ARCHAEOBOTANICAL STUDIES IN THE LEVANT
I. NEOLITHIC SITES IN THE DAMASCUS BASIN: ASWAD, GHORAIFÉ, RAMAD

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CONTENTS

1. INTRODUCTION

In 1974, with financial support of the Netherlands Organization for the Advancement of Pure Research (Z.W.O.), the research project 'Palaeoethnobotanical investigations in western Syria' commenced. The research programme comprised the examination of charred plant remains from archaeological sites in Syria with the aim of obtaining information on the relations between plants and ancient man. The following sites form part of the research project.

Late Palaeolithic Mureybit, c. 80 km east of Aleppo, on the left bank of the Euphrates river before the area became submerged under the water of the Tabqa dam reservoir, was excavated first by M.N. van Loon (Chicago) and subsequently by J. Cauvin (St. André de Cruzières). The study of the charred plant remains of the 1965 campaign has been published (van Zeist, 1970; van Zeist & Casparie, 1968). Bronze Age Selenkahiye, on the right bank of the Euphrates, opposite to Mureybit, was excavated by M.N. van Loon (Chicago, Amsterdam). The material from Bronze Age and Iron Age Hadidi, likewise on the right bank of the Euphrates, c. 20 km north of Selenkahiye, includes samples from areas excavated by H.J. Franken (Leiden) and R.H. Dornemann (Milwaukee). Neolithic levels at Ras Shamra, c. 10 km north of Lattakia, were uncovered by H. de Contenson (Paris). Excavations of the Neolithic sites of Aswad, Ghoraifé and Ramad, in the Damascus basin, have been carried out by H. de Contenson and H. de Contenson & W.J. van Liere (Damascus).

The time span embraced by the sites mentioned above is such that information on the plant husbandry from the late Palaeolithic to the Iron Age might be expected. Thus, early as well as more advanced stages of agriculture are represented in the research project. On the other hand, as the sites are situated in different ecological zones, no continuous record of the plant husbandry in one particular zone could be obtained.

Before the start of the research project some of the material had already been examined in the laboratory. Moreover, during the excavation campaigns, preliminary analyses of samples were carried out in the field. For the palaeobotanical field work an inexpensive binocular stereomicroscope was available. The introductory investigations provided already a fair impression of the archaeological plant remains, such as concentration and preservation of seeds and fruits, seed types present and differences between sites. Moreover, experience was gained and the collecting of modern seed reference material could, at least to a certain extent, be directed to particular taxa represented or probably represented in the charred seed record.

The analysis of the samples was carried out by the second author. In this stage of the examination the contribution of the first author was mainly confined to assistance in the identification of difficult seed types and to discussing the results obtained so far. Unfortunately, for reasons which need not be explained here the second author was unable to complete the study by drawing up the final report. Therefore the first author undertook the working out of the results and the preparation of the publication. Contrary to the original plan to publish the results of all the sites included in the research project in one comprehensive report, it turned out more practical to discuss the data in a series of papers under the title 'Archaeobotanical studies in the Levant'. The present paper deals with the Neolithic sites in the Damascus basin. The palaeothnobotany of Ras Shamra, Mureybit, Selenkahiye and Hadidi will be the subject of forthcoming contributions in this series.

The authors wish to express their sincere thanks to all who co-operated in the field and laboratory work and in the preparation of the publication. The excavators of the sites, Mr. H. de Contenson (Paris, Centre National de la Recherche Scientifique) and Dr. W.J. van Liere (at the time Damascus, U.N. Food and Agricultural Organization) encouraged the palaeobotanical examination and rendered all possible assistance in the field work. H. de Contenson also provided additional information on the sites, including unpublished drawings of sections from Ramad. Dr. A. Bounni (General Directorate of Antiquities and Museums, Damascus) arranged for the permission for the field work and provided transportation facilities for the sampling at Aswad and Ghoraifé. Mr. M. Mamlouk was the representative of the General Directorate of Antiquities and Museums at the sampling of Aswad and Ghoraifé. Mr. J. Dufour (at the time

Damascus, C.N.R.S.) rendered assistance in the field work at Aswad and Ghoraifé. Dr. Y.I. Barkoudah (Department of Botany, University of Damascus) identified plants, seed or pollen of which was collected for reference material and he accompanied the first author on various field trips. Dr. S. Bottema contributed greatly in the sampling of Ramad.

Mrs. R.M. Palfenier-Vegter assisted in no small measure in the laboratory work: examination and re-examination of samples, most of the measurements. The charcoal identifications were carried out by Mr. R. Neef. The drawings of the charred seeds, fruits and other plant remains, which constitute a very substantial part of this publication, have expertly been prepared by Mr. H.R. Roelink. Most of the other drawings were executed by Mr. J.W. Dijkema. The manuscript was linguistically improved by Mrs. S.M. van Gelder-Ottway (Haren). In the preparation of the publication the first author was greatly assisted by Mrs. G. Entjes-Nieborg.

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2. THE SITES

2.1. The environment

In this section the physical and biological environment of the area, in which the Neolithic sites of Aswad, Ghoraifé and Ramad are situated, will briefly be discussed.

2.1.1. *The geography*

The following remarks on the geography of the Damascus basin are taken from van Liere (1960/61) and Kaiser *et al.* (1973). The Damascus basin is a structural basin of internal drainage. To the west it is bordered by the eastern escarpments of the Anti-Lebanon

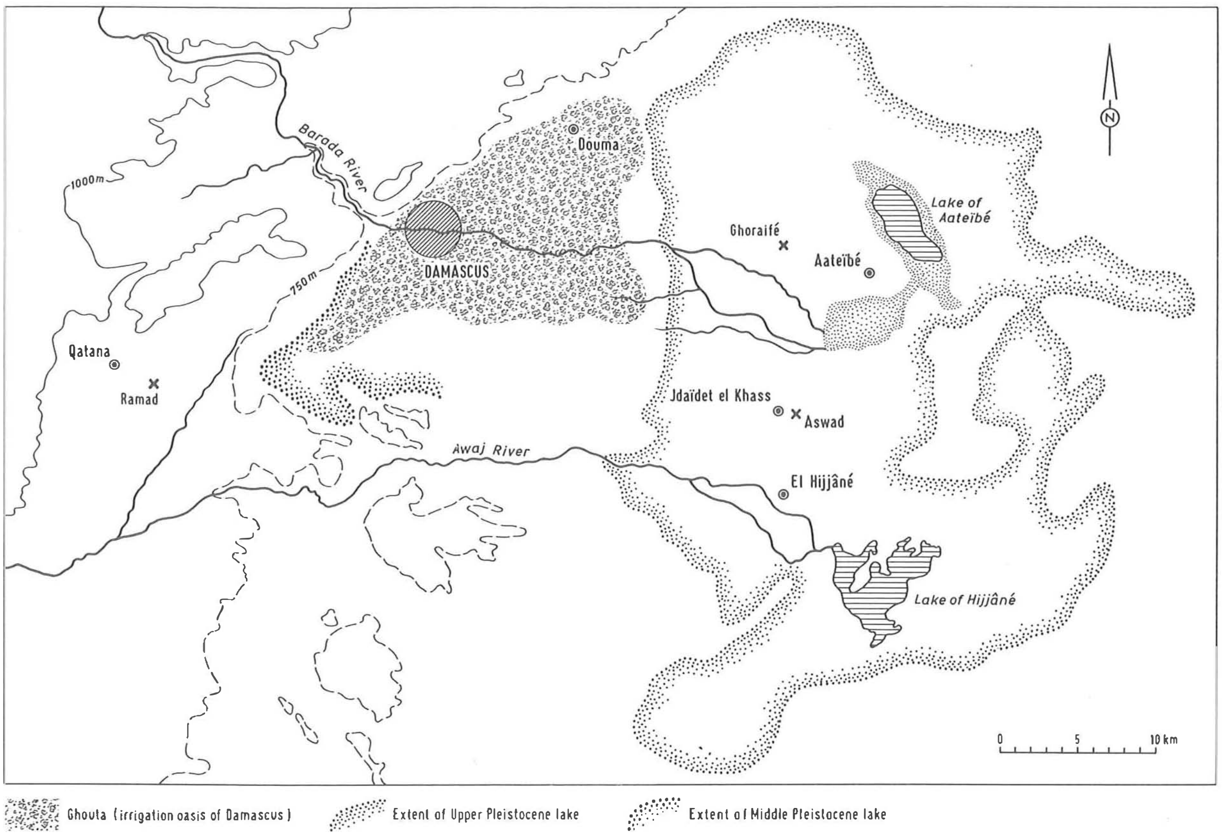

Fig. 1. Map of the Damascus area showing, among other things, the location of the Neolithic tell sites of Ramad, Ghoraifé and Aswad (indicated with a cross). See further 2.1.1.

Mountains, to the north by the limestone hills of the Palmyra range, and to the south and the east by the basalts of the Hauran plateau.

In its eastern, lowermost part the surface of the basin is just above 600 m. Here are situated Lake Aateibé and Lake Hijjâné which are residual lakes of a late Pleistocene lake which covered almost half of the Damascus basin. The extent of this late Pleistocene lake is indicated in fig. 1. The lacustrine marls deposited in the late Pleistocene lake are mostly covered by black fluvial-alluvial clays (black basin clay). In mid-Pleistocene times the lake was of even greater extent in a western direction. Middle Pleistocene lake sediments are found at elevations between 700 and 735 m. The maximum extent of the Middle Pleistocene lake southwest of Damascus, near Qatana, is also shown in fig. 1. The Middle Pleistocene lacustrine marls are partly exposed and partly overlain by younger deposits. Thus, Barada fan gravels cover the lake deposits near Damascus.

Further to the west, above 750 m, Neogene and Pleistocene basalts and Neogene conglomerates form gently sloping plateaus.

Two perennial streams, the Barada and Awaj rivers, enter the basin. The Barada river, which is the more important one, originates from springs in the Anti-Lebanon near Zebdani and ends in Lake Aateibé. The Awaj river has its origin on the eastern slopes of Mount Hermon and debouches in Lake Hijjâné.

The sites of Aswad and Ghoraifé were founded in the area of the late Pleistocene lake. Ramad is situated outside the Pleistocene lake beds, on a basaltic plateau (fig. 1).

2.1.2. *The climate*

The Damascus area, like the whole of Syria, has a Mediterranean-type climate (Wirth, 1971, pp. 68-69. Most of the precipitation falls in the period from November to April. Mean January temperature in Damascus is 7° C. The summers are dry–almost without rainfall–and hot. The mean August temperature for Damascus is 28° C, while mean day temperature maxima of 33-39° C are recorded.

In the Damascus basin, the mean annual precipitation is nowhere more than 250 mm. For Damascus itself a mean annual precipitation of 208 mm is recorded. As is evident from fig. 2, in West-Central Syria mean annual precipitation decreases from 700 mm to less than 200 mm over a distance of only 40–50 km. As for the mean annual precipitation figures, it should be taken into consideration that the fluctuations in the annual rainfall are quite considerable. Thus, during the period 1933–1967 annual precipitation in Damascus varied from 65 to 315 mm (Wirth, 1971, fig. 19). Ramad has an estimated mean annual precipitation of about 250 mm, while Ghoraifé and Aswad receive, on average, less than 200 mm annually.

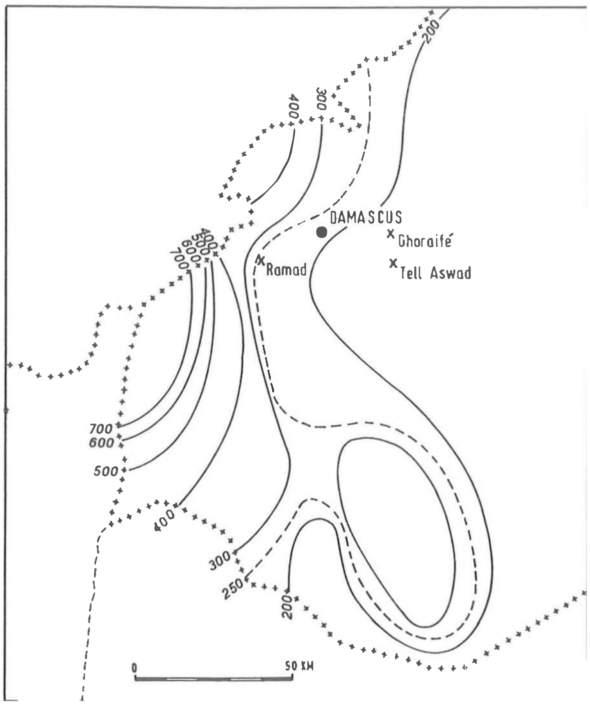

Fig. 2. Precipitation map of West-Central Syria based upon data over the period 1952/53–1961/62. Isohyet values expressed in mm. Information provided by Dr. Y.I. Barkoudah (Damascus).

A mean annual precipitation of 250 mm is considered as a minimum for dry-farming cultivation of autumn-sown crops. Because of the fluctuations in the annual precipation, crop failures due to drought are no exception in areas with mean precipitations of around 250 mm. Yet perhaps not too much value should be attached to this 250 mm limit in evaluating the possibilities of crop plant growing in prehistoric time. Wirth (1971, p. 93) mentions that in present-day Syria, under favourable relief and soil conditions dry-farming is practised at mean annual precipitations well below 250 mm, down to about 150 mm.

2.1.3. *The natural vegetation*

The reconstruction of the natural vegetation of the Damascus basin and its surroundings is rather speculative. The whole of the area is under intensive land use, as a result of which at most a few remnants of the original vegetation are left. As a consequence, a discussion of the assumed natural vegetation must be confined to some more general remarks. No exact borders between the vegetation zones can be determined and no attempt has been made to draw a vegetation map of the Damascus basin and the surrounding areas.

The zonal vegetation is bound to precipitation and elevation (temperature), whereas azonal vegetation types are primarily edaphically conditioned. As in West-Central Syria the isohyets as well as the elevation contour lines run roughly in a north-south direction, the main vegetation zones are also north-south oriented.

The greater part of the Damascus area, approximately east of the 200 mm isohyet, would naturally be covered by treeless *Artemisia* steppe. M. Zohary (1973, pp. 478–9) distinguishes a group of *Artemisia* steppe vegetations characteristic of the Syrian 'desert', the Artemision herbae-albae deserti-syriaci. *Artemisia herba-alba* is usually dominant, but a great number of other species are recorded. Zohary warns that his vegetation records taken in the 1930's all refer to severely affected *Artemisia herba-alba* associations:'Anything edible has been taken away for the livestock and everything woody has been seized upon as fuel'. It will be clear that there is little sense in speculating on the floristic composition of the steppe vegetation of the Damascus area in prehistoric times.

To the west of the steppe zone, at elevations above 750 m and with mean annual precipitations between 200 and 400–500 mm, a Xero-Mediterranean almond-pistachio forest steppe is postulated. This vegetation type forms, as it were, the transition from the continental steppe area to the Mediterranean maquis and forest region. The almond-pistachio forest steppe must be visualized as a steppe vegetation with scattered trees and shrubs. The arboreal components of this vegetation type are *Pistacia atlantica, Amygdalus korschinskii, Amygdalus webbii, Pyrus syriaca, Crataegus aronia* and *Rhamnus palaestinus* (M. Zohary, 1973, p. 522). Solitary specimens of *Crataegus aronia* in steppe vegetations and in fields are indicators of the former presence of an almond-pistachio forest steppe. Tell Ramad was situated in this vegetation zone with its rich potential of wild edible fruits.

Further to the west and northwest, at elevations above 1200 m and with mean annual precipitations of more than 400–500 mm, (Oro-) Mediterranean shrub and tree vegetations are found on the east facing flanks of the Anti-Lebanon Mountains. Thus, along the Damascus-Beirut highway, near the Syrian-Lebanese border, at elevations of about 1300 m, rather dense shrub vegetation was observed by the first author and Dr. S. Bottema in 1965. The following arboreal components were noted: *Quercus calliprinos, Quercus infectoria, Pistacia palaestina, Crataegus* spec., *Amygdalus* spec., *Prunus* spec., *Rhamnus* spec., *Acer syriacus* and *Lonicera* spec. (see also Bottema & Barkoudah, 1979, pp. 442–3).

As for azonal vegetation types, on the annually flooded banks of the Barada and Awaj rivers rather dense tree and shrub vegetation may have been found. One can only guess about the arboreal components of this river bank vegetation: *Populus, Platanus, Fraxinus, Ulmus, Salix, Tamarix, Vitis, Rubus, Ficus*? The lakes of Aateibé and Hijjâné were bordered by extensive marsh vegetations of reeds, sedges and other hydrophytes.

As for the vegetation pattern in the Neolithic and in later prehistoric periods, it should be pointed out that at that time the Ghouta, the famous irrigation oasis near Damascus, did not yet exist (see fig. 1). This landscape is completely man-made. It was not until the last centuries B.C. that a beginning was made with the laying-out of the Ghouta. To that end the carbonate crust on top of the Barada gravels had to be broken and the water of the Barada river was diverted over the area through a system of irrigation channels (*cf.* Wirth, 1971, p. 403).

2.1.4. *Speculations on early Holocene vegetation and climate*

One may wonder whether in the early Holocene, at the time of the habitation of Aswad, Ghoraifé and Ramad, climatic conditions differed from those of today. Thus, under conditions of higher precipitation the almond-pistachio forest-steppe belt would have extended further to the east and conditions for dry-farming would have been more favourable. With respect to the early Holocene climate in the Damascus basin the following can be remarked.

There is no palynological information on the early Holocene vegetation of the Damascus area. The only Holocene pollen record at not too great a distance from the Damascus basin, *viz.* a pollen diagram prepared for sediment in the upper reaches of the Barada river near Zebdani, covers only the last few thousand years, the upper Holocene (Bottema, 1975–1977). Final Pleistocene and early Holocene climatic changes in the Levant can be inferred from pollen diagrams prepared for sediment cores from the Huleh marshes in northern Israel and from the Ghab valley in northwestern Syria (*cf.* van Zeist & Bottema, 1982).

The Huleh pollen diagram shows relatively high tree pollen values in the section dated to 12,00–8000 B.C. In the succeeding period, c. 8000–5400 B.C., tree pollen percentages are lower suggesting a greater climatic dryness. After 5400 B.C. forest expanded again, probably the result of an increase in precipitation. Thus, the Huleh pollen record would point to a relatively dry early Holocene. The Ghab pollen evidence, on the other hand, suggests another climatic history. There, high *Artemisia* and Chenopodiaceae pollen frequencies point to a wide expansion of steppe vegetations in the period of 12,000 to 9000–8000 B.C. A spread of forest vegetation after 9000 B.C. is ascribed to an increase in humidity. It is likely that in northwestern Syria, humidity reached its highest level in the early Holocene, to decrease again to some extent after 6000 B.C.

In conclusion, the Ghab pollen evidence suggests an early Holocene climate that was more humid than the present one, whereas the Huleh pollen record rather points to the contrary. The conflicting or seemingly conflicting palynological evidence prevents us from making inferences on past climates of the Damascus region. We are still left with the uncertainty whether, and if so to what extent, the early Holocene climate, in particular the humidity, of the Damascus area differed from that of today.

2.2. Aswad

Tell Aswad is situated some 30 km east-southeast of Damascus, between the lakes of Aateibé and Hijjâné (fig. 1). The subsoil in the Aswad area consists of lacustrine sediments which have been formed in the late Pleistocene lake that covered a large part of the Damascus basin (2.1.1.). It is likely that in the early Holocene, Lake Aateibé had a much larger surface area than nowadays and that Tell Aswad was founded at the edge of the marshes surrounding the lake (7.2.1., fig. 31). The tell measures 275 m north-south and 250 m east-west, and reaches up to 4.50 m above the surrounding plain.

In 1971 and 1972, two squares, measuring 4 by 4 m and lying c. 100 m apart, were excavated by de Contenson (1972; 1973; 1979). The soundings are indicated as Carré Ouest (Aswad West) and Carré Est (Aswad East) (fig. 3). At Aswad East the virgin soil was reached at a depth of 4.25 m below the surface of the mound, while at Aswad West 3.30 m of occupational remains could be established. The mound consists of a fine, dark ashy soil which has given the site its name: Tell Aswad=Black Hill.

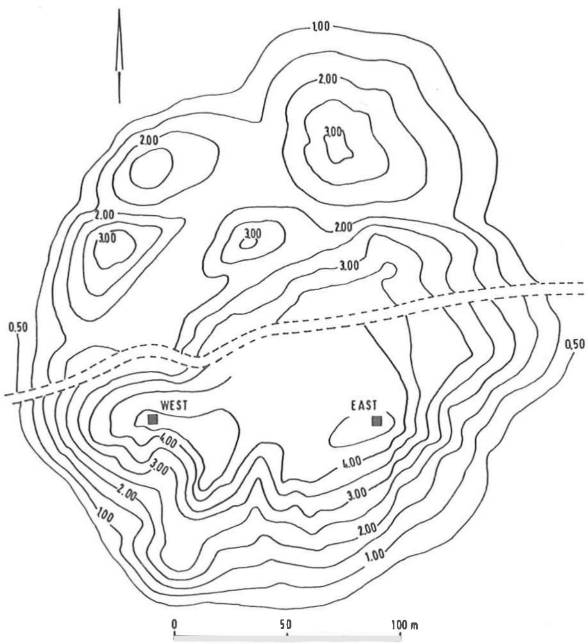

Fig. 3. Tell Aswad. Elevation contour lines in metres above the surrounding plain. The areas West and East have been excavated (de Contenson, 1972, fig. 1).

No stone foundations were found. Structural elements consisted of basins with a diameter of at most 2 m and were filled with burnt clay and ash, narrow cylinder-shaped pits, and floors or benches of crude mud bricks. It seems that the occupants of the site lived in small round huts with sunken floors, the walls of which were made of reeds with clay daub. Fragments of baked clay with reed impressions are reported by de Contenson (1978).

No pottery was found, but in addition to clay figurines and bone implements, great quantities of silex artifacts were recovered. The flint industry has been studied by M.-C. Cauvin (1974; 1979). In all occupation levels sickle blades are predominant. Moreover, arrowheads in various sizes are quite common, which corroborates with the faunal remains. Only wild animals would be represented at Aswad (*cf.* de Contenson, 1979). In contrast to the rich flint industry, polished stone axes, querns made of basalt and limestone bowls were rare: this is ascribed to the absence of the raw material in the vicinity of the site (de Contenson, 1978).

On the basis of the flint industry a few occupation phases are distinguished (de Contenson, 1976b; M.-C. Cauvin, 1974). Phase I, which is represented only in Aswad East, is subdivided into two subphases. Phase IA comprises the lower section of Aswad East, from 4.25 to 2.25 m below the surface of the tell, and is radiocarbon dated to 7800–7600 B.C. (see table 1). Phase IB, at a depth of 2.25–1.80 m, has an inferred date of 7600–7300 B.C. Phase II comprises the upper 1.80 m at Aswad East and the whole of the occupational deposits at Aswad West.

2.3. Ghoraifé

The site of Ghoraifé is situated at c. 25 km east of Damascus, c. 10 km north of Tell Aswad, about 8 km from the shore of Lake Aateibé. The tell measures 300 m north-south and 200 m east-west. The maximum height of the tell is about 5 m above the level of the plain, which constitutes the bottom of the Late-Pleistocene lake (2. I. I.).

In 1974, excavations were carried out at Ghoraifé by de Contenson (1975a; 1976a; 1978). Four test pits, measuring 2 by 2 m, were opened (fig. 4), but in only one of them,

Table 1. Conventional radiocarbon dates (half life value of 5 568 years) for Ramad, Ghoraifé and Aswad. After Vogel & Waterbolk (1967) and de Contenson (1973, 1975b, 1976a).

Sample			Lab. no.	Years BP	Years BC
Ramad					
Phase II	*C8	1.65 m	GrN-4823	7 880 ± 55	5 930
	C8	2.50 m	GrN-4427	7 920 ± 50	5 970
	M4	1.80 m	GrN-4822	7 900 ± 50	5 950
Phase I	M4	4.05 m	GrN-4821	8 090 ± 50	6 140
	C8	5.10 m	GrN-4428	8 200 ± 80	6 250
	H10	0.50 m	GrN-4426	8 210 ± 50	6 260
Ghoraifé					
Phase II	GH-2:	3.00 m	GIF-3372	8 150 ± 190	6 200
Phase I	GH-4:	5.50 m	GIF-3374	8 400 ± 190	6 450
	GH-5:	6.00 m	GIF-3375	8 480 ± 190	6 530
	GH-6:	6.20 m	GIF-3376	8 710 ± 190	6 760
Aswad					
Phase II	West	0.30 m	GIF-2373	8 560 ± 110	6 610
	West	0.40 m	GrN-6676	8 650 ± 55	6 700
	West	0.90 m	GrN-6677	8 720 ± 75	6 770
	West	1.30 m	GrN-6678	8 875 ± 55	6 925
	West	2.30 m	GrN-6679	8 865 ± 60	6 915
	East	0.25 m	GIF-2369	8 540 ± 110	6 590
Phase I	+East	1.75 m	GIF-2370	9 340 ± 120	7 390
	East	2.35 m	GIF-2371	9 270 ± 120	7 320
	East	2.45 m	GIF-2372	9 640 ± 120	7 690
	East	3.25 m	GIF-2633	9 730 ± 120	7 790

* This sample is from a phase III pit, but the charcoal must be derived from phase II layers (6.4.).
\+ According to de Contenson (1979) the level at a depth of 1.75 m should be attributed to phase II, but the date clearly points to phase I.

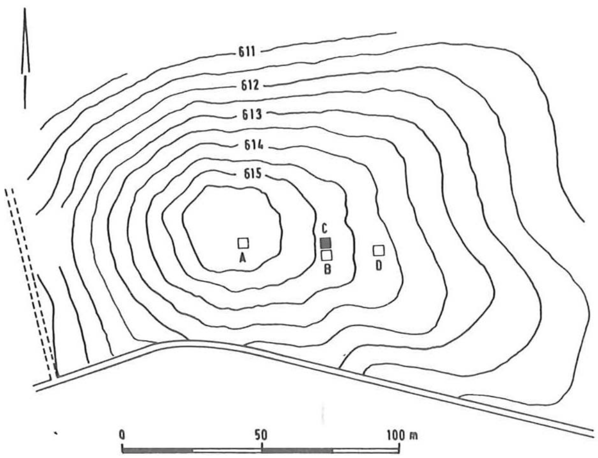

Fig. 4. Tell Ghoraifé. Elevation contour lines in metres above sea-level. Only sounding C was excavated as far down as the virgin soil (de Contenson, 1975, fig. 1).

