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A MIDDLE PALAEOLITHIC SEQUENCE FROM THE HULA VALLEY, ISRAEL

by

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ABSTRACT

The palynological evidence indicates three main humid fluctuations during the first half of the "last Pluvial" in the Hula Valley. The first fluctuation is the most humid, the later ones displaying a drying trend.

The very humid initial phase is probably contemporary with the Negev early-Middle-Palaeolithic depositional phase, and the erosional phase which follows the early Middle Palaeolithic in the caves of northern Israel, which also reflect marked humid conditions.

The lack of late Middle Palaeolithic sites in the Central Negev is more easily explained by the local erosional regime, rather than by a long and extremely arid phase, for which there is no evidence in the Hula pollen sequence.

INTRODUCTION

The few palynological analyses so far available for the Israeli Middle Palaeolithic sites indicate humid conditions for the Mousterian (HOROWITZ, *in* JELINEK *et al.*, 1973; HOROWITZ, 1976), with the early Mousterian somewhat more humid than the late Mousterian (HOROWITZ, *in* JELINEK *et al.*, 1973). In the following Upper Palaeolithic phase the humid conditions are less pronounced (HOROWITZ, 1976, 1979). Sedimentological (GOLDBERG, 1981, 1986) and faunal (TCHERNOV, 1975, 1979; BOUCHUD, 1974) studies, mostly related to prehistoric sites, generally support the palynological evidence.

A detailed study of a Late Pleistocene sequence in the Hula Valley was carried out (WEINSTEIN-EVRON, 1983 and forthcoming, a) and the period revealed lies between ca 130,000-40,000 BP. The sequence thus covers the period of the Middle Palaeolithic industries in the Levant. This provided the opportunity to understand better the palaeoenvironmental changes in the area during this period.

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The Hula Basin is situated at the northern end of the Jordan Rift Valley (Fig. 1) at an elevation of approximately 70 m above sea level. This narrow and elongated shallow basin is flanked by the eastern Galilee mountains to the west and the Golan plateau to the east, both rising to about 800-1000 m (Fig. 2). To the northeast, the Hermon range reaches 2800 m, and to the south the basin is bordered by the small Korazim rise.

The Hula Basin was occupied until recently by a shallow lake, which extended northward into a series of marshes (Fig. 3). The area was drained in 1953-1958 and is now farmed. The basin area is approximately 150 km2 and it serves as an erosion base level for the Upper Jordan catchment area, which is about 1600 km2 (Fig. 2). Most of the water sources of the Hula Valley are in the north and north east, and the final erosion base level of the system is the Dead Sea, through the Jordan Valley and the Lake of Galilee, which is an intermediate lake in the system.

Climatic conditions in the Hula Basin itself are semi-arid, while the climate of the mountainous zones in the area is Mediterranean. Phytogeographically, the northern Jordan Valley, together with the surrounding mountains, belongs to the Mediterranean vegetation belt. Pollen spectra of the area are also influenced by the Irano-Turanian steppe and desert vegetation of the east. A detailed outline of the climate and vegetation of the region is given by WEINSTEIN-EVRON (1983).

The Hula L07 core was drilled at the northwestern part of the drained Hula Lake (Fig. 3), to a depth of 160 m. For a lithological description, see KAFRI and LANG (1979) and WEINSTEIN-EVRON (1983).

THE PALYNOLOGICAL SEQUENCE: CHARACTERISTICS AND POSSIBLE CORRELATIONS

The Hula L07 main climatic changes are summarized in Fig. 4.

The generalized climatic curve (column A) is based on the AP curve, together with climatological considerations discussed below. The numbers indicate pollen zones (WEINSTEIN-EVRON, 1983 and in preparation), some of which are grouped together within a particular climatic fluctuation. The limits of the main fluctuations are shown in column B.

The lower part of the palynological curve, from 109-102 m, has been given only preliminary study (WEINSTEIN, 1982 and in preparation) and is tentatively correlated with the end of oxygen isotope stage 6 (EMILIANI, 1955; SHACKLETON, 1969). In this section, AP levels are high, with high percentages of coniferous pollen, which indicate humid and cold climatic conditions.

The following section, from 102-74.7 m, is correlated with oxygen isotope stage 5. In this part of the curve AP levels are relatively low, indicating dry conditions. Somewhat more humid conditions alternate within the otherwise dry pollen zones, as higher AP levels demonstrate, with *Quercus* as a predominant type throughout. These relatively humid spectra indicate a probable expansion of oak maquis in the Galilee and Golan. The most humid fluctuation in this section is observed in zone 2 of the pollen sequence.

Unlike the relatively homogeneous humid phases, the dry fluctuations are considerably more varied. The earliest dry phase (zone 0, at a depth of 100 m) is characterized by relatively high Irano-Turanian levels (*Artemisia* and Chenopodiaceae), which are indicative of a regional drying. This is probably the driest phase of the sequence. In the second phase (at a depth of 93.0 m), a relatively mild desiccation can be deduced from the rise in the more local types (mainly Gramineae), while in the upper dry phase (pollen zone 5, at a depth of 76 m) a more general desiccation is represented by the high Chenopodiaceae levels (A detailed palynological analysis of this section is now being prepared).

