THE NEGEV MODEL FOR PALEOCLIMATIC CHANGE AND HUMAN ADAPTATION IN THE LEVANT AND ITS RELEVANCE FOR THE PALEOLITHIC OF THE WADI EL HASA (WEST-CENTRAL JORDAN)

by
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Introduction

Knowledge of the paleolithic of Jordan is in a very preliminary state when compared with that of some other areas of the Levant. Despite recent, major efforts by Rollefson[1] and some other prehistorians interested in the early time ranges[2] we are only beginning to appreciate the richness and variety of the archaeological record prior to the Prepottery Neolithic. The Yarmouk University exhibit "Most Ancient Jordan the Past 500,000 years"[3] underscores the fact that the basic time-space systematics of the regional paleolithic and epipaleolithic are beginning to be understood, at least in relative terms. However these studies, which document a human presence here since the Middle Pleistocene, are primarily typological in nature. In no case are they supported by the kinds of paleoecological data which allow for the interpretation of past human adaptations, nor are they linked to a chronology securely founded on radiometric determinations. In fact, to the best of my knowledge, no isotope dates of any kind have been published for the Late Pleistocene of the country.

There are good reasons for these deficiencies. For one thing, most paleolithic sites so far recorded consist of deflated surface finds where industries from a number of different periods are mixed together in an archaeological composite (or palimpsest) without contextual evidence of any kind (e.g., the paleolithic and epipaleolithic sites recorded by the el 'Hasa, Azraq and Black Desert Surveys)[4] (Fig. 1). These remains can only be separated into distinct components of somewhat subjective typological grounds. Only very rarely have stratified materials been found *in situ,* and to date only a few tests have been made.[5] Because of the relatively high incidence of Lower and (especially) Middle Paleolithic sites, knowledge of these industries is somewhat more advanced than that of the Upper Paleolithic and Epipaleolithic.

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1 G. Rollefson, The Paleolithic Industries of Ain el-Assad ('Lion's Spring") near Azraq, eastern Jordan, *ADAJ,* XXIV (1980) p. 129-144; Preliminary Report on the 1980 Excavations at Ain el-Assad, *ADAJ,* XXVI (1982) p. 5-35; G. Rollefson and B. Frohlich, The PPNB Burin Site of Jabal Unweinid, eastern Jordan, *ADAJ,* XXVI (1982) p. 189-198; G. Rollefson, Z. Kaechele, and J. Kaechele, A Burin Site in the Umm Utheina District, Jabal Amman, *ADAJ,* XXVI (1982) p. 243-247.

2 A. Garrard, S. Price, L. Copeland, A Survey of Prehistoric Sites in the Azraq Basin of Eastern Jordan, *Paleorient,* 3 (1977) p. 109-126; D. Henry, Paleolithic sites within the Ras en Naqb Basin, southern Jordan, *PEQ,* 111 (1979) p. 79-85; and, The Prehistory of southern Jordan and relationships with the Levant, *JFA,* 9:4 (1982) p. 417-444; and, Paleolithic adaptive strategies in southern Jordan: Results of the 1979 field season, in *Studies in the History and Archaeology of Jordan,* I, Amman, 1982, p. 41-47.

3 G. Rollefson, Exhibit: Most Ancient Jordan--the past 500,000 years, 1983.

4 Garrard, *et. al., ibid.;* B. MacDonald, E. Banning and L. Pavlish, The Wadi el-Hasa Survey 1979: A Preliminary Report, *ADAJ* XXIV (1980) p. 169-184; and, B. MacDonald, G. Rollefson and D. Roller, The Wadi el-Hasa Survey 1981. A Preliminary Report, *ADAJ,* XXVI (1982) p. 117-131; and, A. Betts, Prehistoric Sites at Qa'a Mejalla, eastern Jordan, *Levant,* 14 (1982) p. 1-34; and, A. Betts, Black Desert Survey, Jordan: Second Preliminary Report, *Levant,* n.d.

5 Rollefson, *ibid.,* Ain el-Assad; Henry, *ibid.,* The Prehistory... and Paleolithic adaptive...

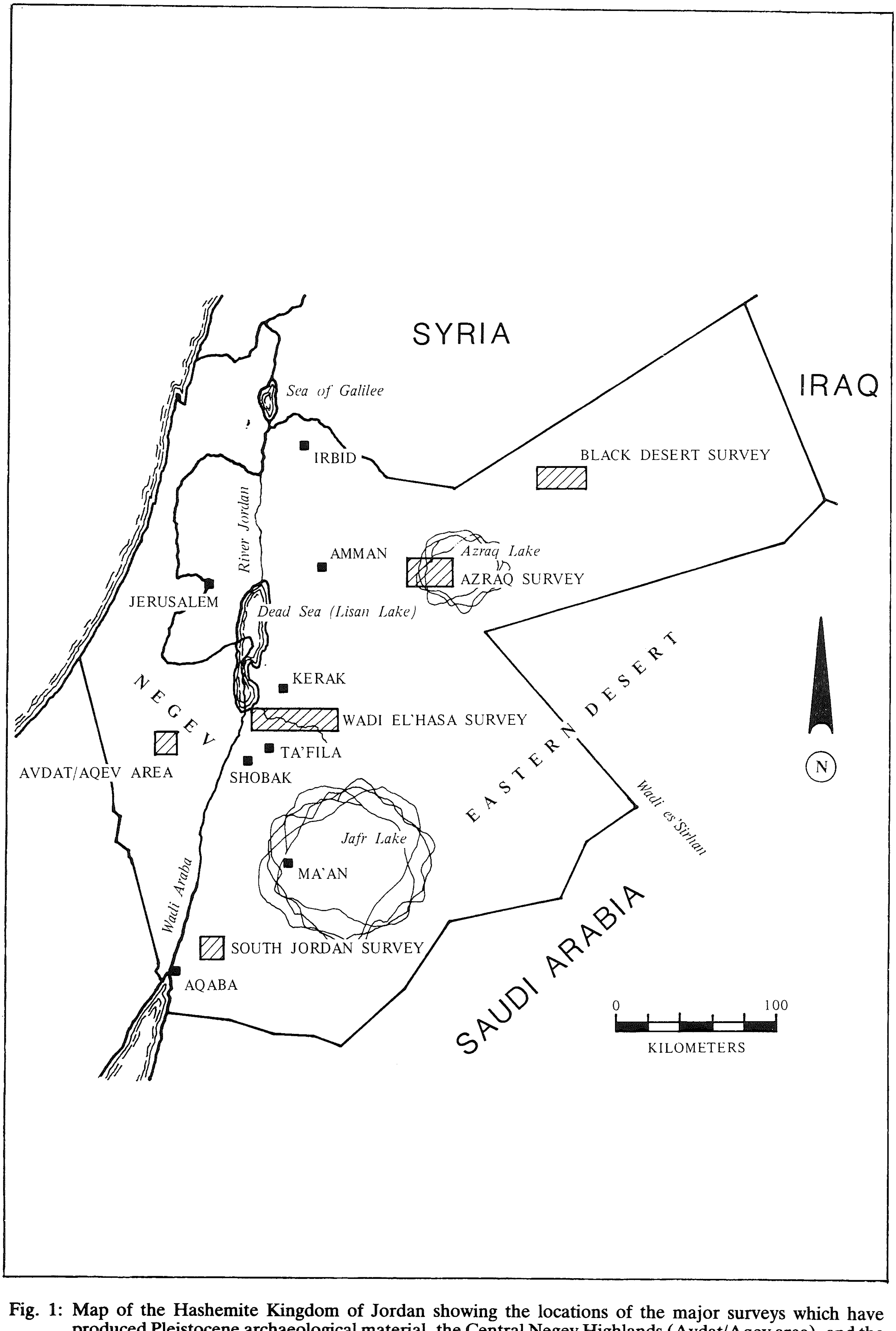

Fig. 1: Map of the Hashemite Kingdom of Jordan showing the locations of the major surveys which have produced Pleistocene archaeological material, the Central Negev Ḥighlands (Avdat/Aqev area), and the very approximate boundaries of fossil Lakes Azraq, Jafr.

The Levantine Middle And Upper Paleolithic: Some Models To Guide Research

Taking note of our poor understanding of the Jordanian Upper Paleolithic, it might seem premature to speak of models to guide Levantine paleolithic research when in fact what we should be doing is simply trying to improve the corpus of excavated material dating from about 40,000 to about 15,000 years ago. However, research on the Upper Paleolithic of the Palestine littoral goes back almost half a century in the Judean Hills, the area of Mount Carmel and in Lebanon,[6] and work in the central Negev highlands,[7] northern Sinai[8] and in central Syria[9] has intensified greatly during the past fifteen years. While there is much disagreement regarding chronologies, time-space systematics and the significance of paleoecological data,[10] at least there is the skeleton of a radiocarbon chronology and enough floral and faunal evidence to provide a basis for discussion.

These studies have been taken furthest by the work of the Japanese at Douara Cave (C Syria), by the French in the recent re-excavation of K'sar Akil[11] and by Marks and his colleagues in the Negev.[12] First approximations of settlement pattern models have been attempted,[13] chronologies defined (e.g., in the Negev sites of Boker Tachtit, Boker and Ein Aqev, which span the entire Levantine Upper Paleolithic [here 47,000-17,000 BP],[14] assemblages described (at Douara; in the Negev) and arguments made for the adoption of consistent typologies for describing these remains.[15] In a few cases, fairly sophisticated intrasite spatial analyses have been carried out.[16] Site distributions have been examined in relation to quaternary

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[6] D. Garrod and D. Bate, *The Stone Age of Mount Carmel,* Oxford, 1937; R. Neuville, *Le Paléolithique et le Mesolithique du Desert de Judée,* Paris, 1951; J. Ewing, Preliminary note on the Excavations at the Paleolithic Site of K'sar Akil, Republic of Lebanon, *Antiquity,* 21:2 (1947) p. 187-196; D. Garrod and D. Kirkbride, Excavation at Abri Zumoffen, a Paleolithic Rockshelter near Adlun in South Lebanon, 1958, *Bulletin du Musée de Beyrouth,* 16 (1961) p. 7-46.

[7] A. Marks, Ein Aqev: A Late Levantine Upper Paleolithic Site in the Nahal Aqev, in *Prehistory and Paleoenvironments in the Central Negev,* Israel, I, Dallas, 1976, p. 227-293; and, Terminology and chronology of the Levantine Upper Paleolithic as seen from the central Negev, Israel, in *Colloque III: Deuxième Colloque sur la Terminologie de la Préhistoire du Proche-Orient* (IX[e] Congrès, U.ISS.P.P, Nice 1976, p. 49-76; and, The Upper Paleolithic sites of Boker Tachit and Boker: A Preliminary Report, in *Prehistory and Paleoenvironments of the Central Negev, Israel,* II, Dallas, 1977, p. 61-80; and, Introduction: A Preliminary Overview of Central Negev Prehistory, in *Prehistory and Paleoenvironments in the Central Negev, Israel,* II, Dallas, 1977, p. 3-34.

[8] O. Bar-Yosef and J. Phillips, *Prehistoric Investigations in Gebel Maghara, Northern Sinai,* Jerusalem, 1977.

[9] K. Hanihara and Y. Sakaguchi, *Paleolithic Site of the Douara Cave and Paleogeography of Palmyra Basin in Syria,* I, Tokyo, 1978; and, K. Hanihara and T. Akazara, *Paleolithic site of the Douara Cave and Paleogeography of Palmyra Basin in Syria,* II, Tokyo, 1979; and, H. Suzuki and F. Takai, *The Paleolithic Site at Douara Cave in Syria,* Tokyo, 1974.

