HOLOCENE VEGETATION AND CLIMATE OF NORTHWESTERN SYRIA

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INTRODUCTION

In 1970, J. Niklewski and W. van Zeist published a pollen diagram prepared for an 11-m-long sediment core from the Ghab valley in northwestern Syria (fig. 1). This valley, through which the Orontes river flows, extends c. 50 km from south to north and has a maximum width of c. 12 km. Before the valley was drained in 1953-1955 it was covered for the greater part by lakes and swamps. To the west of the Ghab valley, the Alouite Mountains (or Ansariye Mountains) reach elevations of over c. 1300 m (4000 ft). The Zawiye Mountains to the east of the valley are much lower. For further particulars on the geography of the area and for climatic data the reader is referred to Niklewski & van Zeist (1970).

The diagram mentioned above (henceforth indicated as the Ghab I diagram) covers the greater part of the last glacial period, but the Holocene is not well represented. A date of c. 10,000 B.P. was obtained for the level of c. 29-37 m and the upper 40 cm of the deposit proved to be too poor in pollen for a satisfactory result. Consequently, only a section of 70 to 75 cm provided information on the Holocene vegetational history, and it was unclear how much of the later phases is missing in this diagram. Gradually the suspicion arose that a quite considerable part of the Holocene may not be represented in the Ghab I diagram. This made it desirable to carry out some more borings in the Ghab valley in an effort to obtain a longer Holocene pollen sequence than that in the Ghab I diagram.

The opportunity for additional coring presented itself in May 1974 when the first author took part in the excavation of Tell Selenkahiye, along the Euphrates in northern Syria, under the direction of Professor M. N. van Loon. Mr. Abdurrasat Zaqaq, director of the Museum at Hama and representative of the Syrian Government at the excavations of Selenkahiye, kindly established contacts with the Maharde Office of the Ghab Development Project. Mr. Majad Farage, Mr. Bassam Sarraj and Mr. Zaid Zaqaq of the said office provided information that was useful in connection with the selecting of suitable coring sites. Mr. Mount Obeid of the Ghab Administration Project at Skebiye accompanied us in the field. In addition to the first author, Mr. P. A. Akkermans and Mr. R. W. Brandt, both of the staff of the Selenkahiye excavations, took part in the coring expedition. The Netherlands Organization for the Advancement of Pure Research (Z.W.O.) provided financial support for the excavations at Selenkahiye. The radiocarbon determinations were carried out under the direction of Professor W. G. Mook.

PRESENT-DAY NATURAL VEGETATION

In the publication of the Ghab I diagram (Niklewski & van Zeist, 1970) a description of the (reconstructed) natural vegetation of the area is presented. In this section the main vegetation zones will briefly be reviewed.

On the west flank of the Alouite Mountains the following zones are distinguished. Between sea-level and c. 300 m altitude the Ceratonieto-Pistacietum lentisci occurs. This vegetation type includes Ceratonia siliqua, Pistacia lentiscus, Quercus calliprini, Pistacia palustris, Alnus humilis, Philyrea lucida and Olea europaea var. oleaster. In the zone between c. 300 m and c. 800 m the Pistacieto-Quercetum calliprini is the natural vegetation. In addition to Quercus calliprini and Pistacia palustris, various other trees and shrubs, such as Prunus syriaca, Crataegus azarolus, Styrax officinalis, Juniperus oxycedrus and the deciduous oak species Quercus infectoria, are found in this vegetation type. Pinus brutia is very likely also a natural constituent of the Pistacieto-Quercetum calliprini. Deciduous oak (Quercus infectoria, Q. cerris, Q. brantii, Q. libani) is the dominant tree above 800 m. Other trees present in the oak-dominated forests include Quercus coryllifolia, Carpinus orientalis, Acer monspeliense and Juniperus oxycedrus.

On the steep east flank of the Alouite Mountains the same vegetation zones as on the west flank are assumed to be present. At elevations above 1000 m Cedrus libani forms part of the mixed-oak forest. Between the valley floor, at about 190 m, and an elevation of c. 500 m the Ceratonieto-Pistacietum lentisci would constitute the natural vegetation, while the Pistacieto-Quercetum calliprini occupies the belt between c. 500 and 800 m.

Before drainage, swamp vegetations covered the greater part of the Ghab valley. Trees which were...
found in the valley include Fraxinus syriaca, Populus pseudosteppica, Tamarix spp., Salix spp. and Platanus orientalis. In the Zawiya Mountains, to the east of the Ghab valley, forest steppe probably constitutes the climax vegetation above 500 m. At lower elevations and further eastward steppe vegetation occurs naturally.