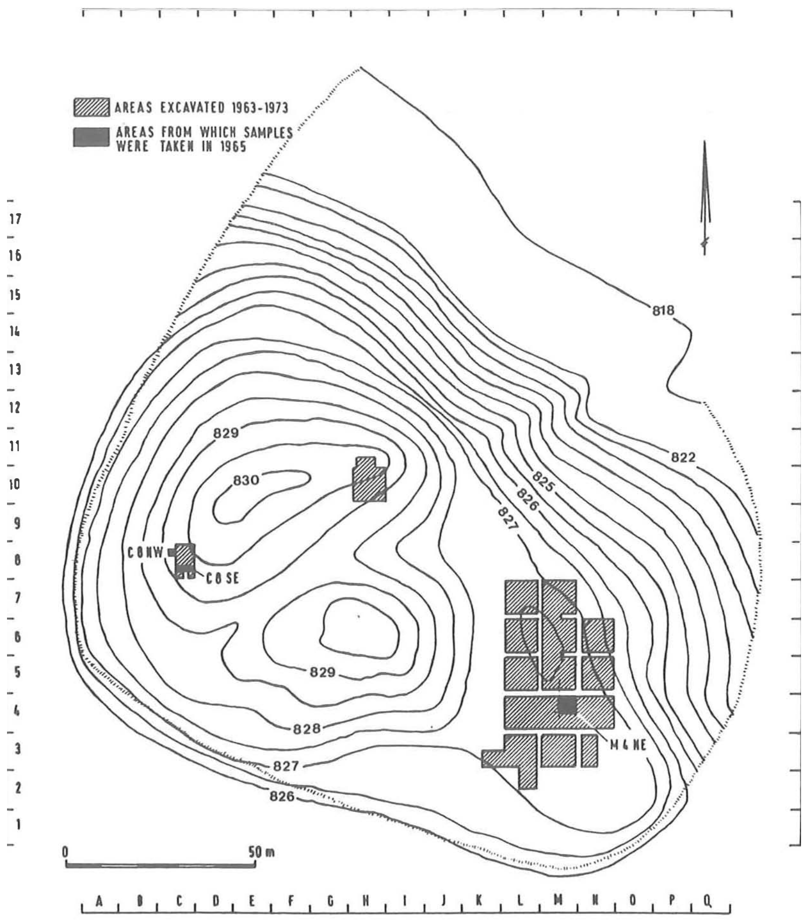

Fig. 5. Tell Ramad. Elevation contour lines in metres above sea-level. The areas from which samples for palaeobotanical examination were taken are indicated in black (M4NE, C8NW, C8SE). After de Contenson (1974, p. 22).

sounding C, the excavation was continued until the virgin soil was reached at 6.40 m below the surface. Three phases are distinguished at Ghoraifé, two of which are Neolithic. Phase I comprises the occupational deposits between the virgin soil and 3.50 m below the surface. There is a succession of compact, brown soil layers and lenses of burnt clay with black ashes. Silex artifacts are quite numerous and the flint industry as well as the clay figurines compare well with those of phase II at Aswad (2.2.). Animal bones are scarce. Phase I at Ghoraifé is dated to 6800–6300 B.C. (see table 1).

Phase II occupational debris reaches the surface of the tell where the upper layers have not been disturbed by Roman and modern burials. In the excavated square, the depth of the post-Neolithic intrusions varies from 0.90 to 1.70 m. Between 3.50 and 1.90 m, the occupational fill consists again of compact, brown soil alternating with thin layers of burnt material. The uppermost metre, if not disturbed, consists of ashy layers on top of a 90-cm-thick bed of yellowish clay. Contrary to those of phase I, the phase II deposits are rich in animal bones, but flint artifacts are less numerous. Bone implements are quite common and the bone industry is related to that of phase I at Ramad (2.4.). Phase II at Ghoraifé is dated to c. 6200 B.C.

2.4. Ramad

Tell Ramad is situated at about 20 km SW of Damascus and about 3 km SE of Qatana, at the foot of Mount Hermon, c. 900 m above sea-level. The site lies at the northern edge of a basaltic plateau, on the Wadi Qatana which has its bed at the contact surface between the basaltic deposits and Neogene conglomerates (de Contenson & van Liere, 1964). The wadi carries water in the winter and spring; in the early summer, in May, the stream dries up. The tell measures 150 m north-south and 175 m east-west. Occupational deposits are up to 6 m thick.

Excavations at Tell Ramad have been carried out by H. de Contenson and W.J. van Liere in 1963 and 1965, and by H. de Contenson between 1966 and 1973. The site has been tested by altogether 8 field seasons. The areas excavated are indicated in fig. 5. A grid system (1, 2, 3, *etc*., A, B, C, D, *etc*.) divides the site in 10×10 m squares. Each 10×10 m square is subdivided in four quadrants, *viz*. NE, NW, SW and SE. See de Contenson & van Liere (1964; 1966) and de Contenson (1971; 1974; 1978).

Three main occupation phases are distinguished. The settlement was founded on the basaltic virgin soil. In the lower levels (phase I), which consist of up to two metres of dark clayish soil, a succession of semi-subterranean huts, with clay walls and plastered ovens was uncovered. The artifacts include flint tools, some obsidian bladelets and querns, hammerstones, mortars and pestles of basalt. Polished stone bowls were made of limestone; bone artifacts include awls and spatules. Animal and human clay figurines are quite common. Moreover, plastered skulls were uncovered with the face remodeled with lime and the top of the cranium painted with red ochre. Phase I is dated to about 6200 B.C. (see table 1).

In phase II levels more elaborate architectural features were uncovered: rectangular houses with mud brick walls on stone foundations and plastered floors. The houses consisted of one room and were separated from each other by yards and narrow lanes. The skull cult appears to have survived in a simplified form. As for the objects, most characteristic of the phase II levels are white, unbaked bowls (*vaisselle blanche*). The phase II layers are very ashy, to which Tell Ramad–Hill of Ashes–owes its name. This phase is dated to around 5950 B.C. Phases I and II belong to the Pre-Pottery Neolithic B culture. The animal bones in both PPNB phases are reported to be of wild species (de Contenson, 1971), suggesting that no animal breeding was practised. It is peculiar that in the aceramic Neolithic of the Damascus basin domestic animals were not represented, at least not according to the rather cursory examinations of the animal bones carried out so far. More detailed analyses of the faunal remains are eagerly awaited.

Phase III is represented only on the western side of the tell, in the uppermost metre and in pits dug in the underlying layers. This phase has true ceramics: crude, hand-made, usually dark-coloured ware. The phase III filling consists partly or predominantly of redeposited phase II material. A radiocarbon assay of a phase III sample gave a phase II date (5930 B.C., because apparently the charcoal was from the latter period. A comparison of the phase III pottery with that of other Near Eastern sites points to the end of the 6th millennium B.C. From phase III levels bones of domestic goat, sheep, cattle and dog

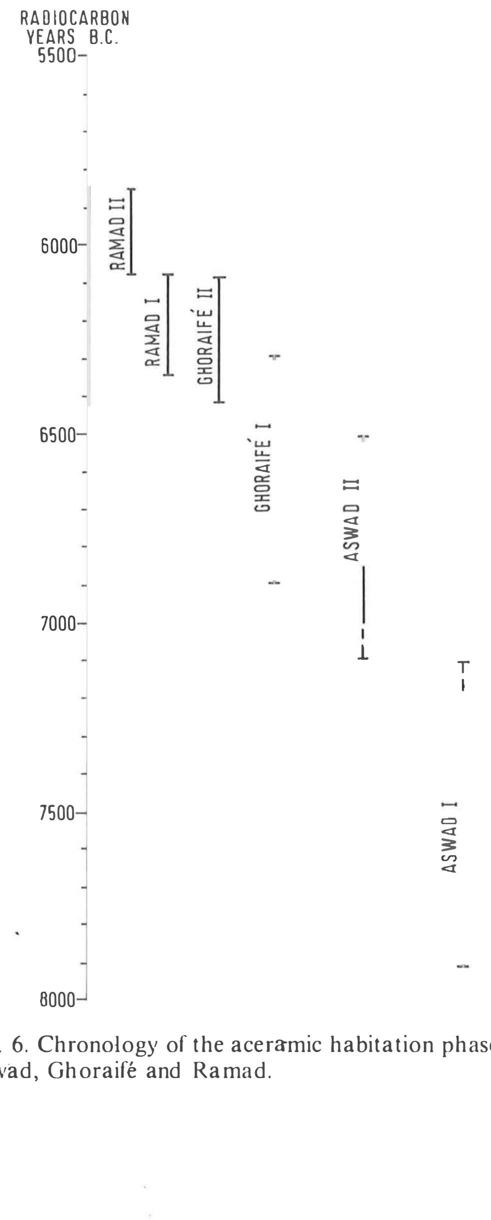

Fig. 6. Chronology of the aceramic habitation phases of Aswad, Ghoraifé and Ramad.

Table 2. Samples from Ramad examined for plant remains

	Sample designation	Depth below surface in m	Where taken
Ramad C8SE			
Phase II	C8 1.10	1.10	Along west balk
	C8 1.20	1.20	Along west balk
	C8 1.55	1.55	Along west balk
	C8 1.65	1.60 - 1.70	2.00 - 2.50 m from east balk
	C8 1.70	1.70	2.00 - 2.50 m from west balk
	C8 1.90	1.90	2.00 - 2.50 m from east balk
	C8 2.25	2.20 - 2.30	1.30 - 2.30 m from east balk
	C8 2.45	2.45	1.25 - 2.00 m from west balk
	C8 2.70	2.60 - 2.80	2.00 m from west balk
	C8 2.95	2.90 - 3.00	2.00 m from west balk
	C8 3.15	3.10 - 3.20	0.80 - 1.30 m from east balk
	C8 3.35	3.30 - 3.40	0 - 1.00 m from east balk
	C8 3.55	3.50 - 3.60	Along east balk
	C8 3.60	3.60	1.00 - 1.30 m from west balk
	C8 3.70	3.65 - 3.75	2.00 m from west balk
	C8 3.90	3.85 - 3.90	2.00 - 2.75 m from east balk
	C8 4.05	4.00 - 4.10	2.50 m from west balk
	C8 4.35	4.30 - 4.40	2.50 m from west balk
	C8 4.55	4.50 - 4.60	1.50 m from west balk
	C8 4.75	4.70 - 4.80	2.00 m from east balk
	C8 4.95	4.90 - 5.00	Whole surface
	C8 5.05	5.00 - 5.10	1.50 m from west balk
Phase I	C8 5.25	5.20 - 5.30	Whole surface
	C8 5.35	5.30 - 5.40	2.50 m from west balk
	C8 5.40	5.35 - 5.40	2.50 m from west balk
	C8 5.55	5.50 - 5.60	Whole surface
	C8 5.60	5.55 - 5.65	2.50 m from west balk
	C8 5.70	5.65 - 5.70	Whole surface
Ramad M4NE			
Phase II	M4 1.75	1.75 - 1.80	Along west balk
	M4 1.80	1.80	Along north balk
	M4 1.90	1.90	1.20 m from west balk, 1.20 m from north balk
	M4 2.10	2.10	Along west balk ('cuvette remplie de graines carbonisées')
	M4 2.30	2.30	Along east-west wall
Phase I	M4 2.80	2.80	Along east-west wall
	M4 3.00	3.00	Whole surface
	M4 3.10	3.10	1.50 m from north balk, 3.00 m from west balk
	M4 3.45	3.45	Along west balk
	M4 3.65	3.60 - 3.70	Along east-west wall, 3.00 m from west balk
	M4 4.05	4.05	Along east-west wall
	M4 4.30	4.20 - 4.40	Southeast corner of square

Table 2 (continued).

	Sample designation	Depth below surface in m	Where taken
Ramad C8NW			
Phase III	C8NW 0.65	0.65	
	C8NW 1.25	1.20 - 1.30	
	C8NW 1.55	1.55	
	C8NW 1.95	1.95	From stratified fill of pit
	C8NW 2.15	2.15	
	C8NW 2.40	2.40	
	C8NW 2.45	2.45	

were recovered, suggesting an emphasis on herding (de Contenson, 1971).

In fig. 6 the approximate time span covered by each of the aceramic habitation phases of Aswad, Ghoraifé and Ramad is presented. This figure shows the chronological relationships of the three sites.

3. THE SAMPLES

3.1. Sample processing

The soil samples taken at the sites under discussion were floated in the field to recover charred plant remains. The conditions are such that only carbonized vegetable material will have been preserved. No flotation machine was employed, but the plant remains were recovered by a simple manual water separation method (*cf.* van Zeist & Bakker-Heeres, 1979). Contrary to the opinion of some other researchers (*e.g.* Keeley, 1978), our experience with manual water flotation is quite satisfactory.

The sorting of the flotation residues and the identification of the plant remains were carried out in the laboratory according to usual procedures. After sorting the sample residues were kept for possible re-examination. For the identifications a seed reference collection of Near Eastern species was available. In spite of its rather modest size, this reference collection permitted the identification of most of the charred seed types, although usually not to the species level. The plant remains are discussed in sections 4 and 5. The descriptions are supplemented by drawings of the plant remains and measurements. In measuring grass caryopses, in particular cereal grains, the

Table 3. Palaeobotanical samples from Aswad.

Aswad East, from north balk east sounding (Carré Est)		
Phase II	0.20	(= 0.20 m below surface)
	0.40	
	0.60	
	0.80	
	1.00	
	1.20	
	1.40	
	1.60	
Phase I	1.80	
	2.00	
	2.20	
	2.40	
	2.70	
	2.90	
	3.10	
	3.30	
	3.60	
Aswa		
Phase II	0.40	(= 0.40 m below surface)
	0.60	
	0.80	
	1.00	
	1.20	
	1.40	
	1.60	
	1.80	
	2.00	
	2.20	
	2.40	
	2.60	
	2.80	

Table 4. Palaeobotanical samples from Ghoraifé

Ghoraifé 1975, from north balk sounding C		
Phase II	1.20	(= 1.20 m below surface)
	1.40	
	1.60	
	1.80	
	2.00	
	2.20	
	2.40	
	2.60	
	2.80	
	3.00	
	3.20	
	3.40	
	*3.60	
Phase I	3.80	
	4.00	
	4.20	
	4.40	
	4.60	
	4.80	
	5.00	
	5.20	
	5.40	
	5.60	
	5.80	
	6.00	
Ghoraifé 1974, samples taken by H.de Contenson in 1974 from exposed surfaces		
Phase II	2.00	
	2.50	
	3.00	
	3.50	
Phase I	4.00	
	4.50	
	5.00	
	5.50	
	5.90	
	6.30	

* According to de Contenson (1975) the level at a depth of 3.60 m should be attributed to phase I, but the seed content points rather to phase II.

radicle point has not been included in the measurement in those cases where the embryo had been preserved. In tables 5 to 10 the numbers of seeds and fruits in the samples examined are presented. The dimensions in the tables showing the results of the measurements are all in mm.

3.2. Sampling and samples

3.2.1. *Ramad*

At the request of H. de Contenson and W.J. van Liere, at Ramad sampling for palaeobotanical research was undertaken by S. Bottema and W. van Zeist in 1965, during the second excavation campaign. At that time the aims of palaeoethnobotanical research were still rather straightforward. Thus, for Ramad our aim was to obtain information on the following questions:

– Was agriculture practised by the inhabitants of Ramad and if so, which crops were grown?

– Which wild seeds and fruits were collected for human consumption?

– What was the vegetation in the vicinity of Neolithic Ramad?

It was decided that we should attempt to sample at least one complete series of occupation layers, covering all three phases distinguished at Ramad (2.4.). In the first (1963) campaign three quadrants (carrées) of 5×5 m had been opened. In two of them, *viz.* C8NE (Carré Ouest of the 1963 campaign)

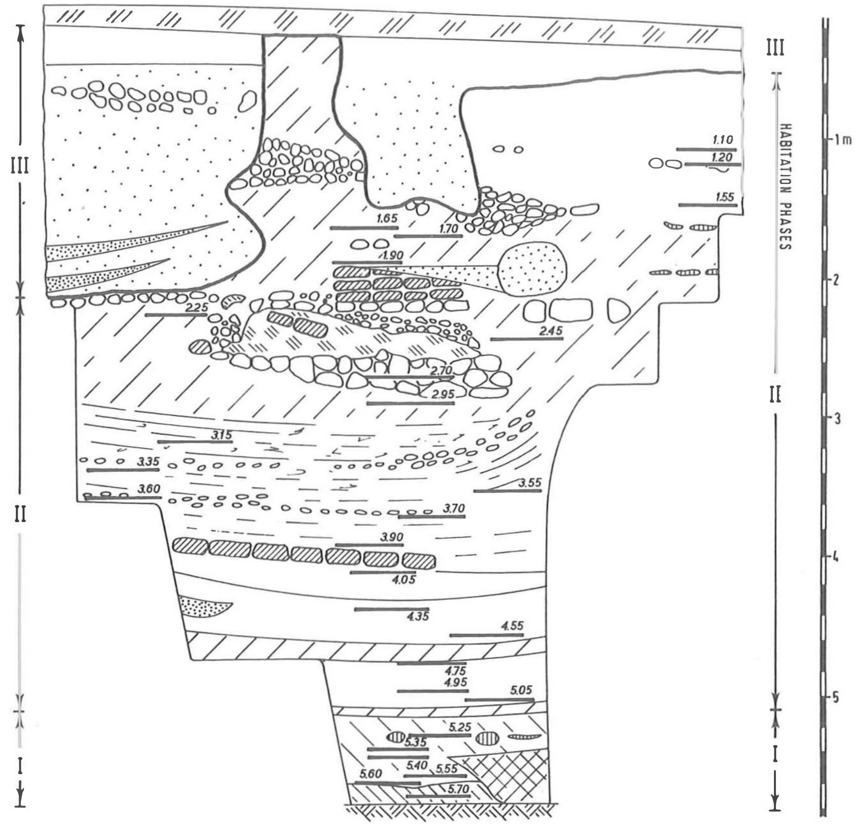

Fig. 7. Ramad, section along south balk of C8SE quadrant. After drawing by H. de Contenson (not yet published). The boundary between phase II and III deposits is clearly indicated. The location of the samples from C8SE that have been examined for charred plantremains is transferred to this section (thick horizontal lines with indication of depth).

and M4SE (old Carré Est), the virgin soil was reached. In the exposed sections of C8NE many ash layers were present and occasional charred seeds could be observed with the naked eye. For that reason this quadrant was selected for a systematic palaeobotanical sampling. Quadrant C8NE was extended on its south side by about 1.5 m (fig. 5). A strip of 1.5×5 m was excavated at intervals of 10 to 15 cm. With increasing depth the length of the excavated strip diminished until in the bottom layers it was only 1.5 m long. From each interval one or two samples were taken. The samples from this strip are from the SE quadrant of C8 and they should consequently be indicated as C8SE, followed by the depth below the surface. As for the Ramad sample designations see table 2.

Of the newly exposed south balk a drawing was made by H. de Contenson (fig. 7). The pits of the phase III habitation, which were dug in the underlying phase II levels, show up clearly in this section. During the sampling for palaeobotancial research it was not always very clear whether undisturbed phase II levels or the fill of phase III pits were concerned. Moreover, it was not until the section was drawn that the extent of the phase III disturbances became evident. At the east side of the section a phase III pit extends down to 2.10 m below the surface. Phase II levels are very thick here and extend to c. 5.10 m below the surface. Phase I levels, on the other hand, cover only about 60 cm, from 5.10 to 5.70 cm, in the C8 square.

In the west balk of C8NE a large ash pit, up to 2.65 m below the surface, was visible. From the layers in this pit a series of samples, at intervals of 15–20 cm, was taken; to that purpose a trench of 2.00 by 1.60 m, to a depth of 2.65 m, was excavated (fig. 8). The C8NW samples are all from levels which archaeologically must be attributed to phase III.

Finally samples were taken from the M4NE quadrant which was excavated in 1965. Here samples were collected from ashy places which became visible on the exposed surfaces. The section along the west balk of the M4NE quadrant is shown in fig. 9.

The volume of the soil samples varied from

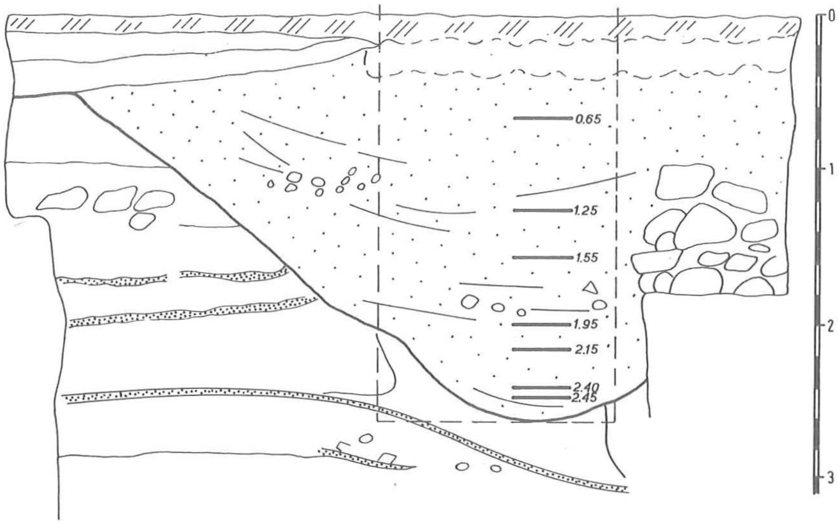

Fig. 8. Ramad, upper part of section along west balk of C8NW quadrant showing a deep pit filled with phase III deposits. After de Contenson & van Liere (1964, pl. XII). The location of the samples from C8NW examined are indicated in this drawing.

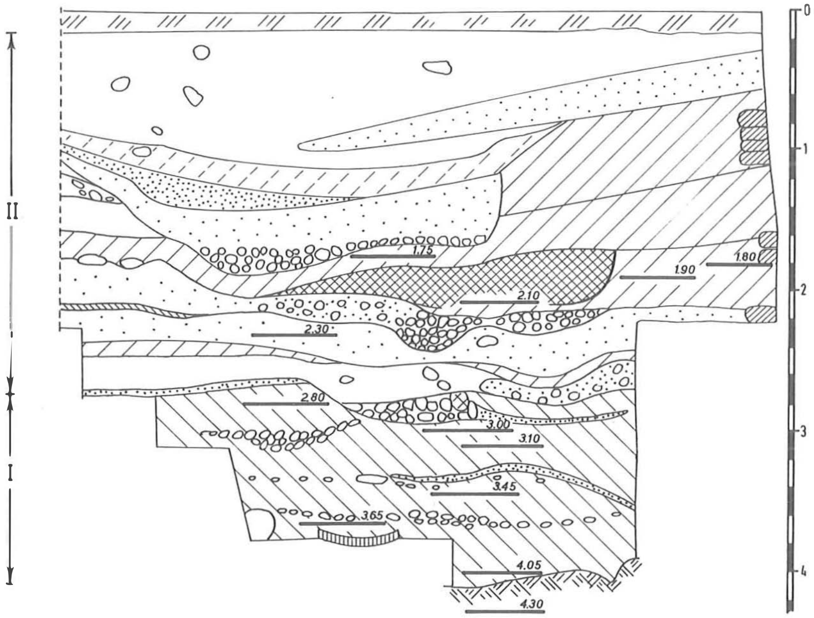

Fig. 9. Ramad, section along west balk of M4NE quadrant. After drawing by H. de Contenson (not yet published). The cross-hatched area, at a depth of approximately 2 m, is the 'cuvette remplie de graines carbonisées' (see 6.1.). The location of the samples from M4NE examined is transferred to this section.

10 to 20 litres. Unfortunately, the actual volume of each sample has not been recorded. It was not until the examination had been completed that it became evident that this would have been useful (6.3.). The samples were floated in a rivulet at the foot of the tell.

Altogether 172 samples were collected and floated for palaeobotanical examination and it soon became clear that only a small proportion of them could be analysed. The mere sorting of the samples was already very time-consuming because of the usually great numbers of seeds, fruits and other identifiable plant remains. In the choice of the samples to be examined it was our leading principle to obtain a good cross-section of the seed content of the phase I and II levels. From C8SE a series of samples at intervals of 5 to 35 cm was selected. In total 28 samples from this quadrant were examined. In the choice of the samples the quality also played a part. Thus, if the flotation residue of a sample from a particular depth was very small or if a first inspection showed that it was very poor in

Table 5. Numbers of seeds, fruits and other plant remains in samples from Ramad, C8 SE quadrant.

Phase	II	II	II	II	II	II	II	II	II	II	II	II	II	II
Sample designation C8	1.10	1.20	1.55	1.65	1.70	1.90	2.25	2.45	2.70	2.95	3.15	3.35	3.55	3.60
Triticum boeoticum	·	·	·	·	·	·	·	1½	1	4	·	·	1	4
Triticum monococcum	·	·	·	1	·	·	·	4	4	1	·	7	8	2
Triticum dicoccum	·	1	6	56	4	18	36	35	91	48	14	326	200	73
Triticum spikelet forks	29	27	20	300	40	97	375	245	1200	350	63	1250	1550	450
glume bases	45	92	13	675	57	37	675	575	1050	750	42	1125	1700	950
Triticum durum/aestivum	·	2	·	3	1	3	1	8	6	3	1	525	65	33
T.durum/aestivum internodes	·	·	·	7	·	1	4	·	4	5	1	457	55	56
Hordeum spontaneum	·	·	·	·	·	·	5	·	1	1	·	·	4	
Hordeum distichum	·	·	1½	10	·	3	16	10	14	7	·	68	35	5
Hordeum internodes	·	·	·	1	·	1	18	14	13	11	·	22	19	3
Hordeum vulgare var. coeleste	·	·	·	·	·	·	1	·	·	2	·	20	·	1
Hordeum vulgare internode	·	·	·	·	·	·	1	·	·	·	·	·	·	
Cereal grain fragments	39	3	19	140	20	64	147	138	235	238	32	1134	932	422
Pisum	·	2	7	4	2	·	7	35	30	·	·	1	5	·
Lens	2	1	2	22	8	7	15	8	2	6	1	49	57	10
Cicer	·	·	·	1	·	·	·	·	·	·	·	7	½	·
Linum usitatissimum	·	·	·	1	1	1	5	·	4	3	1	16	13	1
Pistacia	·	+	·	2	·	+	5½	2	2	3	1	33	100	6
Lithospermum arvense	·	·	·	·	1	·	·	·	3	1	·	7	5	·
Lithospermum tenuiflorum	·	·	·	1	2	·	·	1	1	7	·	4	10	2
Heliotropium	·	·	·	·	·	·	·	·	·	1	·	·	·	·
Cerastium-type	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Silene spec.	·	·	1	·	·	·	1	1	·	8	·	21	3	·
Silene colorata-type	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Vaccaria pyramidata	·	·	·	·	·	·	2	·	·	1	·	5	1	·
Helianthem ledifolium-type	10	·	9	·	19	·	27	·	47	345	1	160	19	3
Helianthemum salicifolium-type	·	·	·	·	·	·	·	·	·	3	·	·	·	·
Centaurea	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Convolvulus	·	·	·	·	·	·	·	·	·	·	·	·	3	·
Carex cf. divisa	·	·	·	·	·	·	·	·	·	·	·	6	·	·
Scirpus maritimus	·	·	·	·	3	1	·	1	1	·	·	·	·	·
Scirpus tabernaemontani-type	·	·	·	·	·	·	5	·	·	·	·	·	·	·
Cephalaria syriaca	·	·	·	·	·	·	·	·	·	·	·	1	·	·
Aegilops	·	·	·	·	·	·	·	·	·	2	·	1	2	·
Avena	·	·	·	·	½	1	·	·	1	1	·	14	5	1
Bromus spec.	·	·	·	·	·	·	·	·	2	½	·	4½	·	·
Bromus sterilis	·	·	·	·	·	·	·	·	·	·	·	1	·	·
Echinaria	·	·	1	·	1	·	5	3	1	7	1	25	7	5
Eremopyron	·	·	·	1	·	·	1	·	·	·	2	1	1	2
Hordeum spec.	·	·	·	·	·	·	·	·	·	·	·	3	·	·
Lolium spec.	½	·	·	3	·	6	6	19	75	8	7	100	49	6
Lolium temulentum	·	·	·	1	·	2	2	·	·	4	1	32	60	13
Phalaris	·	·	·	·	·	·	·	·	·	1	·	·	1	·
Stipa	·	·	·	·	¼	·	·	·	½	½	·	·	·	·
Gramineae type A	·	·	·	·	·	·	·	1	3½	3½	·	10	4	·
Gramineae indet.	·	·	·	2	·	2	5	·	4	2	2	15	3	13
Gramineae fragments	·	·	·	·	·	·	·	·	+	+	·	+	+	·
Teucrium-type	2	·	·	1	·	·	·	1	1	2	·	1	2	·
Ziziphora	·	·	·	·	·	·	·	·	·	·	·	382	394	47
Astragalus	116	3	17	3	13	20	24	14	172	147	9	·	·	1
Coronilla	·	1	·	·	·	·	·	·	4	2	1	32	14	8
Medicago spec.	·	·	·	2	3	5	5	3	1	10	3	3	5	1
Medicago radiata	2	·	·	·	·	1	·	·	7	2	·	13	17	1
Melilotus	·	·	·	·	·	1	·	·	2	4	·	·	10	
Onobrychis	·	·	·	·	·	·	·	·	·	·	·	22	35	4
Trigonella astroites-type	69	·	13	·	14	3	8	4	67	133	4	84	32	6
Vicia spec.	·	·	·	2	·	·	10	7	1½	2	1	·	·	·
Vicia ervilia	·	·	·	·	·	·	·	·	·	·	·	·	·	·