[10] A. Marks, The Upper Paleolithic of the Levant, *Colloques Internationaux du C.N.R.S.,* No. 598, Paris, 1981, p. 369-374; and. The Upper Paleolithic of the Negev, *Colloques Internationaux du C.N.R.S.,* No. 598, Paris, 1983, p. 343-352.

[11] J. Tixier and M.L. Inizan, K'sar 'Aqil: Stratigraphie et ensembles lithiques dans le Paleolithique Superieur, *Colloques Internationaux du C.N.R.S.,* No. 598, Paris, 1981, p. 353-368.

[12] A Marks, Prehistoric Settlement Patterns and Intrasite Variability in the Central Negev, Israel, *American Anthropologist,* 73:5 (1971) p. 1237-1244; and, Ein Aqev..., *ibid.:* Terminology..., *ibid.;* The Upper Paleolithic..., *ibid.,* Introduction..., *ibid.;* The Upper Paleolithic of.... *ibid.,* The Upper Paleolithic of the Negev, *Ibid.;* and, The Middle to Upper Paleolithic Transition in the Levant, *Advances In World Archaeology,* 2 (1983) p. 51-98; and, A. Marks and D. Friedel, Prehistoric Settlement Patterns in the Avdat/Aqev Area, in *Prehistory and Paleoenvironments in the Central Negev, Israel,* II, Dallas, 1977, p. 131-159.

[13] Marks and Friedel, *ibid.;* Marks, The Middle..., *ibid.*

[14] Marks, Introduction..., *ibid.*

[15] I. Gilead, Upper Paleolithic Tool Assemblages from the Negev and Sinai, *Colloques Internationaux du C.N.R.S.,* No. 598, Paris, 1981, p. 331-342.

[16] H. Hietala and D. Stevens, Spatial Analysis: Multiple Procuedures in Pattern Recognition Studies, *American Antiquity,* 42:4 (1977), p. 539-559; H. Hietala and A. Marks, Changes in Spatial Organization at the Middle to Upper Paleolithic Transitional Site of Boker Tachit, Central Negev, Israel, *Colloques Internationaux du C.N.R.S.,* No. 598, Paris, 1981, p. 305-318.

paleoenvironments[17] and a regional paleoenvironmental sequence has been established[18] supported by palynological[19] and paleontological evidence.[20] Because of the proximity of the Negev, and of the Palestine littoral, and because of the strong likelihood of past environmental continuity on both sides of the Jordan Rift, these studies are fruitful sources of hypotheses which ultimately can be evaluated using data from our paleolithic sequence.

Late Quaternary Environments And Archaeological Assemblages In The Central Negev Highlands

Studies of the ways in which humans adapt to their physical and social environments, and the effects of environmental change in the distribution of human societies over the face of the land are an essential part of the long-term study of human biological and social evolution. It has often been noted that archaeologists are in an especially privileged position to understand human adaptation because of the enormous time-depth characterestic of much archaeological data. Although few archaeologists today are environmental determinists, it remains reasonable to assume that for many early hunter-gatherers, the nature of the physical environment imposed constraints which restricted choice in many areas (e.g., subsistence, settlement, social organization, etc.) and which resulted in adjustments between humans and their environments over time which should be detectable in the archaeological record. One particular constraint, precipitation, is especially important for many areas of the Levant which were, and are, characterized by marginal environments due to aridity. In order to exert some control over the effects of a changing environment, it is first necessary to be able to reconstruct it at various points of interest to the investigator. Tentative late Quaternary Stratigraphic and palynological sequences are available from adjacent parts of Palestine which might be used to provide a set of expectations for Jordan in general and for west-central Jordan in particular. Although caution is urged because the evidence is spotty both in space and time, the late Quaternary of Palestine is well enough studied archaeologically for the time periods of interest here (i.e., the Middle and Upper Paleolithic, the Upper-Epipaleolithic transition) that it should be possible to avoid the dubious practice of using the characteristics of prehistoric stone tool industries to "date" sites and/or to place sites in particular climatic episodes. Of special relevance to the paleolithic of west-central Jordan, where a number of rare *Upper* Paleolithic sites have been reported,[21] is the long paleoclimatic and archaeological sequence developed over the past fifteen years by Anthony Marks and his colleagues for the central Negev highlands. Although redeposited Acheulean industries occur in both areas, the part of the Negev sequence for which relatively fine-grained paleoclimatic data and excavated archaeological remains are available begins abuot 90,000 years

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17 C. Vita-Finzi, The Hasa Formation: Alluvial Deposition in Jordan, *Man.* 1:4 (1966) p. 387-390; K. Butzer, The Late Prehistoric Environmental History of the Near East, in *The Environmental History of the Near and Middle East since the Last Ice Age,* New York, 1977, p. 5-14; J. Schuldenrein and P. Goldberg, Late Quaternary Paleoenvironments and Prehistoric Site Distributions in the Lower Jordan Valley: A Preliminary Report, *Paléorient,* 7:1 (1981) p. 57-71; J. Schuldenrien, A Micromorphological Study of Soils in the Lower Jordan Valley, Israel, Ph.D. dissertation, unpublished, 1983.

18 P. Goldberg, Upper Pleistocene Geology of the Avdat-Aqev Area, in *Prehistory and Paleoenvironments in the Central Negev,* 1, Dallas, 1976, p. 25-53; and, Late Quaternary Stratigraphy of Israel: An Eclectic View, *Colloques Internationaux du C.N.R.S.,* No. 598, Paris, 1981, p. 55-56.

19 S. Botteman and W. van Zeist, Palynological Evidence for the Climatic History of the Near East 50,000-6,000 BP, *Colloques Internationaux du C.N.R.S.,* No. 598, Paris, 1982, p. 111-132; A. Leroi-Gourhan, Le Levant à la fin du pleistocene et a l'holocene d'apres palynologie, *Colloques Internationaux du C.N.R.S.,* No. 598, Paris, 1981, p. 107-110.

20 H. P. Uerpmann, The Major Faunal Areas of the Middle East during the late Pleistocene and early Holocene, *Colloques Internationaux du C.N.R.S.,* No. 598, Paris, 1981, p. 99-106.

21 MacDonald, *et. al.,* The Wadi el-Hasa Survey, 1979 and 1981, *ibid.;* B. MacDonald and G. Rollefson, The Wadi el-Hasa Survey 1982: A Preliminary Report, *ADAJ,* XXVII.

ago, and extends up in time until the end of the Pleistocene (12-13,000BP). This period of time appears to correspond to the Levantine Middle, Upper and early Epipaleolithic.[22]

Early Mousterian (+90,000 -*ca.* 65,000 BP)

The early part of the Mousterian is associated with the formation of gravel terraces and travertines which attest to a climate considerably wetter than today, since similar deposits are not formed at present anywhere in Palestine. No pollen data certainly pertain to this time range, with the possible exception of a sequence from the site of D-35, in the Avdat/Aqev area (C Negev highlands), where 25% arboreal species is recorded (vs2% today).[23]

Site D-35 contains a Mousterian industry and is only one kilometre from a perennial spring (Ein Aqev). The archaeological assemblage is similar to that from Level D at coastal Tabun, which Goldberg believes can be correlated with the so-called Naamian Transgression of Sanlaville (= Tyrrhenian II-III, with raised beaches at 10-20 metres above sea level). Another "typologically early" Mousterian has been identified at Zuttiyeh Cave (Lower Galilee), where a travertine associated with a Mousterian breccia has been dated by U/Th at 97,000±13,000 BP.[24] Finally, Goldberg[25] reports a travertine about 150 m SSW of D-35 which contains a Levalloiso-Mousterian assemblage like that from D-35. The travertine site (D-15) was also dated by U/Th and yielded determinations of 74,000±5,000 BP and 85,200±10,000 BP.[26]

The physical stratigraphy at both Negev sites is characterized by channel aggradation at the base followed by increased colluviation near the top. At the beginning of the sequence, the picture is one of a climate wetter and cooler than today's, with high energy transport of abundant coarse materials possible during strong seasonal floods. Sparse pollen samples also indicate a more heavily vegetated landscape than is the case today, with arboreal species (dominated by *Quercus* and *Olea* accounting for 25% of the spectrum. The non-arboreal species are dominated by *Gramineae* and *Cyperaceae* (together 17%), *Chenopodiaceae* (17%) and *Compositae* (13%). All this taken together indicates a paleoclimate which is completely distinct from that of the present, with climatic belts distributed as much as 200-250 kms. south of their present locations and with the desert border well to the south of the Avdat/Aqev area.[27] Sediments in the long sequence at Tabun Cave, Mt. Carmel,[28] as well as those from the Hula Valley (N Galilee) and Birket Ram (N Golan) boreholes also support wetter climates between 70,000 and 40,000 years ago.[29]

Later Mousterian (*ca.* 65,000-45,000 BP)

The latter part of the Mousterian (*ca.* 65,000-45,000 BP) is poorly represented in the Avdat area because of an episode of erosion which Goldberg and Horowitz believe to be a general, pan-Levantine phenomenon. They subscribe to this view because *wadi* downcutting is indicated not only in the Avdat region, but also at Tell Fara and in the Wadi Besor (W Negev), and in the region of Qadesh Barnea (E

[22] J. Cauvin and P. Sanlaville, Préhistoire du Levant, *Colloques Internationaux du Centre National del La Recherche Scientifique,* No. 598, Paris, 1981.

[23] Goldberg, Late quaternary..., *ibid.,* p. 83.

[24] I. Gisis and O. Bar-Yosef, New Excavations at Zuttiyeh Cave, Wadi Amud, Israel, *Paléorient,* 2 (1974) p. 175-180; H. Schwarcz, P. Goldberg and B. Blackwell, Uranium Series Dating of Archaeological Sites in Israel, *Israel Journal of Earth Science,* 29 (1980) p. 107-139.

[25] Goldberg, Late quaternary..., *ibid.,* p. 56.

[26] H. Schwarcz, B. Blackwell, P. Goldberg and A. Marks, Uranium series Dating from Archaeological Sites, Nahal Zin, Israel, *Nature,* 277 (1979), p. 558-560.

[27] A. Horowitz, *The Quaternary of Israel,* New York, 1979, p. 245.

[28] A. Jelinek, W. Farrand, G. Haas, A. Horowitz and P. Goldberg, New Excavations at the Tabun Cave, Mount Carmel, Israel 1967-1972: A Preliminary Report, *Paléorient,* 1:2 (1973) p. 151-183; and, A. Jelinek, The Tabun Cave and Paleolithic Man in the Levant, *Science,* 216:4553 (1982) p. 1369-1375.

[29] Horowitz, *ibid.*

Sinai). Goldberg[30] suggests a drying trend, during which rainfall and runoff were just sufficient to remove most of the "early Mousterian" deposits. As a consequence, sedimentary "traps" for later Mousterian industries probably did not exist. This phase of erosion and increased aridity terminated in the Avdat area prior to about 45,000 BP.

Middle-Upper Paleolithic Transition *(ca.* 47,000 - *ca.* 45,000 BP)

Marks[31] has identified a series of transitional Middle-Upper Paleolithic industries at Boker Tachtit and elsewhere in the Avdat/Aqev region which are dated by radiocarbon at 47,000-45,000 BP. These industries are associated with alluvial sand/gravel terraces up to 15.00 m. thick, as a new cycle of aggradation apparently began to fill up to incised landscape after about 45,000 years ago.[32] The length and intensity of this cycle of aggradation is the subject of some discussion because of *lacunae* in the later part of the sequence and because of partially conflicting pollen evidence.