3. BORINGS AND LITHOLOGY

Two sediment cores were obtained with a Dachnowsky sampler with an inner diameter of 37 mm. The borings had to be carried out in one hole.

Fig. 1. Map of northwestern Syria. The coring sites Ghab I, II and III are indicated with an x. Elevation contour lines are given in feet.

3.1. Ghab II

The Ghab II core was taken at a locality c. 5 km westnorthwest of Skelbiye (fig. 1). Before the drainage of the Ghab valley, seasonal marshes were found in this area. The boring was carried out at the edge of a cotton field in unploughed soil. The following lithology was recorded:
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The site of the Ghab III core is situated on the west side of the valley, west of the village of Ain el Taka, c. 14 km northwest of Skelbiye. In this area perennial marshes were present formerly. The boring was carried out in a harvested grain field. Sampling started from the bottom of a 40-cm-deep pit. The following lithology was recorded:

0.17-0.57 m dark-grey clay with black spots
0.19-1.06 m red-brown clay with shell detritus
1.06-1.52 m grey to dark-grey clay with shell detritus
1.52-2.74 m grey clay with red-brown (oxidation) spots
2.74-1.16 m dark-grey clay
2.30-2.83 m plastic grey-blue clay with shell detritus
2.83-3.45 m grey-blue clay with shell detritus

Because of a sampling error the section between 2.03 and 2.83 m had to be cored in a second hole c. 30 cm away from the first one.

The boring was terminated at a depth of 3.43 m because it was assumed that the bottom of the core sampled would date back to beyond the beginning of the Holocene. This assumption, which was based upon the results obtained for the Ghab I core, turned out to be wrong. The aim to obtain a new sediment core covering the whole of the Holocene has not been achieved.

4. PRESENTATION OF THE RESULTS

The results of the examination of the Ghab II and Ghab III cores are presented in fig. 2. The upper part of the Ghab II core, above 1.45 m, proved to be too poor in pollen for a satisfactory result. Moreover, the upper section of the Ghab I diagram (Niklewski & van Zeist, 1970) is shown in fig. 2, although for the herbs only a selection of the pollen types established for the core section concerned is presented here. The sequence of the three diagrams as presented in fig. 2 is to a certain degree a chronological one. As will be discussed below (section 6) the earliest phases of the Holocene are represented only in the Ghab I diagram, whereas the upper part of the Ghab III diagram is definitely later than the upper sections of the Ghab I and Ghab II diagrams.

The construction of the pollen diagrams is the same as that of the original Ghab I diagram. All identified pollen and spore taxa are included in the basic pollen sum, with the exception of those of obvious marsh and water plants (to the right of the column with the pollen sums). Various herbaceous pollen types included in the basic sum, such as Gramineae, Cruciferae and Umbelliferae, may have originated at least partly from local marsh plants. Moreover, representatives of Compositae and Chenopodiaceae probably expanded locally on the valley floor (see section 6).

To the right of fig. 2 “main diagrams” showing the ratios between total tree pollen and the sum of Artemisia and Chenopodiaceae are presented. The latter ratios should provide a better picture of the upland vegetation pattern, that is to say, of the proportions of forest and steppe, than the AP/NAP ratios in which all herbaceous pollen types are included. However, this assumption is somewhat invalidated by the admission that Chenopodiaceae may also have formed part of the local vegetation.

5. POLLEN ASSEMBLAGE ZONES

The three Ghab pollen diagrams are subdivided into a number of zones. The zoning is mainly based upon changes in the AP/NAP ratios, but other features are also of importance in this respect. As will be discussed below, the correlation of the three diagrams presents serious difficulties, which must be ascribed at least in part to rather marked differences in the local pollen precipitation in the various parts of the Ghab valley. For that reason each of the three diagrams has its own zonation; that is to say, it has not been considered here to what
extent the diagrams may overlap.

3.1. Ghab I (pollen assemblage zones 1-4)

The zonation of the section of the Ghab I diagram presented in fig. 2 is the same as that in Niklewski & Zanten (1988). There are differences only in the zone designations (the original (sub)zone numbers are given between brackets).

Zone 1, spectra 37-40 (subzone Y1), is characterized by very low total arboreal pollen values. Of the tree pollen types, only Quercus, Pinus, Salix, Juniperus and Cedrus show continuous curves in this zone. Artemisia and in particular Chenopodiaceae show very high pollen percentages. As for the other herbaceous pollen types, the comparatively high values for Polygonum ancilare-type may be mentioned here.

