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Past and Present Environments of the Jordan Valley

Introduction

Information on past environments of the Jordan Valley, and in fact of any region, should primarily be provided by geological, palaeontological and palaeobotanical data. However, for a proper understanding of the situation of the past, in particular as a starting point for reconstructing prehistoric environments on the basis of usually deficient data, the present-day environment is of paramount importance. It is for this reason that the first part of this paper will be devoted to the present natural environment of the Jordan Valley, although archaeologists will be more interested in the situation of ancient times. For we hope that knowledge of the environment of the past will contribute to our understanding of the economy of prehistoric and early historical man. In this paper particular attention will be paid to the vegetational aspects of present and past environments.

We will look at the environment in view of its potential for ancient man. Was the area suitable for plant cultivation or only for animal husbandry? Was dry-farming possible or did irrigation have to be practised to ensure satisfactory yields? Could the natural vegetation in the vicinity of a particular site meet the demand of timber for construction purposes and heating? Which edible wild seeds and fruits could be collected; which animals could be hunted? It was the environment which to a large extent determined the activities of early man.

One may safely assume that for the inhabitants of the Jordan Valley and its side valleys the adjoining uplands were also of economic importance, whereas the population of the uplands in turn may have exploited parts of the valley, for instance, as winter pastures. For that reason, the uplands bordering the Jordan Valley will be included in the discussion.

Geographic setting

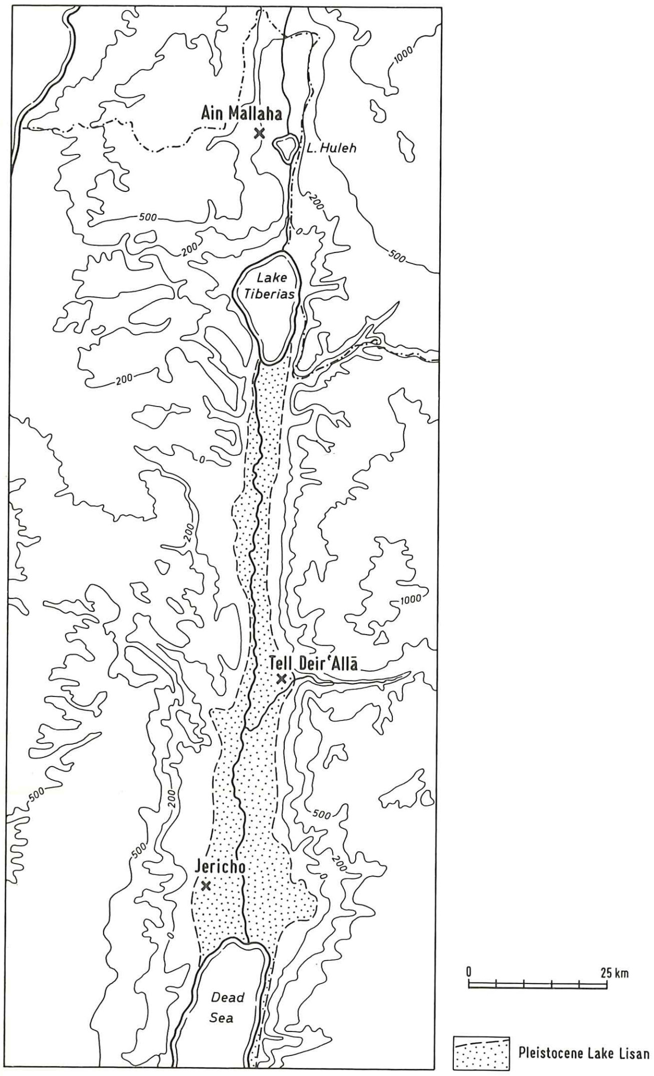
The Jordan Valley forms part of the Jordan–Arava Rift Valley which runs in a south–north direction from the Gulf of Aqaba up to the foothills of the Hermon Range. The Jordan Valley, to the North of the Dead Sea, is divided into three parts (cf. Horowitz, 1979, pp. 18–19, from which the following is derived). The Southern Jordan Valley extends to about 50 km. north of the Dead Sea. The valley floor consists of sediments of the Lisan Formation and descends from c. 200 m. below sea level in the north to about 400 m. below sea level at the Dead Sea. The Central Jordan Valley, which extends to the northern shore of Lake Tiberias, has a flat bottom at an elevation of approximately 200 m. below sea level. The mountains on both sides of the Southern and Central Jordan Valley rise to altitudes of 800–1000 m. above sea level (FIG. 1). The relatively small Northern Jordan Valley consists largely of the Huleh Basin, about 70 m. above sea level. A basaltic barrier, through which the Jordan River cuts its way, separates the Huleh Basin from Lake Tiberias. The Huleh Basin, which prior to drainage contained a lake and marshes, is flanked by rather steep mountain slopes.