Site D-101, which has a transitional Middle-Upper Paleolithic assemblage dated at 45,000 to 40,000 BP, has produced a combined pollen sample of 90 grains in which the arboreal fraction (excluding riparian tamarisk) is 17% (oak, olive, pine, acacia and cypress are represented). The non-arboreal fraction, however, resembles the rather dry contemporary vegetation of the area. Horowitz[33] cautions that the D-101 sediments were deposited in water, that acacia and tamarisk are typical *wadi*-bed species, that the oaks and olives are probably relics of the Mediterranean flora of Mousterian times and that pine and cypress are wind-transported over long distances, thus effectively disposing of any ecological significance that the arboreal fraction might have had. We are left to conclude, despite the evidence for renewed alluviation, that the Avdat area was rather dry *ca.* 45,000 BP, and drier than it was during previous and successive episodes.

Upper Paleolithic (*ca.* 45,000-20,000 BP)

Knowledge of the Negev Upper Paleolithic is also based mainly on data from the Avdat/Aqev area. Upper Paleolithic assemblages there occur rather early (*ca.* 45,000 BP, coeval with the late Mousterian) and are characterized by a lot of technological and typological variability (cf. below). Marks regards the area as marginally habitable due to aridity during much of the last glaciation and, except during a brief "climatic optimum" (32,000-27,000 BP) when conditions became wetter,[34] suggests that use/occupation might have been confined to the rainy season and/or to the vicinity of perennial springs. Goldberg[35] cites evidence from Ein Aqev (D-31) for continued alluviation during this period, althoug the sediments corresponding to the Upper (esp. the later) Paleolithic are finer, comprising silts and clays (instead of the earlier, coarser sands and gravels), indicating a decline in runoff energetics when compared with sediments deposited during the Middle-Upper Paleolithic transition. A generally moist, relatively warm climate is indicated up until about 27,000 years ago, when conditions once again became cooler and more arid. Paleoclimate and vegetation in the C. Negev during the Upper Paleolithic were therefore probably Mediterranean in nature and have been compared with those of present-day N. Judea or Samaria, suggesting in turn that climatic belts were distributed some 150-200 kms. South of their present locations.[36]

These conclusions are substantiated by pollen samples from Upper Paleolithic sites D-22, D27a, and D-27b, which have spectra comprising 16% arboreal species, dominated by oak and olive, and with occasional traces of aleppo pine, pistachio, tamarisk, acacia and juniper. Although the

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[30] *Goldberg, Late Quaternary..., ibid.,* p 83.

[31] Marks, The Upper Paleolithic..., *ibid.;* and, The Middle to... *ibid.*

[32] Goldberg, Late quaternary..., *ibid.*

[33] *Horowitz, ibid.,* p. 247.

[34] Marks, Ein Aqev..., *ibid.;* and, Terminology..., *ibid.;* and Bar-Yosef and Phillips, *ibid.*

[35] Goldberg, *ibid.*

[36] Horowitz, *ibid.*

arboreal fraction is a little lower than that of the Mousterian (due to a decline in the frequency of *Olea,* it is indicative of an essentially similar vegetational configuration, although perhaps somewhat cooler and drier than that of the early Mousterian (since olives favor somewhat warmer and more humid micro-climates than those indicated by the rest of the arboreal species). The non-arboreal fraction, dominated by grasses and sedges (25%), chenopodia (35%) and compositae (15%) is essentially the same as that of early (*i.e.,* pre-65,000 BP) Mousterian, indicating humid conditions *vis à vis* those of the present.[37] Horowitz[38] believes that D-22 and the D-27 sites probably fall into the 32,000-22,000 BP interval, corresponding to what he calls his "Second Wurm Stadial". These sites have not been dated radiometrically as yet.

Late Upper Paleolithic-Epipaleolithic Transition (23-22,000-15,000 BP)

Goldberg's[39] analyses of the younger sediments in the Boker terrace indicate a larger fine component and more colluvium beginning around 27,000 BP. This is taken to mean declining stream energetics and the onset of a drier trend which lasted until about 14,000 BP. The late Upper Paleolithic site of Ein Aqev (D-31), which has been well dated between 18,000 and 17,000 BP (Marks 1976), occurs in these sediments. At D-31 itself, the underlying strata lack archaeological remains, but replicate the sequence of (coarse) alluvial gravels in which the nearby Boker and Boker Tachtit sites are found.

Two of the Late Pleistocene Avdat/Aqev sites have yielded pollen sequences (D-31, D-34). D-34 is slightly older than D-31 and more or less represents the Upper Paleolithic configuration known from D-22 and D-27 (cf. above). The arboreal fraction goes from 7% in D-34 to only 3% in D-31, with corresponding increases in the non-arboreal component (from 35% to 40% grasses, sedges; from 8% to 28% chenopodiaceae; 9% to 10% compositae). The importance of these changes for making inferences about climatic change should not be overstated, however, since the D-34 sample in particular is poor (65 grains) and contains a lot of tamarisk (39%, excluded in all these percentage calculations). Clearly, though, these data suggest a continuation of the trend toward greater aridity, which apparently reached a maximum around 16,000-15,000 BP.[40] Horowitz,[41] however, notes that both spectra are richer in composites and arboreal pollen than would be expected from the make-up- of the contemporary vegetation, which he believes indicates a climatic episode somewhat more humid than today, although drier than previously. Using comparisons with the Hula Valley and Birket Ram borehole sequences, he places the occupation of D-31 and D-34 toward the end of his "Middle-Late Wurm" interstadial phase, a relatively dry episode during which cover in the area consisted mainly of grasses and sedges, with only a few scattered stands of trees. He remarks that climate was still favorable enough to allow for settlement of the central Negev in the vicinity of permanent water sources (*e.g.,* Ein Aqev), but that the "paradise" of Mousterian and early Upper Paleolithic times had ceased to exist in the area. This is in close agreement of Marks[42] impression of marginal utilization after the end of the Mousterian.

Epipaleolithic-Early Natufian (*ca.* 17,000-13,000 BP).

The last significant geomorphological event in the Avdat region is the incision of

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37 A. Horowitz, Climatic and Vegetational Developments in Northeastern Israel during Upper Pleistocene-Holocene Times, *Pollen et Spores,* 13:2 (1971) p. 255-278; and, Development of the Hula Başin, Israel, *Israel Journal of Earth Sciences,* 22 (1973) p. 107-139.

38 Horowitz, The Quaternary..., *ibid.*

39 Goldberg, Upper Pleistocene..., *ibid.;* Late quaternary..., *ibid.*

40 D. Henry and A. Lerois-Gourhan, The Excavation of Hayonim Terrace: An Interim Report, JFA, 3:3 (1976) p. 391-406.

41 Horowitz, The quaternary..., *ibid.,* p. 246-248.

42 Marks, The upper..., *ibid.;* and, Introduction..., *ibid.*

these younger sediments beginning around 23,000-22,000 BP. After this point in time, there is no significant alluvial deposition in the Avdat/Aqev wadis. While a long-term drying trend seems to be indicated, the silty colluvium associated with the Epipaleolithic here (dated at *ca.* 17,000-12,000 BP) is taken to indicate periodic, slightly moister oscillations during which enough water was available to strip the slopes of vegetation and fines but not enough to allow for the development of a protective mantle of vegetation.[43] Such oscillations are apparently not identified in the pollen record.

The Natufian (post 13-12,000 BP) sees the resumption of somewhat drier conditions, according to Goldberg,[44] a conclusion at variance with the pollen evidence for a substantially more humid climate elsewhere in the Levant between 14,000 and 12,500 BP.[45] Horowitz[46] draws attention to the complete lack of pollen data from the Avdat area during the preceding Kebaran and Geometric Kebaran periods (17,000-11,000 BP) so, although the Avdat region was occupied during this interval (Geometric Kebaran A site D-5 produced no pollen), the paleo-climatic data are equivocal. Horowitz,[47] in discussing the pollen data from the Natufian site of Rosh Zin (D-16), suggests the reappearance of a dry Mediterranean climate, considerably drier than that of the Mousterian and early Upper Paleolithic periods, but more humid than that of the Late Upper Paleolithic known from D-31. Rosh Zin is a *Late* Natufian site and would date after *ca.* 10,500 BP.[48]

A tentative paleoclimatic sequence for the C. Negev highlands based on the material just discussed is given in table 1. I reiterate that it is the most relevant body of information available as yet to structure post-survey research on late Pleistocene climatic and industrial change in west-central Jordan. Since these sequences of paleoclimatic change are argued by their creators (primarily Goldberg, Horowitz) to have pan-regional validity (at least as first approximations), they might in particular apply to the Wadi el 'Hasa, where paleolithic remains are abundant. The Negev reconstruction is not without its critics, however. The pollen sequence in particular is often regarded as over-interpreted due to small samples, statistical naivété and use of an anthropogenic environment as a baseline for assessments of the intensity and direction of Pleistocene paleoclimatic changes.[49] A reasonable objective for post-survey research in west-central Jordan would be to derive *independent* paleoclimatic data from optimal lacustrine locales known to exist at the eastern-end of the Wadi el 'Hasa (loci where the anthropogenic component can be eliminated or minimized) and then attempt to assess the significance of any discrepancies with the Negev sequence which might be detected.

The Avdat/Aqev region and the eastern end of the Wadi el 'Hasa are separated by about 100 kms. Since they are on almost the same latitude, there are broad similarities in rainfall (both receive on the average 50-100 mm. per annum), in the kinds of sediments and landforms present and in the elevational distribution of sites.[50] Both are characterized by a mosaic of so-called Saharo-Sindian, Irano-Turanian, and Mediterranean zonal environments (these are composite zonal phytogeographic configurations determined by dominant vegetation, temperature, moisture regimen, elevation, exposures, soils and fauna),[51] and, so far as is known, both have similar kinds and frequencies of archaeological

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43 *Goldberg, Late quaternary... ibid.*, p. 57-58.
44 *Ibid.*
45 Horowitz, The Quaternary..., *ibid.;* Marks, Ein Aqev..., *ibid.;* Marisk, Terminology..., *ibid.;* Henry and Leroi-Gourhan, *ibid.*
46 Horowitz, The Quaternary..., *ibid.*, p. 248-249
47 *Ibid.*
48 O. Bar-Yosef, The Epipaleolithic Complexes in the Southern Levant, *Colloques Internationaux du C.N.R.S.*, No. 598, Paris, 1981, p. 389-408; and, The "Prepottery" Neolithic Period in the Southern Levant, *Colloques Internationaux du C.N.R.S.*, No. 598, Paris, 1981, p. 551-570.
49 Fish, Personal communication.
50 G. Clark, A Preliminary Analysis of Upper Paleolithic assemblage variability from the Wadi el-Hasa, West-central Jordan, manuscript.
51 Horowitz, The Quartenary..., *ibid.*, p. 28.

TABLE 1.

