Syrian Djezireh nowadays, one meets a barren landscape, sometimes ploughed all over up to the horizon. Where no plough marks are visible, a hard gypsum layer or solid rock kept the farmers from turning over the soil. Still this is a fairly late development. Some twenty-five years ago, when the road along the Euphrates from Meskeneh up to Abu Kemal was still a dirt track with Egyptian vultures resting on the telegraph poles, dense shrubby steppe vegetation on state property that had been fenced in for military purposes showed the potential plant cover. At that time random ploughing, a risky way of farming, was beginning to develop. However, plenty of undisturbed soil was still present, carrying a vegetation that, although heavily suffering from overgrazing, showed some natural aspect.

It is not surprising that human habitation in the Djezireh concentrated upon the rare water sources. Not all these water sources could be efficiently exploited for agriculture. The water regime of the Euphrates included the inundation of the wide valley in the spring thus frustrating any attempts at farming on the lower river-banks. The water of this river could only be used at the time when pumps were constructed that were able to transport water to levels that could be farmed and that were not threatened by the spring floods. Of the rivers of northern Syria the water of the Balikh seems to have been the most accessible, as is also suggested by early records. The Khabour has cut a channel that at least nowadays makes the water run up to 3 metres below the level of the Pleistocene bed and the upland. This situation must have prevailed at least from the Late Bronze Age onward, as can be concluded from the minimum date of prehistoric canals constructed on both sides along the Habur for irrigation purposes. The water could be diverted upstream and led to arable land downstream (Ergenzinger et al., in press).

What conditions did prehistoric farmers meet in the Djezireh and how did they exploit the area? To obtain an answer to such questions cooperation between archaeologists and natural scientists is of fundamental importance. The results of the study of past vegetation

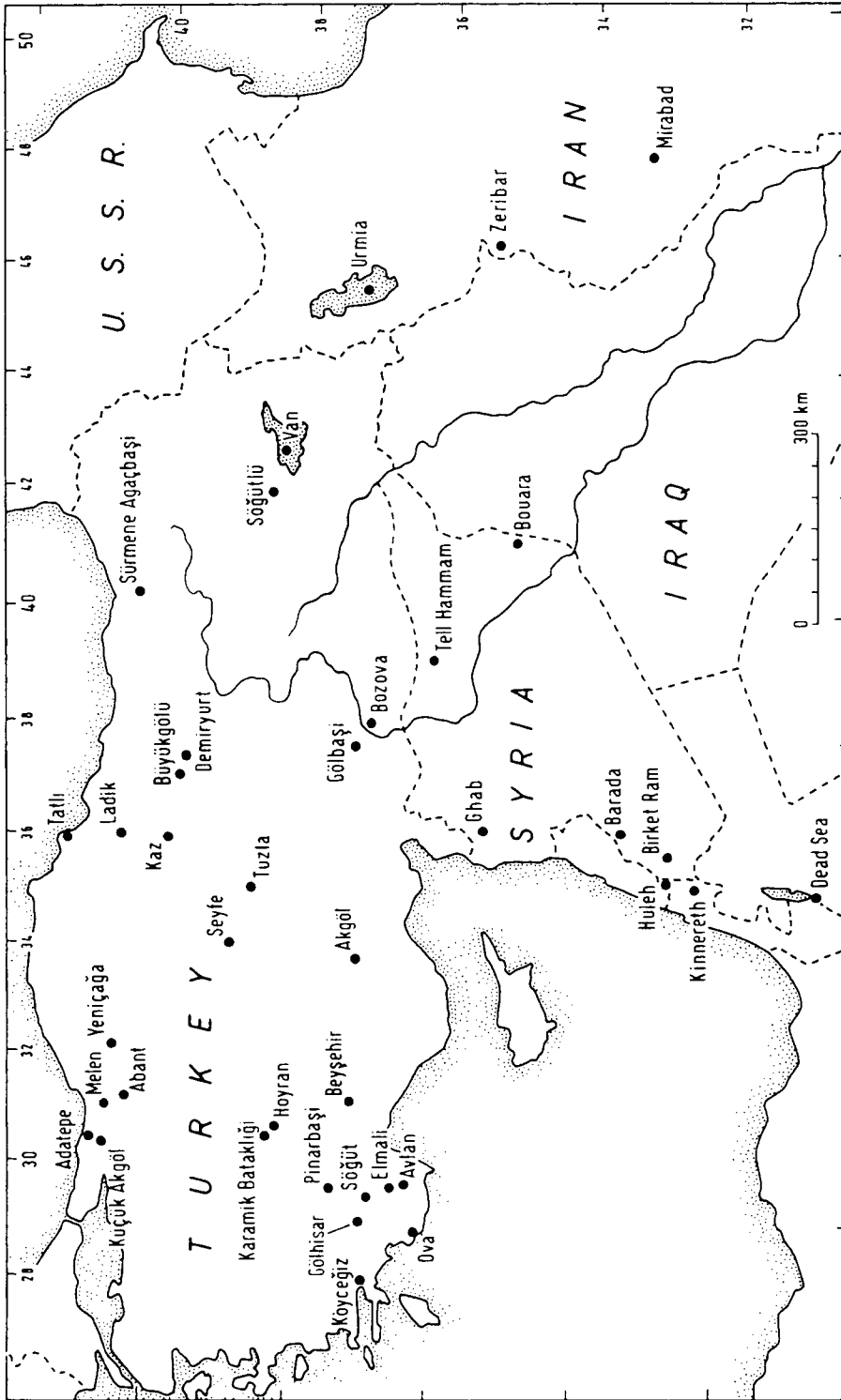


Fig. 1. Map of the Near East showing the pollen coring sites.

and climate have to be projected upon a background of archaeological information supplied by field surveys and excavations. Palaeobotanical research had already taken place in the area during the excavation of the prehistoric settlement of Mureybit, Selenkahiye, Hadidi, and Bouqras, which covered various time periods (van Zeist and Bakker-Heeres 1984 (1986); 1985 (1988); van Zeist and Waterbolk-van Rooijen 1985).

More recently attention has been paid to palynology in the area (Gremmen and Bottema, in press). In close cooperation with the University of Amsterdam's Archeological Mission to Syria, directed by Maurits N. van Loon, coring for pollen analysis formed part of extensive palaeobotanical sampling. At the invitation of Hartmuth Kühne (Freie Universität, Berlin), who directed archaeological excavations in the Habur area, a series of pollen cores were taken in that part. Some of the results of these recent palynological investigations in connection with human habitation also form part of this paper.