II	II	II	II	II	II	II	II	I	I	I	I	I	I	Phase
3.70	3.90	4.05	4.35	4.55	4.75	4.95	5.05	5.25	5.35	5.40	5.55	5.60	5.70	Sample designation
·	½	·	·	·	2	1	1	·	·	·	·	·	·	Triticum boeoticum
·	6	8	4	·	31	14	14	·	·	·	·	·	·	Triticum monococcum
129	231	86	61	46	662	390	577	41	5	1	4	1	3	Triticum dicoccum
750	2200	500	350	117	1925	2000	1350	93	34	18	7	·	8	Triticum spikelet forks
350	2400	100	520	62	2725	2850	1850	77	28	12	·	·	15	glume bases
29	30	30	18	10	167	230	202	7	·	·	·	·	1	Triticum durum/aestivum
28	8	7	7	6	5	145	60	1	·	·	·	·	·	T.durum/aestivum internodes
	1	·	·	1	4	4	5	·	·	·	·	1	·	Hordeum spontaneum
19	11	7	14	7	114	86	72	4	2	·	·	2	·	Hordeum distichum
25	3	4	22	·	10	193	16	1	·	·	·	·	1	Hordeum internodes
·	·	1	·	·	10	13	5	1	·	·	·	·	·	Hordeum vulgare var. coeleste
·	·	·	·	·	·	·	·	·	·	·	·	·	·	Hordeum vulgare internode
535	595	270	132	157	1080	1238	874	92	42	14	22	8	9	Cereal grain fragments
1	4	4	1	4	10	11	16	2	·	12	5	4	2	Pisum
27	15	4	6	6	140	98	82	5	7	15	10	8	7	Lens
1	1	·	·	·	5	3	1	·	·	·	·	·	·	Cicer
6	5	2	1	·	32	44	24	1	·	·	1	2	·	Linum usitatissimum
6	½	1	7½	1	25	23	14	·	·	6	·	½	+	Pistacia
8	6	1	·	·	1	·	3	·	·	·	·	·	·	Lithospermum arvense
14	1	·	·	2	13	20	7	·	9	1	23	14	4	Lithospermum tenuiflorum
·	·	·	·	·	5	1	1	·	·	·	·	·	·	Heliotropium
1	·	·	1	·	·	·	·	·	·	·	·	·	·	Cerastium-type
·	1	·	3	·	4	7	3	·	·	·	·	·	·	Silene spec.
·	·	·	1	·	·	·	·	·	·	·	·	·	·	Silene colorata-type
1	1	·	·	·	3	6	4	·	·	·	·	·	·	Vaccaria pyramidata
·	·	1	85	1	18	25	36	·	·	·	·	·	·	Helianthem ledifolium-type
·	·	·	·	·	·	·	·	·	·	·	·	·	·	Helianthemum salicifolium-type
1	·	·	·	·	·	1	·	·	·	·	·	·	·	Centaurea
·	2	·	·	·	·	·	·	·	·	·	·	·	·	Convolvulus
1	·	·	·	·	·	2	·	1	·	·	·	·	·	Carex cf. divisa
8	·	·	·	·	1	·	·	1	·	·	·	·	·	Scirpus maritimus
	·	·	·	·	·	·	·	·	·	·	·	·	·	Scirpus tabernaemontani-type
	·	·	·	·	·	·	·	·	·	·	·	·	·	Cephalaria syriaca
	·	·	·	·	·	·	1	·	·	·	·	·	·	Aegilops
2	6	3	·	1	1	9	23	3	·	½	·	·	·	Avena
	4½	·	·	·	13	6	8	·	·	·	·	·	·	Bromus spec.
½	·	·	·	·	1	·	·	·	·	·	·	·	·	Bromus sterilis
2	5	·	3	1	9	18	8	·	·	·	·	1	·	Echinaria
1	2	·	·	·	6	·	1	·	·	·	·	·	·	Eremopyron
	1	·	·	·	·	·	1	·	·	·	·	·	·	Hordeum spec.
46	75	50	3	11	165	165	170	10	4	1	1	2	2	Lolium spec.
24	50	39	1	·	40	20	35	·	1	·	·	·	·	Lolium temulentum
	1	1	·	1	·	5	5	·	·	·	·	·	·	Phalaris
	·	·	·	·	·	·	·	·	·	·	·	·	·	Stipa
11	6	·	2	·	17	17	18	1	·	·	·	·	·	Gramineae type A
5	8	2	5	·	11	6	5	1	1	·	·	·	·	Gramineae indet.
	·	·	+	·	+	+	+	·	·	·	·	·	·	Gramineae fragments
1	·	·	·	·	1	·	·	·	·	·	·	·	·	Teucrium-type
1	·	·	·	·	·	·	·	·	·	·	·	·	·	Ziziphora
892	70	72	72	8	86	134	87	43	2	·	·	·	·	Astragalus
1	·	·	·	·	·	·	·	·	·	·	·	·	·	Coronilla
10	6	2	14	6	31	19	24	6	·	·	·	·	·	Medicago spec.
13	7	3	1	·	16	4	11	·	2	1	·	1	·	Medicago radiata
4	4	13	·	4	40	35	51	3	1	2	1	·	·	Melilotus
2	·	·	·	·	1	·	3	·	·	·	·	·	·	Onobrychis
65	9	6	23	·	16	86	21	2	·	1	·	·	1	Trigonella astroites-type
4	4	1	4½	5	49	21	28	4	1	6	·	·	·	Vicia spec.
	·	·	·	·	·	·	·	·	1	·	·	1	·	Vicia ervilia

Table 5 (continued).

Phase Sample designation C8	II 1.10	II 1.20	II 1.55	II 1.65	II 1.70	II 1.90	II 2.25	II 2.45	II 2.70	II 2.95	II 3.15	II 3.35	II 3.55	II 3.60
Leguminosae indet.	·	·	·	1	·	·	2	·	·	4	·	·	5	·
Bellevalia	·	·	1	1	·	1	1	·	3	4	1	9	9	·
cf. Ornithogalum	1	1	3	4	5	4	9	5	17	52	·	194	87	14
Liliaceae indet.	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Malva	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Ficus	·	·	·	1	·	·	4	·	·	2	2	37	1	7
Fumaria densiflora-type	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Glaucium aleppicum-type	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Plantago lagopus-type	·	·	·	·	·	·	1	·	1	·	·	·	·	1
Plantago psyllium-type	·	·	·	·	·	·	·	·	·	·	·	1	·	·
Polygonum venantianum-type	·	·	·	·	·	·	·	1	·	·	·	1	·	·
Rumex pulcher	·	·	·	·	·	·	·	·	1	·	·	3	2	·
Rumex spec.	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Androsace maxima	·	·	·	·	2	·	·	·	16	89	·	26	3	1
Adonis	·	·	1	·	·	1	1	·	·	1	·	·	·	1
Amygdalus	·	·	+	2½	·	+	2	1	½	½	·	+	⅔	+
Crataegus	·	·	·	1	1	1	2	2	4	7	·	1½	2	·
Pyrus	·	·	·	·	·	·	·	·	·	·	·	+	·	·
Galium mollugo	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Galium spec.	·	·	1	6	2	3	7	2	1	·	·	11	3	2
Ammi majus	·	·	·	·	·	·	·	·	·	·	·	5	2	·
Bifora	·	·	·	·	1	·	·	1	·	·	·	·	·	·
Bupleurum spec.	·	·	·	·	·	·	·	·	·	1	·	·	·	·
Torilis nodosa-type	·	·	·	·	·	·	·	·	·	·	·	14	1	·
Umbelliferae indet.	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Unidentified	·	·	·	·	·	·	8	1	8	15	·	+	19	7

seeds or of poor preservation, this sample was rejected and another sample from about the same depth was chosen for examination. It has already been mentioned that in the upper one to two metres of the deposit the distinction between phase II levels and phase III disturbances was not always clear on the exposed surface during sampling. No phase II samples from above 1 m were examined and from the samples between 1 and 2 m below the surface only those that could safely be attributed to phase II levels were selected. The location of the samples examined is transferred to the drawing of the section along the south balk (fig. 7). Moreover, these samples are listed in table 2. Similarly, the M4NE samples that have been examined are listed in table 2, and the location of these samples is indicated on the drawing of the section along the west balk (fig. 9). In this case the result is less satisfactory than for the C8SE samples because various M4 samples were taken at quite some distance from the west balk, so that there is no correspondence between the stratigraphy of the section and the situation at the sampling spot. Thus, in the west section, shown in fig. 9, the virgin soil is reached at 4.10 m, whereas at other places of the M4NE quadrant the basaltic surface goes down to 4.75 m (de Contenson & van Liere, 1966).

As for the phase III samples, the fill of the pits of this phase is at least of mixed origin (2.4.) and part, if not most of the charred vegetable material in these ash pits is of phase II origin. A palaeobotanical examination of these samples is only meaningful in that it may result in seed or fruit types not present in the older deposits. For instance, other crop plants could have been grown by the phase III inhabitants. Seven samples from the fill of the large pit in C8NW were included in the examination (fig. 8). The phase III samples are discussed in 7.5.

In the discussion of the vegetable material (sections 4–7), the samples from C8SE are simply indicated as (Ramad) C8, and those from M4NE as (Ramad) M4. Only for the phase III samples it is indicated that they are from the NW quadrant (C8NW). Another

II	II	II	II	II	II	II	II	I	I	I	I	I	I	Phase
3.70	3.90	4.05	4.35	4.55	4.75	4.95	5.05	5.25	5.35	5.40	5.55	5.60	5.70	Sample designation
·	1	·	4	·	8	7	9	·	·	3	·	·	·	Leguminosae indet.
·	165	59	1	·	18	14	10	1	·	·	·	·	·	Bellevalia
·	126	53	49	38	118	215	140	25	1	·	·	1	½	cf. Ornithogalum
·	·	·	·	·	·	·	6	·	·	·	·	·	·	Liliaceae indet.
·	·	·	·	·	·	·	1	·	·	·	·	·	·	Malva
·	1	1	3	·	29	9	14	1	4	5	75	25	12	Ficus
·	·	·	·	·	·	·	1	·	·	·	·	1	·	Fumaria densiflora-type
1	·	·	·	·	·	·	·	·	·	·	·	·	·	Glaucium aleppicum-type
·	·	·	·	·	·	·	·	·	·	·	·	·	·	Plantago lagopus-type
·	·	·	1	·	·	·	·	·	·	·	·	·	·	Plantago psyllium-type
·	·	·	·	·	·	1	·	·	·	·	·	·	·	Polygonum venantianum-type
2	·	·	2	·	·	1	4	·	·	·	·	·	·	Rumex pulcher
·	·	·	·	·	2	1	1	1	·	·	·	·	·	Rumex spec.
19	1	1	58	·	16	26	23	2	·	·	·	·	·	Androsace maxima
2	·	·	·	2	1	1	1	·	·	·	·	·	·	Adonis
+	+	·	½	+	⅔	⅔	½	·	·	+	·	·	+	Amygdalus
11	1	1	13	½	35	19	13	3	1	1	·	·	+	Crataegus
·	·	·	·	·	·	·	·	·	·	·	·	·	·	Pyrus
·	·	·	·	·	·	1	·	·	·	·	·	·	·	Galium mollugo
·	·	·	2	1	20	11	10	1	·	·	·	·	·	Galium spec.
·	·	·	·	1	1	5	·	·	·	·	·	·	·	Ammi majus
·	·	·	·	·	·	·	·	·	·	·	·	·	·	Bifora
·	·	·	·	·	·	·	·	·	·	·	·	·	·	Bupleurum spec.
1	·	·	2	·	1	4	1	·	·	·	·	·	·	Torilis nodosa-type
·	·	·	1	·	·	·	·	·	·	·	·	·	·	Umbelliferae indet.
7	4	1	6	2	6	+	8	·	·	·	·	·	·	Unidentified

simplification is that only one figure is given for the depth. Thus, if, for instance, a sample is from 3.30–3.40 m this is indicated as 3.35.

One may perhaps wonder why during the campaigns after 1965 no palaeobotanical samples were taken. In this respect the following should be remarked. Many more samples had already been collected than could ever be coped with. At the time the possible relation between sample composition and archaeological feature was not yet an important issue, so that this was no impetus to take samples during succeeding field campaigns. The analysis of the Ramad samples had a slow start due to other research commitments of the first author. It was not until 1973 that the systematic examination of Ramad could begin and more progress was made. When the need was felt for samples from distinct archaeological features, excavations at Ramad had come to an end.

The samples selected for analysis have, with one exception, been examined completely. The numbers of seeds, fruits and other vegetable remains recovered are shown in tables 5, 6 and 7.

3.2.2. *Aswad*

In 1973, H. de Contenson submitted a number of small soil samples from Aswad to the first author for botanical examination. These samples yielded some charred seeds and other plant remains, suggesting that more detailed palaeobotanical research could provide valuable information on the plant husbandry of Aswad. To that end two series of soil samples were collected by the first author in April 1975. There was no other choice than taking samples from sections exposed in the soundings excavated in 1971 and 1972 (2.2.). From the north balk of Aswad East, samples of c. 26 litres in volume (two baskets) were taken at intervals of 20 to 30 cm. At Aswad West, the east balk was sampled at 20 cm intervals; in this case the volume of each sample was about 13 litres (one basket). Prior to sampling the balks had been cleaned.

The samples were floated near the site. Water was supplied by a pump which serves to pump up irrigation water for the fields. The samples are listed in table 3. All samples collected at Aswad have been analysed. With

Table 6. Numbers of seeds, fruits and other plant remains in samples from Ramad, C8NW quadrant (phase III). Of C8NW 2.15, only ¼ of the sample has been examined.

Sample designation C8NW	0.65	1.25	1.55	1.95	2.15	2.40	2.45
Triticum monococcum	·	1	1	1	·	1	2
Triticum dicoccum	1	4	5	76	8	13	72
Triticum spikelet forks	53	148	180	285	144	106	470
glume bases	132	730	1200	750	1100	263	1500
Triticum durum/ aestivum	·	1	2	10	3	5	7
T.durum/aestivum internodes	·	·	2	2	1	·	·
Hordeum spontaneum	·	·	·	1	1½	·	2
Hordeum distichum	1½	3	4	24	9	6	20
Hordeum internodes	·	12	2	12	21	·	3
Hordeum vulgare var. coeleste	·	·	·	1	3	·	1
Cereal grain fragments	11	34	77	105	46	23	147
Pisum	·	4	5	4	3	4	8
Lens	3	10	16	16	5	4½	24
Cicer	·	1	·	1	·	·	·
Linum (usitatissimum)	·	·	·	·	·	1	2
Pistacia	⅓	6½	2½	18	4	2	5
Lithospermum arvense	1	·	·	·	·	·	2
Lithospermum tenui- florum	·	·	·	2	·	1	1
Silene spec.	·	2	1	1	·	·	·
Vaccaria pyramidata	·	·	·	4	·	1	·
Helianthemum ledifolium-type	·	71	12	1	9	47	·
Alyssum	·	·	1	·	·	·	·
Scirpus maritimus	1	7	2	1	·	1	1
Scirpus tabernae- montani-type	·	·	13	·	·	·	·
Cephalaria syriaca	·	·	·	1	·	·	·
Aegilops	·	·	·	·	·	·	+
Avena	·	·	1	·	1	·	·
Bromus spec.	·	·	·	·	·	1	·
Echinaria	·	5	4	1	·	2	·
Eremopyron	·	·	·	4	½	·	·
Lolium spec.	1	2	4	5	1	3	14
Lolium temulentum	·	·	·	1	3	1	2
Phalaris	·	1	·	·	1	·	·
Stipa	·	·	·	·	1	·	·
Gramineae type A	·	·	·	·	·	2	·
Gramineae indet.	·	3	·	12	2	·	1
Teucrium-type	1	1	½	·	1	·	·
Ziziphora	·	1	·	·	·	·	·
Astragalus	5	28	17	4	8	21	4
Coronilla	·	·	·	·	1	1	·
Medicago spec.	·	8	3½	5	2	5	11
Medicago radiata	·	3	·	·	1	1	·
Melilotus	·	6	5	·	1	1	·
Onobrychis	·	·	·	·	1	·	·
Trigonella astroites- type	2	41	9	1	4	13	·
Vicia ervilia	·	·	·	·	2	·	1
Vicia spec.	·	5	4	11	1½	3	3
Leguminosae indet.	·	6	·	·	·	13	1
Bellevalia	·	·	·	·	·	1	11

Table 6 (continued).

Sample designation C8NW	0.65	1.25	1.55	1.95	2.15	2.40	2.45
cf. Ornithogalum	1	7	4	21	9	3	11
Ficus	·	4	1	·	·	6	5
Androsace maxima	·	·	·	2	·	4	1
Amygdalus	+	⅓	1½	1	+	+	+
Crataegus	·	+	·	2	+	1½	·
Galium spec.	·	10	2½	6	2	·	3
Ammi majus	·	1	·	·	·	·	·
Bifora	·	·	1	·	·	·	·
Torilis nodosa-type	·	·	·	1	·	·	·
Unidentified	·	7	+	5	2	25	7

regard to the numbers of seeds and fruits presented in table 8 the following should be remarked. For unknown reasons the sorting of the samples had not been carried out accurately enough. Particularly small seeds and other small plant remains, such as glume bases and spikelet forks, had only partly been retrieved. Thus, it was decided to examine the sample residues again. Part of the samples were re-examined completely; of the large samples usually 1/2 to 1/10 of the volume was re-examined. If part of the sample had been re-examined, the numbers of plant remains recovered were converted to obtain the total numbers for that sample before the results of the first and second examination were added together. The latter implies that the numbers of seeds, fruits and other plant remains shown in table 8 may be higher than the numbers actually recovered. For example, for Aswad West 2.00, 60 fruits of *Ziziphora* are listed, whereas only 6 specimens were retrieved (from 1/10 of the sample re-examined).

3.2.3. *Ghoraifé*

After the sampling at Aswad had been completed, a series of samples was taken at Ghoraifé in April 1975. In 1974, a test pit had been carried down to the virgin soil by H. de Contenson (2.3.). The north balk of this sounding was sampled at 20 cm intervals. Flotation of the samples, c. 13 litres in volume (1 basket), was carried out in the Barada river, a few km to the south of the site. The samples are listed in table 4.

Although the transition between phases I and II is laid at 3.50 m by the excavator, the sample at 3.60 m is attributed to phase II

Table 7. Numbers of seeds, fruits and other plant remains in samples from Ramad, M4NE quadrant.

Phase		II	II	II	II	II	I	I	I	I	I	I	I
Sample designation	M4	1.75	1.80	1.90	2.10	2.30	2.80	3.00	3.10	3.45	3.65	4.05	4.30
Triticum boeoticum		2	2	1	·	1	·	2	·	·	·	2	·
Triticum monococcum		24	5	3	8	5	4	1	2	2	5	5	1
Triticum dicoccum		372	150	98	119	97	54	9	23	19	61	46	14
Triticum spikelet forks		2250	665	700	1100	250	70	50	106	240	380	390	32
glume bases		2550	800	1000	1500	350	24	60	62	200	190	520	24
Triticum durum/aestivum		62	322	145	10	43	·	1	·	·	1	·	2
T.durum/aestivum internodes		20	2	23	13	1	·	·	·	·	1	·	·
Hordeum spontaneum		·	·	·	·	·	·	·	1	·	·	3	·
Hordeum distichum		51	28	32	31	63	·	·	4	5	1	9	1
Hordeum internodes		69	14	23	34	18	1	·	·	1	1	·	1
Hordeum vulgare var. coeleste		·	1	1	2	1	·	·	·	·	·	·	·
Cereal grain fragments		1499	174	461	776	46	99	1	64	36	103	51	85
Pisum		5	1	4	10	7	·	·	·	·	·	·	·
Lens		7	7	21	11	39	1	2	1	2	4	13	·
Cicer		·	·	1	·	5	·	·	·	·	·	·	·
Linum usitatissimum		80	9	5	5	8	1	1	1	4	5	13	3
Pistacia		6	5	22	+	3	1	·	·	½	1	1	·
Lithospermum arvense		3	6	1	1	20	2	·	·	·	·	·	28
Lithospermum tenuiflorum		3	6	4	·	6	48	2	·	1	1	·	5
Heliotropium		·	1	·	·	·	·	·	·	·	·	·	·
Cerastium-type		4	·	·	·	·	·	·	·	·	·	·	·
Gypsophila-type		1	2	·	·	·	·	·	·	·	·	·	·
Silene spec.		26	39	21	1	8	2	·	·	·	·	·	·
Vaccaria pyramidata		3	1	·	·	1	·	·	·	·	·	1	·
Helianthemum ledifolium-type		215	31	20	6	1	1350	·	1	2	1	5	·
Crepis-type		2	2	·	·	·	·	·	·	·	·	·	·
Alyssum		3	·	·	·	·	·	·	·	·	·	·	·
Carex cf. divisa		·	1	2	·	·	·	·	·	·	·	·	·
Scirpus maritimus		·	·	·	1	·	·	·	·	·	·	·	·
Aegilops		·	1	·	·	·	·	·	·	·	·	·	·
Avena		7	3	2	7	3	·	·	·	·	·	·	·
Bromus spec.		2	2½	·	·	·	·	·	·	1	·	·	·
Echinaria		41	11	10	·	28	·	·	·	·	1	·	·
Eremopyron		13	1	2	6	·	·	·	·	·	·	·	·
Hordeum spec.		·	1	·	·	·	·	·	·	·	·	·	·
Lolium spec.		24	·	5	11	1	6	4	1	10	16	110	·
Lolium temulentum		36	18	9	15	105	2	1	·	·	5	13	23
Phalaris		1	1	1	·	·	·	·	1	·	·	·	1
Stipa		·	·	·	·	½	·	·	·	·	·	·	·
Gramineae type A		67	17	10	6	1½	·	1	·	2	2	·	·
Gramineae indet.		24	97	28	11	1	·	·	·	2	2	·	·
Gramineae fragments		+	+	+	·	+	·	·	·	·	·	+	·
Teucrium-type		1	·	1	·	·	·	·	·	·	·	·	·
Ziziphora		1	·	·	·	·	·	·	·	·	·	·	·
Astragalus		101	76	51	26	36	2639	23	7	22	·	1	1
Lathyrus cf. cicera		·	·	·	1	·	·	·	·	·	·	·	·
Medicago spec.		5	7	4	1	·	4	·	·	·	·	·	·
Medicago radiata		9	·	·	1	2	30	·	·	1	·	·	·
Melilotus		2	·	·	2	·	·	·	2	·	2	2	5
Onobrychis		1	·	1	·	·	·	·	·	·	·	·	·
Trigonella astroites-type		26	22	9	5	6	89	·	·	1	·	·	·
Vicia spec.		7	14	15	14	33	·	1	2	·	·	7	2
Leguminosae indet.		3	1	4	9	·	21	·	·	·	·	·	·
Bellevalia		7	1	1	·	·	·	·	·	1	1	3	·
cf. Ornithogalum		330	31	18	69	46	4	3	·	6	3	13	2
Ficus		3	10	18	3	·	4	·	1	·	2	1	1
Plantago spec.		·	1	·	1	·	·	·	·	·	·	·	·
Rumex pulcher		2	4	·	·	·	·	·	·	·	1	·	·

Table 7 (continued).

Phase		II	II	II	II	II	I	I	I	I	I	I	I
Sample designation	M4	1.75	1.80	1.90	2.10	2.30	2.80	3.00	3.10	3.45	3.65	4.05	4.30
Rumex spec.		3	1	·	1	·	·	·	·	·	·	·	·
Androsace maxima		18	10	1	·	6	133	1	·	·	·	·	·
Adonis		1	·	·	·	3	·	·	·	·	2	·	·
Amygdalus		1	+	1	+	+	·	·	+	⅔	+	2	·
Crataegus		4	8½	6	3	6	·	·	·	·	8	·	·
Crucianella		1	·	·	·	·	·	·	·	·	·	·	·
Galium spec.		1	·	1	·	·	·	·	·	·	·	·	·
Ammi majus		5	6	1	·	·	·	·	·	·	·	1	·
Torilis nodosa-type		20	2	·	·	·	·	·	·	·	·	·	·
Verbena		1	·	·	·	·	·	·	·	·	·	·	·
Unidentified		17	1	5	1	15	3	2	·	·	·	·	·

Table 8. Numbers of seeds, fruits and other plant remains from Aswad, soundings West and East. The numbers shown in this table may be higher than those actually recovered (see 3.2.2.).

	Aswad West													
Phase	II	II	II	II	II	II	II	II	II	II	II	II	II	II
Sample (depth below surface)	0.40	0.60	0.80	1.00	1.20	1.40	1.60	1.80	2.00	2.20	2.40	2.60	2.80	0.20
Triticum monococcum	·	·	·	·	1	3	·	3	1	3	·	·	·	2
Triticum dicoccum	8½	12	10	18	58	307	430	103	207	226	75	5	·	22
Triticum spikelet forks	42	40	59	53	309	446	1901	390	987	1003	129	24	3	65
glume bases	61	48	102	84	302	900	1708	500	2907	2042	265	58	5	196
Triticum durum/aestivum	1	1	·	·	·	22	42	5	24	32	·	·	·	
T.durum/aestivum intern. fragm.	·	·	·	·	·	·	1	·	·	·	·	·	·	
Hordeum spontaneum/distichum	3	4	8	5	3	55	90	46	43	62	5½	·	·	1½
Hordeum vulgare var. coeleste	·	1	·	·	·	9	2	1	·	·	·	·	·	
Hordeum internode fragments	3	10	7	2	15	16	55	60	50	14	·	·	·	
Cereal grain fragments	61	57	61	80	276	359	1311	338	1676	2100	493	70	5	92
Pisum	½	2	·	2	1	2	·	·	2	5	1	2	·	
Lens	·	1	1	1	4	1	3	2	·	1	3	1	·	
Linum (usitatissimum)	·	·	·	·	13½	·	·	·	·	·	2	·	·	
Aizoon	1	1	·	·	·	·	·	·	·	·	·	·	·	
Pistacia	2	2	1	½	1	+	½	3½	2	4	1½	2	+	+
Arnebia decumbens	1	·	·	·	·	·	·	·	·	·	·	·	·	13
Lithospermum arvense	·	·	·	·	5	3	1	2	2	2	1	·	·	
Lithospermum tenuiflorum	1	5	11	2	·	4	·	·	5	10	2	1	·	2
Capparis	·	·	·	·	·	·	4	2	1	4	7	1	·	
Arenaria-type	1	·	·	·	·	·	·	·	·	·	·	·	·	
Silene spec.	·	·	:	·	3	1	·	1	·	·	·	·	·	
Vaccaria pyramidata	·	·	·	·	·	2	6	4	2	·	·	·	·	
Atriplex	·	·	·	·	·	·	·	·	·	·	·	·	·	
Suaeda	·	·	·	·	·	·	·	·	·	·	·	·	·	
Chenopodiaceae indet.	·	1	·	·	·	9	·	·	·	·	·	·	·	
Carthamus	·	·	·	·	·	·	·	·	·	·	·	·	·	
Centaurea	·	·	·	·	·	·	·	1	·	·	·	·	·	
Carex cf. divisa	9	38	3	3	9	40	107	82	729	824	53	15	·	2
Scirpus maritimus	8	12	1	1	6	149	284	137	169	112	35	3	1	3
Avena	·	·	·	·	·	1	3	·	2	3	·	·	·	
Bromus spec.	½	·	·	½	·	2	18	41	14	6	½	1	·	
Echinaria	1	1	·	·	·	1	·	6	10	·	5	·	·	
Eremopyron	·	·	·	·	1½	1	2	2	2	·	·	·	·	
Hordeum spec.	·	·	1	·	·	15	5	3	5	1	·	·	·	
Lolium spec.	·	½	2	9	17½	79	148	129	694	661	17	6½	·	7
Phalaris	7	12	·	1	7	42	75	56	151	165	73	6	·	1

because the charred vegetable content of the sample compares with the other samples of this phase and not with those of phase I (table 9). The uppermost metre has not been sampled because of post-Neolithic disturbances (2.3.). The samples at 1.20–1.80 m have been taken from seemingly undisturbed layers, although one cannot be absolutely certain in this respect. The seed content of these samples does not suggest contamination.