TENTATIVE PALEOCLIMATIC SEQUENCE FOR THE LATE PLEISTOCENE OF THE CENTRAL NEGEV (FROM GOLDBERG 1973, 1979, 1981; HOROWITZ 1976, 1979)

ARCHAEOLOGICAL UNITS	SEDIMENTOLOGICAL & VEGETATIONAL CHARACTERISTICS*	AVDAT/AQEV SITES*	MACROCLIMATIC TRENDS	MARKS' (1981, 1983) SETTLEMENT PATTERN CHARACTERISTICS
EPIPALEOLITHIC - EARLY NATUFIAN [ca. 17,000 - 13,000 BP]	periodic very slightly more humid oscillations 17-12,000 BP followed by contradictory evidence: drier conditions post-13,000 BP indicated by the sediments (Goldberg 1981), wetter conditions post-14,000 BP by the pollen (Horowitz 1979); by the late Natufian (ca. 10,500 BP) a drier climate as indicated by pollen data from Rosh Zin (D-16)	D-5, Rosh Zin (D-16) D-101, Ein Aqev (D-31)	DRYING SOMEWHAT WETTER	climatic evidence equivocal; possible brief return to radiating configuration during the early Natufian, followed by circulating pattern in the late Natufian
UPPER - EPIPALEOLITHIC TRANSITION [23-22,000 - 15,000 BP]	continuation of drying trend with arboreal fraction 7% (D-34), then 3% (D-31); NAP indicates slightly wetter conditions than present; erosion beginning ca. 23,000 BP becomes marked after ca. 15,000 BP; formation of colluvial silt lenses after ca. 18,000 BP; maximum aridity ca. 16-15,000 BP	Ein Aqev (D-31) D-34	DRYING	
UPPER PALEOLITHIC [ca. 45,000 - 20,000 BP]	complex sedimentary sequence with continued alluviation characterised by the accumulation of coarse, then fine terrace gravels, sands (until ca. 27,000 BP), then silts, clayey colluvium (until ca. 20,000 BP); decline in runoff energetics over time; climate somewhat more humid (and considerably more humid 32,000-27,000 BP) until ca. 27,000 BP, when a trend toward greater aridity begins; 16% AP at D-22, D-27; climatic belts 150-200 km S of present locations	D-22, D-27a,b D-100 D-34	DRYING WETTER DRYING	circulating pattern with no significant intersite variability (i.e., more difficult to distinguish between base camps, limited activity stations); repeated reoccupation of sites (but without spatial consistency in activity area placement); more mobile settlement/subsistence system tied to increased importance in scheduling in resource procurement in a more arid environment than during the Middle Paleolithic
MIDDLE - UPPER PALEOLITHIC TRANSITION [ca. 47,000 - ca. 45,000 BP]	new cycle of alluviation with formation of terraces up to 15 m thick; somewhat drier than previously with 17% AP at D-101; NAP much the same as early Mousterian	D-101	DRY BRIEFLY SOMEWHAT WETTER?	shift to circulating pattern with trend toward increased dessication; decline in site size, intersite variability and evidence of sedentism
LATER MOUSTERIAN [ca. 65,000 - ca. 45,000 BP]	drying trend; erosion (wadi downcutting with destruction of many early Mousterian sites), consequently few sedimentary traps for later Mousterian industries		DRYING	radiating settlement/subsistence system with base camps and associated limited activity sites; base camps characterised by high artifact density, stratified deposits and the formation of middens, spatially-consistent tool kits; indicative of relatively sedentary pattern or pattern of re-occupation at regular intervals; logistical strategy possible due to optimal climatic conditions (vis à vis Upper Paleolithic)
EARLY MOUSTERIAN [90,000+ - ca. 65,000 BP]	wet; formation of gravel terraces and travertines; 25% AP at D-35; channel aggradation followed by colluviation; climatic belts 200-250 km S of present locations	D-35, D-15	WET	

* should be read from bottom to top

* sites not in stratigraphic order within archaeological units

sites and site-depositional contexts.

The Upper Paleolithic of Jordan

The Azraq Basin, south Jordan and Black Desert surveys all produced very little material which could unequivocally be assigned to the Upper Paleolithic.[52] The Wadi el 'Hasa survey[53] produced substantial quantities of Upper Paleolithic remains but here, as in other areas, only a few stratified sites were recorded (Fig. 1). As is evident from the publication dates of the above cited projects, all this interest in the Upper Paleolithic is a very recent phenomenon.

Henry's South Jordan Survey

About the only systematic work so far within the national boundaries which involves Upper Paleolithic *excavation* was Donald Henry's Survey of four areas surrounding the villages of Ras en Naqb and El Qumeira in the Wadi Hisma, southern Jordan.[54] This region is located about 160 kms. due south of the Wadi el 'Ḥasa (Fig. 1). It was selected because of environmental diversity, and the corresponding expectation of site functional and settlement pattern differences determined ultimately by different adaptations across an altitudinal gradient ranging from 1000.00 m. (Ras en Naqb) to 800.00 m. (at El Qumeira some 20 km. to the South). The study area transected the southern margin of the Jordanian Plateau and the adjacent Wadi Hisma. Divided into four strategically located subunits, it was systematically surveyed on foot over a combined 24.5 square kilometre area, resulting in the discovery of eighty-one prehistoric sites which ranged in time from the lower Paleolithic through the Chalcolithic. Only two stratified, *in situ* Upper Paleolithic sites were found (J403, J412), although five additional deflated surface scatters also contained Upper Paleolithic tools. Both stratified sites, associated with rockshelters, were tested producing what is, to the best of my knowledge, the only *in situ* Jordanian Upper Paleolithic material excavated to date. Although paleoenvironmental data were reportedly collected,[55] they remain unpublished, so that this discussion must be confined to the characteristics of the lithic assemblages.

Two *sondages* at J412 (Jebel Humeima) yielded 8,746 chipped stone artefacts of which 269 are what Henry calls "tools forms". Numerical data from J403 have not been published. At both sites the retouched component of the assemblage is said to be dominated by simple endscrapers, burins and retouched elements. The assemblages also supposedly share a lithic technology focused upon blade production from prismatic cores. Although retouched pieces account for over 50% of the tools at J412, the majority are discontinuously retouched blades and flakes that were casually manufactured. Abrupt and Aurignacian (scalariform) retouch are rare in the assemblage. While simple endscrapers on blades constitute most of the scrapers, endscrapers on flakes with extensive lateral retouch are also common. The burins are typically made on truncations on thick blades and flakes, but dihedral forms also occur.[56] The high debitage densities together with cores and primary manufacturing debris denote an emphasis on the early stages of lithic reduction at these sites (esp. J412, Jebel Humeima). Although this emphasis on primary reduction was first thought surprising because of an apparent lack of local raw material, chert cobbles were discovered in abundance in the bed of the Wadi Qalkha, less than .5 km. distant.

Henry points out that while blade production was clearly emphasized at these two sites, the presence of large flakes and primary elements that bear evidence of elaborate platform preparation imply that reduction of blade cores began with the removal of a series of flakes (or that there was a secondary technology related to the

52 Garrard, *et. al.*, *ibid.*; Henry, The Prehistory..., *ibid.*; Henry, Paleolithic Adaptive..., *ibid.*; Betts, n.d., *ibid.*

53 MacDonald, *et. al.*, *ibid.*

54 Henry, *ibid.*

55 Henry, The Prehistory..., *ibid.*

56 Henry, *ibid.*, p. 427.

production of large flakes). Apparently, only after most of the cortex had been removed did blade production begin. Once blade production had begun, platform preparation and edge strengthening continued throughout the reduction process until the core was exhausted.[57]

Although Henry's tests have not been reported in detail, they provide for the first time a set of expectations about what an Upper Paleolithic assemblage should look like in Jordan. Moreover, enough material has been described to allow for the tentative placement of these assemblages in the broader context of the Upper Paleolithic found elsewhere in the Levant.

Patterns of Levantine Upper Paleolithic Assemblage Variability

Very recently, a dichotomous pattern of variability in the composition of stratified (rare) and surface (relatively common) Upper Paleolithic assemblages from Lebanon, the Negev, and the West Bank has been identified and described (apparently independently) by Gilead and Marks.[58] In reasonable agreement with one another, both authors have suggested that the Levantine Upper Paleolithic prior to the Kebaran consists of two distinct "traditions" which overlap to some extent with one another in space and time. One of these is the well-known Levantine Aurignacian, characterized by a dominance of endscrapers and burins made of normal blades and flakes. The other, which Gilead has christened the Ahmarian (after Erq el Ahmar, in the Judean desert)[59] is characterized by significant numbers of small blades and bladelets; retouched and backed blades, bladelets and points (>35%) and a relative scarcity of the "classic" Aurignacian diagnostics — endscrapers and burins (≤40%). The Ahmarian has been relatively well dated between 38/41,000 and 17,000 BP; the few radiocarbon dates associated with Levantine Aurignacian assemblages do not antedate about 29,000 BP.[60]

While both workers come up with basically the same arrangement of sites, thus engendering some confidence in the model, they differ somewhat regarding methodology and the behavioral significance which they attach to the dichotomous pattern.[61] Gilead[62] has suggested that Aurignacian assemblages are primarily associated with Mediterranean phytogeographic zones and reflect adaptations to verdant, more heavily forested zones. The Ahmarian, found mainly in the Negev, is thought to be an adaptation to an open grassland, steppe and desert regime (i.e., should be associated with Saharo-Sindian, Irano-Turanian phytogeographic zones). Henry's sites J403 and J412 are affiliated with the Levantine Aurignacian, which is consistent with the proposed Mediterranean zone adaptation for the industry, given retrodiction of past climatic conditions from the modern environmental setting of the Jordanian plateau and the adjacent foothills.[63]

Adaptation In The Arid Near East, Or What We Could Study If We Could Control For Chronology And Paleoclimatic Change

Henry[64] has recently published what amounts to an over-arching research design for the study of ancient human adaptation in the Levant. Although linked specifically to his own research area on the southern edge of the Jordanian Plateau, it has relevance for any Levantine archaeological project which is concerned with the early (i.e., preagricultural) time ranges. Fundamental to his approach is the development of an understanding of the paleoenvironmental milieux in which Pleistocene hunter-gatherers lived, and from which they extracted their resources. He takes the position that control of chronolo-

[57] Henry, *ibid.*, p. 428.
[58] Gilead, *ibid.*; and, Marks, The Upper Paleolithic of the Negev, *ibid.*
[59] R. Anati, *Palestine Before the Hebrews*, London, 1963.
[60] D. Henry and. F. Servello, Compendium of C-14 Determinations Derived from Near Eastern Prehistoric Sites, *Paléorient* 2 (1974) p. 19-44.
[61] Marks, *ibid.*
[62] Gilead, *ibid.*
[63] Henry, *ibid.*, p. 428, 430.
[64] Henry, Paleolithic Adaptive..., *ibid.*

gy and environment must precede more problem-specific research designs, and that such controls should be developed independently of efforts to control for variation in archaeological and faunal assemblages. Although Redman[65] has pointed out that these variables should be controlled simultaneously rather than sequentially, to allow for an ongoing feedback process to correct for potential defects in the research design which were not apparent beforehand, if adequate monitors of paleoenvironmental change can be developed, models related to settlement patterns, intrasite compositional variability, intersite organizational networks, site densities, differences in site sizes and site catchments, and in lithic and faunal assemblages over time can be addressed. Ideally such research should proceed in a multistage fashion from a sophisticated site survey research design, developed to insure sample representativeness in terms of site types and environmental parameters, through a testing programme at various levels of scale, and culminate in the excavation of a variety of different site types most relevant for the time periods and questions of interest.[66] However, the Wadi el 'Hasa survey design was judgmental and oriented toward the recovery of *all* evidence of human occupation of the area from earliest times until nearly the present. Although many paleolithic sites were recorded, most consisted of deflated surface scatters without good contextual information. Post-survey research based on el 'Hasa data would be more efficiently accomplished if use were made of the extensive (although less than ideal) information already available. This is possible to do because the most promising Middle, Upper and Epipaleolithic sites have already been identified.