In zone 2, spectra 61-63 (subzone Z1), a conspicuous rise in tree pollen values takes place. In addition to Quercus, Pistacia, Olea and Carpinus orientalis/Ostrya-type increase markedly. Cedrus has relatively high values. The decline in the Σ AP values is largely accounted for by Chenopodiaceae and Artemisia. The Polygonum ancilare-type curve falls drastically. Zone 3, spectra 64-66 (subzone Z2), shows high Σ AP values in which all tree pollen types mentioned above take part except Cedrus which declines markedly at the zone 2/3 border. Pinus pollen percentages remain rather low. The zone 2/3 transition (1.19-1.17 m) has been radiocarbon dated to 10,080 ± 55 B.P. (GRN 810).

In zone 4, spectra 67-74 (subzone Z3), Σ AP values are somewhat lower than in the previous zone. Pinus and Quercus caliphrus percentages increase to some extent. Alnus shows a continuous curve from spectrum 68 onwards, but its values remain low.

3.2. Ghab II (pollen assemblage zones 5-7)

In the whole of the Ghab II diagram, Compositae values are noticeably higher than in the Ghab I diagram. Gramineous pollen percentages are, on the average, lower. These differences are very likely due to local conditions.

Zone 5, spectra 1-9, is characterized by rather low Quercus cerri-type values. Alnus shows a distinct maximum in this zone. Pinus has rather low percentages.

In zone 6, spectra 10-17, Σ AP values show a maximum, which is accounted for completely by Quercus cerri-type pollen. The Pinus curve rises in the upper part of the zone, where Quercus values decrease again. In this zone various Compositae pollen types show lower values or occur less frequently than in zones 5 and 8.

Zone 7, spectra 18-22, is characterized by a marked decline in the Quercus cerri-type curve. Quercus caliphrus-type, Olea and Ostrya/Carpinus orientalis decrease likewise, but other types, such as Pinus, maintain themselves. Compositae, in particular Liguliflorae, reach high percentages in this pollen zone.

3.3. Ghab III (pollen assemblage zones 8 and 9)

In the Ghab III diagram, Chenopodiaceae pollen values are markedly higher and those of Liguliflorae Compositae are lower than in the Ghab II diagram. On the basis of the Quercus cerri-type values two zones are distinguished in this diagram. Zone 8, spectra 1-13, shows comparatively high Quercus cerri-type percentages. The zone 8/9 boundary is marked by a decline in the deciduous oak curve.

The subdivision into subzones 8a and 8b is based, in part, on the comparatively high Fraxinus ornus values in spectra 12 and 13, which indicate the beginning of manna ash cultivation in the area. Consequently, subzone 8b provides the first palynological evidence for the activity of man.

In zone 9, spectra 14-26, indications of human interference are quite numerous. The conspicuous decline of deciduous oak and pistachio at the beginning of the zone must very probably be ascribed to the clearance of forest. Fraxinus ornus, Olea, Juglans and to a minor extent Vitis reach comparatively high percentages in this zone. As for the herbaceous pollen, Sanguisorba minor-type and Polygonum ancilare-type increase distinctly. Plantago lanceolata-type is more common than in the previous zone. Chenopodiaceae decrease, but this may have been due to changes in the local marsh vegetation. The border between subzone 9a (spectra 14-17) and subzone 9b (spectra 18-26) is placed at the increase in Fraxinus ornus, Juglans and Sanguisorba minor-type.

In subzone 9b culture indicators show in general the highest frequencies. For the level of 184-192 cm, in the lower part of
zone 9, two radiocarbon dates have been obtained. The shell fraction gave an age of $44^{1110} \pm 40$ B.P. (GrN-9291), while the organic fraction of the same sample has been dated to $35^{1110} \pm 240$ B.P. (GrN-9471). Because of the small amount of organic material, the latter fraction has not been pretreated. Consequently, the age obtained may be somewhat too late because of younger contaminant (filtration of humic acids). On the other hand, the shell determination may be somewhat too old because of the presence of fossil carbonates in the water of the Orontes river. It seems fair to state that $35^{1110}$ B.P. is a minimum age and $44^{1110}$ B.P. a maximum age for this sample.

6. CORRELATION OF THE POLLEN DIAGRAMS

It has already been mentioned that the correlation of the three diagrams presents difficulties. This may be partly due to the considerable distance between the coring sites (the sites of Ghab I and II lie more than 30 km apart). As a result, the influx of regional pollen may have shown differences in the localities from which the sediment cores originate. In this connection it should be mentioned that particularly on the west side of the valley substantial amounts of pollen may have been washed in from the steep east flank of the Alaouite Mountains.