In 1974, 10 small samples consisting of a few litres of soil had been collected by H. de Contenson at 50 cm intervals. These samples have also been included in the examination. All Ghoraifé samples have been analysed (tables 9 and 10).

4. CROP PLANT REMAINS

4.1. Emmer wheat

Triticum dicoccum Schübl.(emmer wheat) is one of the oldest cultivated plants in the Damascus basin. Already from the lowest habitation levels at Aswad remains of *Triticum dicoccum* were recovered. We are

Aswad East																
II	II	II	II	II	II	II	Ib	Ib	Ib	Ia	Ia	Ia	Ia	Ia	Ia	Phase
0.40	0.60	0.80	1.00	1.20	1.40	1.60	1.80	2.00	2.20	2.40	2.70	2.90	3.10	3.30	3.60	Sample (depth below surface)
			2			2										Triticum monococcum
25	52	92	108	82	30	34	1½	1	1½	4	2	7	6		½	Triticum dicoccum
87	133	306	415	392	162	222	28	8	4	6	14	21	8		21	Triticum spikelet forks
271	336	938	1558	574	422	468	68	21	15	52	105	58	50	3	44	glume bases
1			3	14	6											Triticum durum/aestivum
																T.durum/aestivum intern. fragm.
		2	3	6	35	9	2			2		15	7		4	Hordeum spontaneum/distichum
				1	1											Hordeum vulgare var. coeleste
	3	4			57	12	5		1	1	7	9				Hordeum internode fragments
130	228	362	432	274	296	122	35	9	18	16	50	103	23	16	11	Cereal grain fragments
				4	14			1½		3	5	25	3	1		Pisum
				2	1		2				3	1				Lens
																Linum (usitatissimum)
																Aizoon
+	+	+		2		½	3½	½	2½	5	22	17	8	1½	4	Pistacia
3																Arnebia decumbens
				1							1½	2				Lithospermum arvense
				4	3		5									Lithospermum tenuiflorum
							1	3								Capparis
																Arenaria-type
																Silene spec.
																Vaccaria pyramidata
								12				4				Atriplex
																Suaeda
																Chenopodiaceae indet.
																Carthamus
																Centaurea
		3	10	27	29	8	9	15	4	15	4	2	6	7	1	Carex cf. divisa
6	8	9	25	31	17	8	7	25	4	8	54	36	11	1	16	Scirpus maritimus
						1										Avena
	¼		4	2	10½	4	1					½				Bromus spec.
												1				Echinaria
	½							½								Eremopyron
					1											Hordeum spec.
2	5	24	32	5	2½											Lolium spec.
			2	3	29	5						3			1	Phalaris

Table 8 (continued).

	Aswad West												
Phase	II	II	II	II	II	II	II	II	II	II	II	II	II
Sample (depth below surface)	0.40	0.60	0.80	1.00	1.20	1.40	1.60	1.80	2.00	2.20	2.40	2.60	2.80
Gramineae type A	·	·	·	·	·	·	1	·	9	4	·	·	·
Gramineae indet.	·	1	·	½	3	12	7	17	14	18	·	1	·
Ziziphora	·	·	·	·	·	·	·	·	60	·	5	·	·
Astragalus	·	1	·	·	6	3	44	6	1	8	6	·	·
Medicago spec.	·	·	·	·	·	·	·	1	·	·	·	·	·
Medicago radiata	3	1½	2	1	·	11	15	4	1	17	9	2	·
Melilotus	3	5	4	·	11	·	·	·	·	·	·	·	·
Onobrychis	·	·	·	·	·	·	·	·	·	·	·	·	·
Trigonella astroites-type	44	162	17	·	7	52	178	26	60	182	145	5	1
Vicia ervilia	·	·	·	·	·	·	·	·	·	·	·	·	·
Vicia spec.	4	5	5	½	6	6	8	5	44	52	12	2	1
Leguminosae indet.	·	·	·	·	1	2	·	2	·	·	6	·	·
Bellevalia	·	·	·	·	·	·	1	1	·	3	2	·	·
cf. Ornithogalum	1	1	·	1	8	1	10	·	·	·	·	·	·
Ficus	·	13	66	·	·	·	30	3	1	·	·	·	·
Fumaria densiflora-type	·	·	·	·	·	1	·	·	·	·	·	·	·
Polygonum venantianum-type	8	12	·	1	·	18	110	44	11	19	43	3	1
Rumex pulcher	·	·	·	·	·	·	·	·	1	·	·	·	·
Androsace maxima	·	·	·	·	·	·	·	·	·	·	·	·	·
Adonis	·	·	·	·	·	1	½	·	·	1	·	·	·
Amygdalus	·	·	·	·	·	·	·	·	·	·	·	·	·
Crataegus	·	·	·	·	+	·	·	·	·	·	·	·	·
Rubus	·	·	·	·	·	·	·	·	·	1	·	·	·
Galium	·	·	1	·	1	2	3	1	·	·	·	·	·
Thymelaea	·	1	·	·	·	·	·	·	·	·	·	·	·
Vitis	·	·	·	·	·	·	·	·	·	4	·	·	·
Unidentified	10	11	·	7	3	12	63	·	31	3	45	7	·

concerned here with the morphologically-defined domestic species. No remains of wild emmer wheat, *Triticum dicoccoides* Körn., have been found at Aswad (or Ghoraifé and Ramad), suggesting that the fully domesticated species was introduced into the Damascus basin.

The present distribution of wild emmer wheat could indicate that the early Neolithic emmer wheat of Aswad originated from the area to the south and southwest of the Damascus basin. On the slopes of Eastern Galilee and Gilead, on the basaltic plateaux of Golan and Hauran, and on the eastern slopes of Mount Hermon wild emmer wheat is locally common. One could speculate that in that region wild emmer wheat was taken into cultivation and that subsequently the domesticated form was brought to other areas. The presence of domestic emmer wheat in layers dated to 7800 B.C. (^{14}C years) suggests that at the beginning of the eighth millennium B.C. plant cultivation must have been well under way in the southern Levant.

Triticum dicoccum must have constituted a major crop plant of the Neolithic farmers in the Damascus basin. The proportions of emmer wheat among the seeds and fruits of cultivated plants are usually large (see 7.1.2.) and particularly samples from Ramad yielded great numbers of *Triticum dicoccum* kernels. The shape and the size of the emmer wheat grains show a considerable variation. Distinct differences in size and shape of emmer wheat grains between samples have not been noticed, but in one and the same sample the whole array of shapes may be found. This finds expression to a certain extent in the dimensions and index values obtained for *Triticum dicoccum* grains from four Ramad samples (table 11).

In spite of the rather great numbers of emmer wheat grains in the samples concerned, only 52 and 62 specimens have been measured in samples M4 1.75 and C8 3.35, respectively. This is due to the generally rather poor preservation of the kernels. There are many

Aswad East																
II	II	II	II	II	II	II	Ib	Ib	Ib	Ia	Ia	Ia	Ia	Ia	Ia	Phase
0.40	0.60	0.80	1.00	1.20	1.40	1.60	1.80	2.00	2.20	2.40	2.70	2.90	3.10	3.30	3.60	Sample (depth below surface)
·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	Gramineae type A
3	½	3	·	5	1	·	·	·	·	5	2½	13	1½	·	2	Gramineae indet.
·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	Ziziphora
·	·	·	2	5	·	2	·	38	·	2	·	·	·	·	1	Astragalus
·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	Medicago spec.
1	·	3	2	4	1	7	1	28	·	·	·	·	·	·	·	Medicago radiata
1	1	3	4	16	6	·	2	·	·	·	·	·	·	·	1	Melilotus
·	·	·	·	·	·	·	·	1	·	·	·	·	·	·	·	Onobrychis
1	5	4	10	22	21	39	5	409	3	10	235	36	40	8	11	Trigonella astroites-type
·	·	·	·	·	·	·	·	·	·	1	·	·	·	·	·	Vicia ervilia
·	1	·	·	4	10	6	2	3	·	9	16	14	2	1½	2	Vicia spec.
1	·	·	·	·	·	·	·	·	·	·	4	2	·	·	·	Leguminosae indet.
·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	Bellevalia
·	·	·	·	1½	·	2	1	6	·	·	·	·	·	·	·	cf. Ornithogalum
·	·	·	·	·	·	1	4	8	3	50	25	69	28	·	10	Ficus
·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	Fumaria densiflora-type
·	·	3	14	3	6	2	4	91	·	·	5	6	1	1	·	Polygonum venantianum-type
·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	Rumex pulcher
·	·	1	2	1	·	·	·	1	·	·	·	·	·	·	·	Androsace maxima
	·	·	·	·	·	·	·	½	·	·	1	·	+	·	·	Adonis
	·	·	·	·	·	·	·	·	·	·	·	+	·	·	·	Amygdalus
	·	·	1	·	·	·	·	·	·	·	·	·	·	·	·	Crataegus
	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	Rubus
	·	·	1	1	·	·	·	1	·	¼	·	·	·	·	·	Galium
	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	Thymelaea
	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	Vitis
	5	1	18	18	6	7	18	+	1	7	12	+	·	·	10	Unidentified

damaged grains of which only 1 or 2 dimensions could have been taken, and, moreover, various kernels have been more or less seriously deformed by the carbonization. As a rule, only reasonably well preserved grains have been selected for measurement. This does not imply that the shape of these grains has not at all been affected by the carbonization. Not only for emmer wheat, but also for the other cereal species the numbers of grains that were suitable for measurement are relatively small.

In addition to the more or less normally developed emmer wheat grains, conspicuously small specimens were found. These grains do not make the impression of being under-developed in the sense of not full-grown, but they may have been formed under less favourable conditions, *e.g.* in a basal spikelet of the ear or on a plant which did not grow well. These small grains which occur also with the other cereals have not been included in the measurements. For Ramad C8 4.75 the effect of small grains on the dimensions and index values of the whole of a sample has been determined. Of this sample, in addition to 101 grains of normal size, 15 small specimens have been measured. The dimensions and index values for C8 4.75 are shown, the small grains being included (N=116) and not being included (N=101) (table 11). As could be expected, the small specimens bring about a decrease of the minimum and average dimensions. The effect of the modest number of small grains on the average dimensions is certainly not negligible. The comparatively high L/B index values of the small grains cause a higher mean L/B index value.

There are no conspicuous differences between the dimensions and index values of the emmer wheat grains in the Ramad samples of table 11. Samples C8 4.75 and C8 5.05 for which the greatest numbers of grains could be measured show mostly a somewhat greater amplitude between minimum and maximum values than the other two samples. For the

Table 9. Ghoraifé 1975. Numbers of seeds, fruits and other plant remains in samples from Ghoraifé, north balk of sounding C. Samples collected in 1975.

Phase	II	II	II	II	II	II	II	II	II	II	II	II	II	I	I	I	I	I	I	I	I	I	I	I	I
Sample (depth below surface)	1.20	1.40	1.60	1.80	2.00	2.20	2.40	2.60	2.80	3.00	3.20	3.40	3.60	3.80	4.00	4.20	4.40	4.60	4.80	5.00	5.20	5.40	5.60	5.80	6.00
Triticum monococcum	2	·	·	·	·	·	3	5	·	·	·	·	3	·	·	·	·	·	·	·	·	·	·	·	·
Triticum dicoccum	1	5	11	·	7	11	11	16½	2	6	4	10	10	1½	·	1	1½	·	·	·	1	·	·	·	·
Triticum spikelet forks	14	4	44	2	25	29	37	49	1	8	18	36	74	11	1	3	3	·	3	·	·	·	1	1	3
glume bases	21	6	58	7	44	58	51	51	8	19	50	41	84	14	·	·	5	1	4	1	·	·	4	2	2
Triticum durum/aestivum	6	·	6	·	5	1	11	13	·	3	·	3	·	·	·	·	·	·	·	·	·	·	·	·	·
T.durum/aestivum internodes	·	1	2	1	1	1	1	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Hordeum spontaneum/distichum	1	·	5	·	·	·	·	1	·	1½	·	1	1	·	·	·	·	·	·	·	·	2	1	·	·
Hordeum vulgare var. coeleste	·	1	·	·	2	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Hordeum internodes	·	4	·	·	4	·	·	3	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Cereal grain fragments	9	7	36	4	19	35	20	34	1	9	22	30	30	4	+	1	9	1	1	3	1	3	3	·	1
Pisum	·	1½	·	·	·	·	·	·	·	1	·	½	3	·	·	·	4	·	·	1½	1	2½	4	1	2
Lens	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	1	·	·	2	·	·	·	·	·
Cicer cf. arietinum	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	1	1	1	·	·	·	·	·
Linum (usitatissimum)	2	·	·	·	·	·	·	·	·	1	1½	6	4	·	·	·	·	·	1	1	·	·	1	·	·
Pistacia	·	·	+	·	·	·	·	+	·	+	·	+	+	+	+	+	1	+	+	+	+	+	+	+	+
Arnebia decumbens	·	·	·	·	·	·	·	1	·	·	·	1	·	·	·	·	·	·	·	·	·	·	·	·	·
Lithospermum arvense	·	·	·	·	·	·	·	6	·	·	·	2	6	·	5	4	10	·	·	·	1	1	2	·	·
Lithospermum tenuiflorum	·	·	·	·	·	·	·	1	·	·	·	·	1	·	·	1	2	2	·	·	·	·	2	·	·
Silene spec.	·	1	·	·	·	·	·	1	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Vaccaria pyramidata	·	·	·	·	·	·	·	1	·	·	·	·	2	·	·	·	1	·	·	·	·	·	·	·	·
Chenopodium	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	1	·	·	·	·	·
Suaeda	·	1	·	·	·	·	·	·	·	·	·	1	·	·	·	·	·	·	·	·	·	·	·	·	·
Carex cf. divisa	·	5	2	1	2	2	4	15	32	12	2	1	3	1½	1	1	3	·	1	·	1	·	3	·	·
Eleocharis	·	·	2	1	·	·	·	·	·	·	·	1	·	·	·	·	·	·	·	·	·	·	·	·	·
Scirpus maritimus	5	5	6	1	2	3	11	8	10	13	1	4	4	1	·	4	2	2	3	·	1	·	·	·	1
Avena	·	·	·	·	·	·	·	·	·	·	·	1	·	·	·	·	·	·	·	·	·	·	·	·	·
Bromus spec.	·	·	·	·	·	·	·	·	½	·	·	·	1	·	·	·	·	·	·	·	·	·	·	·	·
Echinaria	·	·	·	·	·	·	·	5	4	·	·	2	·	·	·	·	·	·	·	·	·	·	·	·	·
Lolium spec.	20	9	13	1½	18	12	11	5½	·	10	10	25	32	1	·	·	·	·	·	·	1	·	2	6	7
Phalaris	·	1	·	2	·	1	1	·	·	·	·	1	1	·	·	·	1	·	·	·	·	·	·	·	·
Gramineae indet.	·	·	1	·	½	2	·	·	·	·	5	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Astragalus	·	·	·	·	2	·	1	·	·	·	·	1	·	·	·	·	·	·	·	·	·	·	·	·	·
Medicago spec.	1	2	·	·	·	·	2	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Melilotus	10	·	3	6	14	6	16	91	9	18	24	52	42	·	1	1	·	·	·	·	·	·	·	·	·
Trifolium	·	·	·	·	·	·	·	1	2	·	·	·	2	·	·	·	·	·	·	·	·	·	·	·	·
Vicia ervilia	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	1	·	·	·	·	·	·	·	·
Vicia spec.	2	·	·	1	·	·	2	11	·	·	1	5½	7	·	·	1	5	2	·	1	2	1	1	2	4
Leguminosae indet.	2	·	·	·	·	2	5	·	1	2	2	4	8	·	·	·	·	·	·	·	·	·	·	·	·
Bellevalia	1	·	·	·	·	1	1	1	·	1	2	2	2	·	·	·	·	·	·	·	·	·	·	·	·
cf. Ornithogalum	1	1	4	·	4	3	2	8	·	2	1	3	3	1	·	·	·	·	·	·	·	·	·	·	·
Ficus	·	·	·	·	·	·	·	·	·	·	·	·	·	1	·	·	·	·	·	·	·	·	·	·	·
Plantago spec.	·	·	1	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Polygonum venantianum-type	·	·	·	·	·	·	·	·	·	·	·	·	2	·	1	·	·	·	1	2	·	·	·	·	·
Adonis	·	·	·	·	·	·	1	·	·	·	·	·	·	·	·	·	·	1	·	·	·	·	·	·	·
Crataegus	·	·	·	·	·	·	·	·	·	·	·	·	·	·	1	·	·	·	·	·	·	·	·	·	·
Galium spcc.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	1	·	·	·	·	1	1	·	·
Thymelaea	·	·	·	·	·	·	·	·	·	·	·	·	·	·	1	·	·	·	·	·	·	·	·	·	·
	·	·	·	·	·	·	·	4	1	·	1	3	2	·	·	1	·	1	·	·	1	·	2	·	·

Table 10. Ghoraifé 1974. Numbers of seeds, fruits and other plant remains in samples from Ghoraifé, sounding C. Samples collected in 1974.

Phase	II	II	II	II	I	I	I	I	I	I
Sample (depth below surface)	2.00	2.50	3.00	3.50	4.00	4.50	5.00	5.50	5.90	6.30
Triticum monococcum	·	2	·	1	·	·	·	·	·	·
Triticum dicoccum	2	8	2	7	·	·	·	·	1	·
Triticum spikelet forks	3	21	·	117	1	·	·	·	·	1
glume bases	7	38	4	120	2	·	3	·	·	·
Triticum durum/aestivum	3	2	·	6	·	·	·	·	·	·
Hordeum spontaneum/distichum	·	·	·	1	·	½	·	·	·	·
Cereal grain fragments	7	14	1	23	1	+	3	+	·	·
Pisum	·	·	·	·	1	1	·	·	·	·
Linum (usitatissimum)	·	5	·	1½	·	·	·	·	·	·
Pistacia	·	·	·	·	+	·	·	+	+	+
Arnebia decumbens	·	1	·	·	·	·	·	·	·	·
Lithospermum arvense	·	2	·	·	4	·	·	·	·	·
Lithospermum tenuiflorum	·	·	·	·	·	1	3	·	·	1
Carex cf. divisa	·	7	25	5	2	·	3	·	·	1
Eleocharis	·	1	·	1	·	·	·	·	·	·
Scirpus maritimus	1	2	8	1	r	2	·	1	½	1
Echinaria	·	·	4	·	·	·	·	·	·	·
Lolium spec.	3	9	4	33	·	·	·	·	2	·
Phalaris	·	1	·	·	·	·	·	·	·	·
Astragalus	·	1	·	2	·	·	·	·	·	·
Lathyrus cf. cicera	·	·	·	·	·	·	·	1	·	·
Melilotus	4	57	13	250	·	·	·	·	·	·
Trifolium	·	1	·	1	·	·	·	·	·	·
Trigonella spec.	·	·	·	1	·	·	·	·	·	·
Vicia spec.	·	½	1	·	·	2	1	2	·	·
Leguminosae indet.	·	2	·	1	·	·	·	·	·	·
Bellevalia	·	·	·	7	·	·	·	·	·	·
cf. Ornithogalum	·	2	·	4	·	·	·	·	·	·
Ficus	·	·	·	·	·	·	1	·	·	·
Polygonum venantianum-type	·	·	·	·	·	·	1	·	·	·
Galium spec.	·	·	·	·	1	·	·	·	·	·
Unidentified	·	2	·	·	1	·	·	·	·	·

first-named samples also frequency distribution graphs for the length and the L/B and T/B index values have been drawn (fig. 10). The lengths of the emmer wheat grains in both samples show largely similar frequency distributions. The L/B and T/B index value histograms are rather flattened out, indicating that no particular grain shape is dominant.

Although some Aswad samples yielded fair amounts of emmer wheat grains, only relatively few specimens were suitable for measuring (table 11). For Ghoraifé, with only small numbers of *Triticum dicoccum* grains, the measurements of grains of various samples have been taken together in table 11. It is striking that the Aswad emmer grains (phase II) are, on average, longer and more slender (higher L/B index values) than those from Ramad. One wonders whether this could indicate that the Aswad emmer wheat was still rather close to the wild form, *Triticum dicoccoides*. In this connection it may be mentioned that at early-Neolithic Cayönü, in southeastern Turkey, the *Triticum dicoccoides*-type grains have distinctly higher L/B index values than the *Triticum dicoccum*-type kernels. Of the small numbers of emmer wheat grains from phase I layers at Aswad none was suitable for measuring. The L/B index values of emmer wheat recovered from phase II levels at Ghoraifé compare with the corresponding values obtained for Ramad. One could argue that this was to be expected because phase II at Ghoraifé corresponds to phase I at Ramad (see fig. 6).

If the above suggestion of a close affinity of

Table 11. Dimensions and index values of *Triticum dicoccum* grains.

Ramad		L	B	T	L/B	T/B
C8 3.35	min.	4.0	1.8	1.8	160	74
N = 62	aver.	5.02	2.50	2.28	202	91
	max.	6.0	3.4	3.0	248	113
C8 4.75	min.	4.1	1.8	1.6	153	73
N = 101	aver.	5.12	2.31	2.16	224	94
	max.	6.3	3.1	2.6	282	115
C8 4.75	min.	3.1	1.1	1.1	153	73
N = 116 (15 small	aver.	4.96	2.20	2.07	230	95
specimens included)	max.	6.3	3.1	2.6	343	119
C8 5.05	min.	4.0	1.8	1.5	161	71
N = 90	aver.	5.02	2.27	2.11	222	93
	max.	6.0	3.4	3.0	291	115
M4 1.75	min.	4.0	1.8	1.7	175	70
N = 52	aver.	5.03	2.39	2.22	212	93
	max.	6.1	3.0	2.8	250	112
Aswad West						
1.40 m	min.	4.8	1.8	1.9	221	83
N = 15	aver.	5.30	2.21	2.11	240	96
	max.	6.2	2.4	2.4	278	111
1.60 m	min.	5.0	1.8	1.6	203	73
N = 14	aver.	5.54	2.23	2.06	251	93
	max.	6.1	2.6	2.6	336	114
2.20 m	min.	5.0	1.8	1.7	197	88
N = 11	aver.	5.46	2.31	2.12	238	92
	max.	5.8	2.6	2.4	280	97
Ghoraifé 1975						
Phase II, various levels	min.	3.8	2.0	1.8	171	71
N = 18	aver.	5.03	2.39	2.19	211	92
	max.	5.8	3.0	2.4	242	100

the Aswad emmer wheat to the wild form is correct, the emmer wheat from phase I levels at Ghoraifé, which correspond to those of phase II at Aswad, should show similarly high L/B index values. Unfortunately, only one grain from a definitely phase I level at Ghoraifé (from a depth of 4.20 m) could be measured. Although this grain has a high L/B index value (5.1×2.0×2.1 mm, L:B 256, T:B 92), it does, of course, not prove anything.

4.2. Einkorn wheat

Domestic einkorn wheat, *Triticum monococcum* L., is also represented in the sites from the Damascus basin. In einkorn wheat, usually one grain develops in a spikelet. The grains are laterally compressed, with longitudinally curved ventral and dorsal sides (fig. 11: 4, 5, 6). In addition, einkorn wheat grains which have developed in two-seeded spikelets may be expected. The ventral side of these grains is not curved but straight and flat as in emmer wheat grains. They can be distinguished from emmer wheat grains by their great slenderness and by their more pointed upper and lower ends. However, it is often difficult to decide whether a grain is of two-seeded einkorn wheat or of emmer wheat. At Ramad, an occasional hulled wheat grain was found which could possibly be of two-seeded einkorn wheat. All hulled wheat grains with a flat dorsal side have been counted as *Triticum dicoccum*.

Another possible identification problem concerns emmer wheat grains which had developed in one-seeded spikelets. These spikelets are usually found in the top of the ear. The grains from one-seeded emmer wheat spikelets resemble those of einkorn wheat in that they have a convexly curved ventral side. However, the upper and lower end are rather blunt and the dorsal side is not sharply ridged as in einkorn wheat. Although it cannot be ruled out that a few einkorn-type grains have been attributed to the wrong species, by far the majority of the grains listed as *Triticum monococcum* are definitely of this species.

Triticum monococcum is absent in phase I levels at Aswad; the first einkorn wheat grains are from phase II levels. The fact that einkorn wheat appeared later in the Damascus area than emmer wheat is not astonishing. Above (4.1.) it has been discussed that the emmer wheat at Aswad may have originated from the region of northern Palestine and southwest Syria, one of the present-day distribution areas of the wild species. On the other hand the domestication of einkorn wheat must have taken place at a much greater distance from the Damascus basin. Western Anatolia is the most likely area where one-seeded einkorn was taken into cultivation, because it is there that *Triticum boeoticum* Boiss, emend. Schiem. ssp. *aegilopoides* (Link.) Schiem., is found in primary habitats. The distribution centre of two-seeded wild einkorn, *Triticum boeoticum* ssp. *thaoudar* (Reuter) Schiem. is much greater and includes southeastern Turkey, northern Iraq and western Iran. Outside the distribution areas of primary habitats wild einkorn occurs exclusively as a segetal plant, in secondary habitats, such as roadsides, fields and other disturbed places. It is likely that wild einkorn was dispersed outside its natural habitat zones

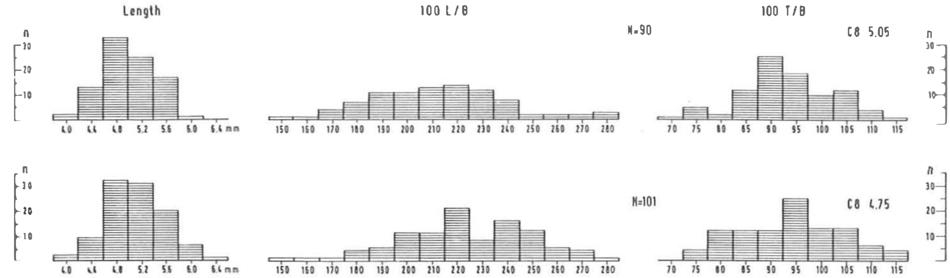

Fig. 10. Ramad, *Triticum dicoccum*. Frequency distribution histograms.