Pollen zones 0 and 5 represent pronounced dry conditions, and their correlation with oxygen isotope substages 5e and 5a seems to be justified. However, the identification of oxygen isotope substage 5c in the Hula sequence is less certain. The slightly lower AP levels at a depth of 93.0 m, which are replaced by higher Gramineae levels, may reflect local conditions only. In this case, oxygen isotope substage 5c would be more adequately correlated with the hiatus in the pollen curve, at a depth of 78 to 83.5 m (Fig. 4). The marly layers in this part of the sequence had undergone severe oxidation, probably through local drying (WEINSTEIN-EVRON, 1983). However, the exact nature of this hiatus and its relative duration have yet to be determined. A study of the fossils contained within these layers could shed some light on the origin and hence the possible rate of sedimentation in this part of the sequence (B. BEGIN, personal comunication). Allochthonous vs. autochthonous fossils could indicate increased erosion and/or runoff and hence a relatively high rate of sedimentation and a short span of time. Unfortunately, the solution to this problem lies within a hiatus in the palynological record.

An apparently contemporary gap is reported from the top of the Dead-Sea-Basin Hammarmar formation (ROSSIGNOL, 1969). Thus it is possible that Hula pollen zone 5 represents the drying phase of the Hammarmar lake, and the very humid Hula zone 6 coincides with the beginning of Lake Lisan, some 70,000 years ago (BEGIN, 1986; BEGIN *et al.*, 1985).

Zones 6 through 16 include the "last Pluvial", alternatively termed by some scholars the "last glaciation", the "Würmian pluvial", the "Near Eastern Würm", the "Pleniglacial", etc. (HOROWITZ, 1979; FARRAND, 1981a; BOTTEMA and van ZEIST, 1981; BAR-YOSEF, 1984). The onset of pluvial conditions is generally estimated to have occurred around 75,000 BP. (BAR-YOSEF, 1984) and is correlated with oxygen isotope stage 4, which demonstrates cold conditions in the deep sea cores (EMILIANI, 1955). These pollen zones are thus correlated with oxygen isotope stages 4 and the beginning of 3 (Figs. 4 and 5). Zone 6 shows that the beginning phase was wet and cold. Oak forests spread over the Galilee, Golan and the Hula Valley and cedar forests in the Lebanon and Hermon. The Irano-Turanian and desert plants, poorly represented in the spectra, apparently were displaced eastward. After a mild desiccation (zone 7), a renewed increase in humidity was detected in zones 8-9. This period was relatively brief and, based upon the evidence of an abundance of cedar pollen, is noted by its coldness, which is more marked than in any other zone. The high values of cedars are also consistent with continental conditions. During the time interval of zone 10 there was a strong desiccation, indicated by high values of open fields and Irano-Turanian pollen. Humidity increased again in zones 11-13, with gradually decreasing temperatures. A short, dry period (zone 14) was then followed by a short, relatively cold, humid phase (zone 15). For a detailed study of this section see WEINSTEIN-EVRON (1983).

After a short, relatively dry phase at a depth of 54 m, a renewed rise in humidity is indicated by the higher AP levels of zone 16, especially in its upper part. Relatively high olive values characterize this zone and indicate a possible spreading of a mixed maquis over the mountainous areas, and especially the Galilee. This, together with the relatively lower AP levels, indicates that the climatic conditions which prevailed during this period were less humid and probably slightly warmer than during the earlier part of last Pluvial. The generally low cedar and high *Artemisia* levels lend further support to this view (a detailed study of this section is in preparation).

The above climatological interpretations are based on an AP diagram calculated on the basis of the total pollen counted, excluding hydrophilous pollen (Fig. 5, column A). Another mode of representation is attempted, namely an AP diagram based on a pollen total composed of trees, *Artemisia* and Chenopodiaceae pollen only (Fig. 5, colum B). This facilitates both the exclusion of the partly local plants (NIKLEWSKI and van ZEIST, 1970) and also comparisons with other palynological sequences in the area, which are dealt with using this mode of represenation (van ZEIST and BOTTEMA, 1977; BOTTEMA and van ZEIST, 1981). In this diagram the more local changes, represented by pollen zones 7 and 8 (WEINSTEIN-EVRON, 1983), are considerably less marked, and the cold phase of zones 8+9 is merged with zone 6, indicating colder conditions at the end of the same humid fluctuation. The merging of zones 11 through 13 into one fluctuation is further supported by this mode of representation. Zones 15 through 16 seem to comprise another humid phase. Zone 15 is somewhat problematic, however, because it shows exceptionally high *Vitis* values, which may be a result of local contamination (WEINSTEIN-EVRON, 1983). However, the possibility that it represents an independent humid/cold fluctuation should not be ruled out.

To summarize, the overall pattern that emerges from the research is of three main humid phases during the early part of the last Pluvial in the Hula. The beginning phase (zones 6 through 9) is the most humid and probably the coldest. The last Pluvial sequence (zones 6-16) as a whole indicates more humid and cooler climatic conditions than during the preceding phases (zones 0-5).

NIKLEWSKI and van ZEIST (1970) have presented a similar Pleniglacial sequence for the Ghab Valley, some 300 km north of the Hula. A cold and humid phase (zones T1-T2) ends with a less humid but considerably colder period (zone U1), with the highest cedar percentages of the whole sequence (Hula zones 6-9). This is followed by two somewhat less humid fluctuations. The first is represented by the triple undulations of zones U2-U3 (Hula zones 11-13), the second is found at zone W1-W2. As in Hula zone 16, the most humid conditions prevailed toward the end of this fluctuation, where high pine levels are reported. Though pine pollen is relatively rare in the Hula sequence, because of the soil composition of the surrounding areas, relatively high pine levels are found in the contemporary Hula section.