Differences in the local marsh vegetation are probably a much more serious disturbing factor. In the case of Cyperaceae, Sparganium-type, Juncus, Elatiglottis and some other marsh and water plants, there can be no doubt that these formed part of the local vegetation. Various other taxa may be represented in the local as well as in the regional vegetation. A well-known example is constituted by Gramineae. High values for Tubuliflorae and Liguliflorae Compositae and Centaurea type, and notably high percentages of $\Sigma$ AP values and notably high Artemisia and chenopod percentages. A similar pollen assemblage is not found in the Ghab II diagram. This conclusion follows from the comparison with the Ghab III diagram. The comparatively high percentages for $\Sigma$ AP values and notably high Artemisia and chenopod percentages. A similar pollen assemblage is not found in the Ghab III diagram. The comparatively high values for $\Sigma$ AP values and notably high Artemisia and chenopod percentages. A similar pollen assemblage is not found in the Ghab III diagram.

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doubt that chronologically zone 9 has to be placed above zone 4. However, it remains uncertain how much of zones 3 to 8 fits in between zones 4 and 9; in other words, which section of zones 3-8 fills the gap between the end of zone 4 and the beginning of zone 9. The course of the pollen curves does not give any clues for solving this problem satisfactorily. Consequently, for the sequence proposed in fig. 3 no convincing arguments can be adduced. Zone 1 links up fairly well with zone 4, particularly if spectrum 74 with the anomalously high *Pinus* percentages is left out. As for zone 7, it is assumed that the pollen contents of the core section concerned differs quite markedly from the original pollen influx. The high Compositae percentages in this pollen zone point to an intermittent drying out of the section concerned of the valley floor, which may have resulted in a selective preservation of durable pollen types. In the sediment above zone 7 very little pollen had been preserved, so that it was unsuitable for palynological examination. Because of its possibly distorted pollen picture, zone 7 had to be disregarded in attempting to reconstruct the Holocene pollen sequence. One may wonder to what extent the high *Quercus cerris*-type values in zone 6 could have been due to local factors. The question whether the deciduous oak maximum in zone 6 is of regional or of local nature is not without consequences for the reconstruction of the Holocene climatic history (see 7.3).

It should be stressed that the reconstruction of the “middle Holocene” sequence (zones 5, 6 and 8) is mainly guesswork. It is very well possible that the section covering zones 5 and 6 overlaps with zone 4 on the one hand and with zone 8 on the other. However, for the time being there is no better alternative.

7. VEGETATIONAL AND CLIMATIC HISTORY

7.1. Zone 1

The extremely high herbaceous pollen percentages indicate that during zone 1, steppe and desert-steppe vegetations were predominant in northwestern Syria. Larger parts of the Alasouite Mountains, the present-day natural vegetation of which consists of forest, would have been covered by steppe vegetations. The climate of zone 1 must have been very unfavourable for tree growth. This phenomenon is not confined to northwestern Syria, but pollen diagrams from other areas in the Eastern Mediterranean basin show comparable pollen assemblages. The scarcity of growth must have been caused by climatic dryness. During zone 1, which period coincides largely with the Late-glacial of the European Warm-glacial chronology, temperature must have risen markedly, so this cannot possibly have been the limiting factor for tree growth. One could imagine that a possible increase in precipitation did not keep pace with the rise in temperature. The higher evaporation rate was not or only insufficiently compensated for by an increase in precipitation, in consequence of which the climate of zone 1 was extremely dry.

7.2. Zones 2 and 3

The expansion of trees which probably started about 11,000 B.P. must have been induced by a marked increase in humidity. Zone 2, the period of the rapid spread of forest vegetations, coincides wholly or in part with the Late Dryas period, the final phase of the Late-glacial. During this period, the temperature dropped again which must already have resulted in a rise in humidity, but also precipitation itself may have increased. Considerably higher precipitation, compared to that of zone 1, must certainly be assumed for zone 3 and subsequent zones, which can be placed in the Holocene (the zone 4/3 transition is radiocarbon dated to 10,080 B.P.). In spite of the early Holocene rise in temperature, forest constituted the natural plant cover of the mountains to the west of the Ghab valley during the whole of the Holocene. In this connection it must be taken into consideration that the high Σ NAP percentages in some pollen zones must be ascribed at least partly to local vegetations on the valley floor (see section 6).