Table 12. Dimensions and index values of *Triticum monococcum* grains

Ramad		L	B	T	L/B	T/B
C8 3.35, 3.55, 4.05	min.	3.8	1.3	1.6	204	103
N = 13	aver.	4.46	1.81	2.09	253	117
	max.	5.0	2.3	2.4	317	133
C8 4.75	min.	3.8	1.3	1.7	196	100
N = 13	aver.	4.49	1.84	2.14	249	117
	max.	5.0	2.5	2.4	344	143
C8 4.95, 5.05	min.	3.8	1.4	1.7	196	104
N = 10	aver.	4.45	1.78	2.14	257	122
	max.	4.8	2.2	2.5	341	138
M4 1.75	min.	3.9	1.5	1.7	215	96
N = 10	aver.	4.51	1.82	2.01	250	111
	max.	5.0	2.2	2.4	332	132
Aswad						
Phase II, various levels	min.	4.3	1.6	2.1	214	100
N = 7	aver.	4.95	2.00	2.30	250	116
	max.	5.4	2.3	2.5	300	130

Table 13. Dimensions and index values of *Triticum boeoticum* grains from Ramad C8, various levels (N = 11)

	L	B	T	L/B	T/B
min.	3.7	0.9	1.3	307	107
aver.	4.20	1.20	1.47	355	124
max.	5.2	1.6	1.9	455	146

together with the domesticated form.

In conclusion, the *Triticum monococcum* in phase II levels at Aswad most likely originated from western Turkey. One may assume that it was grown intentionally although the proportions of einkorn wheat grains suggest that it was not a major crop plant of the Neolithic farmers in the Damascus basin. The question whether it was a crop plant in its own right or whether it was grown mixed with emmer wheat will not be touched upon here. The dimensions and index values of einkorn grains are shown in table 12. There are no great differences in size and shape of the einkorn kernels in different levels at Ramad. The average dimensions of the few grains measured for Aswad are about 10% greater than those of the Ramad specimens.

Wild one-seeded einkorn wheat, *Triticum boeoticum* ssp. *aegilopoides*, is also represented, albeit by very small numbers of grains and only at Ramad. The wild einkorn grains are distinguishable from those of the domestic species by their extreme lateral compression (fig. 11:1,2,3). The average width of 11 *Triticum boeoticum* caryopses from Ramad is 1.20 mm, whereas for *Triticum monococcum* from the same site an average width of 1.78–1.82 mm was established (table 13). The yet greater lateral compression than in domestic einkorn grains finds expression in the average L/B index values: 355 and 249–257, respectively. In contrast to the grains of domestic einkorn wheat which show a convexly curved ventral as well as dorsal side, in the wild species the dorsal side is longitudinally straight or only slightly curved. It has to be admitted that the wild einkorn grain depicted in fig. 11:2 has a rather curved dorsal side.

It has already been mentioned that *Triticum boeoticum* is not an indigenous species of the Damascus area. It was introduced inadvertently by Neolithic farmers. *Triticum boeoticum* is not reported for the present vegetation of the Damascus area and of the whole of western Syria, but the species has been collected in Lebanon (D. Zohary, 1969 fig. 1). Most probably wild einkorn occurred as a weed in the grain fields of the Ramad farmers.

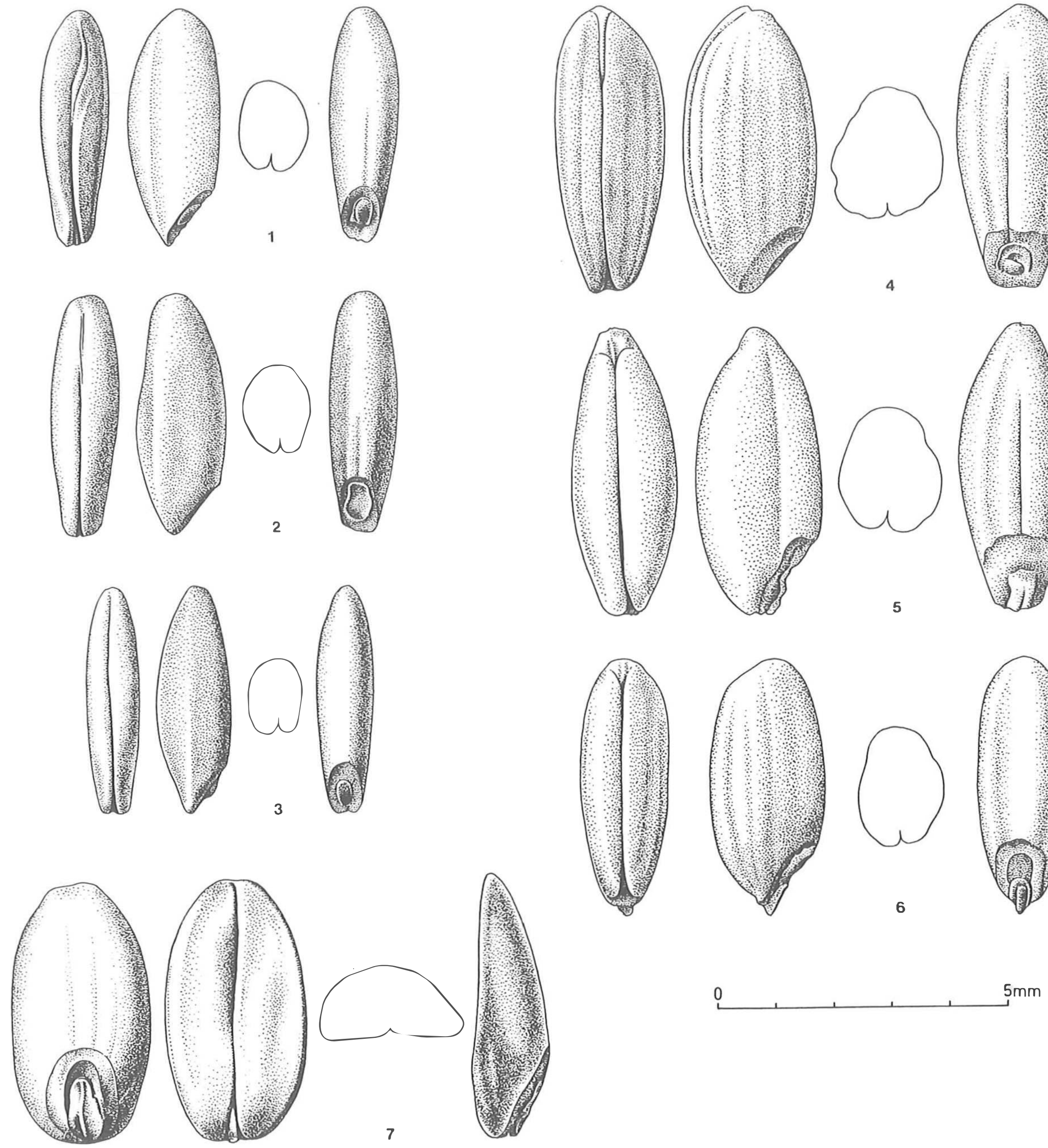

Fig. 11. 1. *Triticum boeoticum*, Ramad C8 2.95; 2. *T. boeoticum*, Ramad C8 3.60; 3. *T. boeoticum*, Ramad C8 4.75; 4,5,6. *T. monococcum*, Ramad C8 4.75; 7. *Aegilops* spec., Ramad C8 3.55.

4.3. Spikelet remains of hulled wheats

In addition to the caryopses of *Triticum dicoccum* and *T. monococcum*, glume bases and spikelet forks of glume wheats were found (fig. 14:5,6,7). In this connection the following should be remarked. In wild einkorn and emmer wheat, at maturity the ear disarticulates spontaneously into the individual spikelets; these wheats have a brittle rachis. In *Triticum monococcum* and *T. dicoccum*, on the other hand, the mature ear stays intact, which is the most characteristic trait of domestic cereal species. However, when pressure is exerted, and this happens in threshing, the ear of domestic einkorn and emmer wheat breaks up into the separate spikelets. The rachis internodes usually break at the disarticulation point leaving a distinct scar. *Triticum monococcum* and *T. dicoccum* are so-called semi-brittle wheats. Subsequent processing of the hulled wheat crop, such as pounding or grinding to free the grains, results in a breaking up of the spikelets into separate parts. In burning crop-processing waste the dense spikelet forks and glume bases had a fair chance of becoming preserved in a charred condition (*cf.* Hillman, 1984).

Various samples from Aswad and particularly from Ramad yielded large quantities of spikelet forks and glume bases. Now the question arises whether it is possible to distinguish carbonized glume bases and spikelet forks of *Triticum dicoccum* from those of *T. monococcum*. How do the proportions compare of einkorn and emmer wheat among the glume bases and spikelet forks with those among the grains? The spikelets of einkorn wheat are smaller and more slender than those of emmer wheat, which should find expression in the dimensions. In carbonized spikelet remains two dimensions are usually taken, *viz.* the width of the spikelet fork and of the glume base. Helbaek (1952) introduced a standard method of taking these measurements. The width of the spikelet fork is measured across the articulation scar, and that of the glume base at its narrowest point, just above the suture (fig. 12).

For 7 samples from Ramad 100 glume bases

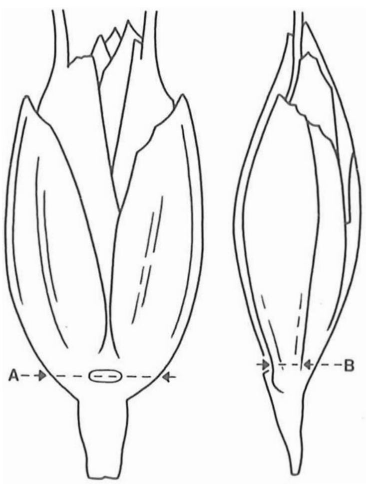

Fig. 12. Emmer spikelet, showing where the dimensions A (width of spikelet fork) and B (width of glume base) were measured.

Table 14. Width of *Triticum monococcum/dicoccum* spikelet forks and glume bases from Ramad

		Spikelet forks	Glume bases	Proportions of einkorn wheat grains (see 4.3.)
C8 2.45	min.	1.2	0.5	
N = 97/100	aver.	1.74	0.74	10%
	max.	2.2	1.0	
C8 2.70	min.	1.4	0.6	
N = 100	aver.	1.84	0.81	4%
	max.	2.5	1.0	
C8 3.90	min.	1.4	0.6	
N = 100	aver.	1.80	0.81	3%
	max.	2.3	1.0	
C8 4.05	min.	1.4	0.5	
N = 100	aver.	1.78	0.74	9%
	max.	2.2	1.0	
C8 4.75	min.	1.6	0.6	
N = 100	aver.	1.95	0.84	5%
	max.	2.3	1.1	
C8 5.05	min.	1.3	0.7	
N = 100	aver.	1.82	0.84	2%
	max.	2.2	1.0	
M4 1.75	min.	1.4	0.6	
N = 100	aver.	1.68	0.78	6%
	max.	2.1	1.0	

and spikelet forks have been measured. The results are presented in table 14 and in the frequency distribution histograms of fig. 13. In the samples concerned, in addition to emmer wheat grains those of einkorn wheat were counted. The proportions of einkorn wheat among the glume wheat grains (*T. monococcum* + *T. dicoccum*) are also shown in table 14 and fig. 13 (2–10%). In theory the proportions of einkorn wheat among spikelet remains and grains should be the same.

To what extent do the above-mentioned dimensions allow a reliable distinction between einkorn and emmer wheat? In this respect the following should be remarked. At ceramic Hacilar, dated to the sixth millennium B.C., Helbaek (1970) claims that the widths of spikelet forks and glume bases are clearly divided into two groups. The widths of spikelet forks of einkorn and emmer wheat range here from 1.24 to 1.84 mm (mean 1.56 mm) and from 2.00 to 3.28 mm (mean 2.59 mm), respectively. For the width of the glume bases the dimensions are 0.48–0.88 mm (mean 0.66 mm) and 0.96–1.72 mm (mean 1.32 mm), respectively. If these figures are applied to

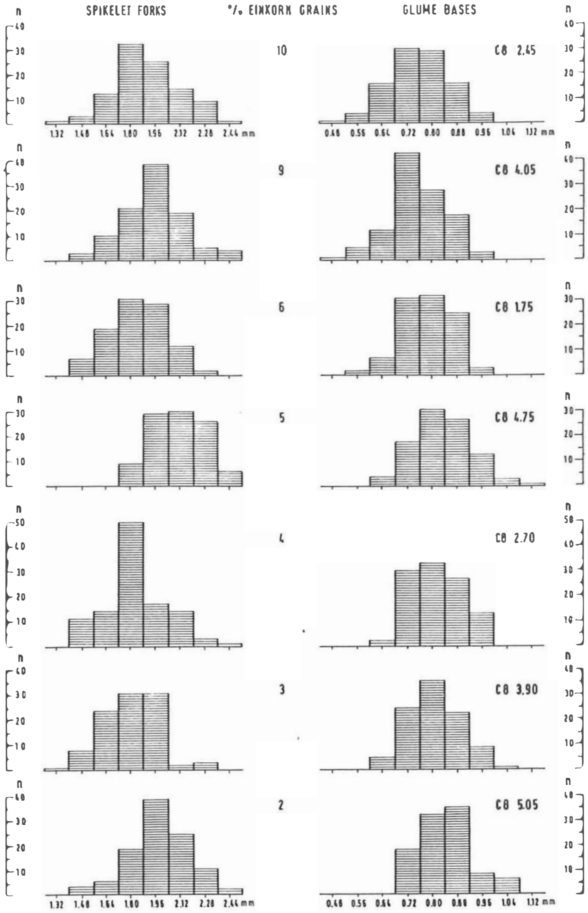

Fig. 13. Ramad. Frequency distribution histograms for the width of spikelet forks and glume bases of hulled wheat. The proportions of einkorn among the glume wheat grains (*T. monococcum*+*T. dicoccum*) in the samples concerned are also shown.

Ramad, 80–97% of the glume bases and 38–86% of the spikelet forks would be of einkorn wheat, which is highly unlikely. Helbaek reports that the Hacilar emmer wheat is of an extraordinarily coarse and dense spike, in consequence of which the dimensions of the glume bases and spikelet forks give unusually high figures.

For Late Bronze Age Beycesultan, Helbaek (1961) was unable to separate the two hulled wheats on the basis of the width of the spikelet forks. On the other hand, the dimensions obtained for 16 glume bases are grouped into two classes, *viz.* 0.48–0.72 and 0.88–1.06 mm. If the latter figures are applied to Ramad, the proportions of einkorn wheat-type glumes would be considerably lower (18–61%) than those mentioned above, but still very much higher than those of the einkorn wheat grains. Helbaek (1952) reports a slight overlap in the dimensions of glume bases and spikelet forks of modern einkorn and emmer wheat. Knorzer (1967) is of the opinion that in charred material only rather extreme values allow a reliable species identification, but that within a wide range of dimensions it is not possible to attribute glume bases and spikelet forks to either einkorn or emmer wheat.

The present authors take the line that it is not possible to draw a sharp dividing line between einkorn and emmer wheat on the basis of the dimensions of spikelet forks and/or glume bases. Appreciable proportions of einkorn wheat among the spikelet remains from Ramad should result in size frequency distributions which are skewed to the lower end of the graphs. The dimensions of the Ramad spikelet forks and glume bases show rather regular frequency distributions. The greater frequencies of low values for the width of the glume bases in C8 2.45, C8 4.05 and M4 1.75 seem to correspond to the relatively high proportions of einkorn wheat grains in these samples (6–10%). The spikelet forks show a similar though less consistent picture. On the other hand, a comparison between the width of the spikelet forks in samples M4 1.75 and C8 4.75 should call for some caution in this respect. Although in C8 4.75 the einkorn grain proportion (5%) is only slightly (not significantly) lower than in M4 1.75 (6%), the differences in the width of the spikelet forks are quite considerable. There is not only a conspicuous difference in mean values (table 14), but in C8 4.75 the lowermost size classes (which should be characteristic of einkorn wheat) are absent among the measured specimens. In the Ramad samples, the proportions of einkorn wheat are too small to influence appreciably the frequency distributions of the spikelet fork and glume base dimensions.

The above leads to the conclusion that on the basis of the dimensions of the spikelet remains it may be impossible to demonstrate convincingly einkorn wheat if the latter species occurs in a low percentage relative to emmer wheat. This is not so much a problem for Ramad because here the charred grains provide information on the proportions of einkorn and emmer wheat. However, if of hulled wheat only spikelet forks and/or glume bases are preserved, possible information on

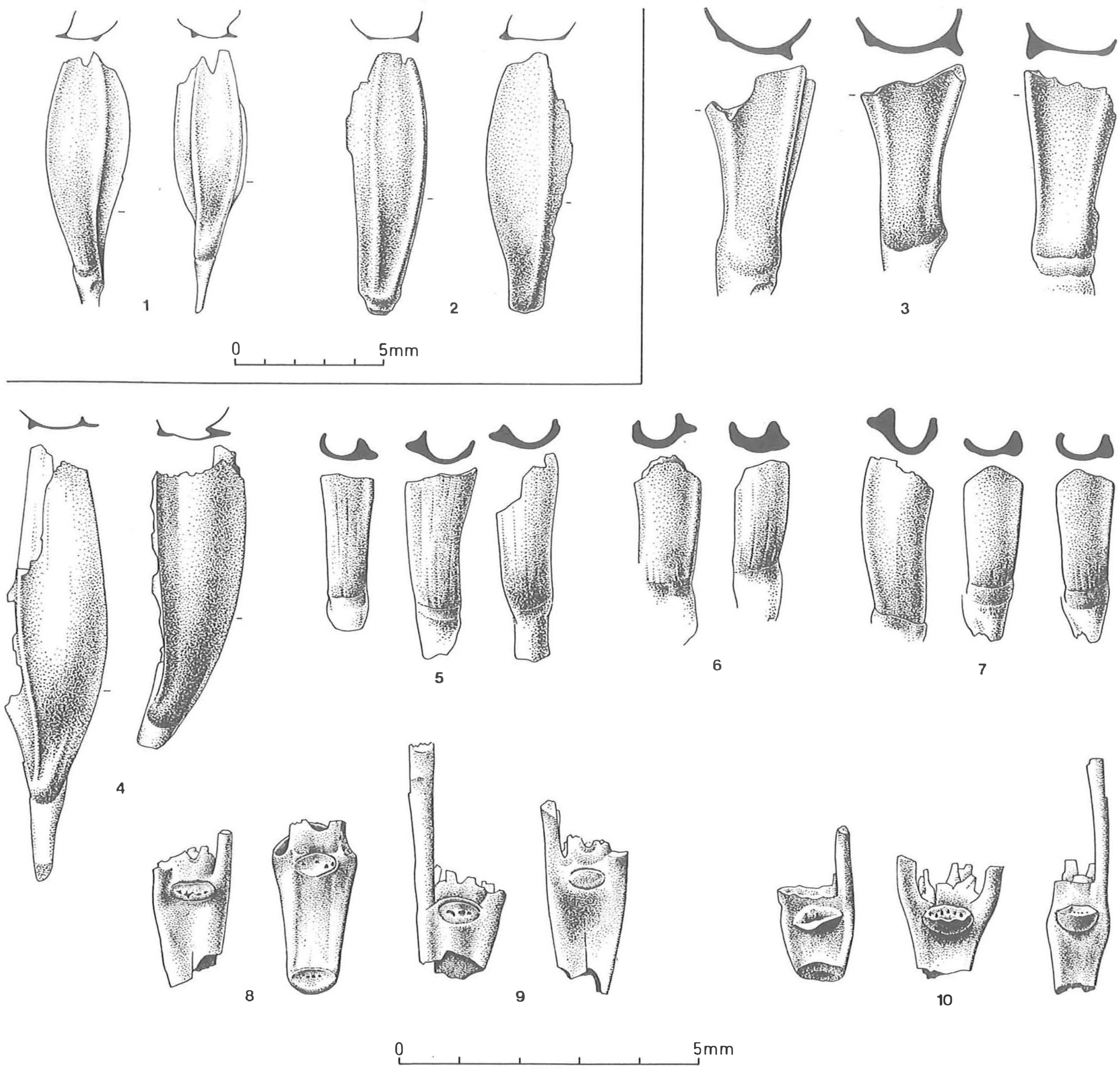

Fig. 14. 1–7: *Triticum* glumes and glume bases. 1. *T. monococcum*, modern; 2. *T. diococcum*, modern; 3. *T. dicoccum*, Valkenburg 8448; 4. *T. monococcum*, Toszeg; 5. glume bases, Ramad C8 2.70; 6. glume bases, Ramad C8 3.90; 7. glume bases, Ramad C8 4.75; 8. *Hordeum spontaneum*-type internodes, Ramad C8 4.95; 9. *H. spontaneum*-type internodes, Ramad C8 4.75; 10. *H. distichum*-type internodes, Ramad C8 4.75.

the species concerned must come from these remains. Can charred spikelet remains of both hulled wheat species be distinguished one from another on the ground of morphological features?

The glumes of einkorn wheat have two keels which both terminate in a pointed beak (a tooth). The keel at the dorsal side of the spikelet (the side which shows the articulation scar) is more pronounced. In emmer wheat, on the other hand, the glumes show only one prominent keel, namely at the dorsal side of the spikelet. Modern glumes of both hulled wheats are depicted in fig. 14: 1, 2. In charred glume bases (only very seldom a greater part of the glume is preserved) these keels are present in the form of sharp edges. In einkorn wheat, the charred glume bases have a sharp edge at both sides, whereas in emmer wheat one edge of the glume base is sharp and the other more rounded. This is illustrated here in two examples of archaeological wheat in which there is no question about the species identity.

An almost pure einkorn wheat sample from Bronze Age Toszeg in Hungary contained whole spikelets and many spikelet remains. Virtually all glume bases display a sharp edge at both sides (fig 14:4). In the emmer wheat glume bases from a large *Triticum dicoccum/ T. spelta* sample from the Roman castellum at Valkenburg (Holland), dated to A.D. 69, only one sharp edge can be observed, the other edge being more rounded (fig. 14:3). Thus, in principle it should be possible to determine the species of hulled wheat glume bases. It is clear that not too small a part of the glume should have been preserved and that the edges of the glume should be reasonably undamaged.

For Ramad great numbers of glume bases have been examined with a view to species determination. Much to our surprise no distinctly einkorn-type glume bases were found. Admittedly perhaps too much emphasis was laid on unequivocal evidence of einkorn wheat (some specimens could possibly be einkorn wheat glumes), but it is striking that no distinct einkorn wheat glume bases were observed, whereas those of emmer wheat were found in great numbers.

Knörzer (1967) points out that in spikelet forks the position of the glume bases is characteristic for the species. In the one-grained einkorn wheat spikelets, the glumes diverge only slightly or run parallel to each other. In emmer wheat spikelets, the glumes are usually attached at more oblique angles. On the basis of this criterion prehistoric charred spikelet forks are attributed by Knörzer to either einkorn or emmer wheat. Remains of one-grained emmer wheat spikelets (from the top of the ear) can be recognized as such by the absence of the articulation scar. At Ramad, spikelet forks which according to the above distinguishing feature should be attributed to *Triticum monococcum* occur rather frequently. However, the glume bases of these spikelet forks show only one sharp edge, indicating that they are of *T. dicoccum*. Moreover, the Toszeg einkorn wheat spikelet remains cast some doubt on the validity of the position of the glume bases as a distinguishing character. In various spikelet forks from Toszeg the glumes (showing two distinct keels) are diverging, which according to Knörzer should be characteristic of *Triticum dicoccum*.

The above makes one wonder whether spikelet remains of *Triticum monococcum* do, indeed, not occur at Ramad. Are the distinguishing features perhaps not sufficiently valid for Ramad (and other sites), or is it the fault of the investigators who did not recognize einkorn spikelet remains? Be this as it may, the observations discussed above demonstrate that there are serious pitfalls in determining the species of prehistoric charred spikelet remains of diploid and tetraploid hulled wheats.

4.4. Free-threshing wheat

In addition to the glume wheats *Triticum dicoccum* and *T. monococcum*, a free-threshing wheat species occurs in Aswad, Ghoraifé and Ramad. Mostly small numbers of naked wheat grains were recovered from phase II layers at Aswad and from Ghoraifé, but at Ramad this wheat type is better represented. Various Ramad samples yielded considerable numbers of naked wheat grains (tables 5 and 7). Moreover, rachis fragments of free-threshing wheat were found at Ghoraifé and particularly at Ramad. A fair proportion of the rachis fragments consists of more than one internode (fig. 16).

The free-threshing wheat grains could, as a rule, easily be distinguished from those of emmer wheat. Only in case of serious deformations, mainly in consequence of puffing, it was difficult, if not impossible, to determine the type of wheat. In naked wheat the greatest breadth is usually found in the lower part of the kernel, but naked wheat grains with the greatest breadth in the middle occur likewise. The apex of the grains is often truncated-rounded, but other kernels show a more gradually tapering upper part. The dorsal side is in cross-section usually more rounded than in emmer wheat.

The Ramad free-threshing wheat grains show a rather great variation in shape and size. Short and plump grains with low L/B index values (club wheat-type grains) as well as more slender specimens (bread wheat/hard wheat-type) occur at Ramad (fig. 15). At Aswad, on the other hand, squat naked wheat grains are almost absent. Only in Aswad East 1.20 a few

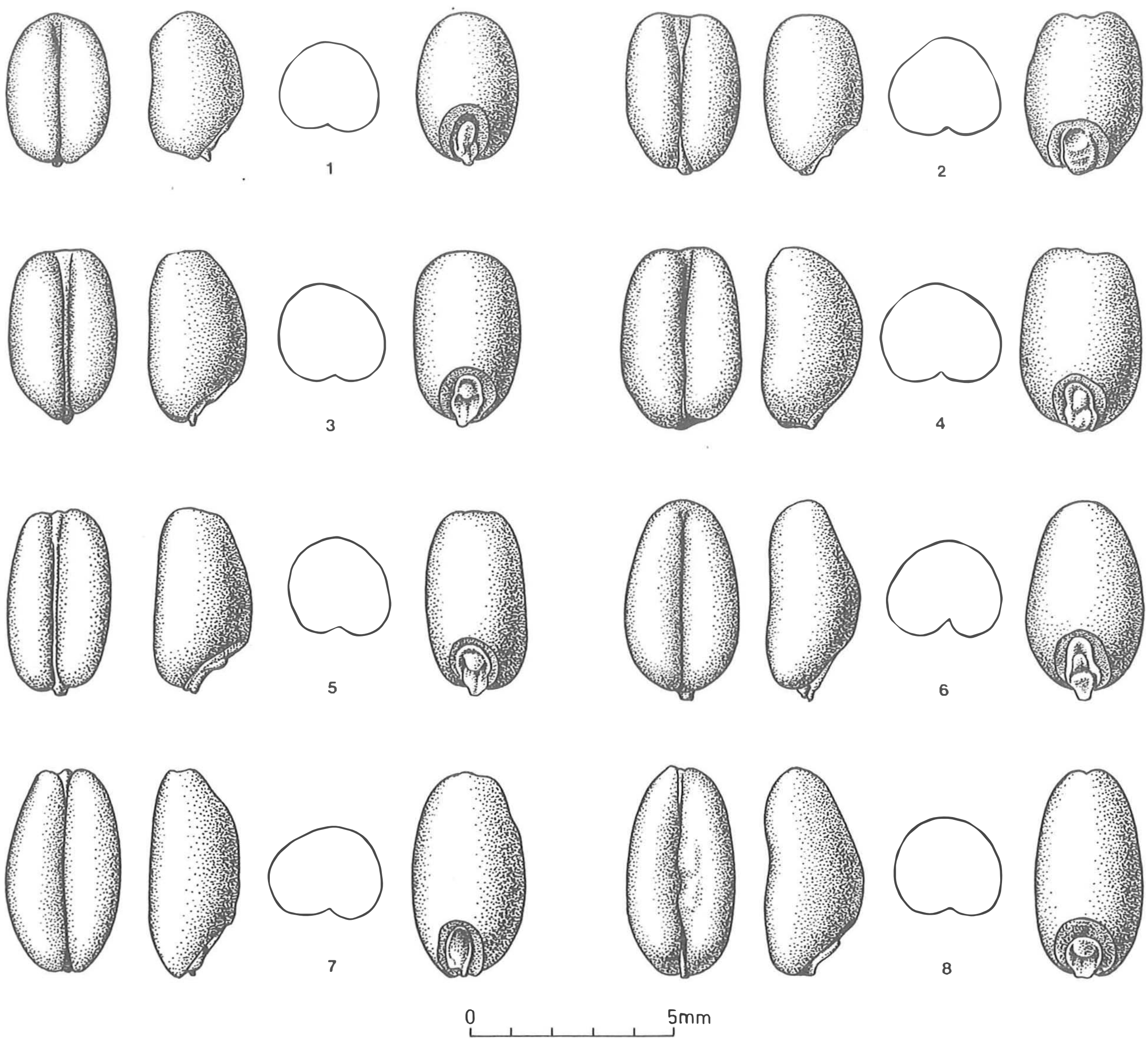

Fig. 15. *Triticum durum/aestivum* grains, Ramad.

grains of this type were found. This finds expression in the comparison of the dimensions and index values obtained for free-threshing wheat grains from both sites (table 15). The minimum and average length of the Ramad grains is considerably less than of those from Aswad. The maximum length, on the other hand, is about the same for the caryopses from both sites. Clear differences are also displayed by the L/B index values, the minimum and average values for Ramad being much lower than for Aswad. The differences in the dimensions and index values of the naked wheat grains between both sites are brought about by the absence of club wheat-type grains at Aswad. The mean length at Ramad is depressed by the short club wheat-type grains. L/B index values for typical club wheat-type grains range from about 124 to 156.