Oak pollen is the main component in both the Ghab and Hula sequences. Thus, characterization and correlation of the various fluctuations is difficult, especially when more local changes occur (eg the high *Carpinus/Ostrya* levels in Ghab zone Z1 and the high *Vitis* values in Hula zone 15). However, it seems that when coniferous pollen is involved, changes in the Ghab Valley are echoed within the Hula Basin as well.

The present study sheds more light on the "mirror image" phenomenon, concerning the Hula and Ghab Levantine pollen diagrams as opposed to both the European and African palynological sequences (WEINSTEIN-EVRON, 1983 and forthcoming, a). It seems that this "mirror image" effect can be now identified not only on a large scale - namely the opposing trends within oxygen stages 5 and 4/3 - but also in tracing the smaller scale fluctuations, especially within stages 4/3 (in preparation). It is worth noting in this regard, that, as in the Ghab and Hula sequences, the coldest phase of the European pollen curves also occurs at the end of oxygen isotope stage 4 (WOILLARD, 1978).

Some additional clarifications seem to be required, regarding the question of the two modes of representation discussed above.Usually, the same trends can be seen in the two Hula pollen diagrams (Fig. 5). Only at the top of the sequence, especially in the three pollen samples at a depth of 42 to 43.5 m, a somewhat opposite trend could be observed.

These samples show the highest hydrophilous pollen values of the sequence, namely 48-55 % of the total pollen counted. The important hydrophilous component, dominated by

Cyperaceae pollen, represents a dense bank vegetation, probably of a relatively shallow to marshy environment. This is also indicated by the humic nature of the samples. Such a dense vegetation could have masked the lake, which in turn, would have resulted in a clear underrepresentation of the more regional pollen types. The reliability of these samples for palaeoenvironmental reconstructions is thus questionable. When these samples are excluded, the two diagrams resemble one another quite closely, throughout the sequence under discussion.

Two other high hydrophilous samples were studied at zones 11-13 (Fig. 5). However, these were isolated samples and thus their influence on the pollen diagram is not marked. The Chenopodiaceae peak, at a depth of 49 m, may also indicate, at least to some extent, local conditions. This is based on the very high values of small grains (less than 20 pores - van ZEIST and BOTTEMA, 1977), and the occurrence of many lumps of this pollen type, indicating a nearby source.

In the Hula sequence, hydrophilous levels of 45 % seem to serve as a possible criterion for the reliability of the pollen counts. Other values may be found to be adequate for other sequences.

ARCHAEOLOGICAL IMPLICATIONS

The Hula and Ghab sequences are only partly coeval. Nevertheless, the correlations between the two sequences seem to be quite well established. This, in turn, supports the chronological framework suggested above. However, correlations with the Israeli Middle Palaeolithic sites are still difficult to make. This is the result of two main factors:

1. Unlike the continuous palynological sequences, the palaeoenvironmental data derived from prehistoric sites is, for the most part, partial and fragmentary.

2. Relatively few absolute datings are so far available for this period, and especially for the beginning of the Middle Palaeolithic, mainly because it is out of the range of ^{14}C dating.

The early phase has been the focus of some recent studies, and its relative antiquity seems to have been widely accepted (BAR-YOSEF and VANDERMEERSCH, 1981; BAR-YOSEF, 1984; GOLDBERG, 1986; COPELAND, 1981; KIRKBRIDE *et al.*, 1983). This is partly the result of broad cultural correlations based on the adoption of the few absolute datings available.

The reliability of some of these correlations has been questioned lately. The Mousterian layers of Na'ame, which provide a corner-stone for this argument (FLEISCH, 1971; SANLAVILLE, 1981; COPELAND, 1981), are probably younger than was previously thought (G. GVIRTZMAN, personal communication). Thus, the universality of this early stage seems to be still open to question, especially as some of the dates (Zuttiyeh - SCHWARCZ *et al.*, 1980) can be regarded as maximum dates only.

Only one "marker zone" seems to be identifiable within the Hula palynological sequence, namely a very humid phase at the beginning of the last Pluvial (isotope stage 4). During this humid phase quite a few "pluvial lakes" (FARRAND, 1971, 1981b) were apparently formed, either along the Jordan Rift Valley (Lake Lisan - BEGIN *et al.*, 1974) or in the desert areas (El-Jafr - HUCKRIEDE and WIESEMANN, 1968; Azraq - GARRARD *et al.*, 1975-77 and Palmyra - HANIHARA and SAKAGUCHI, 1978). These indicate the vast and pervasive influence of this humid phase throughout the Levant.

Similar "marker zones" are suggested by the sedimentological evidence from both the caves of northern Israel and Lebanon as well as the arid zones of Israel and Sinai. A very humid period apparently caused renewed karstic activity and a severe erosional phase, following the deposition of the early Mousterian layers at Tabun, Qafzeh, Shukbah (BAR-YOSEF and VANDERMEERSCH, 1981) and Adlun (KIRKBRIDE *et al.*, 1983; SWEETING, 1983). This was probably also the cause of the disappearance of 5 species of microfauna (TCHERNOV, 1981).

It was during a very humid phase that the major part of the early Middle Palaeolithic sediments was deposited in northern Sinai, the Negev and the Judean desert (GOLDBERG, 1981, 1986; GOLDBERG and BRIMER, 1983).

As only one such phase is indicated by the palynological data, it seems that the two sedimentological processes discussed above are coeval. If this correlation is accepted, the early Mousterian originated in the north and later spread southward, with the onset of the humid pluvial. This is also supported by the apparent continuity of the "Mugharan Tradition" in Tabun (JELINEK, 1982). The caves of northern Israel and Lebanon were probably unfit for human occupation during this humid phase.