The natural vegetation

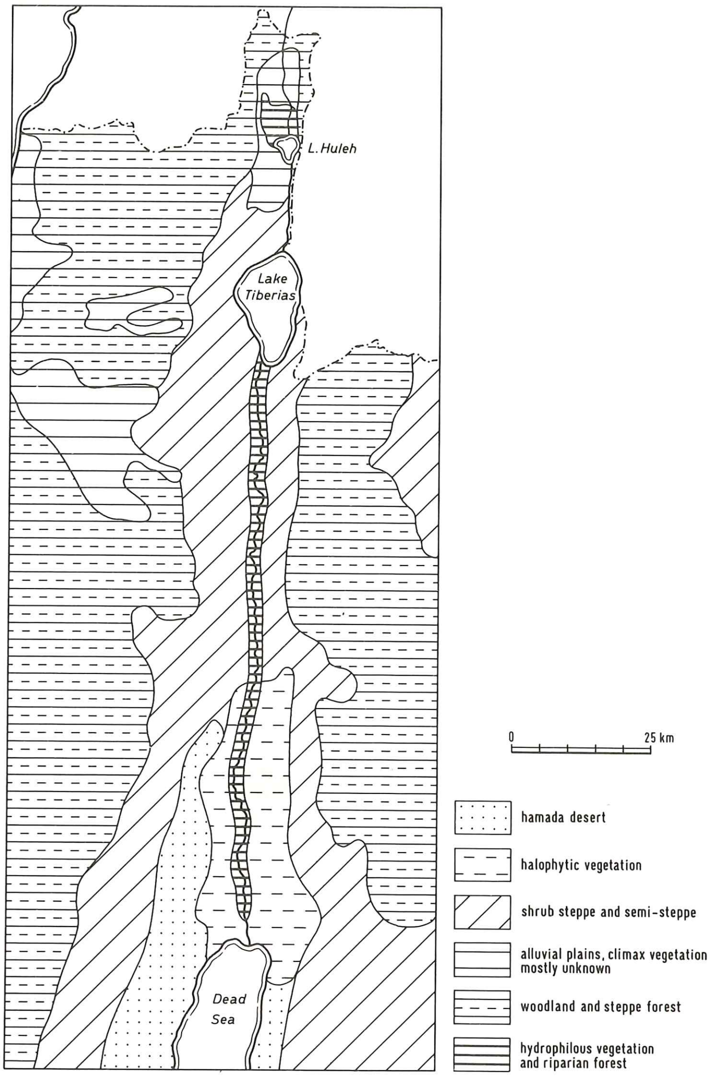
As a result of the interference of man with the vegetation over thousands of years only very little is left of the natural plant cover of the Jordan Valley and adjacent areas, and the same is true for the whole of the Levant. Consequently, a reconstruction of the natural vegetation, that is the plant cover which would be found in the area without the influence of man, is often rather speculative and sometimes even impossible.