Among the naked wheat grains from phase II levels at Ghoraifé, the short and plump type is quite common (table 15). It looks as if the earliest free-threshing wheat in the Damascus basin was almost exclusively of the more slender grain type, and that later on varieties which produced the short and plump grain type became more common.

In a few of the Ramad samples, rachis

Table 15. Dimensions and index values of *Triticum durum/aestivum* grains.

		L	B	T	L/B	T/B
Ramad						
C8 3.35	min.	3.4	2.0	1.6	127	67
N = 78	aver.	4.34	2.66	2.20	162	83
	max.	5.4	3.3	2.9	204	100
C8 4.75	min.	3.4	1.9	1.6	133	71
N = 29	aver.	4.22	2.67	2.20	160	83
	max.	6.0	3.4	2.7	238	97
C8 5.05	min.	3.4	2.2	1.9	124	75
N = 28	aver.	4.40	2.79	2.37	159	85
	max.	5.6	3.2	2.9	207	97
Aswad West						
1.40 m	min.	4.5	2.0	1.6	182	69
N = 8	aver.	5.06	2.50	2.00	205	80
	max.	5.8	2.7	2.3	248	85
1.60 m	min.	4.4	2.2	1.7	188	69
N = 10	aver.	5.08	2.57	2.02	198	79
	max.	5.6	3.0	2.4	217	91
2.20 m	min.	4.6	2.3	1.8	161	70
N = 9	aver.	5.00	2.60	2.11	193	81
	max.	5.4	2.9	2.5	216	94
Ghoraifé 1975						
Phase II, various levels	min.	3.7	2.4	2.0	121	77
N = 10	aver.	4.14	2.86	2.46	146	86
	max.	5.4	3.2	2.9	183	91

Table 16. Rachis internodes of *Triticum aestivum/durum* from Ramad C8 3.35 (N = 100)

	L	B	L/B
min.	0.9	0.9	65
aver.	1.42	1.28	113
max.	2.0	1.8	183

fragments were found in considerable numbers. In view of the variation in the shape of the grains a corresponding variation in the shape of the internodes might be expected. Short and plump grains most probably developed in short and dense ears with short rachis internodes. The ears in which the more slender grains were formed must have been rather long and lax with comparatively long rachis internodes.

Length and breadth of 100 rachis internodes from C8 3.35 were measured (table 16, fig. 17). As for the breadth, the greatest breadth was taken. A measure for the length was less self-evident, so that somewhat arbitrarily this dimension was determined in the way indicated in fig. 16. The measurements confirm that there is, indeed, a great variation in the degree of plumpness or slenderness of the internodes. The frequency distribution histograms for grains and internodes of free-threshing wheat from C8 3.35 (fig. 17) suggest that internode L/B ratios of less than 100 would largely correspond to club wheat-type grains (L/B index values below 160). No measurements were carried out for rachis internodes from C8 4.95 because the free-threshing wheat grains from this sample had got lost. In this case a comparison between L/B index values of internodes and grains is not possible.

The problems in determining the species of carbonized caryopses and rachis remains of free-threshing wheat have already been discussed in an earlier paper (van Zeist, 1976). In principle two species or species complexes come into consideration here, *viz.* tetraploid *Triticum durum* Desf. (hard wheat) and hexaploid *T. aestivum* L. (bread wheat). The latter species includes the dense-eared, plump-grained variety *T. aestivum* grex *aestivo-compactum* Schiem. (club wheat), the former *T. compactum* Host. *Triticum durum* is a mutant of *T. dicoccum* and this free-threshing wheat could have originated anywhere inside the area where emmer wheat was grown. *Triticum aestivum* arose from the hybridization of *T. dicoccum* and/or *T. durum* with the diploid wild grass species *Aegilops squarrosa* L. (*Ae. tauschii* Cosson) followed by chromosome doubling. Hexaploid wheats could not have come into existence until Neolithic wheat agriculture had reached the distribution area of *Aegilops squarrosa* which includes the south Caspian region, northern Afghanistan, Turkmenistan and Uzbekistan (D. Zohary, 1969; 1971).

Carbonized *durum* wheat grains cannot be separated from those of bread wheat. The shape of the grains does not allow a species identification, nor is the variation in slenderness (variation in L/B index values) of any help in determining the species. D. Zohary (1973) reports that in living material it is frequently impossible to distinguish between *durum* and *aestivum* varieties on the basis of the kernel morphology.

From a comparison of the central axes (rachises) of the ears of modern *aestivum* and *durum* wheats with each other and with the charred rachis fragments from Ramad, van Zeist (1976) concluded that rachis remains are very likely not of much help in distinguishing between both free-threshing wheat species. Hillman (1978, p. 168), on the other hand, claims that the shape of the rachis internodes does provide clues for a species identification. No description of the distinguishing features has so far been published. For that reason a possible identification of the Ramad rachis remains must wait until later. At least for the time being, we are left with the uncertainty whether *Triticum durum* or *T. aestivum* or perhaps both species are represented in Ramad, Ghoraifé and Aswad.

On ecological grounds *Triticum durum* would be the most likely candidate. *Durum* wheats are adapted to the Mediterranean climate with mild, rainy winters and warm, dry summers. Until recently *durum* wheat was the most important wheat grown in the Mediterranean basin. Hexaploid *aestivum* wheats, on the other hand, are widely grown in the more continental areas of western Asia and in temperate central and western Europe (D. Zohary, 1971).

Van Zeist (1976) argues that in the 7th millennium B.C., hexaploid wheats could not possibly have been grown in the Damascus basin. It would not have been until after 6000 B.C that Neolithic agriculture had arrived in the area, in which primary habitats of *Aegilops squarrosa* occur. Consequently, *aestivum* wheat could have been grown in western Syria at the earliest in the 6th millennium B.C. The weak point in this reasoning is the near-absence of radiocarbon dated evidence for early Neolithic habitation in the distribution area of *Aegilops squarrosa* and in the greater part of Iran. Recent excavations at Mehrgarh in Pakistan (Jarrige & Meadow, 1980) seem to indicate that Neolithic agriculture may have expanded much more rapidly in an eastern direction than is suggest by Braidwood (*cf.* Braidwood's (1975, p. 143) isochronic lines indicating the spread of village farming). At Mehrgarh, impressions of grains of barley, einkorn wheat, emmer wheat and bread wheat/hard wheat (identifications by Costantini) are reported for pre-pottery Neolithic strata dated to the 6th millennium B.C. The animal bones point to the presence of domesticated animals in the same period. Continued archaeological, botanical and zoological investigations at Mehrgarh, combined with radiocarbon dating, should provide more precise information on the beginnings of agriculture in that area.

From the above it is clear that one should seriously consider the possibility that the Neolithic agriculture reached the south Caspian region well before 6000 B.C. and that consequently *Triticum aestivum* could have been present in western Syria at an earlier date than is suggested in a previous paper (van Zeist, 1976). Moreover, Hillman (1978, p. 168) claims that at the aceramic Neolithic site of Can Hasan III in South-Central Anatolia, *Triticum aestivum* could be demonstrated for levels radiocarbon dated to c. 6000 B.C. Thus, if Hillman's identifications of the rachis remains of free-threshing wheat are correct, bread wheat was cultivated in Turkey already in the 7th millennium B.C. If this is true the species could equally have been known to the 7th millennium B.C. farmers in the Damascus area. As a consequence, the identity of the free-threshing wheat at Aswad, Ghoraifé and Ramad–hard wheat, bread wheat or perhaps both–must remain uncertain. However, one wonders whether a certain degree of semi-brittleness could point to *durum* wheat. For Ramad it was observed that quite frequently the rachis had been broken at the joint between two internodes (as happens in *T. dicoccum*).

It should be mentioned furthermore that the naked wheat from the Neolithic sites in the Damascus area and from other prehistoric sites in the Near East and the Balkans is attributed by Kislev (1979/1980; 1981) to the archaeobotanical species *Triticum parvicoccum* Kislev. This species has been found only in archaeological sites and the species definition is based exclusively on charred grains and ear remains. *Triticum parvicoccum* is supposed to be a tetraploid wheat and a direct descendant of *T. dicoccum*. *T. parvicoccum* would differ from other tetraploid wheats by its dense ear and short grain, and from hexaploid species by its Mediterranean and Near Eastern distribution. The question to what extent it is justified to distinguish a separate archaeobotanical species will not be touched upon here. As has been discussed above, only part of the naked wheat grown by the Neolithic farmers in the Damascus area was dense-eared, one of the characteristics of *T. parvicoccum*.

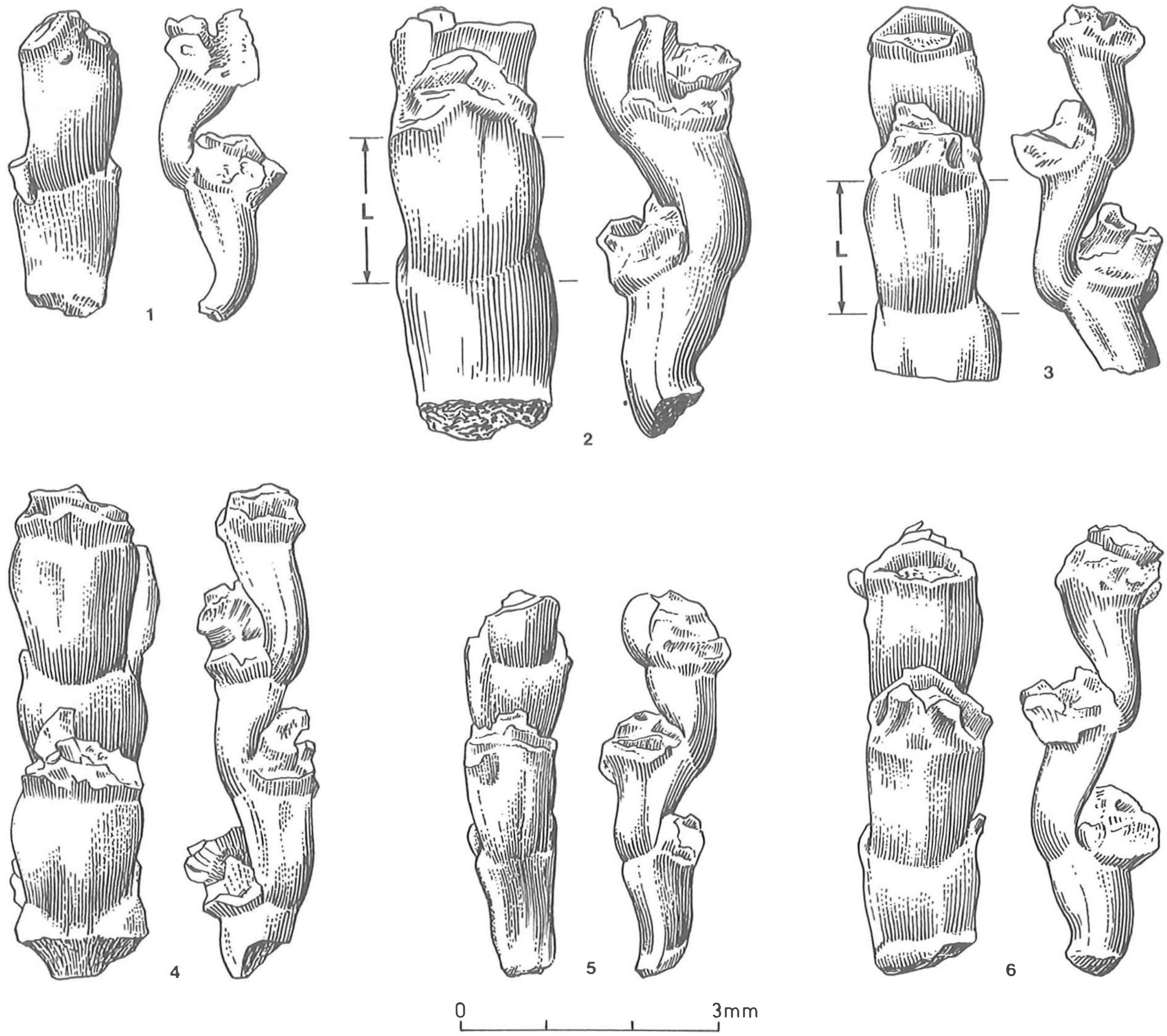

Fig. 16. *Triticum durum/ aestivum* rachis internodes, Ramad. In 2 and 3 it is indicated how the length of the internodes has been determined.

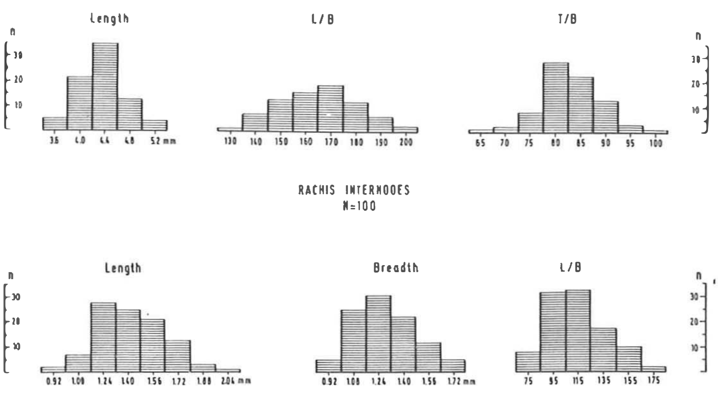

Fig. 17. *Triticum durum/aestivum* from Ramad C8 3.35. Upper row: frequency distribution histograms for grains; lower row: for rachis internodes.

4.5. Two-rowed hulled barley

Of *Hordeum*, grains as well as rachis internodes were recovered from all levels, sometimes in rather great numbers. By far the majority of the barley remains are of hulled varieties. No evidence of six-rowed hulled barley, *Hordeum vulgare* L. emend. Lam., was found. Among the well preserved grains no distinctly lop-sided specimens, indicative of *Hordeum vulgare*, occur. Internodes, the upper part of which is preserved, point definitely to two-rowed barley. Although an occasional six-rowed barley cannot be excluded, one may safely assume that all or almost all hulled barley at Ramad, Ghoraifé and Aswad is of the two-rowed type.

As for the two-rowed hulled barley, two species come into consideration, *viz.* domestic *Hordeum distichum* L. emend. Lam. and its wild progenitor *Hordeum spontaneum* C. Koch. The latter species is, at least in theory to be expected for two reasons. In the first place the Damascus basin lies within the distribution area of *Hordeum spontaneum*, and in fact wild barley was observed by the first author in the immediate vicinity of Tell Ramad. Further, Helbaek (1966) claims that morphologically-defined wild barley was grown by the inhabitants of Pre-Pottery Neolithic Beidha in Jordan. For that reason it should not be excluded that the barley grown by the earliest farmers in the Damascus basin (Aswad) was likewise of the wild type. Consequently, particular attention was paid to distinguishing between the charred remains of both barley species.

Table 17. Dimensions and index values of *Hordeum (distichum)* grains

		L	B	T	L/B	T/B
Ramad						
M4 1.75, 1.80, 1.90	min.	5.4	2.3	1.7	177	67
N = 9	aver.	5.88	2.72	2.04	217	75
	max.	6.4	3.1	2.4	232	86
C8 3.35	min.	4.6	2.2	1.6	166	67
N = 17	aver.	5.50	2.64	1.96	210	74
	max.	6.7	3.2	2.3	254	93
C8 4.75	min.	5.1	2.3	1.8	173	68
N = 24	aver.	5.86	2.76	2.08	213	75
	max.	6.8	3.4	2.6	235	86
Aswad West						
1.40 m	min.	4.6	2.3	1.6	182	67
N = 17	aver.	5.39	2.58	1.92	209	74
	max.	6.0	3.1	2.5	247	89
1.60 m	min.	4.9	2.2	1.5	182	66
N = 18	aver.	5.49	2.63	1.95	210	74
	max.	6.1	3.0	2.4	250	86

The internode remains should provide the most reliable species identification. Charred internodes of shattering, brittle-rachised *Hordeum spontaneum* should show an intact articulation scar (if the latter is preserved) because at maturity the ear disarticulates naturally into the individual spikelets. Not only the articulation scar but also the base of the internodes of brittle-rachised barley may be expected to be undamaged. In tough-rachised *Hordeum distichum*, on the other hand, the ears stay intact until threshed. In threshing the rachis usually does not break up at the joints between the internodes. In charred archaeological material two or more internodes may be found still adhering together. More often only one internode or internode segment with the basal part of the next internode attached to it is found. At Ramad, Ghoraifé and Aswad internode remains of both types were recovered (fig. 14: 8, 9, 10), and consequently one may assume that wild as well as domesticated two-rowed barley are represented. Below the rachis remains will again come up for discussion, but one more morphological feature will be treated here.

In *Hordeum spontaneum*, the sterile lateral florets are distinctly pedicellate. Remains of the stalks of the lateral florets are preserved in various wild barley-type internode fragments from Ramad, which is according to expectation. However, domesticated barley-type internodes provide likewise evidence of pedicellate lateral spikelets, whereas according to Schiemann (1948) in modern *Hordeum distichum* the lateral florets are sessile. Pedicellate lateral florets in tough-rachised two-rowed barley are reported for a few other sites. Helbaek (1959a) describes non-brittle two-rowed barley with pedicellate lateral florets for Jarmo. Helbaek suggests that stalked lateral florets in the Jarmo barley are a primitive feature which may be considered as a transitional stage between wild and fully domesticated forms. However, pedicellate *Hordeum distichum* is not confined to early-Neolithic sites, but Hopf (1978) describes and depicts two-rowed barley internodes with short stalks at each side from

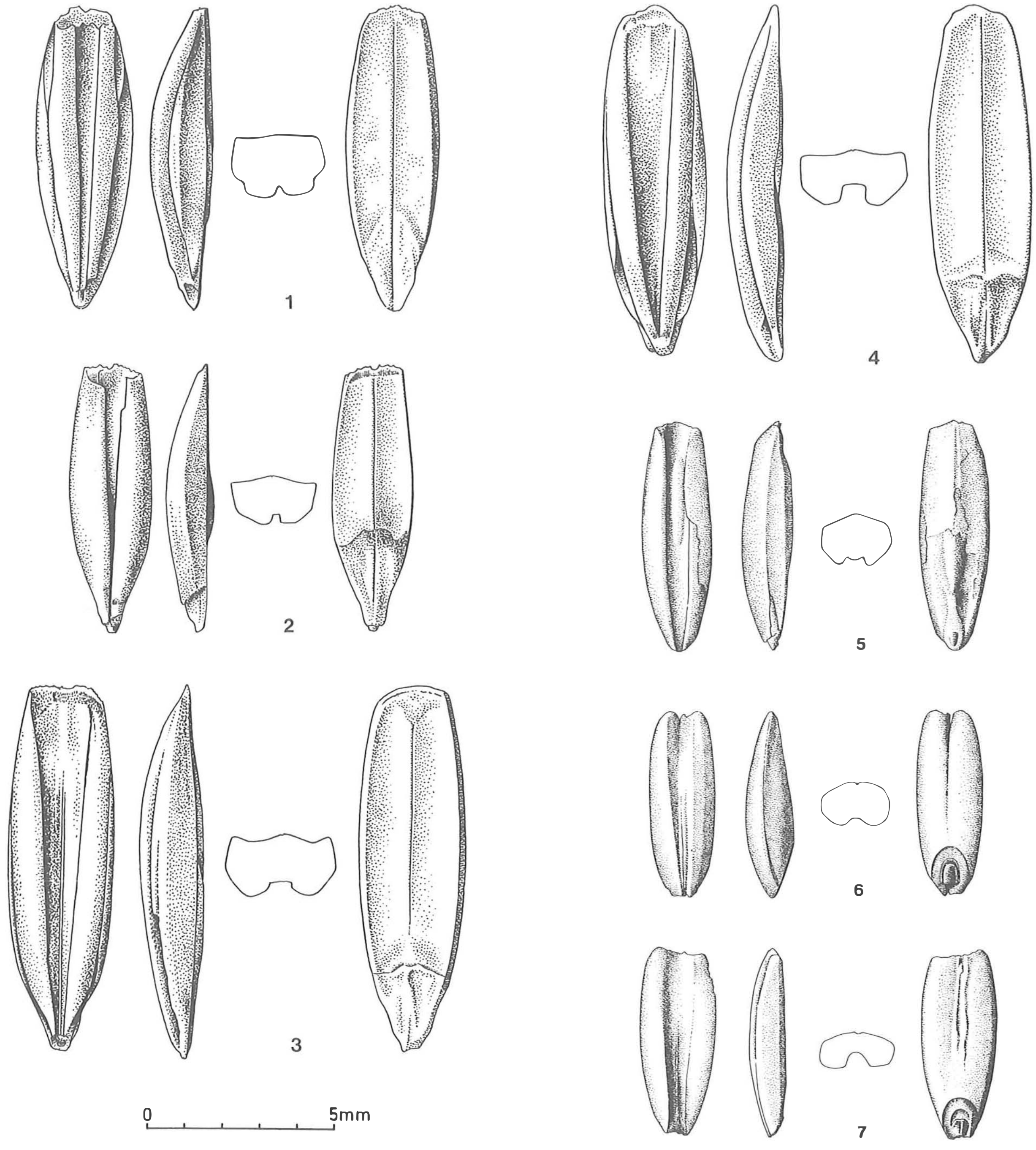

Fig. 18. 1, 2. modern *Hordeum spontaneum*. near Ramad; 3, 4. modern *H. spontaneum*, along Damascus-Beirut highway; 5, 6, 7, *H. spontaneum*, Ramad C8 5.05.

Early Bronze Age levels at Arad in Israel. Moreover, in modern two-rowed barley collected in a grain field in the Damascus area the lateral florets appeared to be shortly pedicellate instead of sessile. Consequently, up to the present two-rowed barleys with pedicellate lateral florets are grown.

Thus, wild-type (brittle) and domesticated-type (non-brittle) rachis internodes can easily be distinguished. On the other hand, the carbonized caryopses present more difficulties in this respect (figs. 18: 5, 6, 7 and 19: 4, 5, 6). To that effect modern grains of *Hordeum spontaneum* and *H. distichum* were studied.

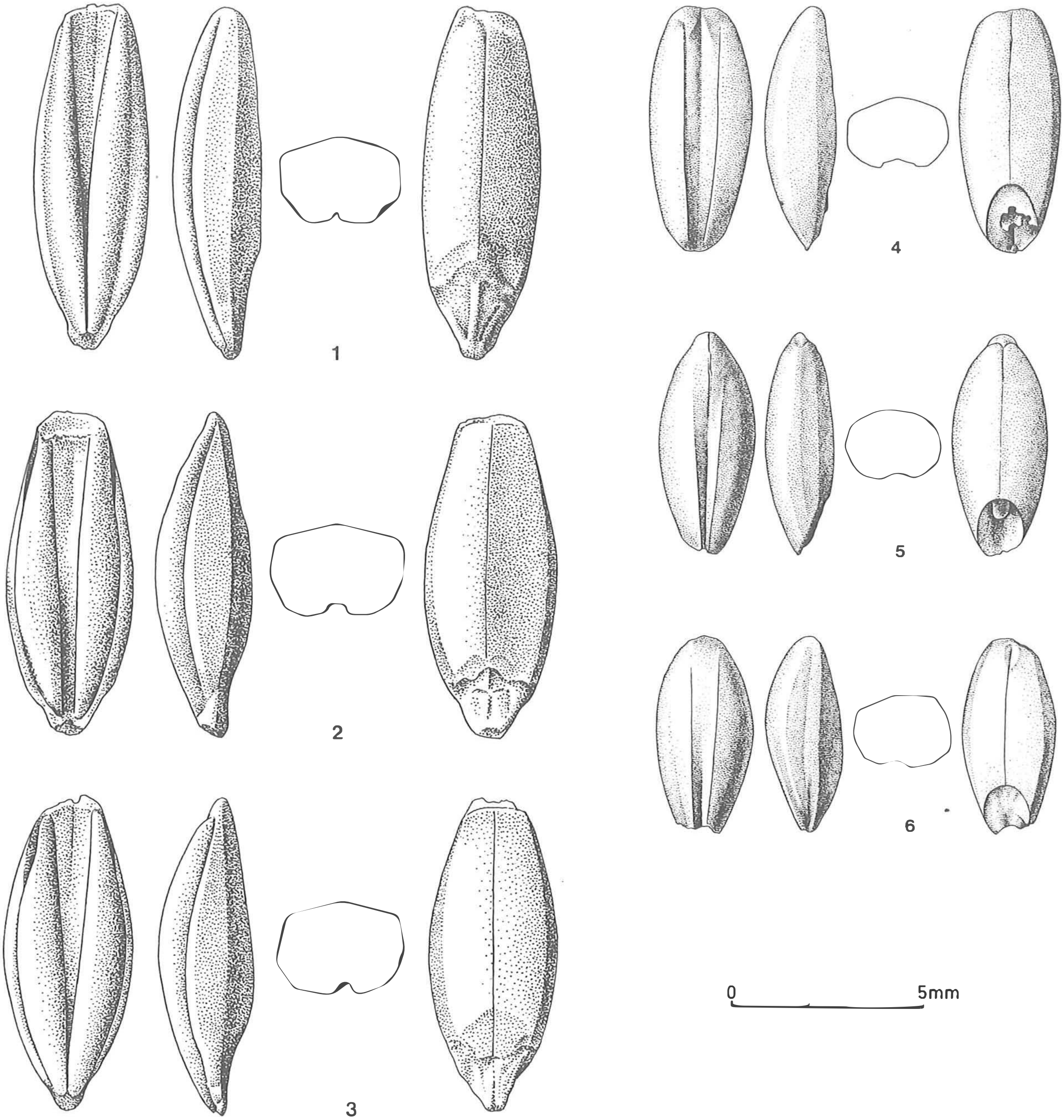

Fig. 19. 1, 2, 3. modern *Hordeum distichum*, near Ramad; 4, 5, 6. *H. distichum*, Ramad C8 4.75.