The evaluation of the lag between the early Middle Palaeolithic of the different areas once again depends on the availability of absolute dates. The early Mousterian layer of Tabun D, for example, could be represented by zone 4 or even zone 2 of the Hula sequence, thus indicating a considerable lag. However, it is also possible that it accumulated during the beginning phase of zone 6, to be eroded during the somewhat later period of pronounced humidity (JELINEK, 1982; FARRAND, 1979; KIRKBRIDE *et al.*, 1983). Correlation of Tabun D with a relatively humid phase is suggested by the sedimentological (GOLDBERG in JELINEK *et al.*, 1973), palynological (HOROWITZ, *in* JELINEK *et al.*, 1973) and faunal (TCHERNOV, 1975, 1979) data.

The original chronological framework suggested by GOLDBERG (1981) seems to coincide best with the palynological data. Moreover, there is no ground for believing that the Negev and Sinai were considerably more humid while dry conditions still prevailed in northern Israel, as suggested by the chronological framework later adopted by GOLDBERG (1986) to account for the same sedimentological processes.

If any time lag occurred, it would probably have exhibited an opposite trend, and the more northern areas would have been the first to be influenced by the onset of the humid conditions. This is supproted by the present-day ecological gradients, as well as by the palaeoenvironmental evidence (HOROWITZ, 1979; BEGIN *et al.*, 1974; HOROWITZ and GAT, 1984).

The same is probably indicated by the sedimentological data itself. The occurrence of late Middle Palaeolithic assemblages,at the base of the "Upper Palaeolithic" silts of Far'ah II, is believed to indicate a rather late occurrence of this type of Mousterian in the Northern Negev, and synchroneity with the Middle Palaeolithic - Upper Palaeolithic transitional phase at Boker Tachtit is suggsted by GILEAD and GRIGSON (1984). However, as the Far'ah II Middle Palaeolithic assemblages are of a late Mousterian nature, it is possible that this depositional phase started somewhat earlier in the Northern Negev than in the Central Negev.

The En Eqev Uranium Series dates for travertines containing Middle Palaeolithic artifacts may fall within the early part of the last Pluvial (SCHWARCZ *et al.*, 1979; SCHWARCZ *et al.*, 1980). Even if the earlier part of the date range is accepted (GOLDBERG, 1986) this does not necessarily imply that the travertines were contemporary with the very humid early Mousterian depositional phase. Travertine formation occurred during the warm oxygen isotope stages (LIVNAT and KRONFELD, 1985), probably during somewhat more humid fluctuations (WEINSTEIN-EVRON, in press). Travertines are still formed in the area today. Thus the possibility that some of the En Aqev travertines represent a somewhat earlier phase than the major depositional process and the main human occupation cannot be discounted. The occurrence of Middle Palaeolithic assemblages in arid phases is not unusual, as indicated by the faunal analyses of Far'ah II (GILEAD and GRIGSON, 1984).

There is no indication in the Hula sequence of the long and extremely arid phase which would have resulted in the severe erosion of the Early Middle Palaeolithic sediments (GOLDBERG, 1981, 1986). The gradual abandonment of the Central Negev during the late Mousterian, and the occupation of higher, more humid elevations in Jordan, are also considered to be linked with this dry phase (MARKS, 1983 and this volume; HENRY, 1982, 1985). Even though climatic conditions during the Hula zone 11-13 were less humid than during the preceding phase (zone 6), it is difficult to conceive how the even less humid phase of zone 16 would be represented in the Boker-Tachtit – Boker sequence of the Central Negev, even if the latter is correlated only with the relatively more humid phase at the top of zone 16 (Figs. 4, 5).

The correlation of Hula zone 16 with the Boker-Tachtit – Boker sequence is based on a ^{14}C date of 42590 + 2010 (Pta 2538) for the top of this zone and a ^{14}C date of 45000 for the beginning of the corresponding Ghab phase (NIKLEWSKI and van ZEIST, 1970). The alternative interpretation suggested above, namely that the Negev sequence is represented only by the end of this fluctuation, is supported by a calculated age of ca. 50000 BP for the beginning of this phase (NIKLEWSKI and van ZEIST, 1970; van ZEIST and BOTTEMA, 1977), based on correlations with other dated palynological sequences in the area. Unfortunately, the sedimentological and palynological evidence for this Negev sequence seem to be somewhat contradictory. A more humid phase, followed by a decrease in humidity, is suggested by the sedimentological data (GOLDBERG and BRIMER, 1983), while a seemingly opposite trend is interpreted from the palynological evidence (HOROWITZ, 1983).

The chronological framework suggested above could possibly solve the problem of the "monolithically long" ... "depositional and erosional episodes and inferred climates", as well as the difficulty of conceiving "that less pronounced climatic shifts did not take place over this ca. 50,000 year [90,000-45,000] interval" (GOLDBERG, 1986, p. 239). This 50,000 year interval is a function of the dating of the early Middle Palaeolithic depositional phase to 90,000-70,000 BP. In any case, it seems easier to conceal one moderately humid fluctuation (Hula zone 11-13) than two fluctuations, the first of which is extremely humid (Hula zone 6). One should also bear in mind that there is no way of evaluating the actual duration of the post-early-Middle-Palaeolithic erosional phase (GOLDBERG and BRIMER, 1983) and it could have consisted of one or more brief episodes.