The natural vegetation cover is determined by climatic and edaphic factors. In the Southern Levant, up to altitudes of 1000 m., precipitation is the predominant climatic factor. On the uplands the distribution of forest and steppe and the composition of these vegetation types depend primarily on the rainfall. The Jordan Valley receives considerably less precipitation than the adjoining uplands. This is due to the fact that the valley lies in the rain shadow; precipitation is carried in from the Mediterranean by westerly winds. Low rainfall in the Jordan Valley is locally compensated for by favourable edaphic conditions. Thus, the high water table in the Jordan floodplain, the Zōr, provides suitable conditions for riverine forest vegetation. On the other hand, the vegetation of the greater part of the Southern Jordan Valley is determined by the high salinity of the soil. The following discussion of the vegetation is derived from Zohary's (1962, 1982) publications on the plant life of Palestine. See also FIG. 2.

1. Map of the Jordan Valley and adjacent areas, showing the maximum extent of Pleistocene Lake Lisan (stippled area) and the location of archaeological sites discussed in this paper. Contour lines are in metres above sea level.



2. Vegetation map of the Jordan Valley and the adjoining uplands (after Zohary, 1962, 1982).



In the Lower and Central Jordan Valley, on the banks of the Jordan River, poplar (*Populus euphratica*) and tamarisk (*Tamarix jordanensis*) form dense stands under natural conditions. Poplar occupies the belt closest to the river, while behind this belt tamarisk occurs in almost pure stands. This strip of riparian wood and shrub vegetation is quite narrow; it is confined to the flood zone of the Jordan River.

Outside the strip of riparian forest and shrub vegetation the Southern Jordan Valley is occupied by various halophytic plant communities. The high salinity of the soil is due to two factors. The Lisan Formation sediments which form the valley bottom were deposited in a saline lake. After the sediments became exposed in late Pleistocene times (see below), the salt was not washed out from the upper layers because of the low precipitation (100–150 mm.) and high temperatures.

The Lisan clays and marls of the Central Jordan Valley are overlain by conglomerates and loams of fluviatile origin. The natural vegetation of the valley bottom and of the hillsides facing the Jordan Valley is brushwood steppe. Two species characteristic of this vegetation type are *Ziziphus lotus*, a densely branched shrub, 1–2 m. high, with small spines and edible fruits, and *Retama raetam*, a broom-like shrub. Intermittent wadis and perennial streams coming from the uplands and debouching into the Jordan River were bordered by tamarisk stands. Near springs, marsh vegetations had developed. Precipitation ranges from 200 mm. in the southern part of the Central Jordan Valley to 400 mm. at Lake Tiberias. Because of intensive cultivation of the valley, only remnants of the original vegetation are left.

The mountains to the east and west of the Jordan Valley, with average precipitations of 400–600 mm., are naturally covered by Mediterranean wood and shrub vegetation. A great number of arboreal species form part of these usually rather open forest vegetations, such as *Quercus calliprinos* (evergreen oak), *Quercus ithaburensis* (tabor oak), *Pinus halepensis* (Aleppo pine), *Pistacia palaestina* (turpentine tree), *Styrax officinalis* (storax), *Amygdalus communis* (almond), *Crataegus azarolus* (hawthorn) and *Ceratonia siliqua* (carob tree). The open tree canopy permits a rich ground cover of low shrubs and herbaceous species.

The southern part of the Huleh Valley was occupied by a shallow lake, while marshes covered the central part of the basin. Vegetations dominated by *Cyperus papyrus* (papyrus) occupied large stretches of the Huleh swamps. *Quercus ithaburensis* steppe-forest constitutes the natural vegetation of the mountains above the Huleh Basin.