#### THE MODERN VEGETATION

A clear description of the modern vegetation of the eastern part of the area considered here is given by Frey and Kürschner (in press), while additional information on soil and climate of the Balikh area is supplied by Boerma (in press). Both studies are thought to be reasonably representative for the whole area.

The vegetation of the Djezireh can be divided into two main categories: one where trees are present and treeless vegetation. The first group includes steppe-forest on the Jebel Abdel-Aziz and riverine forest along the Euphrates, Balikh and Khabour. The steppe-forest on those slopes of the Jebel Abd el-Aziz which are less exposed to the sun still show pistachio (*Pistacia khinjuk*), almond (*Amygdalus orientalis*), hawthorn (*Crataegus azarolus*, *Crataegus aronia*) and cherry (*Cerasus microcarpa*). Of the herbs, mallow (*Alcaea rufescens*) and St. John's wort (*Hypericum triquetifolium*) attract the attention of the traveller. Rejuvenation of the steppe-forest was and is very problematic because of grazing pressure, as can be witnessed on the Jebel Bichri, G. Mrâh and G. Abu Rezméine in central Syria, where *Pistacia atlantica* will gradually become extinct.

Very few remnants of riverine forest are found nowadays. Incidentally willow shrubs were seen along the Balikh and Khabour. Poplar (*Populus euphratica*) was often seen in plantations. Willem van Zeist and the present author witnessed a natural-looking riverine forest formed by *Populus euphratica* and some mulberry trees in 1965 on an island in the Euphrates, not far from Deir ez-Zor. The forest even housed a large rookery (*Corvus frugilegus*). Such islands were said to form part of large estates, and the forest was protected up to the time when the property of the landowners was re-distributed and given to smallholders, who were already cutting down the trees when we visited the island.

Due to human interference natural steppe vegetation is very rare or even absent. Already in the 1960s heavy overgrazing was seen. Grazing pressure was lower only in those parts where no water supply was found, although in 1965 water transport by car to the interior could be witnessed. Information on the actual, anthropogenic vegetation as well as on the potentially natural vegetation is given by Frey and Kürschner (in press). Frey and Kürschner postulate a wormwood (*Artemisia herba-alba*) shrub-steppe as the natural dominating vegetation in the Djezireh. Most of this vegetation cover has long

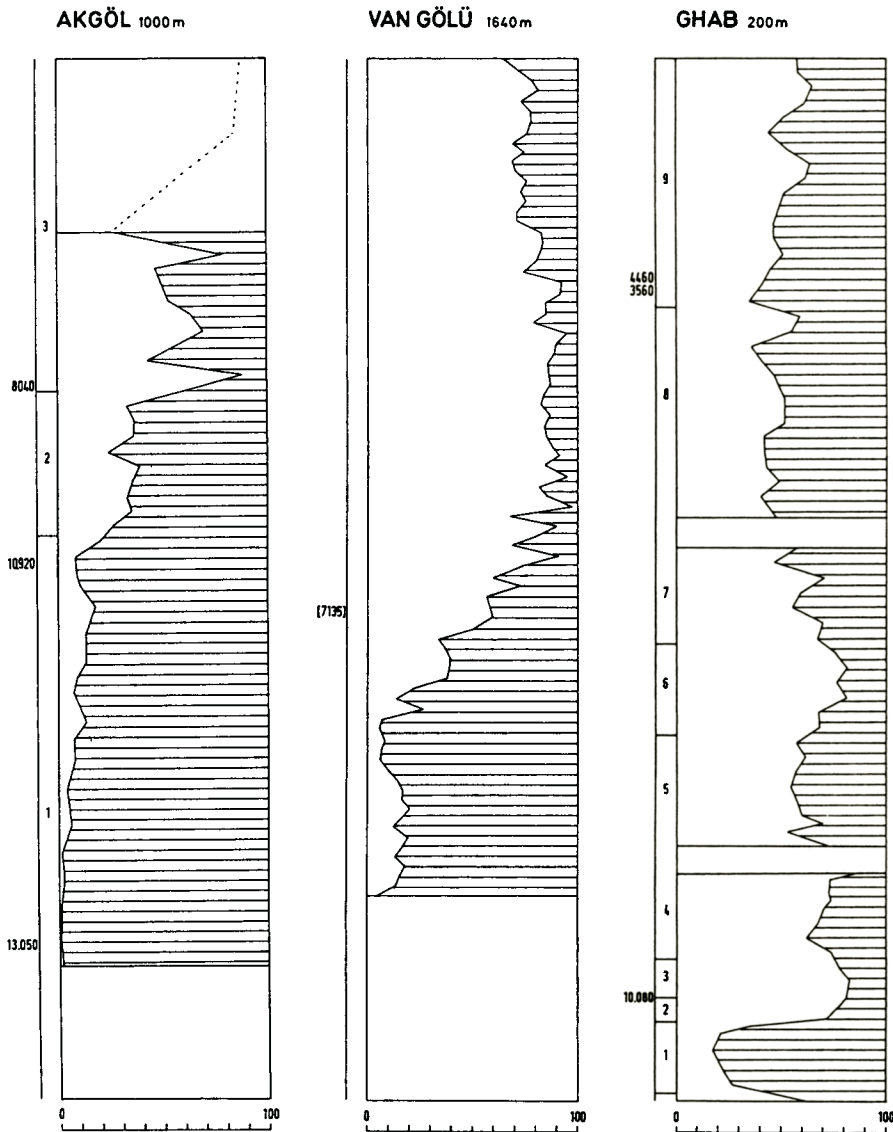
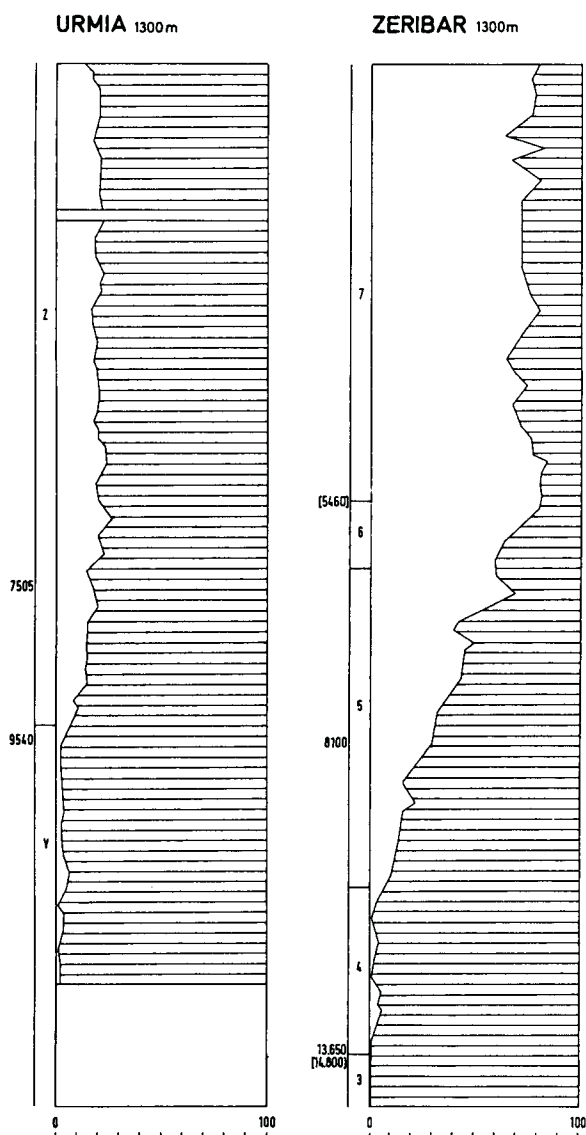