In the final stages of the Late-glacial, and particularly in the early stages of the Holocene, in the period between c. 11,000 and say 8000 B.P., precipitation must have increased markedly. It should be remarked here that from the Ghab pollen record discussed in this paper, changes in humidity can be deduced, but that with one possible exception the
Fig. 3. Proposed sequence of Late-glacial and Holocene pollen record (discussed in section 6).
Holoce11e vegetatio11 a11d cli111iate oj 11orth1nstem Sj1ria
pollen data do not allow any conclu sio ns on tem­
temperature or precipitation separately. Suggested
changes in temperature are based on temperature
data established elsewhere, particularly in Europe.
Conclusions on precipitation, in turn, must be de­
duced from the inferred temperature and humidity
data. Moreover, it should be stressed that the type
of vegetation depends not only on mean annual
temperature and precipitation, but also on the dis­
tribution of these climatic factors throughout the
year. Thus, in the Mediterranean area the length of
the period of summer dryness plays an important
part.

During zone 2 (subzone Z1), the present-day na­
tural vegetation pattern must, in broad outline,
have established itself in northwestern Syria. In the
Alaouite Mountains, forest vegetations expanded
on the west flank as well as on the east flank. From
the relatively high values for _Olea_ and _Pistacia_ one
may conclude that already in zone 2 time Cer­
tonieto-Pistacietum vegetations (see section 2) with
_Pistacia lentiscus_, _P. palestina_ and _Olea europeae ves.
walester_ (wild olive) were found on the east flank, at
elevations just above the valley floor. _Quercus cal­
iculiflorus_ should likewise have formed part of this
vegetation type, but kermes oak must also have
been an important constituent of the Pistacieto­
Quercetum cailiprini, the vegetation belt above the
Ceratonieto-Pistacietum. At higher elevations,
forests dominated by deciduous oak expanded.

It has been discussed above that already during
zone 2 the Eu-Mediteraneon Ceratonieto-Pis­
tacietum was found on the east flank of the
Alaouite Mountains, implying that at that time
winter temperatures must have been fairly high, as
this vegetation type is very sensitive to cold win­
ters. Thus, in spite of the general decline in tem­
perature during the Late Dryas period, after the
temperature maximum of the Allerød period,
winter temperatures apparently remained high
enough to allow the establishment of the Cera­
tonieto-Pistacietum.

On the other hand, the fairly frequent occurren­
cne of _Cedrus_ during zone 2, as is suggested by
the relatively high pollen values, can be explained
as the result of a rather cool climate, that is to say
cooler than at any time during the Holocene. At
present, a separate _Cedrus_ zone is not present in the
Alaouite Mountains, which is very probably be­
cause these mountains are not high enough. In Le­
banon, the cedar zone (_Cedrus libani_) is found at
elevations between 1500 and 2000 m (Pabot, 1959).
The lower temperatures during the Late Dryas
period must, with sufficient humidity, have
favoured the expansion of cedar.

7.3. Possible changes in climate

In this section the question will be discussed as to
how far the pollen evidence points to changes in
climate, in particular changes in humidity, during
the Holocene. Which pollen curves could be in­
dicative of climatic change? Changes in the
AP/NAP ratios should reflect changes in the distri­
bution of forest and steppe. Consequently, fluctu­
ations in the proportions of _Σ AP_ and _Σ NAP_
could be interpreted as evidence of changes in hu­
midity. The interpretation of the AP/NAP ratios in
terms of forest/steppe distribution is handicapped
by the fact that for various herbaceous pollen taxa
it cannot be determined to what extent they are of
local or of regional origin (Chenopodiaceae, 
Gramineae, Compositae). Moreover, the Ghab Ho­
locene pollen record is composed of the inform­
ation obtained for three cores. In each of the loca­
lities from where the cores were taken the local
vegetation may have been different. This implies
that in the three diagrams, the absolute _Σ AP per­
centages may not be comparable. Fluctuations in
the AP/NAP ratios in one and the same diagram
may generally be the outcome of changes in the
upland vegetation pattern, but differences in the _Σ
AP percentages between two diagrams, such as be­
tween zone 4 (Ghab I) and zone 5 (Ghab II), may
have been brought about by local conditions.

Leaving aside zone 6 (because of its possibly dis­
torted pollen picture) and zone 9 (to be discus­
ed in 7.4.), only a few tree pollen curves show more
fluctuations. The most marked fluctuations are
displayed by _Quercus cerris-type_. Pine pollen
percentages suggest that the proportion of pine in
the forest vegetation underwent alterations. It is
doubtful whether the pine pollen percentages could
provide information on possible climatic changes.

Pine trees, which pine species is most probably
the one concerned here, occurs in humid as well as
Consequently, from a climatic point of view the
fluctuations in the pine pollen values can be explained in two different directions. Moreover, *Pinus brutia* could have profited from human activity (this tree invades forest clearings), but it should be admitted that even for zone 9, with distinct indications of the interference of man with the vegetation (7.4), no evidence of a large-scale pine expansion could be established.