Speculations on past environments

The vegetation pattern described above is that which presumably would be found here under the present-day climatic conditions. However, climatic fluctuations have taken place in the course of time, and as a consequence the vegetation cover of the past must have differed from that of to-day. Information on the vegetation of the past can be obtained from pollen grains and spores preserved in lake sediments, peat layers and other deposits. Particularly long sediment sections, covering several thousands of years, are informative because the pollen content of these sections may reflect changes in vegetation due to changes in climate or, for the younger periods, due to the activity of man. For the area under consideration a few long pollen sequences are available. Pollen diagrams have been prepared for sediment cores from the Huleh Basin, the longest core of which covers approximately 80,000 years. A pollen diagram prepared for a core from Lake Tiberias would reflect the vegetational history of the area during the Holocene, that is to say, during the last 10,000 years. It has to be admitted that many uncertainties still attach to the dating of the pollen sequences and that, moreover, opinions on the interpretation of the pollen assemblages in terms of vegetations of the past may differ quite considerably.

A lower time limit for a discussion on past environments of the Jordan Valley and the adjoining uplands is determined by geological events. During the greater part of the last glacial period, the Southern and Central Jordan Valley were uninhabitable because the valley was occupied by Lake Lisan, which extended from the present Dead Sea to midway Lake Tiberias. The maximum elevation attained by Lake Lisan is 180 m. below present-day sea level, that is 20 m. above the floor of the Central Jordan Valley (Begin *et al.*, 1974). During its existence the lake level must have shown fluctuations, but after 18,000 B.P. the final recession of Lake Lisan started. This recession of the lake would have been due to down faulting that resulted in the formation of the deep basins of the northern Dead Sea and Lake Tiberias (Neev and Emery, 1967). A *terminus ante quem* for the recession of Lake Lisan from the Lower Jordan Valley constitutes the Natufian habitation at Jericho, dated to about 12,000 B.P. From the above it will be clear that it was not until the terminal phase of the Pleistocene that the Southern and Central Jordan Valley became inhabitable for man and that the section of the Jordan River between Lake Tiberias and the Dead Sea came into existence.

Information on the vegetational history of the Northern Jordan Valley and the surrounding uplands is provided by the pollen evidence from deposits in the Huleh Basin (Horowitz, 1968, 1971, 1979; cf. Van Zeist and Bottema, 1982). The Lake Tiberias pollen diagram (Horowitz, 1971, 1979) covers at most the northern section of the Central Jordan Valley, but for the greater part of the Central and Southern Jordan Valley and the adjacent uplands no direct palynological information is available. The vegetational and climatic history of this region has to be inferred, at least in part, from the Huleh and Tiberias pollen diagrams. Moreover, geomorphological evidence in the area itself can be indicative of past climatic conditions (cf. Schuldenrein and Goldberg, 1981). It is tempting to draw inferences on past climates from distribution patterns of prehistoric habitation, but this can easily lead to circular arguments. Unfortunately, opinions on the late-Pleistocene and Holocene climate and vegetation of Israel and Jordan differ widely, and the scheme presented in TABLE 1 should be considered with the utmost reserve.

Table 1 Vegetation and climate of Palestine during the last 14,000 years

years B.P.	climate	upland vegetation
5,000–present	warm, humidity same as to-day	reduction of forest due to man (and climate?)
10,000–5,000	warm, somewhat moister than to-day	compared to previous period retreat of forest
14,000–10,000	cooler and moister than to-day	maximum expansion of forest

During the period of c. 14,000–10,000 B.P., when the Jordan Valley fell dry, forest vegetations had a greater extension than they would have at present under natural conditions. A (slight) retreat and perhaps thinning of the forest took place at the Pleistocene–Holocene transition, approximately 10,000 years ago. During the first half of the Holocene, between c. 10,000 and 5,000 years ago, temperatures must approximately have been the same as the present-day ones, but it would have been moister, particularly during the first few millennia of the Holocene. After 5,000 B.P. it would have become drier. Admittedly, the hypothesis of drier climatic conditions during the second half of the Holocene is primarily based upon geomorphological evidence.