Fig. 2. The arboreal/non-arboreal pollen ratio for a selection of Near Eastern sites. White: the total amount of tree pollen. Hatched: pollen of *Artemisia* and *Chenopodiaceae* as most important steppe indicators.

since disappeared because of grazing, subsequent overgrazing, fuel gathering and in more recent times by extensive ploughing for hazardous rain-fed agriculture. These activities favoured unpalatable or prickly plant species avoided by the domestic animals, weeds of summer and winter crops, plough-resistant species, ruderals or plants of disturbed habitats. Irrigation involves typical weeds such as *Tribulus terrestris*, while abandoned saline fields may carry *Prosopis farcta* and *Alhagi maurorum*. Former



settlements or camp sites often show *Peganum harmala* or *Atriplex leuoclada*. On saline soils, halophytic vegetations are found rich in chenopods, such as *Haloxylon*, *Salsola*, *Noaea*, *Halocnemum*, *Aellenia*, *Seidlitzia*, *Suaeda* a.o., depending on local conditions.

#### PALAEO-VEGETATION AND CLIMATE

Some 15,000 years ago steppe or desert-steppe prevailed in the Eastern Mediterranean and the Near East, as can be concluded from the pollen record (fig. 1) (van Zeist and

Bottema 1982). Most of the area was devoid of any tree growth and tree refuge areas were only found where local conditions were more favourable, as for instance along the Black Sea coast or in open forest in the Levant. For that period it can be assumed that plant growth was limited by temperature. Global temperatures were on average 10° C lower than they are at present. More important however was the low humidity indicated by the nature of the steppe and desert-steppe vegetation which has been reconstructed from the pollen record. Tree growth must have been restricted to a narrow zone because at low and medium levels the amount of precipitation was too low, whereas in the higher mountain belt it was too cold. The AP/NAP ratio seems to be a good indicator of the relative moisture conditions (fig. 2).

At about 14,000 B.P. a change in climate must have taken place in northern Israel. An increase in oak pollen points to more humid conditions that were geographically of a fairly restricted character. It took another 3000 years before a comparable increase in precipitation was felt in northwestern Syria as was demonstrated in a pollen diagram from the Ghab (Niklewski and van Zeist 1970). At the same time forest started to expand in northwestern Turkey indicating an amelioration of climate. Still in the greater part of the Near East conditions did not change much and steppe remained the characteristic vegetation. On the southern edge of the Anatolian Plateau, on the Taurus mountains and on the Iranian Zagros an increase in tree pollen took place starting around 9000 B.P. From that time on oak and pistachio slowly started to spread on higher elevations. Humidity gradually increased, to reach modern conditions at about 5500 B.P. at the latest in western Iran in the Zeribar area (van Zeist and Bottema 1977).

The early increase in precipitation in the northwestern part of Syria did not last very long and dry conditions had returned about 8000 B.P. At 8000-7000 B.P. a slow increase in moisture became effective on the southern flanks of the Anatolian Plateau and the western side of the Zagros, but only at about 6000-7000 B.P. did modern conditions become established in the Taurus area. The south-facing Middle Taurus bordering northern Syria is very important as a catchment area for the run-off water supply of the Djezireh by the Euphrates, Balikh and Khabour. From c. 8000 B.P. on a slow increase in precipitation took place, as is indicated by the pollen record. From that time on the amount of water transported by the rivers must have increased. At about 6000 B.P. the river discharge established itself at the level that it shows nowadays.

The mechanism behind the change of climate is not fully understood. The world-wide rise in temperature that took place towards the terminal Pleistocene did not necessarily result in better conditions for tree growth everywhere. Initially the increase in temperature was not matched by an increase in precipitation, and it resulted in even drier conditions than before. Today the climate in large parts of the Near East is of the Mediterranean type and is generally effected by the westerly flow. (The reason that northern Israel ran so much out of line could be explained by the fact that during the terminal Pleistocene that part was not influenced by the westerly flow but by the monsoon).

In temperate Europe palynology has been of great help in reconstructing the past environment. This discipline depends upon the presence of pollen-bearing sediments or deposits. Only in some parts of the Near East are such conditions fulfilled, for instance at high elevations where a moisture regime prevailed that guaranteed peat growth, or the presence of perennial water bodies in which sediments such as clay were formed. Favourable conditions could occur in coastal areas that received enough precipitation to

prevent sediments from drying up. It is obvious that humid conditions permitting peat growth or which are responsible for the development of perennial water bodies are absent or extremely rare in steppe regions. To reconstruct the past vegetation and climate of the steppe area, we have to rely upon the general picture of the Near East.

The development of the climate of the Djezireh has to be constructed mostly from the evidence obtained for adjacent areas (fig. 1), and only to a lesser extent from the pollen record of the area itself. Besides, the latter evidence does not date back to before c. 7000 B.P. (Gremmen and Bottema, in press). So far no sediment covering the complete Holocene has been collected in which pollen has been preserved. The oldest sediment collected was obtained from the salt lake of Bouara, on the border of Syria and Iraq. In Bouara the beginning of the sedimentation is dated at c. 7000 B.P., at which time grey-blue clay was deposited on a brown/ochre coloured impenetrable clay, that may be of Late Pleistocene age. The 430-cm-long core was radiocarbon-dated  $5730 \pm 120$  B.P. (GrN-13376) at a depth of 340-350 cm. The formation of Lake Bouara is in phase with the development of the climate indicated by the pollen record of Lake Van and Söğütü in East Anatolia and the lakes or Urmia, Zeribar and Mirabad in Northwest Iran (see also van Zeist and Bottema 1982).