The rather pronounced fluctuations in the *Abies* pollen percentages are most likely due to local conditions. One must assume that alder occurred in the Ghab valley. Zohary (1973, p. 378) mentions that *Abies alnoidalis* is often found in riverine jungles together with *Salix*, *Pistacia* and other trees. At present, *Abies* seems to be rare in northwestern Syria.

The maximum *Quercus* and \( \Sigma \) AP values in zone 3 suggest that during this period forest underwent a greater expansion than even since in the Holocene. It seems justified to assume that zone 3 experienced the most humid climate of the whole of the Holocene. It is likely that during this period deciduous-oak dominated forest covered a greater area than it would at present under natural conditions. One wonders whether during zone 3 deciduous oak was perhaps found also in the Zawiyeh Mountains to the east of the valley (see section 2).

The decline in *Quercus* and \( \Sigma \) AP percentages at the zone 3/4 transition points to a certain reduction in extent of the deciduous forest, most likely due to a decrease in humidity. The increase in *Quercus* cul­tivaris-type percentages in zone 4 suggests that part of the deciduous oak was replaced by the more drought-resistant kermes oak. The decline in *Pistacia* pollen values at the zone 3/4 boundary could indicate that the Eu-Mediterranean *Ceratonoto­Pistacia* lentisci vegetation at the foot of the east flank of the Alaouite Mountains became impoverished to some extent as a result of greater aridity. The decrease in humidity as inferred from the pollen evidence was not necessarily brought about by lower precipitation. It is possible that during zone 3, at the beginning of the Holocene, temperature was still somewhat lower than during the succeeding zones. The lower humidity of zone 4 could have resulted from a further rise in temperature, precipitation remaining at the same level.

Another change in the distribution of forest and steppe is suggested by the course of the *Quercus* and \( \Sigma \) AP curves in zone 6. The pollen record of zone 6 points to a temporary expansion of forest at the expense of the steppe, implying moister climatic conditions compared to those of zone 5. Because of the supposedly deviating pollen contents of the succeeding zone 7 one ought perhaps be somewhat cautious in attaching too much weight to the increased *Quercus* cerrisi-type percentages in zone 6.

On the other hand, a temporary increase in humidity during some period in the mid-Holocene, which at present cannot be dated more accurately, should not be ruled out. The effect of possible climatic changes on the vegetation in the period after c. 4000 B.P. (zone 9) must have been completely suppressed by the effect of the interference of man with the vegetation.

In summary, one may remark that at the beginning of the Holocene, in the period which may be dated from c. 10,000 to 8000-9000 B.P., the climate of northwestern Syria was moister than at present. Another period of increased humidity may have occurred in the mid-Holocene period.

### 7.4. The influence of man

Palynological evidence for the activity of man is not evident until subzone 8b which shows comparatively high values for *Fraxinus ornus* (manna ash). This tree must have occurred naturally in the Oros-Mediterranean forest vegetation of northwestern Syria as is attested by the pollen record. The considerably increased pollen values in subzone 8b and zone 9 point to the cultivation of *Fraxinus ornus* for its sweetish exudate called manna which can be obtained by making incisions in the bark. Van Zeist *et al.* (1975) found evidence for the cultivation of manna ash in southwest Turkey.

The sharp decline in deciduous-oak pollen percentages at the bottom of zone 9 points to large-scale clearances of forest. As for farming practices, the pollen record provides evidence particularly for fruit tree cultivation. *Olea*, *Vitis* and *Juglans* reach comparatively high values in zone 9, especially in subzone 9b, suggesting that olive, grape and walnut were widely grown. The cultivation of manna ash, which is strictly speaking not a fruit tree, has already been mentioned. The marked decline of *Pistacia* at the zone 8/9 transition seems to
Holocene vegetation and climate of northwestern Syria

indicate that olives especially were planted in the Ceratonieto-Pistacietum belt, the natural habitat zone of Olea. The regular occurrence of Elaeagnus pollen indicates that also oleaster was planted, probably for its edible fruits.

There are no obvious palynological indications of cereal growing. It is true that Cerealia-type pollen is present in zone 9, but its percentages are not higher than in various other sections of the Ghab pollen record. In this connection it may be remembered that in southwest Asia, Cerealia-type pollen is in itself not indicative of grain growing. Various Near Eastern wild grass species produce pollen grains of the Cerealia-type (cf. van Zeist et al., 1975). Grazing, or at least open terrain in formerly forested areas, is particularly suggested by the notably increased values for Pobigoninae type and Salvia type pollen. Plantago lanceolata-type pollen shows likewise higher percentages in zone 9. One wonders whether the somewhat higher values for Quercus rotundifolia and Pinus in the upper part of the zone could indicate that kermes oak and pine spread to some extent on abandoned forest clearings. However, there can have been no question of a large-scale expansion of these trees.