Moreover, there is already some evidence for the occurrence of relatively humid conditions during the "late Mousteian erosional gap". These are indicated by the Middle Terrace of Nahal Havarim (GOLDBERG and BRIMER, 1983); the standing-water-lake sediments of Nahal Secher, with an attributed age of 60,000-50,000 BP (ENZEL, 1984), which, however, is disputed by GOLDBERG (1986 and personal communication); and the possible late Mousterian age of the base of the "Upper Palaeolithic" sediments at Far'ah II, discussed above.

The apparently continuous sedimentation, in both Nahal Secher and Nahal Besor/Be'er Sheva, is explained by GOLDBERG (1986, p. 240) as a result of their being "relatively far from the inland highlands and therefore changes in sediment supply and runoff would less likely be felt there than in areas closer to the mountain front ...". However, the possibility that these more continuous sequences are also influenced by the somewhat more humid conditions in the more northern areas should not be ruled out.

A possible different (more severe?) erosional regime in the Nahal Zin area should also be taken into account. Unlike the more northern wadis, which flow towards the Mediterranean, Nahal Zin drains the Central Negev eastward, to the Arava Valley, which results in quite steep topographical gradients over a relatively short distance. This may indicate that erosion played an important role in creating an apparent late Middle Palaeolithic occupational gap in the Central Negev.

To summarize, the palynological evidence indicates three main humid fluctuations during the first half of the last Pluvial. The first fluctuation is the most humid, the later ones displaying a drying trend.

The very humid initial phase is probably contemporary with the Negev early-Middle-Palaeolithic depositional phase, and the erosional phase which follows the early Mousterian in the caves of northern Israel, which also reflect marked humid conditions.

The lack of late Middle Palaeolithic sites in the Central Negev is more easily explained by the local depositional and erosional regime, rather than by a very long and extremely arid phase, for which there is no evidence in the Hula pollen sequence. However, human habitation in the Negev could be influenced just as much by short periods of drought or by cultural factors, neither of which are detectable in the palynological data.

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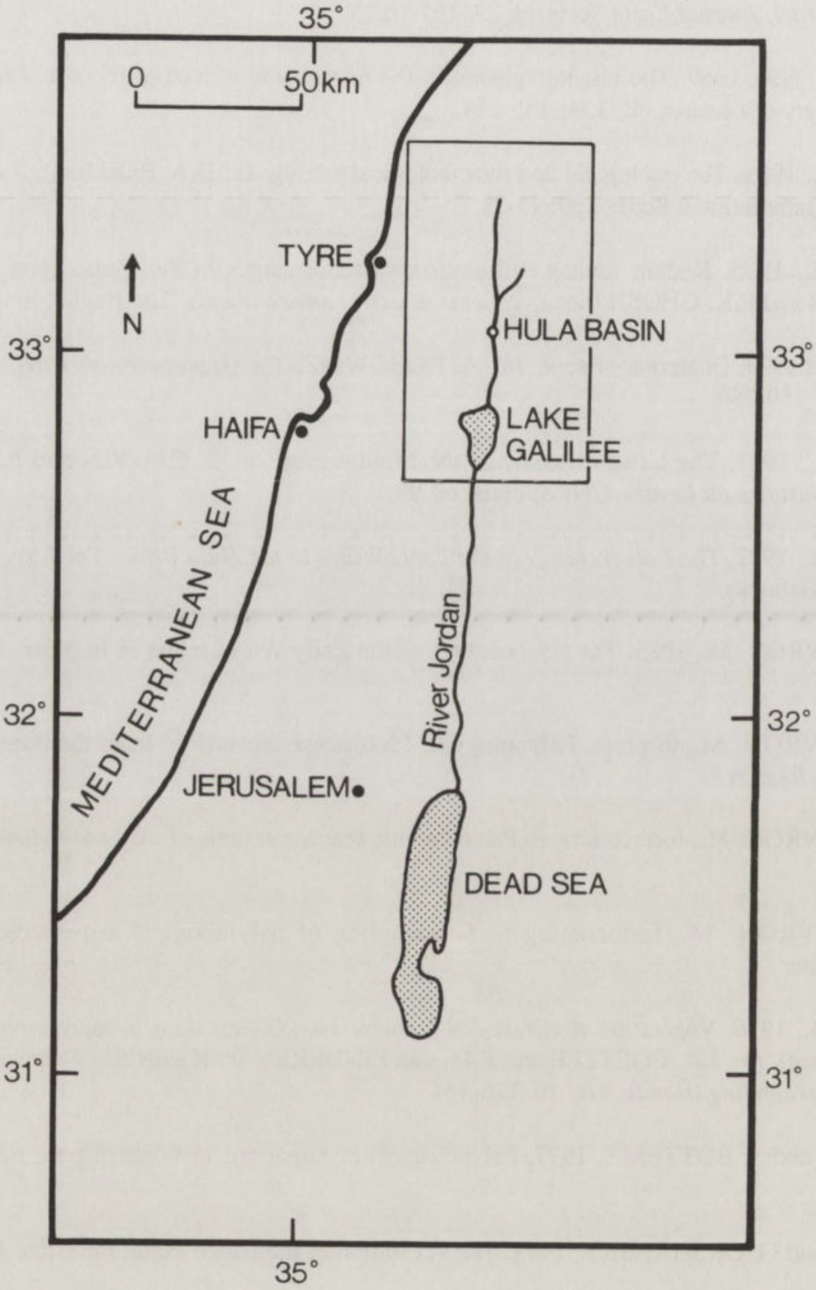