It is questionable to what extent the Holocene moisture regime in the western part of the Syrian Djezireh resembled that of the eastern part. In this respect the reader is referred to the general description of the development of the climate in the Near East, where it is stated that for northern Israel the most humid conditions were found already from c. 14,000-11,000 B.P. on. More recent information on the Huleh basin, obtained by Uri Baruch (The Hebrew University, Jerusalem) and the present author confirm that at that time deciduous oak woodland predominated. Remarkably high values for Cerealia-type pollen draw attention. Cerealia-type pollen of the size that includes *Triticum dicoccoides* was regularly met with. It is not unlikely that such early favourable conditions predisposed the development of the Natufian culture. Still the distance between northern Israel and the Djezireh is rather large and the climatic development of the latter would more likely have been in phase with that of northwestern Syria, as has been studied for the Ghab valley (Niklewski and van Zeist 1970; van Zeist and Woldring 1980). In the Ghab valley the most favourable moisture conditions occurred from about 11,000-8000 B.P. More favourable conditions in the western Djezireh for the period under discussion are pointed at by the macrofossil record. In the Epi-Palaeolithic layers of the settlement of Mureybit, carbonized caryopses of wild einkorn were found during the excavation by van Loon (van Zeist and Casparie 1968; van Zeist and Bakker-Heeres 1984 (1986)). Nowadays wild einkorn is not recorded for the Mureybit area and the nearest stands of this wild cereal are found on the slopes of the Taurus, for instance the Karadağ above an elevation of 800 m. The habitation of Mureybit, the oldest prehistoric settlement recorded up to now, dates back to 10,500 B.P. Did the Mureybit people collect the wild einkorn as far away as up in Turkey, or did this cereal occur close to their settlement?

The Ghab record indicates that moisture conditions during part of the Late-Glacial and the first millennia of the Holocene were better in the Jebel Alaouite than afterwards. In this respect one should not forget that the global temperature for the period 11,000-8,000 B.P. was lower than at present. Especially at the beginning of the Holocene, the average annual temperature may have been a few degrees lower. Moisture condition, present in the Alaouite area, may have extended somewhat further to the east, causing a shift of the belt of wild einkorn to the south, where it was exploited by the inhabitants of Mureybit.

Overgrazing must have been felt most at the margin of the distribution area of a species like wild einkorn. In this respect it is interesting to learn that at present parts of northern Iraq and Iran show an important increase in the amount of wild cereals in places where they were almost or completely absent. This is a result of the present war, which put an end to grazing because of the danger of mines. The rapid expansion of wild cereals in the Kurdistan area is of great interest for genetics in connection with commercial wheat-breeding, but also for research in ecological prehistory. At the moment field work is not possible and after future pacification natural scientists will have to do their field work faster than sheep and goats (International Meeting on Cereals, Eucarpia, Wageningen; February 1988). It seems, however, very unlikely that grazing or overgrazing led to the disappearance of wild einkorn in the Mureybit area in later periods. The geographical situation and especially the elevation do not seem suitable for the occurrence of this plant species in the Djezireh.

It is possible that the distribution pattern of prehistoric settlements can inform us on past climatic conditions. The presence of farming villages that relied on dry-farming is an indication of a certain level of precipitation. The limit for dry-farming coincides more or less with the 200-mm isohyet. According to TAVO map A VI 4 this isohyet runs c. 30 km south of Raqqa. However, measurements for the Raqqa station give 174 mm during the period 1951-1962. In this respect the mapping of Neolithic sites in the Balikh area by P.M.M.G. Akkermans is of interest. Neolithic people who settled about 8000 B.P. in the Balikh valley were one to two thousand years ahead of the distinct precipitation increase that is suggested by the pollen record of especially the Zagros Mountains. It is note likely that the vegetation showed a delay of a thousand years in reacting to the increase in precipitation.

Although an increase in humidity is concluded from the arboreal pollen values in the adjacent mountain ranges, trees did not expand to the Djezireh steppe. We are hardly or not at all informed on the nature of the upland steppe vegetation during the first half of the Holocene, and we do not know to what extent it differed from that of the upper part. In the first place no pollen diagrams from the area under discussion, which cover the complete Holocene, are available. In addition, there is evidence that many changes in plant cover of the last 6000 years were due to human activity.

The presence or absence, the appearance or disappearance of human cultures is explained too often by archaeologists as being related to climate. Certain forms of economy are directly linked with climate, for instance olive culture, dry-farming or date production, but the disappearance of farming is not necessarily caused by a change in climate. The appearance of Neolithic habitation in the Djezireh must be linked with the presence of water, as many settlements were founded for instance along the Balikh and the wadis running into this river and were not linked with favourable precipitation.

Akkermans (1988 and personal communication) noted that the early Neolithic sites in the Balikh valley, although linked with the drainage system, were not situated at some distance from the Balikh itself, but on the banks of branches of the Balikh or tributary wadis. Only where the stream had cut into the higher Pleistocene plateau, did the banks carry habitation as is, for instance, the case with Tell Assouad and Tell Damishliyye. Akkermans wonders whether the distribution of early Neolithic settlements points to more marshy conditions and a wetter climate around 8000 B.P. This idea is, however, not supported by the pollen evidence. For coastal Syria the early Holocene conditions became drier around 8000 B.P., whereas evidence from adjacent parts in eastern Anatolia

and northwestern Iran points to an increase in precipitation becoming effective after about 7000 B.P.

How can we explain the preference of the Neolithic farmers for locations at some distance from the streams? Even today the traditional farmers of the Balikh area live in their beautiful multi-domed mudbrick farmhouses on the plateau on the west side of the Balikh one or more kilometres away from the water. When they were asked why they lived there, such farmers explained the choice of the location of their homesteads as a matter of drinking water. They said that they stayed away from the Balikh because if they settled any nearer to the river the bad taste of the river water could be traced in the ground water. Close to the water mosquitoes are a nuisance, but even the early Neolithic people of Nea Nikomedeia and Dikili Tash lived at the edge of the marsh, as do present-day Syrians who build along the Balikh.

The pollen and sedimentation record so far obtained for the Balikh or Khabour area hardly informs us about the climate of the Neolithic period. During coring in the shallow Wazgöl, north of Tell Hammam et-Turkman, a hard impenetrable layer was hit at a depth of 310 cm. In the Wazgöl sediment pollen was found down to 50 cm only. From the top down to 50 cm the pollen turned out to be progressively corroded; evidently the disappearance of the palynological contents in these upper layers is only a matter of time, on account of the repeated drying up of the lake. The fact that no pollen was preserved in the lower part of the sediment seems to prove that conditions were not wetter at that time than they are today. If significantly more humid conditions had occurred around 8000 B.P., one would expect relatively soft clay containing pollen to be present at deeper levels.