Settlement Patterns: The Negev Model

Because of the marginal nature of many Near Eastern environments, settlement and subsistence models for the study area are linked more to long and short-term (*i.e.*, annual) variations in the moisture regimen and the effects these have on the distribution of people and their resources at different elevations than to any other single factor. Group size, composition, movement and scheduling are designed to "mesh procurement strategies with the locations and seasonal availability of resources".[67] So far as settlement patterns are concerned, the bipolar model developed by Peder Mortensen[68] has received considerable attention from Levantine archaeologists, and in particular from Marks and his colleagues working in the C. Negev highlands.[69] Mortensen made a distinction between what he called a "circulating pattern", in which movements of prehistoric groups were primarily conditioned by seasonal availability of resources, which were in turn determined by seasonal variation in rainfall; and a "radiating pattern", where in procurement strategies were organized around permanent or semi-permanent base camps, supported by (largely non-residential) exploitation camps. This distinction has recently surfaced again in the ethnoarchaeological literature in terms of a contrast between "foraging strategies", characterized by "mapping on" to resrouces through a relatively high degree of residential mobility, and "logistical strategies", in which base camps play a larger role, and in which collectors provision themselves to a greater extent through specially organized task groups and other adjustments in group size and composition.[70] The two types of orga-

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[65] C. Redman, Multistage Fiedlwork and Analytical Techniques, *American Antiquity,* 38:1 (1973) p. 61-79.
[66] *Ibid.*
[67] Henry, *ibid.,* p. 43.
[68] P. Mortensen, Seasonal Camps and Early Villages in the Zagros, in *Man, Settlement and Urbanism,* London, p. 292-297.
[69] Marks and Freidel, *ibid.*
[70] L. Binford, Dimensional Analysis of Behavior and Site Structure: Learning from an Eskimo Hunting Stand, *American Antiquity,* 43:3 (1978) p. 330-361; and, Willow Smoke and Dogs' Tails: Hunter-gatherer Settlement Systems and Archaeological Site Formation, *American Antiquity,* 45:1 (1980) p. 4-20.

nizational strategies would be expected to produce two distinct kinds of settlement patterns, which in turn would be characterized by distinct site catchment data (site catchments would be smaller for circulating foragers, larger for centrally-based, logistcally-organized collectors; site contents would be more "homogeneous" in the less-functionally-differentiated circulating pattern, more heterogeneous in the radiating pattern, etc.). Many other expected differences are identified by Binford.[71] Generalized and adjusted to the particulars of the Near Eastern data base, they provide a basis for fairly detailed expectations about site numbers, sizes, types, contents and distributions which can be evaluated to some extent using the Wadi el 'Hasa survey material..[72]

By assuming that changes in settlement patterns are at least partially linked to changes in the moisture regimen, Marks and his colleagues have determined that radiating patterns and greater residential stability should be characteristic of the moister intervals that prevailed during the early Levantine Mousterian and the Natufian, while more mobile, circulating patterns should have been operative during drier climatic episodes (the later Upper Paleolithic, Kebaran).[73] In the case of the Negev data, Marks has been able to test this model partially since he has (for the Levant) relatively fine-graind chronological controls and the regional paleoclimatic sequence outlined in Table 1. Henry has also designed a scenario which will eventually allow an evaluation of the model using his South Jordan data, and I am presently trying to "fine-tune" and test it using the El 'Hasa survey data (this work has not been completed yet). However, in neither of the latter cases are there large numbers of *in situ* paleolithic sites in primary depositional contexts, nor do we have the chronological controls and paleoenvironmental information available for the central Negev. That the overall model is credible, however, is supported by studies of the movements of Bedouin groups in the area, which are primarily controlled by rainfall distribution.[74] Their settlement patterns, which involve seasonal transhumance between highland (during the dry months of April-November) and lowland zones (during rainy December-March), should be similar to the pattern predicted for the central Negev during arid climatic episodes.

The Wadi El Hasa Survey

In 1979, 1981 and 1982, a team headed by Burton MacDonald (St. Francis Xavier University) surveyed the south bank of the Wadi el 'Hasa (west-central Jordan) from near its confluence with the Wadi 'Afra, at the western edge of the Jordanian Plateau overlooking the South-East corner of the Dead Sea depression, east to the Desert Highway at the town of Mahattat el 'Hasa, where the wadi disappears in an expanse of alluvial mud flats and lacustrine marls called the Qa el 'Jinz,[75] The survey area (Fig. 1) thus transects the highlands at the eastern edge of the Wadi ʿAraba-Jordan *graben* and extends to the western margin of the Eastern Desert, a distance of more than 60 kms.The altitudinal gradient ranges from a maximum of 1250.00 m. in the west to about 750.00 m. in the east, although elevations as low as 200-300.00 m. are recorded at several isolated localities in the survey area.

The present physical appearance of the survey area is largely the result of anthropogenic alteration of Mediterranean woodlands and Irano-Turanian steppe. Evidence of the paleoenvironmental history of the area is presently quite limited, but it is likely that prior to significant human disturbance, upland plateaux were

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[71] Binford, *ibid.*

[72] G. Clark, A Preliminary Analysis of Upper Paleolithic Assemblage Variability from the Wadi el-Hasa, west-central Jordan, manuscript.

[73] Marks and Friedel, *ibid.;* Marks, The Upper Paleolithic..., *ibid.;* and, The Upper Paleolithic of the Negev..., *ibid.*

[74] R. Patai, *The Kingdom of Jordan,* Princeton, 1958; S. Helms, Paleo-Beduin and Transmigrant Urbanism, in *Studies in the History and Archaeology of Jordan,* I, Amman, 1982, p. 97-113.

[75] MacDonald, The Wadi el-Hasa, 1980..., *ibid.;* MacDonald, *et. al.,* The Wadi el-Hasa, 1982..., *ibid.*

characterized by open woodland, oak-pistachio *(Quercus calliprinos/Pistachia atlantica)* forest associations, whereas slopes and valleys tributary to the wadi were probably covered by Irano-Turanian dwarf shrub *Artemisetum* steppe vegetation.[76] The degradation of the oak woodland has resulted not only from the clearing of farmland on the watershed, but also from its exploitation for timber and charcoal. Uncontrolled grazing, especially after the Byzantine period, has prevented regeneration of forest while simultaneously reducing brush cover, so that the water table has dropped and the rate of erosion has increased somewhat (perhaps dramatically) in recent historical times.[77]

The survey area *as a whole* receives between 200 and 300 mm. rainfall per annum, but the precipitation gradient declines markedly with elevation from west to east, averaging 50-100 mm. in the study area proper. As is true throughout the Levant, precipitation is almost entirely a seasonal phenomenon, being restricted in the survey area to the months of October through May. Structural movements associated with the tectonically-active Rift Valley have created drainage base levels which, combined with high surface water runoff, have caused extensive erosion clearly expressed in the landscape relief. The most striking geomorphological features of the survey area are the deeply entrenched wadi systems resultant from the movements of complex drag fault systems (e.g., the Wadi el Hasa itself, Wadi ʻAfra, etc.),[78] Wadi lattices thus dissect the high tablelands (esp. in the west) creating a stark, rugged landscape which during the dry months is practically devoid of vegetation. Microclimatic regimes are distributed over this landscape in thin, elevation-dependent bands which are largely a function of orographic effects on the terrain.[79]

Over 1000.00 m. of stratigraphy are exposed in the survey area. The most important strata are Mesozoic Kurnub sandstones of Upper Jurassic to Lower Cretaceous age (140-125 MY), and the ʿAjlun and Bal'qa marine limestone series, laid down during the Upper Cretaceous (80-60 MY). Intrusive volcanic basalts of various ages from isolated plateaux and dikes. It is on the ʿAjlun-Bal'qa limestone caps that one would expect to find the oak-pistachio forest association; juniper would tend to occur on the Kurnub sandstone.[80] Water from the winter rains is retained throughout the year in the limestones, and weathering has produced fertile *terra rossa* soils there in some localities.[81] Both the limestone and the sandstone are aquifers, and springs are sometimes associated with deep exposures (although one of the consequences of the lowering of the water table has been the disappearance of some of these).[82] These water sources create pockets of hydrophilic vegetation in an otherwise-arid landscape characterized by such secondary landforms as talus screes, colluvial fans, erosional features related to sheetwash, deflation pockets, desert pavements (esp. in the east) and ancient alluvial terrace fragments.[83]

The Wadi el ʻḤasa Survey produced more than 100,000 artefacts from early

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[76] A. Horowitz, Preliminary Palynological Indications as to the Climate of Israel During the last 6,000 years, *Paléorient,* 2:3 (1974) p. 407-414; A. Horowitz, Some Pollen Spectra from the Neogene of Israel, *Pollen et Spores,* 16:1 (1974) p. 59-65; H. Wright, The Environmental Setting for Plant Domestication in the Near East, *Science,* 194 (1976) p. 385-389.

[77] S. Willimott, *et. al., Conservation Survey of the Southern Highlands of Jordan,* Durham, 1964.

[78] H. Busk, On the Normal Faulting of Rift Valley Structures, *Geology Magazine,* 82:1 (1945) p. 37-44.

[79] F. Bender, *Geology of Jordan,* Berlin-Stuttgart, 1974; M. Evenari, *et. al., The Negev,* Cambridge, 1971; K. Sanford, Structure and Evolution of the Levant and North Africa, *Nature, 154 (1944) p. 569-571.*

[80] *A. Quennel, The Structural and Geomorphic Evolution of the Dead Sea Rift, Geological Society of London Quarterly,* 1958, p. 1-24.

[81] A. Riefenberg, *The Soils of Palestine,* London, 1947.

[82] D. Burdon, *Handbook of the Geology of Jordan,* Amman, 1959.

[83] *Ibid.;* and. E. Huntington, *Palestine and Its Transformations,* London, 1911; and, C. Vita-Finzi, Slope Downwearing by Continuous Sheetwash in Jordan, *Israel Journal of Earth Sciences,* 13 (1964) p. 88-91; and, C. Vita-Finzi, Observations of the late Quaternary of Jordan, *PEJ,* 96 (1964) p. 19-33; and, Vita-Finzi, The Hasa Formation..., *ibid.*

1,100 sites representing no less than fifty-one culture/stratigraphic and culture/historical units extending from the Acheulean up to the end of the Ottoman Empire (AD 1918)[84] Data relevant to the contemporary environmental setting, elevation, associated landforms, features, site size and artefact density were also collected from sites ranging in area from a few dozen square metres to abandoned cities covering many hundreds of hectares. Understandably, responsibility for the analysis of these data sets has been delegated to more than a dozen individuals, for the most part regional specialists in particular time ranges.

Although these survey data are less than ideal because in the sampling design and because of poor resolution due to the high incidence of multicomponent sites, I am trying to use them to determine if there are systematic regularities in site characteristics and placement for *all* of the "early" data *(i.e.,* for the Lower, Middle and Upper Paleolithic; Epipaleolithic, Natufian and Prepottery Neolithic). When completed, this research should allow an informal test of the Mortensen/Marks model, and the C Negev paleoclimatic sequence insofar as crude temporal control is possible (based on the characteristics of the lithic assemblages) and data relevant to environmental parametres have been recorded. This effort at studying the organizational characteristics of settlement-subsistence systems over time can only be regarded as a "first approximation", however, since we have no secure paleoenvironmental information from the region itself, nor adequate descriptions of *in situ* single-component lithic assemblages (cf. below).

With only a few exceptions, the "early" sites were identified as such on the basis of the stone artefacts. Most of the sites with substantial numbers of lithic remains lacked features and consisted of deflated surface scatters exposed on the flanks of the wadi and its tributaries. Altogether 1,074 sites were recorded and of this total 126 (12%) had at least some pieces which were regarded as Upper Paleolithic. Sites with Upper Paleolithic remains were initially identified as such by Rollefson using the widely-recognized criteria of large blades, flake and blade endscrapers and burins, in combination with assessments of the relative degree of patination *vis à vis* other artefacts on the site surface, and the overall condition (fresh, abraded to varying degrees, etc.) of the pieces. By a process involving the successive elimination of Lower and Middle Paleolithic components (which fortunately are both better studied and quite distinctive here), and the less-well-defined Epipaleolithic and Pre-pottery Neolithic, a subset of sites was identified which consisted in the main of Upper Paleolithic materials.