On the assumption of an approximately constant sedimentation rate for the upper two metres of the Ghab III core, the last 800-1000 years should not be represented in the pollen record.

8. TELL MOUREYBIT AND THE GHAB POLLEN EVIDENCE

8.1. Pollen analysis of settlement sites

Finally, a few comments will be made with reference to the pollen diagram prepared by Leroi-Gourhan (1974) for Tell Moureybit, about 175 km northeast of the Ghab valley. This is the only other Holocene pollen record obtained so far for northwestern Syria and it has played a part in speculations on pre-Neolithic farming.

Before a large section of the north Syrian Euphrates valley was flooded by a barrage constructed near Tabqa, Moureybit was situated on the left bank of the river. Excavations of Moureybit were started by M. N. van Loon in 1964 and 1965 (van Loon, 1968) and continued by J. Cauvin in 1971-1974 (Cauvin, 1977). A series of radiocarbon determinations date the late-Palaeolithic habitation of the site from c. 10,500 to c. 9500 B.P. Stone tools for grinding, such as querns and mortars, were found frequently, while among the tools made of flint, sickle blades were present. In addition to this indirect evidence for harvesting and preparing seeds, the plants themselves are also represented. Among the seed types which could be identified, those of one-grained wild einkorn (Triticum boeoticum ssp. thaoudar) constitute the majority. Only seeds of morphologically wild-type plants were found (van Zeist, 1970 and unpublished data). The animal bones recovered from Moureybit are likewise exclusively of wild species.

Leroi-Gourhan (1974) carried out the palynological examination of a few series of samples collected from tell sections exposed by the excavation. The results of Leroi-Gourhan's study are shown in fig. 4. With the help of the radiocarbon dates the results for the different sections (Q3, Q4, etc.) could be arranged in chronological order. At present the natural vegetation of the uplands in the Moureybit area, with a mean annual precipitation of about 200 mm, is a steppe. The pollen evidence obtained for this site suggests that in the early Holocene, too, steppe vegetations were found here. Σ AP values are extremely low. In pollen diagrams prepared for sediment cores from Syria, Turkey and Iran periods with predominantly steppe vegetations are characterized by high values for Chenopodiaceae and Artemisia. In the Moureybit spectra, chenopodiaceous percentages are high, but those for Artemisia are conspicuously low. On the other hand, Compositae show high pollen values at Moureybit, this in contrast to the generally low values in sediment cores. Bottema (1975) has discussed at length the phenomenon of the generally high proportions of Compositae among the pollen preserved in cave and rock shelter deposits and in other archaeological sites where an accumulation of material had taken place, such as tells. Bottema argues that the high Compositae pollen percentages do not necessarily point to a predominant role of representatives of this family in the vegetation in the vicinity of the site, but that they must be ascribed to other factors, of which contamination by burrowing bees and differential corrosion (and dif
In this connection it may yet be mentioned that surface-sample spectra from steppe and desert-steppe areas in Syria do not show such high percentages for Liguliflorae Compositae as have been
8.2. Evidence for increased humidity

The problem whether or not the Moureybi pollen spectra provide a reliable picture of the composition of the early Holocene steppe vegetation of...
the area will not be pursued in this paper. Of more relevance in connection with the Ghab pollen record is the fact that Leroi-Gourhan concludes an increase in humidity around 10,000 B.P. This conclusion is based mainly upon a small increase in tree-pollen percentages at a depth of 6.10 m (square S32). This increase is nearly exclusively brought about by Pinus, but other tree pollen types are also slightly more frequent in the section above 6.10 m. Leroi-Gourhan is of the opinion that trees did indeed not occur in the Moureybit area, but that at least forest vegetation had come nearer to the site. The inference of a more humid climate would be in agreement with the situation in the Ghab, where the pollen record points to optimum moisture conditions around 10,000 B.P.

However, one may wonder whether the increased numbers of pine pollen really point to the approach of coniferous forest. Leroi-Gourhan suggests herself that the pine pollen may not have arrived at Moureybit by air but that it was brought down by the river. In addition to pollen, wood remains of pine were found in the Moureybit samples. Above 6.10 m the curve for aquatic plants attains relatively high values. This could indicate that the clay used for the construction of the houses was taken from other places than in the previous period. From the level of 6.10 m (in square S12) onwards clay was obtained from low-lying places which were flooded each time the water-level of the Euphrates rose. In these places, fresh clay was deposited regularly and with the clay, pollen of pine and possibly other trees originating from the mountains of Turkey was carried in. The clay from the chronologically lower levels may have been taken from other places in the river valley. This would imply that the change in the pollen content was not due to an alteration in the regional pollen influx but to a shift by the inhabitants of the site to other places for digging clay.