What is said above does not mean that the decision of early Neolithic people to settle at some distance from the water was not related to the climate that prevailed at that time. Palaeolimnological investigations of Lake Urmia in northwestern Iran (Kelts and Shah-rabi 1986) in combination with palynological investigation of the same core taken from that lake (Bottema 1986) may be informative in this respect.

During the earlier part of the Holocene an influx of minerals from the adjacent mountains occurred in Lake Urmia. After that period the sediment changed into aragonite, carbonates and other precipitates that originated from the water itself. It seems obvious to explain the first phenomenon by an increase in precipitation resulting in a higher river discharge that washed in minerals. The latter phenomenon could result from dry conditions leading to increased evaporation. The pollen record of the older part, however, points to a very cold and dry open *Artemisia*/chenopod steppe, whereas at the time when various kinds of soluble salts started to precipitate, the pollen record indicates the development of vegetations that could have occurred only under a more humid regime. Very likely the inwash of minerals had been caused by torrential showers, which were indeed rare but which did fall occasionally and could easily have eroded the slopes, unhindered by any substantial plan cover. When a more stable and favourable moisture regime developed this resulted in a denser vegetation which in turn prevented the rapid run-off of the precipitation and melt water, a vegetation that even kept and evaporated an important part of the precipitation itself. Lake Urmia had in time turned from a freshwater body into a hypersaline lake, and a large part of the sediment was formed by local chemical precipitates.

A reason for keeping some distance from the stream channels in the Balikh area may have been the threat of flooding caused by torrential showers. It is not impossible that this

regime changed during later periods, so that people could settle closer to the edge of the streams. In this respect Bar-Yosef's (1986) explanation of the function of the PPNA walls of Jericho is of interest. Bar-Yosef argues that those walls did not form part of a defence system against human intruders like the walls Joshua won his credits for much later, but that they were raised against the threatening floods of the Wadi el Mafjar. In the Balikh valley Neolithic habitation was present along the lateral channels. One wonders whether it was only the Balikh itself that flooded from time to time, floods that were fed by rain or melt-water from the mountains in Turkey. Such explanations are, however, rather speculative.

The preceding part shows that conclusions about the palaeoclimate based upon the settlement pattern have their limits. The pollen record as it is treated by van Zeist and Bottema (1982) is more suggestive, but a definite answer is not obtained from this discipline either as far as the Djezireh is concerned, as especially the Balikh valley lies in between areas with records that are not in phase.

Superimposed upon the natural development influencing the course of the climate were human activities. Anthropogenic pressure strongly influenced the more stable ecosystems where it very rapidly became the controlling factor. In vegetations that occurred under rather marginal conditions as regards precipitation, herding soon became destructive. In a more dynamic system like that of the Balikh valley and adjoining swamps, man was another dynamic factor that became dominant only after some time. If the actual and potential situation in the Balikh valley are considered, it looks as though a relatively short period of protection would restore the vegetation. Regeneration of the upland steppe would take much more time and the situation might even be irreversible to some extent.

It may be assumed that the exploitation of the upland (the area outside the valley) sooner or later resulted in over-cropping. The precise moment in time when such effects became felt is difficult to define. In this respect a case study of Ilse Köhler and Gary Rollefson on the effect of early Neolithic habitation, even leading to the destruction of the ecosystem and the subsequent disappearance of the instigators of the damage, drew attention (oral communication XIIth INQUA Congress, Ottawa 1987). Köhler and Rollefson produced evidence of the complete destruction of the woodland ecosystem in the Ain Ghazal area in northwestern Jordan. This resulted in erosion and may have been the reason for the disappearance of the early Neolithic habitation. According to Akkermans (personal communication) the southern Balikh valley was abandoned c. 8000 B.P., while about 500 years later the same can be said for most of the settlements in the north.

Compared to northwestern Jordan no oak woodland was present in the Djezireh. The find of small fragments of fruits of pistachio, almond and prune in Neolithic Tell Sabi Abyad (Akkermans 1987; 1988) is not sufficient proof of the occurrence of these trees in the neighbourhood. According to van Zeist (personal communication) these few remains may originate from a distant area. The rich fauna identified by H. Buitenhuis points to the presence of an extensive riverine forest as the only locality where trees were found.

The destruction of the vegetation of the upland decreased the carrying capacity for domestic herds and resulted in a gradual lowering of the biomass. This disappearance of plant cover caused a higher albedo, resulting in a large evaporation effect. The temperature of the soil, no longer protected by plants could be increased by maximally 5° C (Geddes 1983). The effect of the wind upon the soil would have increased if the plant cover had disappeared. The heating and drying effect of the wind causes greater loss in

soil moisture than is the case if vegetation is present. In itself a protective plant cover evaporates considerable amounts of moisture, related to the total leaf surface. Still, apart from the important evapotranspiration of the leaves, the soil underneath would be protected to some extent. Especially the dark colour of the vegetation could effect higher precipitation because of the saltation effect. It is stated by Brown et al. (1982) that the destruction of forest can result in the loss of 60% or more of incident rainfall. Subsequent soil losses may be 50-200 times. As the Djezireh never carried any substantial forest, moisture loss will have been lower but the ever increasing anthropogenic pressure must have influenced the moisture balance in a negative way. Although anthropogenic activity may thus have changed the result of the climate, it is difficult to demonstrate the quantitative effect.

#### LOCAL EVIDENCE

In connection with van Loon's excavation in the Balikh valley and Kühne's investigations in the Khabour region palynological investigations in the Syrian Djezireh were carried out by Gremmen and Bottema (in press). Coring, mainly in oxbow lakes of the Balikh and Khabour or shallow basins (Waz Göl, Moi el Faidate, Chatounieh, Bouara), never exceeded 4 metres and generally came to a halt because of the presence of impenetrable layers, presumably old surfaces on which the formation of Younger Holocene sediment had started. The onset of sedimentation could be radiocarbon dated only in the Bouara depression, where organic material had been deposited. There sedimentation started about 7000 B.P. This is in line with the assumed increase in precipitation in the adjacent mountainous area. Still the run-off was never able to form perennial water bodies. Repeated to occasional drying-up of lakes or marshes is assumed from the absence or corrosion of pollen and the red or yellow-brown colour of the sediment, both observations pointing to oxidation. Even Lake Chatounieh must have suffered from fluctuating levels as bordering deposits are devoid of pollen, indicating frequent drought. The Chatounieh sedimentological record very likely dates back to the second half of the Holocene, which was more humid than the first half.