During May and June, 1983, I analyzed the lithics from the sites classified by Rollefson as Upper Paleolithic. The analysis consisted of a discrete and metrical study of the technology, morphology and surface condition of 920 artefacts from 66 sites. In addition, formal tools were classified according to two widely-used typologies for the Upper Paleolithic,[85] debitage was classified according to a morphological typology designed to isolate stages in the reduction process.[86] The objective of this exercise was (1) to allow me to become familiar with the Wadi el 'Ḥasa Upper Paleolithic collections (my previous work had been on terminal Pleis-

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[84] MacDonald, *et.al.,* The Wadi el-Hasa, 1981..., *Ibid.*

[85] D. de Sonneville-Bordes and J. Perrot, Essai d'adaptation de méthodes statistiques et paléolithiques, *Bulletin de la Société Préhistorique Française,* 50 (1953) p. 323-333; and, Lexique typologique du Paléolithique superieur, *Bulletin de la Société Préhistorique Française,* 51, 52, 53 (1954-1956); F. Hours, Remarques sur l'utilisation de listes-types pour l'étude du paléolithique superieur et de l'epipaléolithique du Levant, *Paléorient,* 2:1 (1974) p. 3-18.

[86] G. Clark, El Asturiense Cantabrico, Madrid, 1976; and, The Asturian of Cantabria: Early Holocene Hunter-gatherers in Northern Spain, Anthropological Research Papers of the University of Arizona, No. 41, Tucson, 1983; J. Tixier, et. al., *Préhistoire de la pierre Taillee, I: Terminologie et Technologie,* Paris, 1980.

tocene hunting and gathering adaptations in northern coastal Spain), and (2) to allow for the compilation of a numerical summary of major morphological types and a statistical profile of both the formal tool and debitage components. This in turn allowed me to identify with greater precision those sites which had *significant* Upper Paleolithic components, and to determine those which might have "transitional" Middle/Upper and Upper/ Epipaleolithic industries. These data, in combination with published and unpublished field observations by survey team members, permitted determination of those few sites which were both stratified and *in situ,* and which had a high probability of containing Upper Paleolithic industries and fauna. These are Sites 621, 623, 1065, and 1067. All four are located at the eastern end of the survey area, at the northwestern edge of Pleistocene Lake el 'Hasa, in association with lacustrine marls, alluvial terrace fragments and colluvial deposits related to the ancient shoreline.

Lake El 'Hasa

In June, 1983, I mapped the probable maximum extent of what I am calling Pleistocene Lake El 'Hasa (Figs. 2, 3). This was done by determining the maximum elevation of the accordant, flattened summits of the unconsolidated lacustrine marls which are so prominent a feature at the eastern end of the wadi, near the point where it debouches onto the Qa el 'Jinz. The tops of the marls, which lie at about +820.00 m, are remarkably uniform (Fig. 4). Although heavily eroded near the present-day wadi course and east of the village of el 'Hasa, they are extremely well preserved at what was probably the northwestern end of the former lake. The accordant, platform-like summits of these marls certainly identify what must have been the most recent maximum water level in the lake. The approximate maximum surface area of the lake was about 48 km^2., certainly very small in comparison with that of the Jafr (1000-1800 km^2.) and Azraq (700 $km.^2$) Pleistocene lakes.[87] However, at this very preliminary stage of investigation, the possibility (in fact, likelihood) or more extensive lacustrine deposits cannot be ruled out, nor can the possibility that the el 'Hasa 'lake' might simply have been part of a larger Pleistocene lake, the eastern margins of which have been obliterated by erosion.

If the mapped boundaries are approximately accurate, it seems likely that the lake was breached and drained by continuing headward (eastward) erosion of the wadi, perhaps facilitated by the fault at its northwestern end indicated on Figures 2 and 3. When this event occurred is not known, but a date earlier than the early Holocene seems unlikely since there are no indications of paleolithic or epipaleolithic occupation or use of the lake floor. All paleolithic and epipaleolithic sites in the area are found above 815.00 m.

A Research Design for the Paleolithic Sites of the Wadi El 'Hasa

It should be clear from the beginning of this essay that the paleolithic in Jordan does not suffer from a lack of relevant comparative models which can be used to structure research designs, but, by the same token, any serious attempt at interdisciplinary research must start from scratch with the collection of the kinds of information which will inform us about Pleistocene flora, fauna and climatic regimen in the area of interest. None of this "background" research has been accomplished for west-central Jordan in general, non for the Wadi el 'Hasa in particular. It will require years of effort and many projects before the picture reaches a level of adequacy equivalent to that of Palestine, and probably another half-century or more (assuming that the tempo of research on the early time ranges is sustained here)

[87] R. Huckriede and G. Wiesemann, Der jungpleistozaene Pluvial-See von el Jafr under weitere Daten zum Quartaer Jordaniens, *Geologica et Paleontologica,* 2:1 (1969) p. 73-95; A. Garrard, The Environmental History of the Azraq Basin, Paper presented at the Second International Congress on the History and Archaeology of Jordan, April, 1983.

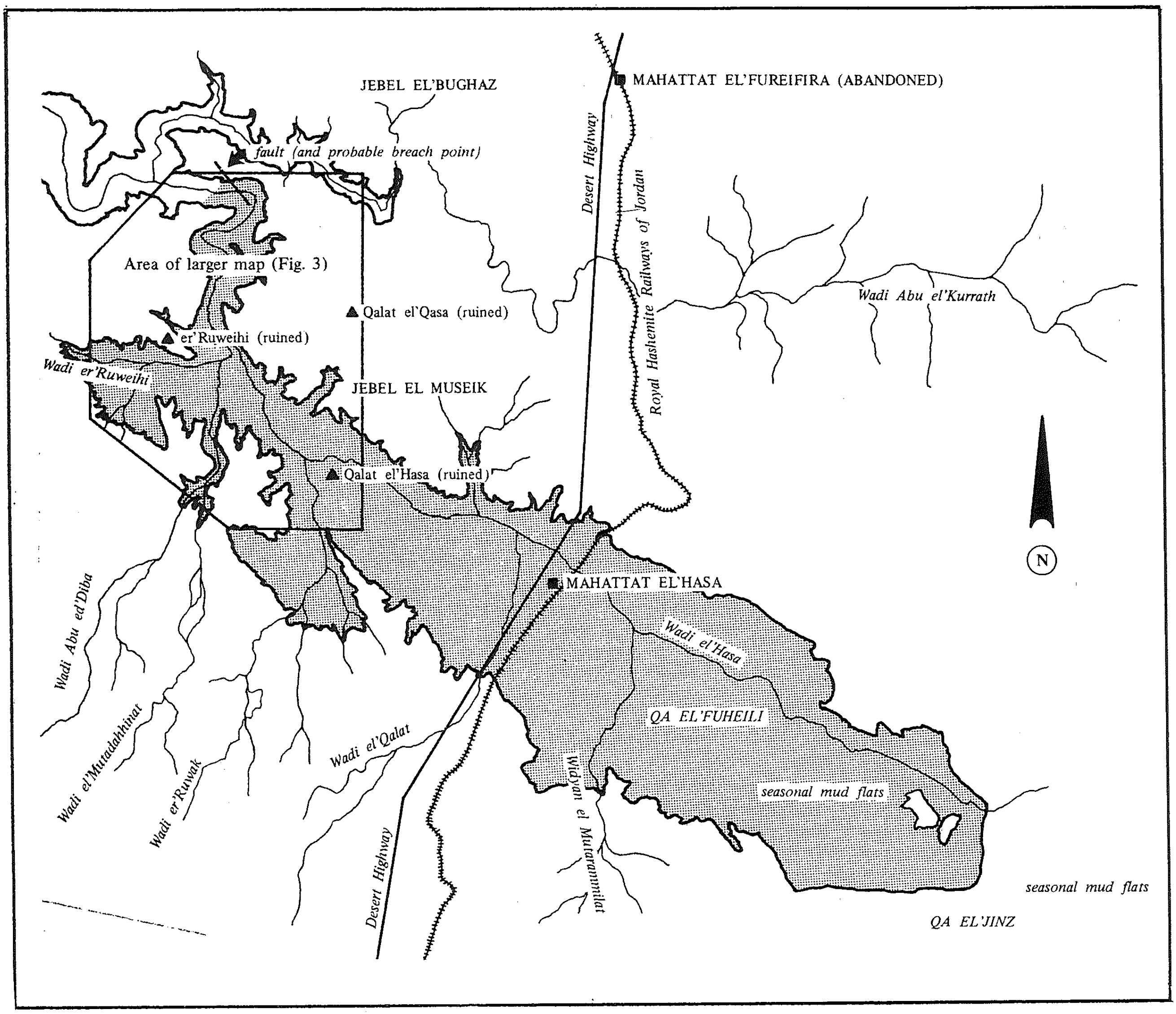

Fig. 2: Pleistocene Lake el Hasa. The maximum extent of the former lake was determined by plotting the elevation of unconsolidated marls located in the northwest end of the lake bed where they are well preserved at a height of +820 metres above sea level (vertical datum: mean sea level of the Mediterranean at Gaza, 1959). The approximate area of the lake was about 48km². The paleolithic sites are concentrated along former lakeshores and present-day wadi banks in the northwest corner of the lake bed, but are scarce elsewhere due to erosion. Source: Sheet 31511, Series K737 (the 'Aina sheet); 1:50,000, contour interval 20/10 metres. U.S. Army Map Service, Corps of Engineers (1959, revised 1967).

before we begin to approach the state of knowledge presently available in western Europe. In light of these considerations, and with obvious funding constraints in mind, it seems most realistic to suggest that a research program for the paleolithic of west-central Jordan be structured initially around rather general objectives or goals, and that it proceed by a series of stages which are more or less "self-contained" (*i.e.*, which are not dependent upon a continuing source of funds) and which make maximum use of the Wadi el 'Hasa survey data already collected by MacDonald and his colleagues in 1979, 1981 and 1982.

The MacDonald survey identified four open-air sites with rare, stratified *in situ* Middle, Upper and Epipaleolithic deposits.[88] These are sites 621, 623, 1065 and 1067, all located near the eastern end of the Wadi. Reasonable first steps would be to make controlled surface collections and stratigraphic tests at each site, since the nature and extent of surface disturbance is not known. Multidisciplinary studies of lacustrine geomorphology, pollen, macrofloral, faunal and sediment data should also