In fig. 18: 1-4 grains of wild barley from a primary and from a secondary habitat (fallow field) and in fig. 19: 1,2,3 grains of domesticated barley from the Damascus area are illustrated. The kernels of both barley species are spindle-shaped and more or less angular in cross-section; the ventral furrow has its maximum breadth at the upper end of the grain. The grains of *Hordeum spontaneum* are characterized by their extreme flatness; they are markedly thinner than those of *H. distichum*. As is particularly clear in lateral view, wild barley grains are very thin at the apex. In the upper part of the wild barley grains a dorsal depression can be observed which is absent in the grains of the domestic species. Although modern grains of both barley species are not difficult to

Table 18. Numbers and percentages of Hordeum internodes and grains (for explanation, see text). Table 8 gives greater numbers of barley grains and internodes for Aswad than accounted for in this table. This is due to the fact that here the actual numbers are concerned.

	Internodes						Grains			
	Brittle		Non-brittle		Uniden-tified		*Hordeum spont.*		*Hordeum dist.*+unid.	
		%		%		%		%		%
Ramad										
C8 SE	133	35.3	184	48.8	60	15.9	25	4.7	506	95.3
M4	53	32.7	85	52.5	24	14.8	4	1.7	225	98.3
Ghoraifé	4		3		4		1½		13½	
Aswad	80	62.5	34	26.6	14	10.9	25	6.8	344	93.2

separate, in carbonized, subfossil specimens the distinction is often less clear. This may to a high degree be due to a puffing of the grains and other kinds of deformation through carbonization. In some of the charred wild barley kernels the thin upper part is slightly curved backwards.

Whereas a large proportion of the rachis internodes is of the wild barley type, relatively few grains could with a fair degree of certainty be attributed to *Hordeum spontaneum*. This discrepancy between the proportions of wild barley-type rachis internodes and grains poses some questions. In table 18 the total numbers of internode(s) (fragments) and grains from Aswad, Ghoraifé and Ramad are shown. Three categories of rachis remains are distinguished: brittle, non-brittle and unidentified (too fragmentary to determine brittleness). The grains are separated into two categories: more or less distinct wild barley type kernels and the others which are predominantly *Hordeum distichum* but which may include some *H. spontaneum*. The latter applies also to *H. spontaneum* and *H. distichum* in Ramad (tables 5, 6 and 7).

At Aswad brittle-type internode fragments are dominant. At Ramad non-brittle internodes are more numerous than those of the brittle type. For Ghoraifé there are too few internode fragments to allow any conclusion as to the proportions. For the proportionally too great numbers of brittle-type rachis internodes two explanations can be brought forward:

1. Many more kernels are of *Hordeum spontaneum* than have been determined on the basis of the grain morphology.

2. The two-rowed barley of the Neolithic farmers in the Damascus basin was not yet fully tough-rachised.

The second hypothesis would imply that as for rachis toughness the barley in the Damascus area was of an intermediate stage between wild and fully domesticated forms; in addition to tough-rachised forms, semi-brittle and perhaps even brittle forms with *Hordeum distichum*-type kernels occurred. As for the hypothetical semi-brittle barley, it is assumed that in threshing, the rachis of this type breaks at the internode joints. The second hypothesis is attractive in that it explains also the fact that at Aswad the proportion of brittle-type internodes is much higher than at Ramad. This would, as it were, illustrate the gradually increasing proportion of tough-rachised forms in the barley grown in the Damascus area.

The large proportion of brittle and semi-brittle barley could also be due to a continual interbreeding, a back-crossing, of morphologically wild and domestic forms. Wild barley is still found as a weed in and along fields in the Damascus area. However, it may not be excluded that among our *Hordeum distichum*-type grains a considerable number is of *Hordeum spontaneum*. In other words, due to deformation and puffing many charred wild barley grains cannot be recognized as such. Be this as it may, it was thought useful to focus attention on the discrepancies in the proportions of internode types and grain types.

The dimensions and index values of hulled barley grains from Aswad and Ramad are shown in table 18. As many kernels had been more or less seriously affected by the carbonization, rather few specimens were suitable for measuring. It cannot be excluded that some of the measured grains have afterwards been attributed to *Hordeum spontaneum*. It was not until the final stage of the investigation that a serious attempt was made to distinguish between domestic and wild barley-type grains. There are some differences in the dimensions of the hulled barley grains between the samples, but the index values hardly differ. Moreover, the differences in size are not systematic. Although, on average, the Aswad barley is smaller than that of Ramad, the dimensions of the grains in Aswad West 1.60 conform to those in Ramad C8 3.35. It seems impossible to draw any other conclusion than that the size differences must have been due to local conditions.

4.6. Naked barley

Free-threashing barley is rather scarcely represented. Only a few samples yielded somewhat greater numbers of naked barley grains This barley species has not been demonstrated for phase I at Aswad. It seems that just like einkorn wheat and free-threshing wheat, naked barley did not form part of the crop plant assortment of the earliest farmers in the Damascus area. It cannot be ascertained whether naked barley was introduced in the Damascus area from elsewhere or whether it had developed locally from hulled barley.

Naked barley grains have a more flowing shape than those of the hulled varieties and they are not angular but rounded in cross-section. The fine transverse wrinkling on the surface of the grains, which is a characteristic feature of naked barley, could be observed in about 15% of the kernels.

The naked barley grains are shorter and plumper than those of the hulled varieties as is clear from a comparison between tables 17 and 19. The greater plumpness of the naked barley finds expression in the considerably lower L/B index values. The naked barley at Ramad, Ghoraifé and Aswad is attributed to the six-rowed species, *Hordeum vulgare* L. emend. Lam. var. *coeleste* L. (*H. vulgare* var. *nudum*). It is true that only a few, somewhat problematical, asymmetric or lop-sided grains have been observed, but the many short and broad kernels point to six-rowed naked barley.

One barley internode fragment has been identified as that of six-rowed barley (Ramad C8 2.25). It could not be established with certainty whether naked barley is concerned here, although this is most likely. The lateral spikelets on this internode were not sessile as in modern six-rowed barley, but they were pedicellate. Short-stalked lateral spikelets are described for naked and hulled *Hordeum vulgare* from Neolithic sites in Central and Western Europe (Villaret-von Rochow, 1967; Knörzer, 1971).

Table 19. Dimensions and index values of *Hordeum vulgare* var. *coeleste* from Ramad

		L	B	T	L/B	T/B
C8 3.35	min.	4.1	2.5	1.8	114	51
N = 9	aver.	4.68	3.00	2.09	159	71
	max.	5.4	3.9	2.5	194	100
C8 4.95	min.	3.2	2.7	2.0	118	67
N = 8	aver.	3.96	2.98	2.14	133	72
	max.	4.4	3.4	2.3	153	81

4.7. Cereal grain fragments

In addition to complete and more or less damaged kernels, great numbers of usually small cereal grain fragments were recovered. Although it would in various instances have been possible to attribute these fragments to a particular grain type, they are all lumped together into the category of 'cereal grain fragments'. In tables 5–9 the numbers of cereal grain fragments are not the numbers of actual fragments, but of estimated complete kernels (on the basis of 0.0074 gram per grain). The mean cereal grain weight of 0.0074 gram was obtained in the following way.

For 100 complete grains of emmer wheat and of free-threshing wheat from 3 samples the weight was determined (table 20). For hulled barley no 100 complete kernels per sample were available for weighing, but here the weights obtained for smaller numbers of grains have been converted to 100 grain weights. The 100 grain weights listed in table 20 result in the mean value of 0.74 gram for 100 cereal grains: the value applied here for converting the weights of the cereal grain fragments into numbers of grains.

The charred grain weights are a measure of the weight of the grains before carbonization and thus of the quality of the crop. So far, few charred grain weights have been published, so

Table 20. (Calculated) 100 grain weights for cereals from Ramad

Triticum dicoccum	C8 3.35	0.87 g	
	C8 3.90	0.66 g	
	C8 4.95	0.75 g	
Triticum durum/ aestivum	C8 3.35	0.70 g	
	M4 1.80	0.72 g	
	C8 4.75	0.76 g	
Hordeum (distichum)	C8 4.75	0.78 g	(based upon 88 grains)
	C8 4.95	0.66 g	(based upon 50 grains)
	C8 5.05	0.73 g	(based upon 55 grains)
Mean 100 grain weight		0.74 g	

that comparisons between sites are hardly possible. For *Triticum durum/aestivum* from sixth millennium B.C. Erbaba, in South-Central Anatolia, a mean 100 grain weight of 1.1 gram was established (van Zeist & Buitenhuis, 1983), whereas for the free-threshing wheat from Ramad this value is only 0.73 gram.

4.8. Linseed

Aswad and Ghoraifé yielded small numbers of seeds of *Linum*, but at Ramad this seed type is better represented. Some of the Ramad flax seeds are depicted in fig. 20, while the dimensions are shown in table 21. The question of the species determination of the *Linum* seeds from Ramad has already been discussed in an earlier paper (van Zeist & Bakker-Heeres, 1975a). The conclusion that the flax seeds from Ramad are of domestic *Linum usitatissimum* L. is based upon the size of the seeds. A few points of the argumentation may be repeated here.

As for the original size of the Ramad flax seeds, it should be taken into consideration that carbonization causes shrinkage of the seeds. Helbaek (1972) mentions a decrease in length of 12–15% after carbonization. The first author established a difference in length and width of 13 and 21%, respectively, between non-carbonized and carbonized seeds of *Linum usitatissimum* in the same

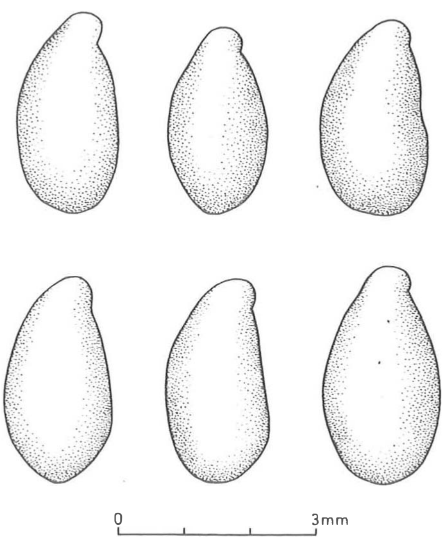

Fig. 20. *Linum usitatissimum*, Ramad.

Table 21. Dimensions of *Linum (usitatissimum)* seeds

		L	Corrected for 13 % shrinkage	B	Corrected for 21 % shrinkage
Ramad					
M4 1.75	min.	2.8	(3.2)	1.3	(1.6)
N = 30	aver.	3.11	(3.57)	1.54	(1.95)
	max.	3.5	(4.0)	1.7	(2.1)
C8 4.75	min.	3.0	(3.5)	1.6	(2.0)
N = 10	aver.	3.21	(3.69)	1.67	(2.12)
	max.	3.4	(3.9)	1.8	(2.2)
C8 4.95	min.	2.8	(3.2)	1.2	(1.5)
N = 30	aver.	3.17	(3.64)	1.55	(1.96)
	max.	3.6	(4.1)	1.8	(2.2)
C8 5.05	min.	2.9	(3.3)	1.4	(1.7)
N = 10	aver.	3.10	(3.57)	1.54	(1.95)
	max.	3.4	(4.0)	1.8	(2.2)
Ghoraifé					
Phase II, N = 8	min.	2.6	(3.0)	1.3	(1.6)
Various levels	aver.	2.92	(3.36)	1.50	(1.90)
	max.	3.3	(3.8)	1.8	(2.2)
Phase I 5.00		2.6	(3.0)	1.2	(1.5)
Aswad West					
Phase II 1.20		2.9	(3.3)	1.5	(1.9)
2.40		2.8	(3.2)	1.5	(1.9)

waterlogged sample from the Neolithic lake shore dwelling site of Niederwil, in northeastern Switzerland. The dimensions after a correction for shrinkage of 13% and 21%, respectively, are also given in table 21. The corrected length of the Ramad seeds varies from 3.2 to 4.1 mm. This size conforms to that of the seeds of domestic flax, whereas most of the wild *Linum* species reported for western Syria have seeds which are either larger or smaller than the Ramad seeds (van Zeist & Bakker-Heeres, 1975a). Only *Linum bienne* Mill. (*L. angustifolium* Huds.), which is considered as the wild progenitor of domestic linseed, could possibly come into consideration because its seed size would range from 2.5 to 3.5 mm according to Brouwer & Stählin (1955). However, *Linum bienne* seeds of unquestionably Near Eastern proveniences do not exceed 3 mm: 3 mm (Post & Dinsmore, vol. 1, pp. 252–253), 2–3 mm (Zohary & Feinbrun-Dothan, vol. 2, p. 260), 2.4–2.7 mm (Helbaek, 1959b), 2.6.–2.7 mm (own measurements). It seems that Near Eastern *Linum bienne* seeds are generally not larger than 3 mm. Even if an occasional *L.*

bienne seed reaches a length of 3.5 mm, the majority of the Ramad seeds, measuring more than 3.5 mm, cannot possibly have originated from this wild flax species. Thus, the size of the Ramad flax seeds points to *Linum usitatissimum*, implying that about 6250 B.C. (the radiocarbon date obtained for a sample at depth of 5.10 m) linseed cultivation was well under way. It is likely that from the beginning of the habitation on *Linum usitatissimum* formed part of the crop-plant assortment of the Ramad farmers.

The *Linum* seeds from Ghoraifé and Aswad are, on average, smaller than those from Ramad. If one takes the line that cultivation of flax resulted in an increase in the size of the seeds, the flax at Aswad and Ghoraifé was of a more primitive–less developed–type than that at Ramad. One could also speculate that the growing conditions at Ramad were better than at the other two sites. On the other hand, the dimensions of the cereal grains do not support such a hypothesis. Although one cannot exclude the possibility that the flax at Aswad and Ghoraifé concerns wild *Linum bienne*, it is tempting to assume that already in the first half of the seventh millennium B.C. (phase II at Aswad) flax was cultivated in the Damascus area. This would be the oldest indication of flax cultivation. The flax seeds at Çayönü, in southeastern Turkey, from a level dated to c. 7000 B.C., are attributed to *Linum bienne* (van Zeist, 1972). The Çayönü flax seeds (dimensions: 2.45 (2.2–2.6) ×1.30 (1.1–1.5) mm; corrected for shrinkage: 2.82 (2.5–3.0) × 1.65 (1.4–1.9)mm) are markedly smaller than those from Aswad and Ghoraifé.

4.9. Lentil

Lentils were found in almost all Ramad samples. Particularly C8 4.75, C8 4.95 and C8 5.05 yielded rather large numbers of lentils. For 4 samples the greatest diameter of the lentils was measured (table 22). From Ghoraifé only a few lentil seeds were recovered, but at Aswad this species is better represented, although no sample yielded more than a small number of seeds. The dimensions of the Ghoraifé and Aswad lentils are also shown in table 22. It was sometimes difficult to distinguish between small, somewhat deformed lentils and flat, lentil-like *Vicia* seeds.

Table 22. Greatest diameter of *Lens (culinaris)* seeds

Ramad		
C8 4.75	min.	1.8
N = 100	aver.	2.94
	max.	4.1
C8 4.95	min.	1.9
N = 62	aver.	2.93
	max.	4.0
C8 5.05	min.	1.8
N= 42	aver.	3.04
	max.	4.0
M4 2.30	min.	1.8
N = 18	aver.	2.87
	max.	3.8
Ghoraifé 1975		
Phase I, 4.40		2.6
5.00		2.6
		2.6
Aswad West		
Phase II, various levels	min.	2.1
N = 8	aver.	2.51
	max.	3.4
Aswad East		
Phase I, various levels	min.	2.0
N = 6	aver.	2.75
	max.	3.6

Lens is present in the lowermost habitation levels (phase I) at Aswad. Was this lentil collected wild or was the species already cultivated by the earliest farmers in the Damascus basin? As for the species identification the following may be remarked. Until recently, *Lens nigricans* (Bieb.) Godr. was considered as the wild progenitor of domesticated lentil (*Lens culinaris* Medik. = *L. esculenta* Moench). This species which has a Mediterranean distribution from Spain and Morocco to the eastern shore of the Mediterranean Sea, produces seeds of 2.0 to 2.5 mm in diameter. However, D. Zohary (1972) has pointed out that another wild lentil species, *Lens orientalis* (Boiss.) Hand.-Mazz., is the most likely candidate as the ancestor of domestic lentil. The distribution of this species coincides largely with that of the wild cereals. The seeds of *Lens orientalis* range from 2.5 to 3.0 mm. The seed size of modern cultivated forms of lentil is 5 to 8 mm, but some present-day cultivated forms (grouped in ssp. *microsperma*) still retain a small seed size: 3–4 mm (Zohary & Hopf, 1973). All prehistoric domestic lentils are to be attributed to this *microsperma* group.

Although it is likely that by carbonization lentils decrease in diameter, no information on the degree of shrinkage is available. For that reason one can only guess at the original diameter of the charred prehistoric lentils. The size of Ramad lentils is such that one may assume that domestic lentil is concerned here. Even if one assumes a decrease in diameter of only 10%, the majority of the Ramad lentils is more than 3 mm in size. However, this cannot be said of the Aswad lentils. Most of the measured specimens, which are admittedly few in number, are smaller than 3 mm after correction for moderate shrinkage. On the other hand, comparatively large lentils do occur at Aswad. One could speculate that lentil was cultivated by the Aswad (and Ghoraifé) farmers, but that the seeds had not yet acquired the size that is characteristic of prehistoric domestic lentils. This would imply that Aswad represents an early stage of lentil cultivation. It is self-evident that there is no strict evidence of the cultivation of lentils at Aswad. It cannot be ruled out that lentil that was collected in the wild is concerned here. In this connection it should be mentioned that the Damascus basin lies within the distribution area of *Lens orientalis* (Zohary & Hopf, 1973).

Table 23. Greatest dimension of *Pisum sativum* seeds

Ramad		
C8, phase II	min.	3.1
Various levels	aver.	4.06
N = 54	max.	5.0
M4, phase II	min.	3.2
Various levels	aver.	4.06
N = 11	max.	4.8
C8, phase I	min.	3.4
Various levels	aver.	4.15
N = 19	max.	5.2
Ghoraifé		
Phase I	min.	3.0
Various levels	aver.	3.61
N = 11	max.	4.1
Aswad		
West, phase II	min.	3.5
Various levels	aver.	3.89
N = 8	max.	4.2
East, Phase II	min.	3.5
Various levels	aver.	4.09
N = 12	max.	4.9
East, phase I	min.	3.4
Various levels	aver.	4.10
N = 10	max.	4.7

4.10. Field pea

Already from the lowest habitation levels at Aswad field pea seeds were recovered. As in the charred peas from Aswad (and Ghoraifé) no remains of the seed coat have been preserved, it cannot be established whether morphologically-defined wild or domestic pea is concerned here. Domestic peas have a smooth seed coat, whereas in wild forms the wall is rough. We take the line that *Pisum* was cultivated and for that reason all peas are attributed to *Pisum sativum* L. On the other hand, the Damascus basin lies within the distribution area of *Pisum humile* Boiss. et Noë, the wild progenitor of *Pisum sativum* (Zohary & Hopf, 1973, map 2), so the collecting or cultivation of wild pea cannot be excluded, in particular for the earliest habitation at Aswad.

Particularly at Aswad and Ghoraifé the distinction between small peas and large vetch seeds had to be rather arbitrary because the characteristic hilum was not present. Pea-like seeds smaller than 2.9-3.0 mm have been attributed to *Vicia* spec. (5.15.). Some of these seeds may actually be of *Pisum* as is suggested by the Ramad material. An occasional Ramad pea (with hilum) measured only 2.8 mm. Also at Ramad, peas in which the oval hilum and/or parts of the seed coat have been preserved are rare.

For peas from various samples the greatest dimension was measured. Because for each sample generally small numbers of peas were available for measuring, the results for the samples from the same archaeological phase are taken together (table 23). From the measurements it is clear that there is hardly any difference in size between the peas from phase I at Aswad (c. 7800–7300 B.C.) and those from phase II at Ramad (c. 6000 B.C.). Consequently, there seems to be no question of an increse in size in the course of time. The smaller size of the peas at Ghoraifé (in time corresponding to those from Aswad phase II) must perhaps be ascribed to less favourable growing conditions.

Table 24. Dimensions of *Cicer arietinum* seeds from Ramad (various levels). The number of seeds measured is 18. Length and breadth have been determined in the plane of the radicle. The thickness is the distance between the plane with the radicle and the opposite end.

	Length	Breadth	Thickness
Minimum	3.3	3.0	2.9
Average	4.36	4.14	3.82
Maximum	4.9	4.6	4.3

4.11. Chick-pea

Ramad yielded small numbers of chick-pea seeds, Ghoraifé altogether 3 specimens. Chick-peas are easily recognized by the squat, angular shape. In a few of the Ramad chick-peas the characteristic protruding radicle is still present. In charred seeds this radicle has mostly fallen off. The dimensions of chick-pea seeds from Ramad are shown in table 24. The Ramad chick-peas are, on average, somewhat smaller than those of Early Bronze Age Arad and Jericho: 4.7×3.8 and 4.73×4.11 mm, respectively (*cf.* Hopf, 1978), but larger than the *Cicer* spec. seeds from aceramic Çayönü, one specimen of which could be measured: 3.8×3.6×3.2 mm (van Zeist, 1972). The Ghoraifé chick-peas are smaller than the Çayönü specimen: 3.2×3.4×3.0, 3.3.×3.2×3.0, 2.6×2.6×2.5 mm.

If chick-pea cultivation resulted in an increase in seed size, the Ghoraifé specimens would represent a more primitive type than those at Ramad. Although the rather few chick-peas at Ramad are no firm evidence of the cultivation of this species, it is assumed that the domestic form, *Cicer arietinum* L., is concerned here. The status of the Ghoraifé chick-peas is more uncertain.

Two wedge-shaped *Lathyrus* seeds, probably *Lathyrus cicera* L., were recovered:one from Ramad C8 2.10 (3.7×3.5×3.0 mm) and one from Ghoraifé 1974, 5.50 (3.9×3.2×3.7 mm).

4.12. Bitter vetch

Only very few bitter vetch seeds (*Vicia ervilia* (L.) Willd.) were recovered: 1 from Aswad, 1 from Ghoraifé and 5 from Ramad. The Aswad specimen must have been an unripe seed. There is some uncertainty as to the species identity of this seed. Bitter vetch seeds are distinguishable from those of other vetches (*Vicia* spec., see 5.15.) by their shape: obliquely pyramidal, with a triangular base and a rounded apex.

Fairly large numbers of bitter vetch seeds are reported for seventh and sixth millennia B.C. sites in Anatolia: Çayönü (van Zeist, 1972), Çatal Hüyük (Helbaek, 1964), Erbaba (van Zeist & Buitenhuis, 1983), Can Hasan III (French *et al.*, 1972) and ceramic Hacilar (Helbaek, 1970). One may assume that already in the seventh millennium B.C. *Vicia ervilia* was grown in Turkey. However, by the end of the seventh millennium bitter vetch cultivation had apparently not yet expanded in a southerly direction. At least, the occasional seeds from Aswad, Ghoraifé and Ramad are no evidence of the cultivation of this potential crop plant in the Damascus area.

According to Zohary & Hopf (1973) truly wild forms of *Vicia ervilia* are known only for Anatolia. This would imply that bitter vetch was introduced into the Damascus area, and that the species must have occurred as a weed in the fields of the Neolithic farmers.

5 WILD PLANT REMAINS

This section provides descriptions of the fruits and seeds of wild plant species recovered from the sites under discussion. The descriptions of the plant remains are supplemented with measurements and illustrations.

The authors wish to make explicit the basis for their identifications. From the descriptions and illustrations it should be clear which kind of seed or fruit has been attributed to a certain plant taxon (species, genus, type). At least to some extent, this provides the reader with the possibility of checking the identifications presented in this paper and obvious mistakes can thus be detected. Palaeobotanists still have little experience with the examination of fruits and seeds of wild plants in Near Eastern sites, and the incompleteness of seed reference collections is a serious handicap for the identification of archaeological plant remains.

The descriptions and illustrations should be of advantage for future research in the sense that they facilitate the identification of similar plant remains from other sites. Archaeobotanical research in the Near East can only make progress if one can profit from the experience of other researchers in this field. It would be of great help if in the course of time a kind of catalogue of archaeological plant remains could be compiled. This is all the more necessary for the Near East because the few archaeobotanists active in this large area are based in institutes that are very far apart, so frequent personal contact between them is severely limited.

5.1. Aizoaceae

Aizoon. Aswad West 0.40 and 0.60 yielded each one *Aizoon* seed (c. 0.8 mm). The laterally compressed seeds are almost circular in outline. A characteristic feature is the surface pattern: concentric ridges on the side faces and rows of papillae on the greater part of the dorsal surface. Two *Aizoon* seeds from Tell es Sinn (eastern Syria) are depicted in fig. 23:5. The subfossil seeds conform to those of *Aizoon hispanicum* L., which species is reported for saline and gypseous soils (M. Zohary, 1973, pp. 443 and 466).

5.2. Anacardiaceae

Pistacia. Mostly pistachio nutshell fragments were recovered. However, some of the Ramad samples yielded also intact nuts (fig. 2:4). Of 39 complete *Pistacia* nuts the dimensions are shown in table 25. The location of the measurements is indicated in fig. 2:5.

Table 25. Measurements of Pistacia nuts from Ramad C8 3.55, 4.75 and 5.05 (N = 39). The location of the measurements is indicated in figure 20:5.

	L	B	T	L/B
Minimum	3.4	3.1	2.8	71
Average	4.58	4.40	3.51	96
Maximum	5.5	5.6	4.2	138

The *Pistacia* nutshells are laterally flattened, elliptic to broadly elliptic in outline. The variation in shape finds expression in the range of the L:B index values: from 71 to 138. The nutshell surface is smooth. In some of the nuts, remains of the fruit flesh (and fruit wall) are still present. Nutshell fragments have been converted to whole specimens on the basis of 0.021 gram per *Pistacia* nut (the average weight of 37 complete, carbonized specimens). If the fragments equal less than half a nutshell, this is indicated in tables 5 to 10 with a plus-sign (+).