The results of these investigations were informative, but not very promising. For a detailed report on the results the reader is referred to Gremmen and Bottema (in press). Some palynological results from Tell Hammam et-Turkman will be discussed here. The prehistoric site very likely started during or before the 'Ubaid period on an alluvial deposit of the Balikh. A short coring was performed to trace the virgin soil under the tell. At the east side of Tell Hammam a deep trench had been made through most of the accumulation of which the 'Ubaid layers had been excavated by Akkermans. The question remained whether the virgin soil could be traced accurately by coring. It is difficult to trace the level where the first strata of a settlement mound started on the virgin soil by means of a Dachnowsky sampler. At Tell Hammam attempts were made to trace the virgin soil by means of coring, but here like other sites in the Near East, no boundary could be seen. It was assumed that virgin soil represented by clay of the Balikh was found where the sediment showed a grey colour, a fine stratification and the typical striated fan-shape if the core sample was broken. From the part attributed to undisturbed clay under the 'Ubaid level, two samples A and B separated by 8 cm in depth have been analysed (Table 1).

Table 1. Pollen analysis of three samples from the Balikh valley in the Hammam et-Turkman area.

Spectra depth	Pre-'Ubaid A	Pre-'Ubaid B	Wazgöl 6 cm
<i>Quercus calliprinos</i>	.	.	0.6
<i>Quercus cerris</i> -type	.	.	1.8
<i>Pinus</i>	1.1	1.1	19.7
<i>Humulus/Cannabis</i>	.	.	0.3
<i>Olea</i>	.	.	1.6
<i>Ostrya</i> -type	.	.	0.2
<i>Vitis</i>	.	.	0.3
<i>Juglans</i>	.	.	0.3
<i>Juniperus</i>	.	.	0.2
<i>Alnus</i>	.	.	0.2
<i>Abies</i>	.	0.2	.
<i>Cedrus</i>	.	.	0.2
<i>Fraxinus</i>	.	.	0.3
<i>Thymelaea</i>	.	0.3	.
AP	1.1	1.6	25.5
Chenopodiaceae	1.9	1.0	11.1
Noaea-type	.	.	1.3
Aellenia-type	.	.	0.5
<i>Artemisia</i>	36.4	47.5	11.5
<i>Centaurea solstitialis</i> -type	6.3	7.4	2.2
<i>Senecio</i> -type	.	.	0.2
<i>Matricaria</i> -type	4.5	4.9	1.3
<i>Xanthium</i>	.	.	0.8
<i>Carduus</i>	.	0.2	.
<i>Carthamus</i>	0.7	1.8	.
<i>Cirsium</i>	0.7	.	.
<i>Filago</i> -type	.	0.4	0.2
Tubuliflorae	8.9	3.8	1.8
Liguliflorae	2.2	3.0	2.7
<i>Plantago lanceolata</i> -type	.	.	0.8
<i>Plantago ovata</i> -type	.	.	0.2
<i>Plantago spec.</i>	0.4	0.2	0.8
Cerealia-type	12.6	8.0	5.7
Gramineae	15.6	14.3	23.9
Caryophyllaceae	.	.	0.6
<i>Pimpinella</i> -type	.	0.2	.
<i>Turgenia</i> -type	.	1.8	.
Umbelliferae	.	1.8	2.4
Brassica-type	.	.	1.4
<i>Capsella</i> -type	.	.	0.6
<i>Euphorbia</i>	0.7	.	.
<i>Crozophora</i>	.	0.2	0.2
<i>Helianthemum</i>	.	0.2	0.2
<i>Convolvulus</i>	.	.	0.2
<i>Calystegia</i>	.	.	0.2
<i>Cressa</i> -type	0.4	1.0	.
<i>Atraphaxis</i>	.	0.2	.
<i>Cuscuta</i>	.	.	0.2
<i>Solanum nigrum ssp. villosum</i>	.	.	0.3

Table 1 (continued)

Spectra depth	Pre-'Ubaid A	Pre-'Ubaid B	Wazgöl 6 cm
Polygonum aviculare	.	.	2.1
Leguminosae	0.7	1.6	0.2
Leontice	0.4	.	.
Rumex cyprius-type	.	.	0.2
Valerianella	.	.	0.2
Aquilegia	.	1.1	.
Ranunculus sceleratus-type	0.4	.	0.5
Cephalaria syriaca-type	1.1	.	.
Prosopis	1.1	1.2	0.3
Sanguisorba minor-type	.	.	0.2
Galium-type	0.4	.	.
Linum austriacum-type	0.4	0.2	.
Ornithogalum-type	.	1.0	.
Muscari-type	.	0.2	.
Haplophyllum	.	0.3	.
Pollen sum	269	609	628
Cyperaceae	2.2	2.1	24.7
Sparganium-type	0.4	0.3	4.1
Potamogeton pectinatus-type	.	.	80.3
Dryopteris	.	.	0.2
Cheilanthes	.	1.8	.
Pediastrum integrum/boryanum brevicorne	.	.	48.4
Hystrix	.	15.0	.
Indeterminata	16.4	3.3	5.3
Pollen preservation	±	+	++

The clay on which the 'Ubaid and younger periods have accumulated was firmly sealed and protected, comparable to the old surface under a burial mound. The construction of a burial mound over the soil surface protects the pollen in the surface layer from oxidation. The samples originating from under the tell form a sharp contrast with those taken from a core obtained from an oxbow of the Balikh at a distance of about 100 m. In the oxbow sediment repeated drying-up was concluded from the ochre-yellow colour of the clay, and drying-up must have caused the oxidation of the less resistant pollen types and lowered the diversity in types considerably. The samples from underneath the tell are of a grey colour and pollen is preserved much better, as can also be concluded from the high diversity in types.

The age of samples A and B (Table 1) cannot be established with certainty. As the samples contain a large amount of Cerealia-type pollen grains, they cannot be expected to be older than early Neolithic times. The upper limit must be the Halaf period, as 'Ubaid layers are found on top of the clay. Roughly speaking, the age of the two samples lies between 6500-8000 B.P.

In Table 1 the pollen percentages are shown of samples A and B taken from under the

'Ubaid layers in Tell Hamman et-Turkman and a modern sample taken from the sediment in Wazgöl at a depth of 6 cm. Samples A and B contained charcoal, especially the lower sample A. Pollen preservation was better in sample B than in sample A, and this permitted the identification of a larger number of pollen types. The spectra are characterized by very low arboreal pollen values; even pine scores only 1.1%. The dominating type is that of *Artemisia*, partly *Artemisia herba-alba*-type, but it also includes other species of this genus. Grasses amount to c. 15%. This pollen may partly have been produced by plants growing in the Balikh valley.