What effects could the changes in climate have had on the environments in the Jordan Valley itself? The poplar forest and tamarisk shrub vegetation along the Jordan River is conditioned by the presence of the river and would not have been affected by climatic changes. Similarly a moister climate, that is to say, higher precipition, would not or hardly have affected the halophytic vegetations of the Southern Jordan Valley because here the high salinity of the soil is the determining factor. In the Central Jordan Valley higher precipitation would have resulted in a somewhat denser shrub vegetation. One could even speculate whether south of Lake Tiberias open oak forest was present in the valley. The inferred higher precipitations during the lower half of the Holocene must have had at least one important palaeo-economical implication. Dry-farming agriculture could have been practised in a considerably larger part of the Central Jordan Valley than would be possible at present.

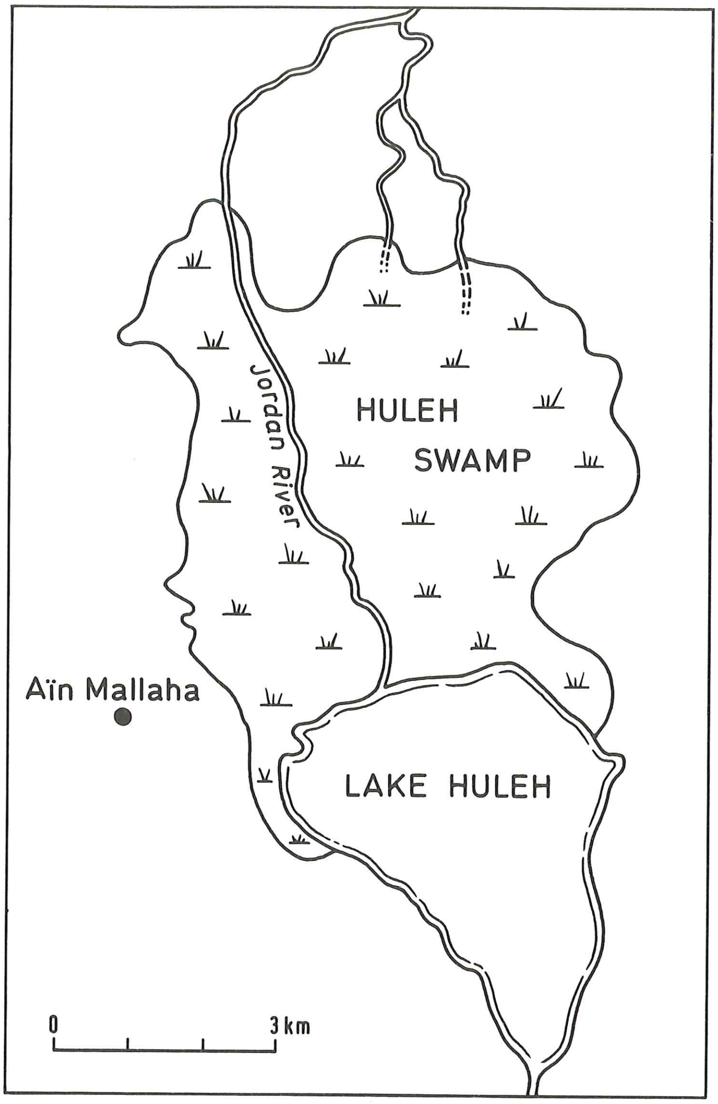
It should, once again, be stressed that the evidence of Holocene climatic changes in the Southern Levant is still far from satisfactory. Moreover, various disciplines, and within one and the same discipline, various investigators may arrive at (seemingly) contradictory conclusions.