[88] MacDonald and Rollefson, The Wadi el-Hasa..., *Ibid.*

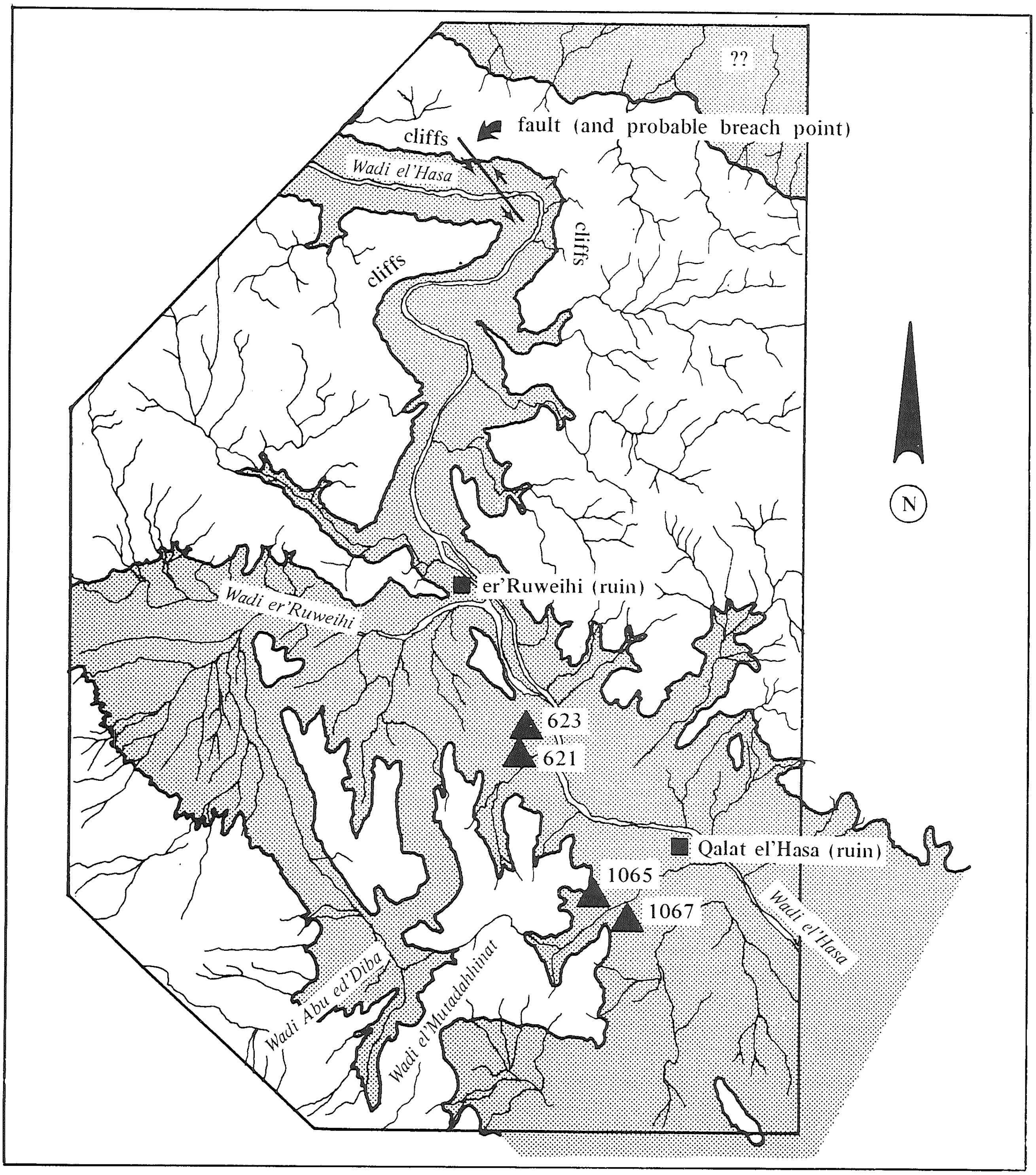

Fig. 3: Detail of the northwest end of the lake, showing locations of Sites 621, 623, 1065 and 1067. Lake margin plotted at +825 metres above sea level. Source: Sheets 225-025, 225-015, Palestine Grid (the Qalat el 'Hasa sheet); 1:25,000, contour interval 5 metres. Huntington Aerosurveys, Ltd., Department of Lands and Surveys, H.K. of Jordan (1953).

be undertaken in order to reconstruct as much as possible of the succession of late Pleistocene paleoenvironments in the region given what will initially be rather limited exposures. The el 'Hasa data should then be compared with the sequence of paleoenvironmental change reconstructed for the central Negev highlands by Goldberg and Horowitz (Table 1). Tests in non-cultural deposits should be undertaken at the same time to secure pollen and sediment samples free of the likelihood of contamination due to human disturbance. Shell from the marls might be suitable for U/Th dating.[89] It is hoped that these initial efforts will provide a strong basis for

[89] Garrard, *Ibid.*

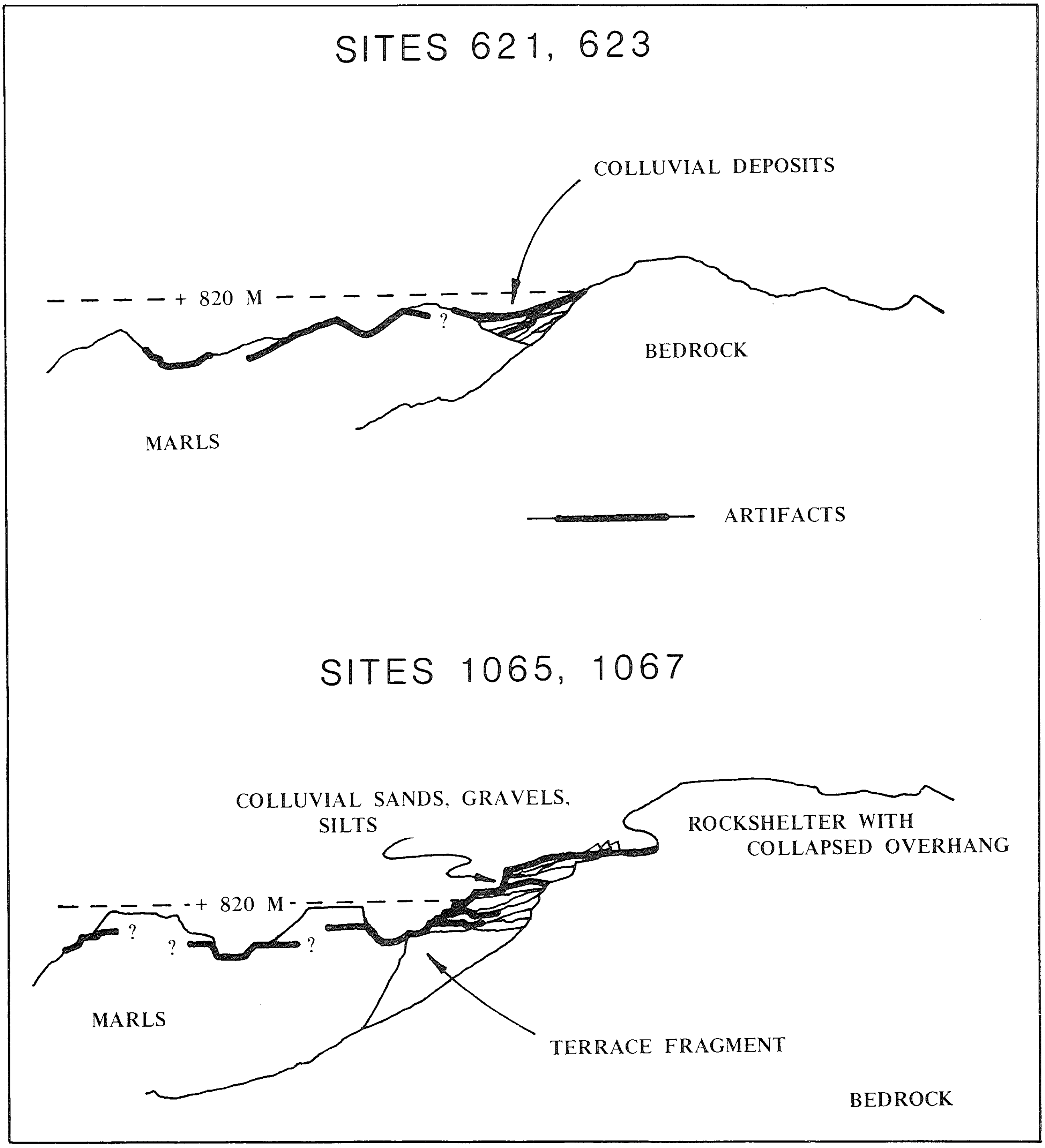

Fig. 4: Hypothetical geological sections through Sites 621, 623, 1065 and 1067. Artefact scatters are indicated by thickened, dark lines. No scale.

continued research on the earlier phases of human use and occupation of west-central Jordan.

Sites 621 and 623 (Middle-Upper Paleolithic Transition)

Sites 621 and 623 are believed to document the transition from the Middle to the Upper Paleolithic, since they contain "classic" Mousterian pieces (levallois flakes, blades, points, cores) in association with typical Levantine Aurignacian artefacts (blades, blade endscrapers, blade cores, "Emireh points" [points and blades with thinning retouch on the ventral surface of the proximal end]). Termed "base camps" by Rollefson,[90] they are part of a group of three penecontemporaneous sites (the third is 622) located along the shore of the el 'Hasa lake near the eastern terminus of the survey area (Fig. 3). Another similar site, 634, is located nearby in a small

[90] MacDonald and Rollefson, *Ibid.*

rockshelter in the Wadi el 'Ali. Unlike most of the numerous Middle and Upper Paleolithic scatters discovered by the survey, these sites are characterized by stratified, *in situ* deposits which can probably be related to fluctuations in the level of the lake. At 621 and 623, there are stratified Middle Paleolithic levels overlain by undisturbed Upper Paleolithic deposits. Charcoal and bone were observed at 621, suggesting that if disturbance had occurred subsequent to deposition, it was probably minimal and also fairly recent. These sites appear to be eroding out of the contact between the lacustrine marls, preserved at various places in the wadi debouchement, and the limestone substrate. A hypothetical geological section through 621 and 623 is presented in Fig. 4. Site 621 covers an area of approximately 800.00 $m.^2$, Site 623 about 2400.00 m^2.

Sites 1065 and 1067 (Upper-Epipaleolithic Transition)

Upper Paleolithic habitation is well documented in the eastern portion of the Wadi el 'Hasa, comprising about 20% of the 298 sites discovered in the 1982 season (when this part of the wadi was surveyed). Two other apparent "lakeshore encampments" contain enormous quantities of Aurignacian and Aurignacian/Epipaleolithic tools, cores and debitage. These are Sites 1065 and 1067. Site 1065 is large (*ca.* 2800.00 m^2), and is situated at the mouth of a small *wadi* at its confluence with the former Pleistocene lake. In addition to the extraordinary density of artefacts on the sloping *wadi* bank and along a long but shallow rockshelter (in some places >200/m^2!), layered deposits of charcoal, ash and bone are visible to a depth of at least a metre in a cut made in the *wadi* bank by persons unknown. There is therefore the certainty of stratified deposits at 1065, and the exciting possibility of living floors and associated features. Site 1067 may be associated with 1065. An enormous surface scatter covering ca. 15000.00 m^2, it consists of artefacts concentrated through erosion in gullies and other small depressions on top of the marls some 500.00 m. SE of 1065. Inspection of the site in June, 1983, failed to identify the source of the artefacts, although they were pretty clearly associated with the marls rather than being derived from the adjacent *wadi* slopes. The amount of disturbance suffered by Site 1067 cannot be ascertained without excavation but its location within the lake marls indicates a shrinking or oscillating lake level. A hypothetical geological section through Sites 1065 and 1067 is shown in Figure 4.

Some Observations On Methodology

Sampling Questions

As is often the case with sites only cursorily inspected and not previously investigated, the precise nature of the context of the archaeological remains is not apparent. While the situation seems to call for a combined surface collection and testing strategy of some kind, it should be one which can reasonably and efficiently be accomplished by a small number of people and which takes the likelihood of surface disturbance into account. A "coarse-grained" block-provenience collection strategy should provide a satisfactory compromise between efficiency, sample representativeness and adequate control over the horizontal distributions of artefacts.[91] Moreover, such a design should be flexible enough to accommodate the differences in site context noted above.

Since Sites 621, 623 and 1065 appear to be more similar to each other than to Site 1067, a systematic surface collection aimed at providing a representative sample of surface lithic debris while simultaneously controlling for horizontal distribution could be based on a grid of 1.00 x 1.00 m. squares. More detailed provenience data are probably not warranted since surface materials are almost certainly deflated. However, some patterning may

[91] C. Redman, Productive Sampling Strategies for Archaeological Sites, in *Sampling in Archaeology*, Tucson, 1965, p. 147-154; R. Whallon, Spatial Analysis of Occupation Floors I: Application of Dimensional Analysis of Variance, *American Antiquity*, 38:3 (1973) p. 266-278.

emerge (it would be a shame to miss it if it did), and it may be possible to locate precisely the point(s) of origin for the lithic scatters. Site sizes vary from *ca.* 800.00 m^2 (621) to *ca.* 2800.00 m^2 (1065), so that a complete collection strategy would obviously be impractical (there are an estimated 500,000+ artefacts on the surface of medium-sized Site 1065 alone). In order to achieve a balance between uniform coverage and sample representativeness, a stratified unaligned sampling design could be employed in which each site would be divided into units comprising a number of quadrats or blocks adjusted for site size, and a random sample of grid squares could be selected within each of these.[92] Sample fractions would vary from a minimum of about 15% to a maximum of 50%. Insofar as Sites 621, 623 and 1065 are more or less continuous scatters of debris, this design should work reasonably well, taking site size, artefact density and available manpower requirements into account.