In samples A and B Cerealia-type pollen measures 12.4 and 8.0%, respectively. Such high percentages point to cereal growing at the sampling spot or to threshing practices in the vicinity, because during threshing pollen is also released. Pollen of weeds that is also present favours the idea that crops were grown in the wet clay of the Balikh at the spot where later a settlement was formed. Nowadays some of these weeds, such as *Prosopis* and *Crozophora*, are to be found in irrigated fields. Other weeds met with are *Carthamus* and *Cephalaria* cf. *syriaca*. In later periods *Cephalaria syriaca* commonly occurred as an admixture in carbonized seed samples, as is evident from the investigations by van Zeist. The *Linum* pollen present in the assemblages does not belong to *Linum usitatissimum*, the species which was grown, but is from some wild species.

Somewhat puzzling is the presence of pollen that resembles *Cressa*. At present, *Cressa* occurs in wet and brackish fields (personal communication R. Neef), usually together with certain chenopod species. In the Tell Hammam samples, however, Chenopodiaceae pollen does not play any role.

In comparing the two spectra from pre-'Ubaid times with a modern spectrum from Wazgöl, conspicuous differences can be observed. Arboreal pollen amounts to 25.5% in Wazgöl, sharply contrasting with the 1.1 and 1.6% in samples A and B. Especially the absence of pine pollen in the pre-'Ubaid spectra points to an age of c. 7000 B.P. or older for the spectra A and B. That Chenopodiaceae values are much higher at present than at c. 7000 B.P. may be explained by the fact that salinization had not yet developed at that time. *Artemisia*, a pollen type that represents species which form an important part of the steppe vegetation, score four times higher in pre-'Ubaid time than in the modern sample.

The spectra A and B suggest that during Neolithic times it was drier than nowadays and that an *Artemisia*-steppe prevailed along the Balikh in the Tell Hammam area. Agriculture was practised in the Balikh valley, whereas outside this valley it was too dry for dry-farming. As some pollen of weed species typical of irrigated fields have been found for the pre-'Ubaid spectra, cereal farming in Neolithic times may have been based already on some form of irrigation, or was at least practised in moist alluvial soils.

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# Landevaluation in prehistoric perspective: Some observations

J.A.K. BOERMA

From the beginning mankind has always exploited the natural resources of the earth. As Beek (1978) puts it: 'people have always been on the look out for land that suits their purposes: for building shelters, for providing food and fibre, for protection against wild animals' and 'land that was unsuitable was left idle as long as possible'. Soil has to be regarded as the main natural resource since it provides food, directly or indirectly. Consequently, the possibilities of soil for agricultural purposes have occupied mankind for a long time. For example 4000 years ago agricultural suitability of soil was used to establish a tax system in China. People were interested not in the soil itself but in its value for a certain use.

Also in modern times it has been the use that can be made of soil that interests people dealing with soils. Dokuchaiev, a pioneer of modern soil science, considered it necessary to express the value of soil for agricultural purposes. Soil genetic considerations, chemical and physical characteristics as well as repartition of types of soil were just a tool for his studies; not the ultimate goal.

Gradually observations on the use of soil for agricultural purposes were transformed into studies on the use of land for both agricultural and non-agricultural purposes. It must be emphasised that land in this respect is a much broader concept than soil. Land includes 'an area of the earth's surface which characteristics embrace all reasonably stable or predictably cyclic attributes of biosphere above and below this area, including those of the atmosphere, the soil and underlying geology, the hydrology, the plant and animal population and the results of past and present human activities' (Beek 1978). This resulted in the preparation of a framework for landevaluation (F.A.O. 1976) in order to provide a system to identify and execute the process of assessment of land performance when used for specific purposes.

Landevaluation should answer the following questions (F.A.O.1976):

- how is the land currently managed; what will happen if present practises remain unchanged?
- what improvements in management practises, within the present use, are possible?
- what other uses of land are physically possible and economically and socially relevant?
- which of these uses offer possibilities of sustained production or other benefits?
- what adverse effects, physical, economic or social, are associated with each use?
- what recurrent inputs are necessary to bring about the desired production and a minimum of adverse effects?
- what are the benefits of each use?

Introduction of a new form of landuse adds two questions to this list:

- what changes in the condition of the land are feasible and necessary and how can they be brought about?
- what non-recurrent inputs are necessary to implement these changes?

Summarizing one can say that management, landuse and its effects, socio-cultural aspects and benefits have to be considered. Although some of the questions listed here are not useful when dealing with landevaluation in a prehistoric context, it is very well possible to reconstruct the landuse potential for a given prehistoric site, environment and time, based on the same series of questions. In that case they have to be adapted to the conditions prevailing in the area and period considered. It is from this point of view that the relevance of the above-mentioned questions will be considered.

With regard to management questions, one must realize that in prehistoric time relatively few tools and virtually no machinery were known to man. Some aspects of management that can be considered are the following. In the first place, tools like 'primitive' hoes sometimes supplemented by men-driven ards. Another management aspect is also important today but in a different way: transportation (manor domesticated animal); in the prehistoric perspective only with respect to the distance to be covered, since it always had a low-velocity character; probably its availability and/or capacity played a minor role. A third aspect of management is its level; e.g. a distinction between rain-fed and irrigated arable landuse if appropriate. A more detailed distinction between the various forms of management does not seem useful considering the prehistoric conditions.

The question on improvement of management practices should not be considered with regard to the use of more sophisticated tools and the like, but mainly with regard to a change of system. For instance, if sufficient water is available in a semi-desert environment, one should consider the possibility - if culturally possible for the period in question - to change from rain-fed agriculture to irrigated agriculture.

Looking at the forms of landuse to be considered in a prehistoric context, the scope can be relatively wide. Taking into account the physical, economic and social terms of the site, the landuse may include purely nomadic landuse, several partly or episodic sedentary forms including gathering of wild fruits and 'wild crops', hunting, fishing and extensive grazing, as well as several sedentary forms including harvesting of agriculturally grown crops and fruits and more or less extensive herded grazing.

It is clear that the physical, economic and social terms cannot be looked at in the same way as in modern landevaluation. Physical terms can be derived directly from the land qualities, which does not represent an approach different from today's practice. Both economic and social terms are much more difficult and frequently, impossible to determine. No written sources are available to the investigator; the only source is the soil archive.

Economic terms can be derived from other factors like the physical environment itself, the size of a site, the density of settlements and the supposed number of inhabitants within a given area, the availability of qualified tracts of land within a certain distance as well as their accessibility (obstacles, e.g. a river to be crossed), *etc.* In this context one must realize that it's very likely that the number of known sites in a given prehistoric environment and time seldom represent the total of sites ever present in the area.