Case studies

In this section palaeo-environmental aspects of three archaeological sites in the Jordan River Valley will briefly be reviewed. The early-Natufian site of Ain Mallaha (Eynan) is situated at the western edge of the Huleh Valley, at the foot of the Galilean Heights (FIG. 1). Excavations carried out by Perrot (1966) revealed the remains of round houses and a great number of burials, inside as well as outside the dwellings. Bell-shaped pits, with a diameter of 1 m. and up to 0.80 m. deep, some of them lined with plaster, are interpreted as grain storage pits. The finds include mortars, pestles and quernstones made of local basalt and artifacts of flint, chert and bone. Sickle blades are common. At the time of the habitation of Ain Mallaha, to be dated to about 10,000 BC, Lake Huleh probably occupied a greater part of the valley than it did in modern times prior to the drainage of the area, and the marshes may have extended somewhat further to the north.

For food-gatherers Ain Mallaha was very strategically located, viz. at the juxtaposition of three different environments (FIG. 3). Each of these environments, the lake, the marshes and the uplands (the Galilee Hills), constituted an important potential resource zone for the inhabitants of the site. The vegetation of the slopes to the west of the valley consisted of an oak forest-steppe (parkland), with scattered trees at lower altitudes and a somewhat denser arboreal cover at higher altitudes. This is the natural habitat zone of gazelle, wild sheep and wild goat as well as of wild emmer wheat and wild barley. The lake was a source of fish and other potential food animals. Waterfowl must have been quite abundant in the marshes, especially during the winter months. The Huleh Valley lies on a major route of bird migration. Riparian woods on the banks of the Upper Jordan River were suitable habitats for fallow deer (*Dama mesopotamica*) and wild cattle. Wild boar is well adapted to a marshy environment.

3. Location of Ain Mallaha. Simplified after Zohary (1982, Map 2).



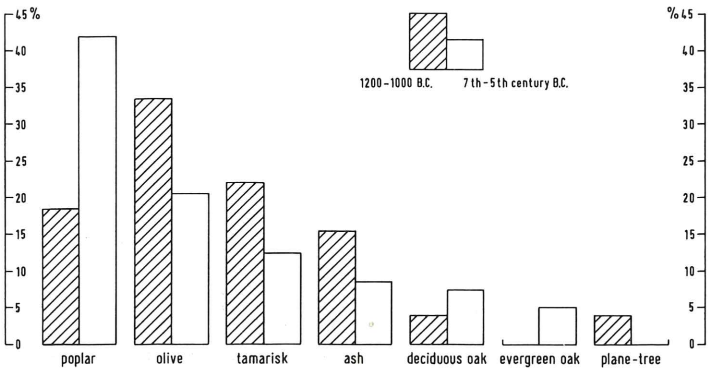
From the above it is clear that the area was eminently suited for hunting, fishing and wild seed collecting. What is the evidence of the actual exploitation of the rich resources by the inhabitants of Ain Mallaha? The faunal material indicates that gazelle, wild boar and deer were the major game animals, and that further wild sheep, wild goat, wild cattle and a few other mammal species were hunted (Ducos, 1968). Bird bones are reported, and the exploitation of the lake is attested by the remains of fish, tortoises, crustaceans and molluscs (Perrot, 1966). In spite of the potential of the area for intensive grain collecting and of the presence of storage pits, so far no actual grains have been found, so that we are left with the uncertainty whether or not wild cereals played a prominent part in the diet of the inhabitants of the site.

Jericho, in the Southern Jordan Valley (FIG. 1), is in more than one respect a remarkable site. From Neolithic and

Bronze Age layers at Jericho seeds and fruits of domesticated cereals and legumes (wheat, barley, lentil, pea, chick-pea) have been recovered in considerable numbers (Hopf, 1969). Could these crop-plant species have been grown near the site in prehistoric times? The average annual precipitation of 140 mm. recorded for Jericho is much too low for dry-farming. Irrigation of the fields is necessary to ensure satisfactory yields. At present, the abundantly flowing spring near Jericho provides the water for the intensive cultivation of fruit trees and annual crop plants. According to current views, it would not have been until 5500–5000 BC that irrigation agriculture was developed. For that reason it has been suggested that the inhabitants of early Neolithic Jericho (Pre-Pottery Neolithic A and B) may have obtained agricultural produce from farmers in the Judean mountains in exchange for salt, bitumen and sulphur from the Dead Sea. On the other hand, one should seriously consider the possibility that at Jericho plant cultivation was practised from the earliest Neolithic on. In this connection it should be mentioned that in the last few years the utilization of surface water has been suggested for some other early Neolithic sites. Be this as it may, it is clear that the gushing spring near Jericho made intensive plant cultivation possible in an area which otherwise would at most have been suitable for rough grazing.