Some emphasis has been laid on an alternative explanation for the observed changes in the pollen curves at Moureybit in order to focus attention on a possible additional complication in interpreting pollen spectra obtained for this site in terms of regional vegetation. This does not alter the fact that very likely in early Holocene times, during the habitation of Moureybit, the climatic conditions of the area were more favourable than at present. For, the Ghab pollen evidence clearly indicates that in the early Holocene, humidity reached its highest level, for northwestern Syria this must have been the period with optimum moisture conditions. This assessment is not without significance in interpreting the economy of the Moureybit settlement. It has already been mentioned that wild einkorn wheat must have played an important part in the vegetable diet of the inhabitants of the site. At present, Triticum boeoticum is not found in the plain of northern Syria, but it grows in massive stands in southeastern Turkey, at elevations between 600 and 2000 m (Harlan & Zohary, 1966). On the assumption that the climate, in particular the humidity, of 9000 to 10,000 years ago did not differ noticeably from that of to-day, van Zeist & Casparie (1968) suggest that the wild einkorn was harvested in the adjacent part of Turkey, at about 100-150 km from the site. However, as we now have evidence for more humid conditions in the early Holocene, it seems more likely that the inhabitants of Moureybit, as well as those of late-Paleolithic Abu Hureyra (see 8.3.), c. 20 km downstream, could have harvested the wild einkorn wheat at a short distance from the site. This makes it easier to understand the prominent role of wild einkorn in the economy of both sites.

8.3. Plant-growing in late-Paleolithic times?

Leroi-Gourhan (1974) and Cauvin (1977) conclude a kind of proto-agriculture for Moureybit, which assumption is based upon the increase in Cerealia-type pollen at the level of 6.10 m in S12 (fig. 4). Leroi-Gourhan argues that up to 8% of Cerealia-type pollen implies that wild cereals must have been quite numerous at the foot of the tell, and she suggests that the growth of these plants was promoted by the inhabitants of the site by means of weeding and watering. In this proto-agricultural stage there would have been no question of domestication.

Against the above conclusion two objections can be raised. In the first place, it must once again be repeated that in the Near East various wild grasses, and not only wild cereals, produce Cerealia-type pollen. The increase in Cerealia-type pollen at Moureybit coincides with the increase in aquatic pollen types. It has been suggested above (8.2.) that
starting from the level of 6.10 m clay was dug in marshy places. One wonders whether a grass species with Cerealia-type pollen grains was a common constituent of the vegetation of regularly flooded parts of the river valley. If, on the other hand, the Cerealia-type pollen had originated largely from wild cereals growing in the vicinity of the site (wild einkorn wheat and to a minor extent wild barley), it is unlikely that it was blown in. Most cereals, wild as well as cultivated, release only very little pollen in the air and, consequently, they are seriously under-represented in the pollen precipitation. In this case the markedly large numbers of Cerealia-type pollen may point to the threshing of cereals on the site. Mature ears contain a fairly large amount of pollen (cf. Robinson & Hubbard, 1977) which is released in threshing.

So far, there is no conclusive evidence for cereal agriculture or proto-agriculture at Mureybet. This applies also to late-Palaeolithic (Mesolithic) Abu Hureyra, for which site Moore (1979) claims cereal cultivation. Hillman (in: Moore et al., 1975) who examined the plant remains of Abu Hureyra is much more cautious and suggests three possible sources for the einkorn wheat, viz. (1) natural stands in the vicinity of the site, (2) the gathering of this wild cereal at a greater distance, and (3) its cultivation by the inhabitants of the site. Without any further evidence the excavator of the site now makes a firm stand for pre-Neolithic farming at Abu Hureyra. It is hard to avoid the impression that wishful thinking played a decisive part in Moore’s interpretation of the botanical results. It is, of course, very attractive to have discovered the earliest farmer’s site: late-Palaeolithic Abu Hureyra is dated from about 11,500 to 10,500 years ago.

The late-Palaeolithic habitation of Abu Hureyra and Mureybet covered some 2000 years. If einkorn indeed was grown by the inhabitants of these sites, it is remarkable that so much time elapsed with no perceptible change in the morphology of the seed. Two thousand years of cultivation or at least of some kind of manipulation would not have resulted in the appearance of morphologically defined domestic einkorn wheat.

9. REFERENCES