FIGURE 1

Location map

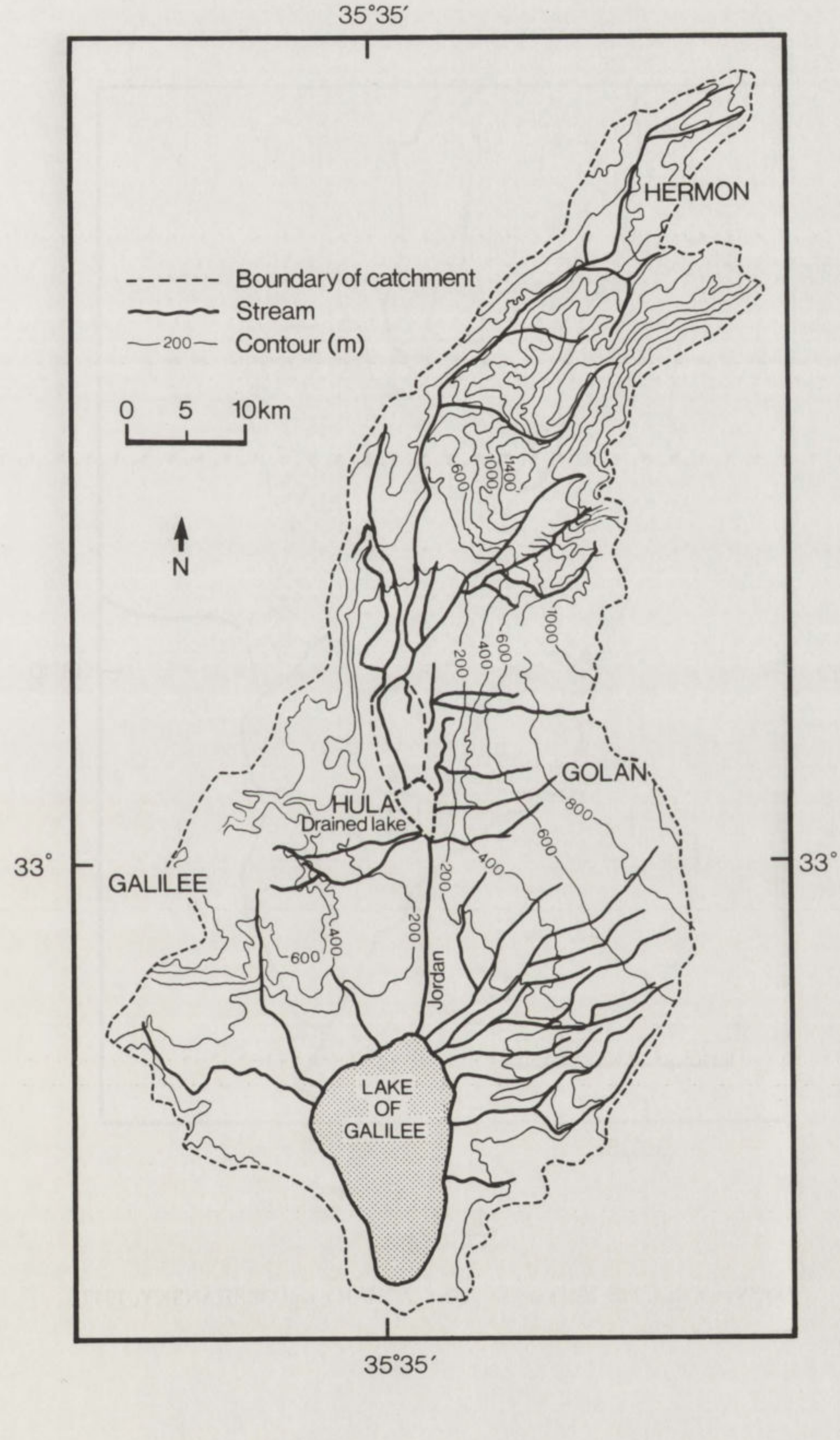

FIGURE 2 – Map of the Upper Jordan – Lake of Galilee catchment area (after MORIN *et al.*, 1979).
The Hula lake is now drained.