A site in the Central Jordan Valley which comes into consideration for a few comments on palaeo-environmental conditions is Tell Deir ʿAllā (FIG. 1). This site, which is being excavated under the direction of Professor H. J. Franken (1969, 1977–78), is known particularly for its Aramaic plaster texts from the 8th century BC, the so-called Bileam texts. Late Bronze Age and Iron Age layers yielded appreciable quantities of charred seeds and charcoal. The plant remains recovered during the excavation campaigns of 1960–64 and 1967 provide evidence of the cultivation of barley, free-threshing wheat, linseed, pea, lentil, chick-pea and bitter vetch (Van Zeist and Heeres, 1973). The agriculture and horticulture of Deir ʿAllā will not be discussed here, but some special attention will be paid to the charred wood remains (FIG. 4).

4. Proportions of charred wood types at Deir ʿAllā. This graphic representation is based upon the data (mean percentages) presented in Van Zeist and Heeres (1973, Table 6). For each period there are 24 samples.



As for the wood identification, the following should be remarked. The deciduous oak-wood type is most likely of *Quercus ithaburensis* (tabor oak). The only evergreen oak species in Palestine is *Quercus calliprinos*. *Populus euphratica* (poplar), *Fraxinus syriaca* (ash) and *Olea europaea* (olive) are the only species which in this area come into consideration for the genera concerned. Poplar wood may include some willow (*Salix*).

In the brushwood steppe of the Central Jordan Valley only firewood could have been collected. Poplar from the riverine forests on the banks of the Jordan River must have constituted a major source of timber for the construction of houses and other buildings. Ash and plane tree (*Platanus orientalis*) must likewise have formed part of the strip of forest along the Jordan River. Particularly ash must have provided valuable timber. As has been mentioned above, tamarisk shrub forms dense stands on the banks of the Jordan River and its tributaries. This shrub may have been used for making fences and as firewood. The charred wood remains suggest that the riverine forest and shrub were exploited by the inhabitants of Deir ʿAllā. As for the other trees represented in the charcoal record, olive was widely cultivated in Bronze Age and Iron Age times. Deciduous and evergreen oaks did not occur in the Jordan Valley, but in the mountains to the east of the valley, at distances of 10 km. and more from the site.

In FIG. 4 the proportions of the various species in the charcoal record are shown for two periods, viz. 1200–1000 BC and 7th–5th centuries BC. It appears that the proportions show marked differences in both periods. One should be cautious in drawing conclusions from these differences. On the other hand, it is tempting to infer from the data presented in FIG. 4 that in the 7th–5th centuries BC the local wood resources became more scarce. At least, this is suggested by the increased proportions of oak which had to be carried in from quite a long distance. An increasing scarcity of local timber may have forced people to put in the effort to obtain wood much further away from the site. Admittedly, this suggestion is highly speculative, but it will be clear that charred wood remains may provide information on changes in the tree cover as a result of the interference of man with the vegetation.

The three examples presented above should give an impression of the utilization of the natural resources in the Jordan Valley and adjacent uplands by ancient man. We have only just begun to learn about the role of the environment in the economy of prehistoric and early historical man in the Jordan River catchment basin. More detailed palaeo-ecological studies and a much greater number of sites will be necessary to arrive at a satisfactory picture of the exploitation of the environment and of the adaptation to environmental conditions by the inhabitants of the Jordan Valley.

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