Site 1067 poses something of a problem since the artefacts have accumulated in erosional features in the marls, and do not form a continuous distribution. A "dendritic transect" design could be operationalized here, wherein transects divided into 1.00 m. units and corresponding to gully lengths and axes will be sampled until a 20% sample of the population of 1.00 m. transect units is obtained for each gully. While the arteficial character of this expedient is recognized,[93] the objective is to obtain a more or less representative sample of the surface debris (since impressionistically 1067 closely resembles 1065 in composition) and, perhaps more important, to pinpoint where the artefacts are coming from (which will be done simply by inspecting the gully banks). Since 1067 surface material is clearly disturbed, a more rigorous sampling design does not seem to be worth the extra effort required to implement it.

Standardized Description

Ideally, the surface collections should be described by widely-accepted, standardized typologies in order to allow for comparison with collections from other Levantine paleolithic sites. This is not so easy as it sounds, however, since there is an apparent absence of generally-agreed-upon typologies in the region and a tendency to ignore the fact that different kinds of typologies have been devised with different objectives in mind. Most paleolithic research in the Near East has emphasized morphological typologies and has sought to describe variability in lithic assemblages in time and space, and to order assemblages (based on similarities and differences in standardized morphological type frequencies) into larger industries.[94] While such descriptive work is essential for delimiting the range of variability found in paleolithic assemblages for revealing recurrent patterns in this variability, and for allowing assemblages to be arranged and compared in a spatial and temporal context, it has led to an unfortunate emphasis on explaining lithic variability as primarily due to the operation of cultural traditions, a problem by no means confined to the paleolithic archaeology of the Near East.[95] As a consequence, however, similarities between lithic assemblages tend to be interpreted as indicating "cultural" relationships between the makers of the assemblages, either through social contacts across space or "genetically" (via gener-

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[92] C. Redman and P. Watson, Systematic, Intensive Surface Collection, *American Antiquity,* 35:3 (1970) p. 279-291.

[93] G. Clark, Sites 37 (Atapuerca Open Site), Anthrological Research Papers, No. 19, Tempe Arizona, 1979, p. 118-133.

[94] A. Jelinek, The Middle Paleolithic of the Levant: Synthesis, *Colloques Internationaux du C.N.R.S.,* No. 598, Paris, 1981, p. 299-302; and, The Middle Paleolithic in the Southern Levant from the Perspective of Tabun Cave, *Colloques Internationaux du C.N.R.S.,* No. 598, Paris, 1981, p. 265-285.

[95] H. de Lumley, Le paléolithique inferieur et moyen du Midi Mediterranéen dans son cadre geologique, *Supplement a Gallia Préhistoire,* Paris, 1971; and, Les civilisations du Paléolithique moyen en Laguedoc Mediterraneen et en Roussillon, in *La Préhistoire Française,* Paris, 1976, p. 1005-1026; and, Les civilisations du paleolithique moyen en Provençe, *La Préhistoire Française,* Paris, 1976, p. 989-1004; and, H. Laville, J-P. Riguad, and J. Sackett, *Rock Shelters of the Perigord,* New York, 1980.

ationally transmitted behaviour) through time. While some aspects of variability among lithic assemblages can indeed probably be ascribed to cultural tradition,[96] it is also very likely that an important part of this variability is due to several other factors *(e.g.,* human adaptation to changing environmental conditions, changes in the technology used to make stone tools, even changes in the raw materials available for knapping). At a minimum, the distinction should be made between *morphological* typologies (based exclusively on shape or form) and *technological* typologies (based on the manner in which reduction take place).[97]

The four collections obtained from the surface sampling phase will be described according to the fifteen technological and morphological variables used in 1983, by the modified Hours[98] typology for retouched tool groups advocated by Gilead (1981) and by the fifteen-part debitage typology developed by Clark.[99] Since for the Middle/Upper Paleolithic transition at Boker Tachtit, it has been shown that technology and morphological typology vary independently of one another,[100] and since it is at least a strong possibility that a similar transition characterizes the el 'Hasa material from Sites 621 and 623, a concerted effort will be made to keep separate morphological and technological classifications, and to make use of the technological variables employed by Marks & Kaufman, in the description of the Boker Tachtit lithic assemblages and core reduction sequences. Since no complete description of a representative sample of *any* of the Wadi el 'Hasa lithic sites has been attempted so far, these data will supplement the evaluation of the purposive samples which I am presently undertaking.

Test Excavations

Stratigraphic trenches at 1065 and 621, with more limited soundings at 1067, 623, and possibly 634, should be undertaken to control for the relationship of the sites to the fluctuating lakeshore and to obtain paleoenvironmental samples. Sites 1065 and 621 have stratified, *in situ* deposits which contain charcoal and faunal material. They are located a few metres above what appears to be the highest stillstand of Pleistocene Lake el 'Hasa (at *ca.* +820.00 m.), marked by the accordant flattened summits of the unconsolidated marls which are so prominent a feature of the wadi in this part of its course. In each case the trenches should extend from exposed bedrock through the cultural deposits and into the marls, such that it should be possible to pick up the contact between sediments which are essentially poorly-sorted colluvia resultant from slope wash (these contain the cultural deposits at 1065 and 621) and the fine, homogeneous, water-laid, lacustrine marls (which appear to have stratified industries in them at 623 and 1067). In addition to these stratigraphic tests, every effort should be made to open broad horizontal exposures if it is determined that in fact occupation surfaces are present. These limited excavations will almost certainly yield materials suitable for radiocarbon dating (and thus provide what will probably become the first Upper Paleolithic C-14 dates for Jordan), as well as equally unique faunal, macrofloral, pollen and sediment samples.

Summary and Conclusions

Studies of the ways in which humans adapt to their environments, and the effects of environmental change on society are essential to an understanding of human culture, both past and present. Because of its great time depth, archaeological research is perhaps uniquely able to focus on environmental conditions and modes of adaptation not observable today. This is especially true of the later part of the Upper Pleistocene, a period which saw the emergence of morphologically modern hu-

[96] S. Yi and G. Clark, The Upper Paleolithic of Northeast Asia and New World Origins, *Current Anthropology,* 26:1, forthcoming.

[97] Marks, The Middle..., *ibid.*

[98] Hours, *ibid.*

[99] Clark, *El Austuriense..., ibid.;* Clark, The Asturian..., *ibid.,* Tixier, et. al., *ibid.*

[100] Marks, *ibid.*

mans around 40,000 years ago, and which witnessed the transition from foraging to domestication economies some 25-30,000 years later.

The Upper Pleistocene comprises the last interglacial and the last series of glacial episodes.[101] It was characterized by changes from environmental conditions very similar to those of the present to conditions quite different from any found in the world today. The environmental changes of the last glacial involved much more than a simple drop in mean annual temperatures accompanied by expansion of the continental ice sheets. They consisted of a complex series of worldwide changes that are still not fully comprehended, including shifts in a number of climatic parameters such as cyclonic patterns and annual distributions of temperature and precipitation, changes in ocean currents, alterations of coastal geomorphology due to sea level regression; changes in the nature, periodicity and intensity of geomorphic processes and the hydrology of steams and lakes, and changes in the distribution of plant associations and animal communities. Human societies of the Middle, Upper and Epipaleolithic were forced to adapt to this incredible variety of interrelated environmental factors. Although the magnitude of change was dampened to some degree in the Levant by virtue of its southerly location, at least when compared with Europe, the impact of paleoclimatic perturbations must nevertheless have been profound in a region considered 'marginal' by many because of its relative aridity.

The programme of surface collection and testing of four stratified *in situ* Middle-Upper Paleolithic and Upper-Epipaleolithic sites in the Wadi el 'Hasa should provide quantities of modern-quality data on Late Pleistocene environments and on human adaptation in the Levant over a period of some 30,000 years. By controlling for chronology and macrotopographical setting through time, we should be in a position to begin to characterize inter- and intrassemblage variability in Upper Paleolithic industries and fauna, and to compare those characterizations with patterns known from better-studied areas of the Levant. Multidisciplinary analysis of artefacts, sediments, geomorphology, pollen and faunal remains from the excavations can be combined with regional survey data and directed toward the reconstruction of a series of Late Pleistocene hunter-gatherer adaptations between 47,000 and 17,000 BP, the approximate span of the Levantine Upper Paleolithic.

More specifically, the el 'Hasa research can be used to test models for changes in paleoclimates and linked changes in technology, settlement patterns and human adaptation developed by Anthony Marks and his colleagues for penecontemporaneous sites in the Avdat-Aqev area, central Negev highlands. Separated from the study area by about 100 kms., the central Negev highlands is the region closest to the Wadi el 'Hasa for which reasonably complete paleoclimatic and archaeological sequences are available. Since both areas are on almost the same latitude, there are broad similarities in precipitation regimes, in the kinds of sediments and landforms present and in the elevational distribution of sites. Both are characterized by similar phytogeographic mosaics and, so far as is known, both share similar kinds and frequencies of archaeological sites and site-depositional contexts. Meaningful comparisons between the two areas are dependent upon establishing better temporal, functional, seasonal and structural controls for the el 'Hasa sites than are presently available. Only when data are generated which are comparable to those from the central Negev highlands can we begin to reconstruct regional settlement/subsistence systems at various points in time and, ultimately, begin to explain long-term changes in human adpatation to a succession of regional Levantine environments.

While it is possible to attempt to make some of these same comparisons using the surface-collected survey data on hand, the survey collections are from deflated, multi-

[101] Butzer, *ibid.*

component sites where the characteristics of the archaeological assemblages and their temporal placement can only be very roughly determined on the basis of prior knowledge of excavated assemblage composition from sites *outside* of Jordan. I have suggested that work done in Syria, Lebanon, Palestine and the Negev is likely to have major implications for the description and explanation of variability in Jordanian Upper Paleolithic assemblages, and that models developed elsewhere in the Levant can be cosidered hypotheses against which to evaluate Jordanian data. However, to be credible, such evaluations must be firmly based upon excavated samples from known and dated paleoenvironmental contexts. Without such data, any conclusions about the nature of Jordanian Upper Paleolithic assemblages, subsistence and settlement patterns, inter- and intrasite variation could be dismissed simply by asserting that our samples are archaeological composites and our temporal controls so bad as to preclude meaningful comparison.

Acknowledgements

This contribution is based on a proposal to the National Science Foundation submitted in 1983 and funded in 1984. I want to thank Drs. Gary Rollefson (Yarmouk University) and Burton MacDonald (St. Francis Xavier University) for gettig me interested in the Paleolithic of Jordan, and David and Linda McCreery (American Centre for Oriental Research) for their hospitality in Amman. Dr. Adnan Hadidi, Director, Department of Antiquities of the Hashemite Kingdom of Jordan, was most encouraging and supportive of my proposed research projects, hopefully the beginning of a long-term commitment to work in that country. Drs. Andrew Garrard (British Institute for Archaeology and History), Anthony Marks (Southern Methodist University), Arthur Jelinek (University of Arizona), Donald McHenry (University of Tulsa) and Charles Redman (Arizona State University) took time to read proposal drafts and provide constructive criticism. Where possible, I have tried to include their observations in this manuscript which, no doubt, greatly improved it.

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