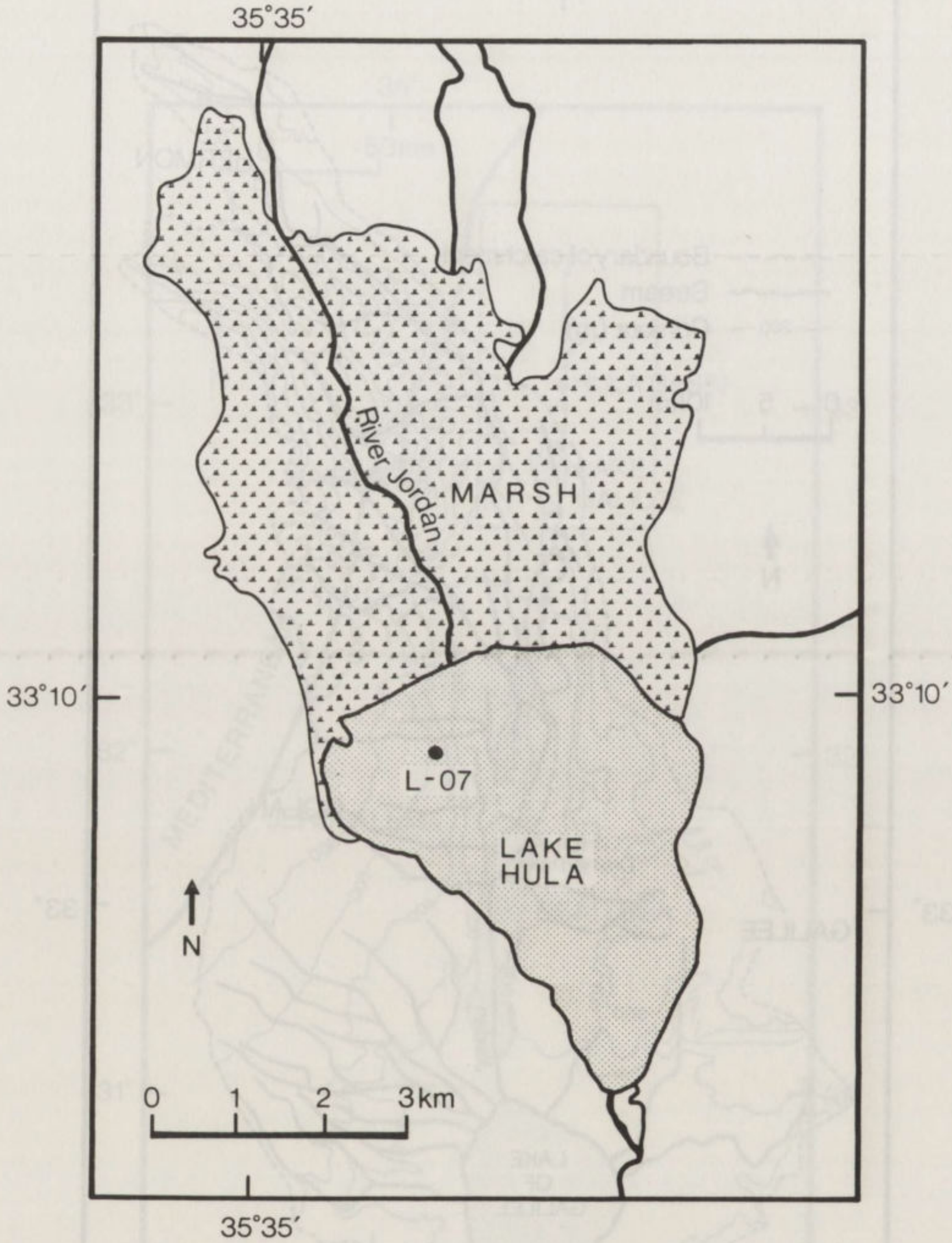

FIGURE 3

The former Hula lake and marshes (after ZOHARY and ORSHANSKY, 1947*).*

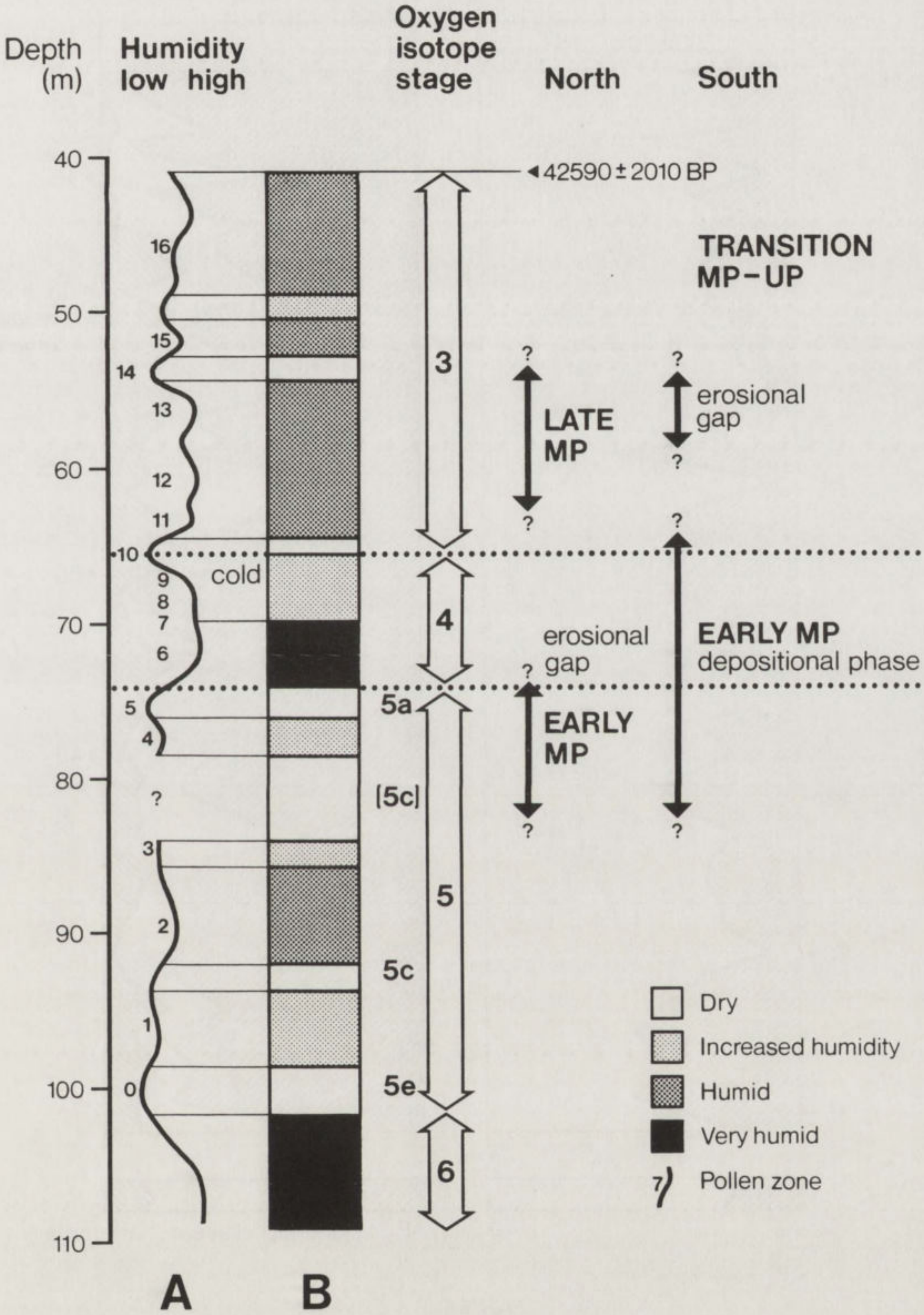

FIGURE 4 – Palaeoclimatological reconstruction in relation to the Middle Palaeolithic occurrences in northern and southern Israel

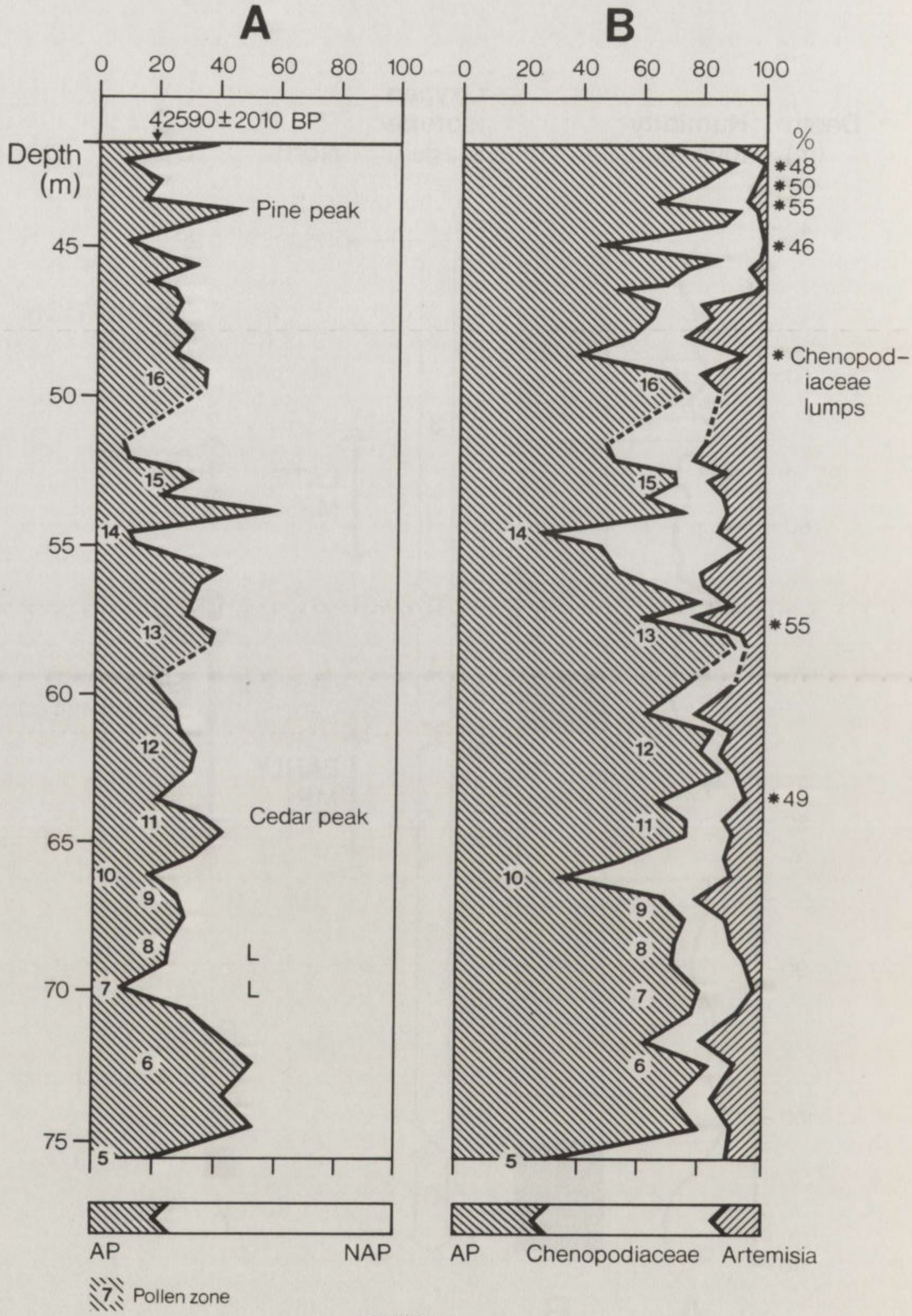

FIGURE 5

Hula L07: The last Pluvial sequence, in relation to the two modes of representation (partly unpublished data)

A : an AP diagram based on the total pollen counted. L indicates local changes

B: an AP diagram based on the sum of trees, Artemisia *and Chenopodiaceae pollen. % indicates hydrophylous pollen levels.*

The two diagrams represent a subsampled series (WEINSTEIN-EVRON, *forthcoming b).*