Social terms are of no relevance for a prehistoric form of land use since any form of reliable information is absent.

As far as the sustained production or other benefits resulting from a certain type of landuse are concerned, the relevance is clear. One must take two factors into account: the potential and the dimensions of the available land. A low potential of the land may lead to a quick wearing-out of the land, followed by abandonment and moving of the activity to another tract of land (i.e. shifting cultivation). In this context the dimensions, availability and distance of suitable land (determined among other things by the size of the settlement) may influence the period during which the land (soil) can restore itself and consequently influence the objective of sustained production. The same holds for the so-called other benefits.

The questions referring to adverse physical, economic or social effects are only relevant with respect to the physical effects, that is the environment. Neither the adverse economic nor the social effects can be taken into account since they concern the society (which we have no sound information about). Adverse physical effects may include erosion and deterioration of the natural vegetation.

The question of recurrent inputs necessary to realize the desired production can only be answered in a very limited sense, particularly since no real currency is involved. These particular inputs have to be expressed in the form of required labour inputs which are difficult to estimate and must be derived from the land qualities. This factor can probably not be taken into account, since labour in the prehistoric perspective is a matter of availability and not of cost.

Finally the benefit of a certain form of landuse should not be expressed in the form of money. Benefits have to be seen as the possibilities offered by the environment for a given form of landuse. Here again, one is forced to consider the landuse potential instead of the benefit level.

The Framework of Landevaluation (F.A.O. 1976) presents two questions on the introduction of new forms of landuse. It is not necessary to take both questions into account because landevaluation in a prehistoric context is an evaluation of (the account possibilities of) the natural resources available to the inhabitants of a certain site in a certain period.

Landevaluation demands a distinction in several major types of landuse or, translated into prehistoric conditions, major types of use of the natural resources. The following forms have to be included:

- use of natural resources (environment) as they are without any specific input or output,
- use of natural resources for any kind of landuse of the collecting type,
- use of natural resources for cultivation purposes.

The most important form of use of natural resources without in- or output is simple and concerns mainly the site choice or part of it. It should be evaluated in terms of presence or absence of physical factors like flooding risk or topographical conditions and cultural factors like a stronghold position or the distance to water for domestic use. One can imagine several other factors.

The second major type of use of natural resources, i.e. exploitation of the natural resources in the form of collecting, includes a variety of landuse forms like the gathering of wild fruits, game and fish, of suitable rocks and clay for stoneware, tools and pottery respectively, or the collecting of building materials.

The third type, i.e. natural resources as a basis for landuse of the cultivation type, comprises forms like rain-fed arable landuse, irrigated landuse or grazing.

Other forms of exploitation of natural resources are not excluded. It is obvious that it is sometimes difficult to separate these major types of landuse.

The above mentioned observations make it clear that landevaluation in a prehistoric context must be limited to its physical aspects since economic and social aspects can be used in a derived form only. The physical aspects to be studied concern the climate, soil, rock, vegetation, topography, hydrology in their respective qualities or attributes. All of them concern physical conditions at the time the site was occupied, which means that one must consider palaeoconditions and reconstruct palaeoclimate, palaeovegetation, palaeo soil conditions, *etc.* These factors must be derived from the soil record mainly, usually in combination with the findings of comparable sites in order to establish the palaeo-environment.

In nearly all cases there is a complete absence of quantifiable assessments regarding output of the landuse form(s). This is mainly caused by the fact, that comparable sites within a given environment are scarce and/or far apart; a subjective fact, since unknown or vanished sites cannot be taken into account.

Only in relatively rare cases where the finds of a large number of sites in a relatively small area are available, may statistic manipulation of data provide some quantified assessments (cf. Kamermans et al. 1985). Thus, in most cases, prehistoric landevaluation must be limited to a qualitative one, based on the physical landuse potential. The physical landuse potential must take into account the known or supposed evidence of a certain level of development or management.

An example of landevaluation according to this concept will be presented elsewhere (Boerma, in preparation).

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# A microwear analysis of sampled borers from Netiv Hagdud, a PPNA settlement in the Jordan Valley

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The tell of Netiv Hagdud is located about 10 km north of Jericho. The site is situated on a natural promontory, at an elevation of -180 m below sea level, overlooking the Salibya depression. The depression, varying in elevation between -190 m and -240 m below sea level, contains several Natufian and preceramic Neolithic sites (Schuldenrein and Goldberg 1981). During the early Holocene, spring activity inside the depression resulted in a marshy environment in which the Natufians camped. Forced by increasing marshy conditions, the early Neolithic population avoided the bogs and situated their settlements on opposite margins of the depression: Netiv Hagdud on the western edge (Bar-Yosef et al. 1980) and Gilgal on a flint ridge on the eastern edge, nearer to the river Jordan (Noy et al. 1980).

Surface evidence indicates that Netiv Hagdud extended over an area of about 10.000 sqm. Sections exposed by modern construction work for a water reservoir revealed that the archaeological deposits have a depth of at least 3 m. At the western side of the tell an area of 100 sqm. has been excavated to a depth of 0.5 m. Here four oval to circular structures ranging in diameter from 4 to 7 m were brought to light. The walls, constructed by limestone blocks, were preserved to a height of 25 cm. In general, the excavated area showed a low density of artifacts. The flint assemblage consisted of core tools such as adzes, small tranchet axes, chisels and picks as well as polished limestone axes. Also present were notched arrowheads and borers. Two pieces of obsidian were recovered, both originating from Göllü Dag in Anatolia (Perlman and Yellin 1980). The ground stone industry includes limestone blocks with cupmarks and limestone and basalt pestles. The low density of finds is not necessarily characteristic of the site as a whole since at nearby Gilgal, dating from the same period, the density of finds varies from zone to zone, possibly as a result of different activities. At Gilgal, retouched pieces, borers and arrowheads are common but axes are rare.

To date, no report on the faunal remains of Netiv Hagdud is available, but in neighbouring Gilgal remains of waterfowl like ducks and geese are plentiful. Among the mammals *G. gazella* is the dominant species but also woodland dwellers like aurochs, deer and boar are found (Tchernov in Noy et al. 1980).

On its western side, Netiv Hagdud was wholly covered by an accumulation of sand and gravel due to heavy slope wash. This is not surprising as the site is located on top of the alluvial fan of the Wadi al-Bagar. Bar-Yosef (1986) has pointed out that in fact many early Neolithic sites are located near the drainage outlets of streams. Such a location was chosen for two reasons: the convenience to have drinking and washing water in the