As for the shape and the size of the nuts, two species come into consideration, *viz. Pistacia atlantica* Desf. and *P. palaestina*

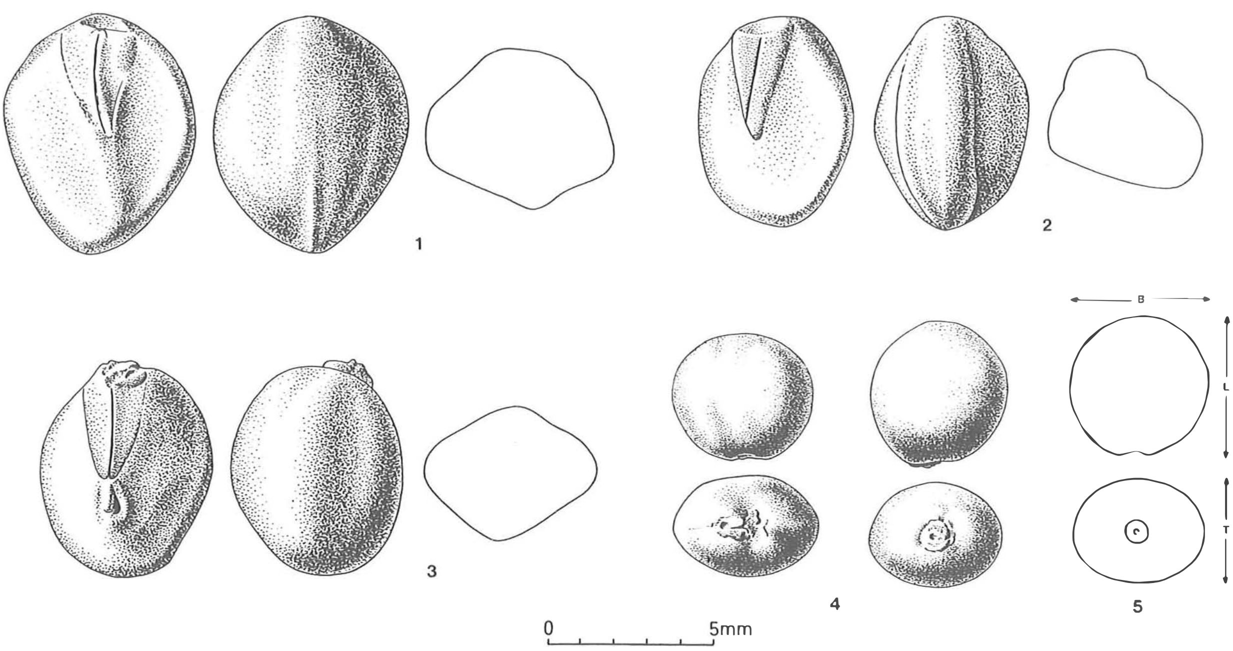

Fig. 21. 1, 2, 3. *Crataegus*, Ramad C8 4.75; 4. *Pistacia*, Ramad C8 3.55; 5. *Pistacia*, position of measurements.

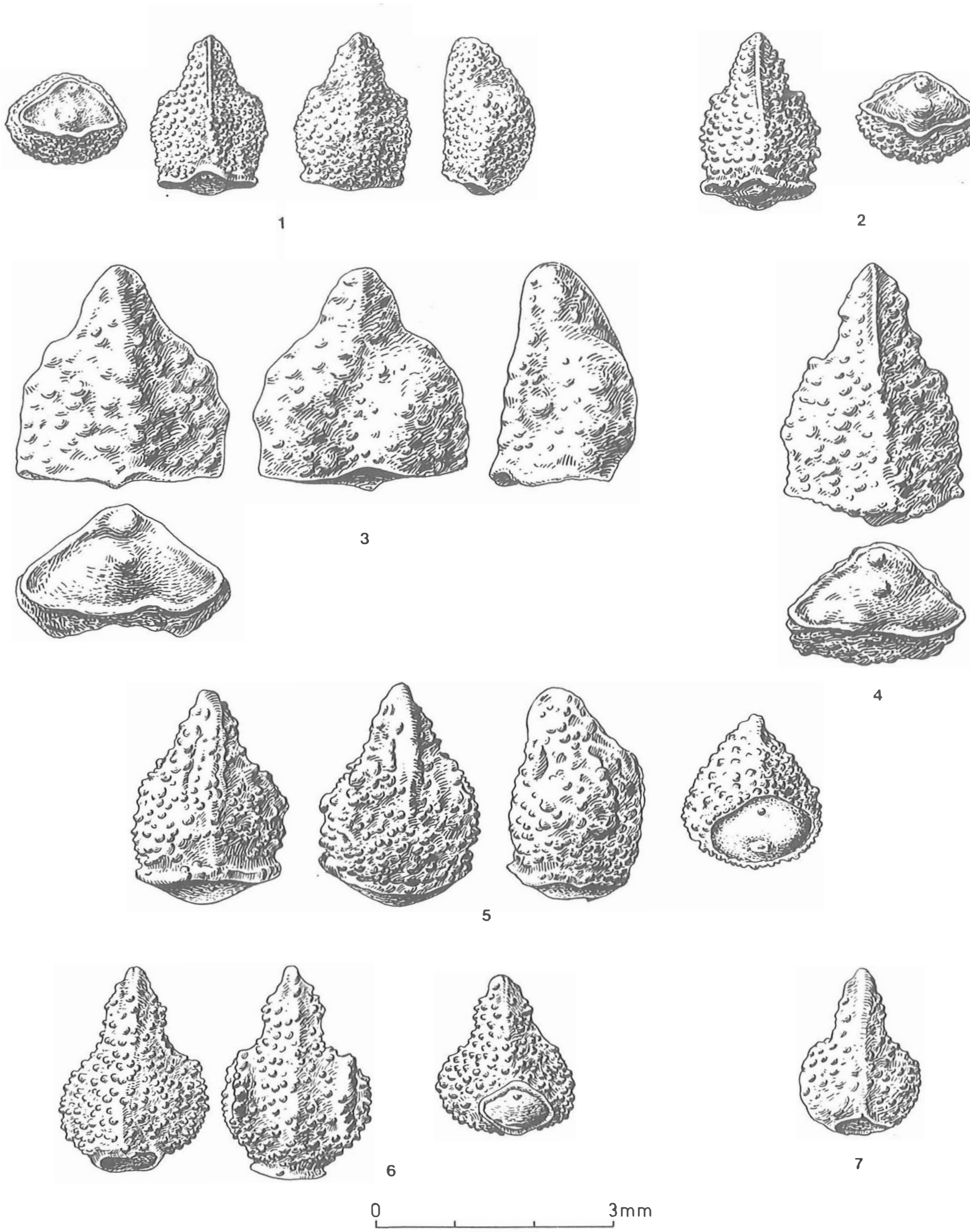

Fig. 22. 1, 2. *Arnebia decumbens*, El Khom; 3, 4. *Arnebia linearifolia*, El Khom; 5. *Lithospermum arvense*, Ramad M4 2.30; 6,7. *Lithospermum tenuiflorum*, Ramad M4 2.80.

Boiss. (see also 7.4.1.). The nuts of *P. lentiscus* L. are usually smaller and laterally more compressed. Moreover, *P. lentiscus* is a species from the coastal area of the Mediterranean, between 0 and 300 (−500) m above sea-level and for that reason one is unlikely to find fruit remains of this species in prehistoric sites in the Damascus area.

5.3. Boraginaceae

A number of boraginaceous species is represented in Aswad, Ghoraifé and Ramad. As has already been expounded in a previous paper (van Zeist & Buitenhuis, 1983), the fruits of Boraginaceae in archaeological sites pose some problems. On burning, the nutlets do not turn black, but they acquire a whitish to grey colour which is due to the silica skeleton. Because of the silica skeleton also of non-carbonized fruits the wall may remain preserved in archaeological deposits. As a result it is not possible to determine whether the fruits are of the same age as the deposit in which they were found or whether they are due to a later intrusion. Boraginaceous fruits may have been carried downwards by burrowing animals, such as ants. Only of those fruits in which the remains of the carbonized contents are present may one be assured that they became incorporated in the archaeological layer at the time when this was deposited. However, from the appearance of the fruit wall (colour, some degree of corrosion, *etc.*) one may conclude that most of the boraginaceous nutlets in the sites under discussion are certainly no modern intrusions.

Arnebia decumbens (Vent.) Coss. et Kral. Nutlets trigonal to ovate in outline, with truncated base and rather obtuse apex. The triangular base is bordered by a distinct collar. The ventral keel extends over the upper 2/3 of the fruit. The surface is densely covered with wart-like projections of uneven size (fig. 22:1, 2). The greatest length and breadth of the fruits are about 2 and 1.5 mm, respectively. *Arnebia decumbens* is represented in a few samples from Aswad and Ghoraifé. The only sample which yielded more than a few nutlets is from just below the surface (Aswad East 0.20) and these specimens look rather fresh.

Arnebia decumbens is a plant from arid regions. At Mureybit (in preparation) the fruits of this species were found in fairly great numbers.

Arnebia linearifolia DC. Squat nutlets, trigonal in outline, with short, rather obtuse apex (fig. 22:3,4). Broad, triangular base. Surface less densely verrucate than in *A. decumbens*. In subfossil fruits the verrucae may have disappeared altogether. This species from steppe and desert-steppe vegetations is not represented in one of the sites of the Damascus basin, but its nutlets were found in Mureybit. It was thought appropriate to describe and to depict the *Arnebia linearifolia* fruit type here in the context of the other boraginaceous nutlets recovered from archaeological sites in Syria.

Heliotropium. Slightly compressed nutlets, ovate in outline, with ridged margin in the upper part of the fruit. Surface irregularly wrinkled. A characteristic feature is the protruding hilum (fig. 23:7). Of the three sites in the Damascus area only Ramad yielded a few *Heliotropium* nutlets. Dimensions of 4 specimens: 1.3×0.9, 1.3×1.0, 1.4×1.1 and 1.7×1.0 mm.

No attempt has been made to arrive at a species determination. *Heliotropium* species are reported for natural vegetations as well as for disturbed habitats in Syria (Mouterde, vol. 3, pp. 50–53).

Lithospermum arvense L. (*Buglossoides arvensis* (L.) Johnston). Nutlets obliquely ovate, with truncated base, rather pointed at the apex (fig. 22:5). Rounded triangular base. Distinct ventral keel. Surface with grooves, densely covered with wart-like projections (verrucae). For dimensions see table 26. *Lithospermum arvense* is represented in a fairly great number of samples of the sites under discussion, though usually in small numbers. It is a plant of waste places and fields (Post & Dinsmore, vol. 2, p. 240; Mouterde, vol. 3, p. 63; Zohary & Feinbrun-Dothan, vol. 3, p. 67).

Lithospermum tenuiflorum L. fil. (*Buglossoides tenuiflora* (L. fil.) Johnston). The nutlets are strongly bigibbous (the most characteristic feature), with an elongated,

Table 26. Dimensions of *Lithospermum* fruits from Ramad

L. tenuiflorum			
C8 3.70	min.	2.2	1.6
N = 14	aver.	2.53	1.81
	max.	2.9	2.0
C8 4.75	min.	2.3	1.6
N = 13	aver.	2.60	1.87
	max.	2.8	2.1
C8 4.95	min.	2.4	1.8
N = 20	aver.	2.62	1.91
	max.	2.9	2.1
L. arvense			
M4 2.30	min.	2.4	1.6
N = 20	aver.	2.63	1.86
	max.	3.0	2.2

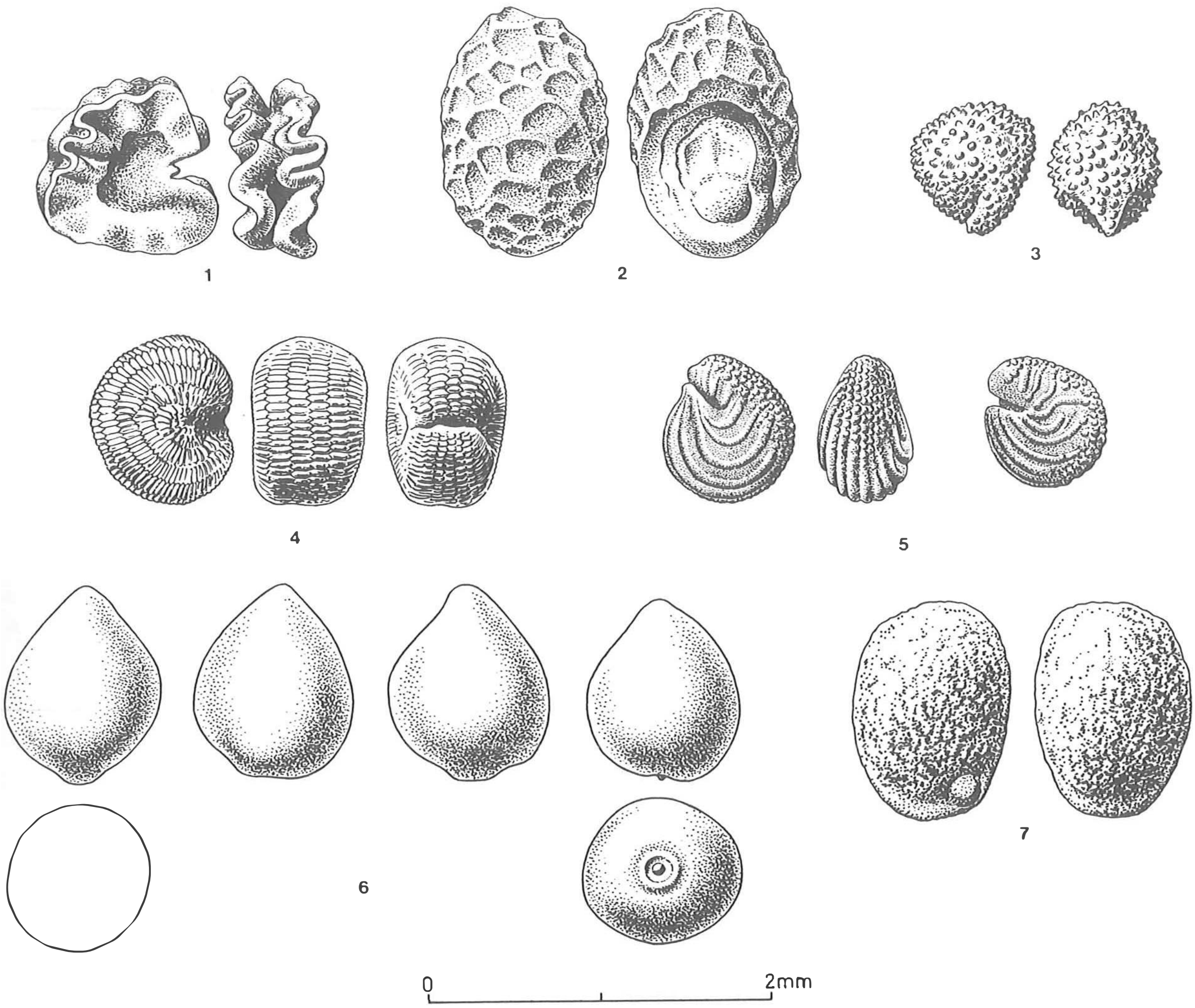

Fig. 23. 1. *Silene colorata*-type, Ramad C8 4.35; 2. *Teucrium*-type, Ramad C8 2.95; 3. *Cerastium*-type, Ramad M4 1.75; 4. *Silene* spec., Ramad M4 1.80; 5. *Aizoon hispanicum*, Tell es Sinn; 6. *Helianthemum*, Ramad M4 2.80; 7. *Heliotropium*, Ramad C8 4.95.

rather pointed apex (fig. 22: 6, 7). The base is conspicuously small compared to that in *Lithospermum arvense* nutlets. The surface is densely covered with wart-like projections. The dimensions are shown in table 26. A few samples yielded fairly great numbers of *Lithospermum tenuiflorum* fruits. The species occurs in fields as well as steppe vegetations.

5.4. Capparidaceae

Capparis. *Capparis* seeds were recovered from Aswad only. The seeds are obovate in outline; in side-view tapering from the top to the base (more or less wedge-shaped). The curved radicle is a prominent feature (fig. 2:1). Most of the seeds had been rather seriously deformed. Sometimes only the 'inner seed', which reminds one of chenopodiaceous seeds, had been preserved. The dimensions of 5 seeds range from 2.2×2.0 to 2.8×2.4 mm. Most likely the seeds are of *Capparis spinosa* L., the fleshy fruits of which are still consumed at present, but *Capparis ovata* Desf. comes also into consideration (Zohary & Feinbrun-Dothan, vol. I, pp. 242–243).

5.5. Caryophyllaceae

Arenaria. One small, kidney-shaped seed has been attributed to *Arenaria* (Aswad West 0.40). On the surface a pattern of oblong, slightly domed verrucae. Size: 0.75×0.55 mm.

Cerastium-type. Seeds ovate-cuneate in outline (tapering from apex to base). Papillae in concentric rows (fig. 23:3). This seed type is scarcely represented at Ramad. The dimensions of 5 seeds vary from 0.75×0.7 to 0.95×1.0 mm.

Gypsophila. Altogether 3 *Gypsophila*-type seeds were recovered (Ramad M4 1.75 and M4 1.80). The seeds are almost circular in outline, with a short but distinct radicle tip. The surface structure consists of concentric rows of radially elongated verrucae, each with a papilla in the centre (the concentric rows of papillae are the most obvious surface structure). Greatest diameter c. 1.4 mm.

Silene spec. Reniform seeds with concentric rows of radially elongated (oblong) and flat verrucae on the side faces as well as on the dorsal surface (fig. 23:4). Of 29 reasonably well preserved specimens from M4 1.75, 1.80 and 1.90 the dimensions have been determined: 0.92 (0.85–1.05) ×0.77 (0.65–0.85) ×0.70(0.65–0.85) mm.

Silene is well represented in Ramad, in some samples by rather great numbers of seeds. From Ghoraifé and Aswad, on the other hand, only a few *Silene* seeds were recovered. The seeds from the latter sites are all more or less seriously damaged, but size and remains of surface structure conform to those of the *Silene* seeds from Ramad. Apparently all seeds are of the same type, though this does not necessarily mean that only one species is involved. A great number of *Silene* species is reported for Syria (Mouterde, vol. I, pp. 483–505).

Silene colorata-type. One seed of this type was found (Ramad C8 4.35). The side faces of this reniform seed show a fine, radial striation. The dorsal surface has a deep groove, forming two undulating wings at the margin (fig. 23:1). Dimensions: 1.1×1.0 mm. The shape of the subfossil specimen corresponds to that of the seeds of *Silene colorata* Poir., but the latter are larger (c. 1.7×1.6 mm).

Vaccaria pyramidata Medik. Almost globular seeds. The surface is densely covered with tiny papillae. The carbonization usually results in serious deformations; the seeds tend to split into two halves (fig. 24: 2, 3). In most of the damaged seeds a part of the characteristic seed wall is still preserved. Very few seeds were suitable for measuring: two seeds from Ramad measure each 1.9 mm, one from Ghoraifé 1.7 mm and one from Aswad 1.6 mm. Most likely the prehistoric *Vaccaria* seeds are of *V. pyramidata* Medik. (*V. segetalis* (Necker) Garcke), which at present is one of the most characteristic weeds of winter crops (Zohary & Feinbrun-Dothan, vol. I, p. 104). The greatest diameter of modern seeds of *Vaccaria pyramidata* collected in western Syria ranges from 1.6 to 2.3 mm. In none of the samples examined were more than a few *Vaccaria* seeds (at most 6) found.

5.6. Chenopodiaceae

Chenopodiaceae are scarcely represented at Aswad and Ghoraifé, and completely absent at Ramad. Chenopodiaceous fruits in Aswad West 0.60 and 1.40 could not be attributed to a genus (poor preservation).

Atriplex. Flat fruits, more or less circular in outline, with a distinct radicle tip. Surface smooth. Greatest diameter: 0.8 to 0.9 mm (6 fruits).

Chenopodium. One lenticular *Chenopodium* fruit was recovered from Ghoraifé (0.7 mm). In the central part of one of both sides a small, round scar is visible. The surface of the subfossil specimen has an obscure radial striation.

Suaeda. Laterally compressed fruits, obovate in outline, with a broad radicle tip. A characteristic feature of *Suaeda* is a small but distinct protuberance in the incurvation between the radicle tip and the median part of the fruit. Surface glossy. Greatest diameter of 2 fruits: 1.0 and 1.2 mm. *Suaeda* species are found particularly on saline soils.

5.7. Cistaceae

Helianthemum ledifolium-type. Small seeds, about 1 mm large (table 27), obliquely ovate in outline. Obtusely pointed at the apex and with a round attachment scar at the base (fig. 23:6). Surface smooth. The carbonized seeds

Table 27. Dimensions of *Helianthemum* seeds from Ramad

C8 2.95	min.	0.9	0.6
N = 68	aver.	1.01	0.85
	max.	1.1	1.0
M4 2.80	min.	1.0	0.7
N = 100	aver.	1.05	0.87
	max.	1.2	1.0

are often more or less seriously deformed, which may hamper the identification. The subfossil seed type conforms to that of *Helianthemum ledifolium* (L.) Mill., which species is reported for steppes and desert-steppes as well as for fields (Zohary & Feinbrun-Dothan, vol. 2, p.34; Mouterde, vol. 2, pp. 543–544). However, as other *Helianthemum* species may likewise come into consideration, this seed type is indicated here as *Helianthemum ledifolium*-type.

Some of the Ramad samples yielded great numbers of *Helianthemum* seeds, but this type has not been established for Aswad and Ghoraifé.

From sample C8 2.95, 3 *Helianthemum* seeds of a different type were recovered. The surface of the seeds (size c. 1.2 mm) shows a pattern of dents and rounded ridges, reminiscent of that in the seeds of *Helianthemum salicifolium* (L.) Mill.

5.8. Compositae

Compositae are scarcely represented in the sites under discussion. Only a few fruit types could be established.

Carthamus. One achene of this type was found (Aswad East 1.20). The fruit is elliptic in outline, laterally somewhat compressed, with a distinct margin. The pappus rim and the indentation at the base are comparatively small (fig. 24:4). The shape of the carbonized achene (2.9×1.9 mm) corresponds to that of the achenes of *Carthamus oxyacantha* M.B., but the latter are much larger (c. 4.5×3.2 mm).

Centaurea. Two achenes have been attributed to *Centaurea*, one of which with some reserve. The two *Centaurea*-type achenes differ markedly one from the other. One specimen (from Aswad West 1.80) is obovate in outline, with truncated upper end. The indentation at the base (in which the hilum is found) is rather inconspicuous and the surface is glossy (1.8× 0.8 mm). The other achene (from Ramad C8 3.70) is more oblong in outline, tapering towards the base. In this specimen no basal indentation is present, which may be due to a deformation as a result of the carbonization. The fruit wall shows fine, longitudinal grooves (3.4×1.1 mm). This type is indicated as *cf. Centaurea*.

Crepis-type. Achenes oblong in outline, slightly tapering at the apex and the base, with ten longitudinal, prominent ribs. Ramad M4 1.75 and M4 1.80 yielded each two rather poorly preserved achenes of this type. Length of 2 specimens: 1.5 and 1.8 mm. The identification remains unsatisfactory; the match with *Crepis* fruits is not wholly convincing.

5.9. Convolvulaceae

Convolvulus. Ramad C8 3.55 and 3.90 yielded a few *Convolvulus* seeds. The seeds are three-sided, obovate in outline. Two faces are flat and the other one is domed. At the basal end a rounded triangular hilum. The surface of the charred specimens is almost smooth. Three seeds measure: 2.6×2.2×1.9, 3.0×2.4×2.0 and 3.1×2.3×2.0 mm.

Some of the *Convolvulus* species reported for Syria are found in fields.

5.10. Cruciferae

Alyssum. In Ramad M4 1.75 three *Alyssum* seeds were found. The flat seeds are oval in outline. The tip of the radicle is free from the cotyledons. The three seeds measure: 1.0×0.7, 1.0×0.8 and 1.1×0.8 mm. The carbonized seeds compare with modern seeds of *Alyssum desertorum* Stapf (*A. minimum* Willd.) without marginal membranous wing. This wing must easily get destroyed as a result of carbonization. An *Alyssum* seed from Ramad C8NW 1.55 is larger: 1.3×1.0 mm.

5.11. Cyperaceae

Carex cf. *divisa* Desf. Compressed fruits, ovate to almost circular in outline. The ventral side is flat or slightly convex; the dorsal side is usually convex, but in some fruits slightly roof-shaped (fig. 24:7,8). The surface is

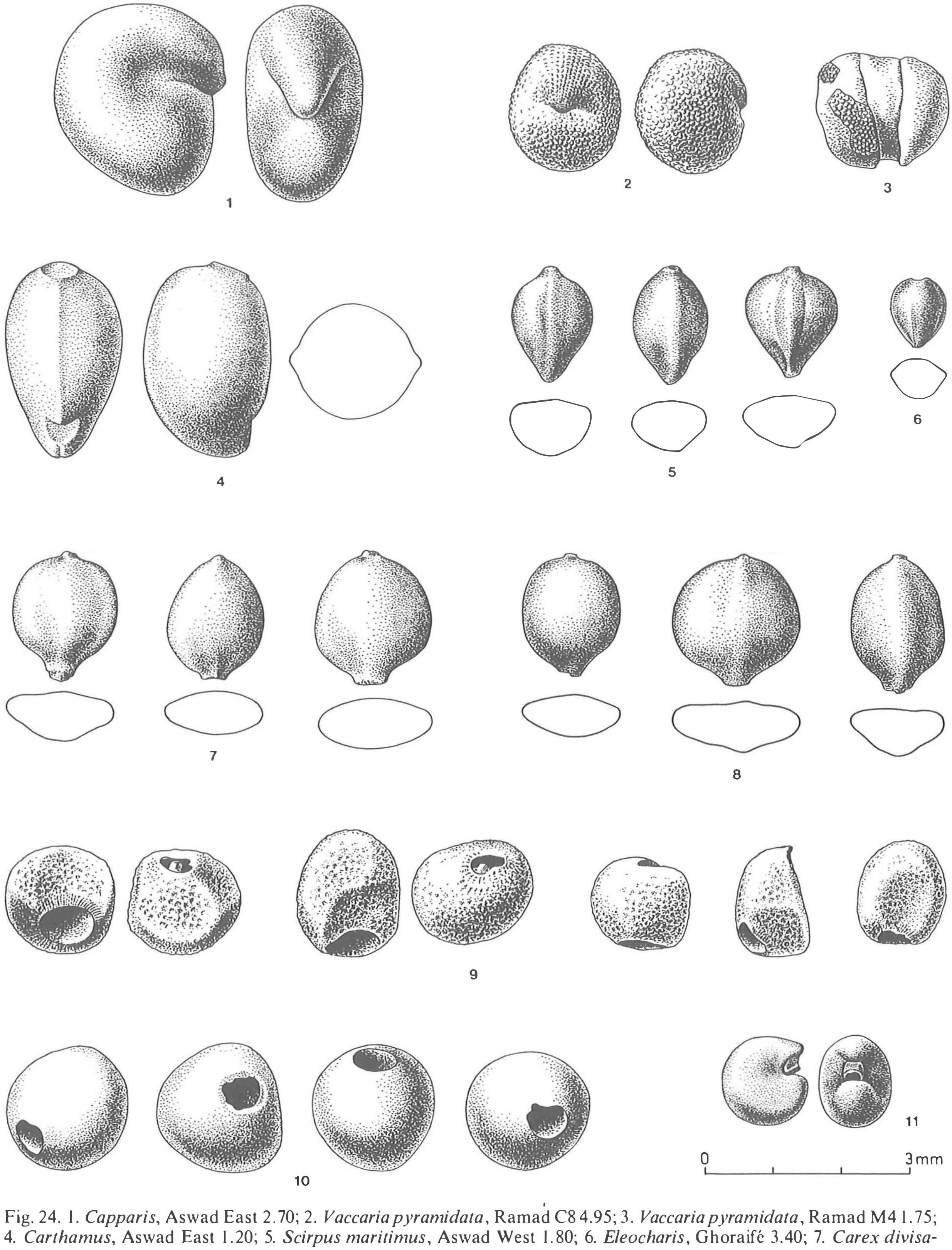

Fig. 24. 1. *Capparis*, Aswad East 2.70; 2. *Vaccaria pyramidata*, Ramad C8 4.95; 3. *Vaccaria pyramidata*, Ramad M4 1.75; 4. *Carthamus*, Aswad East 1.20; 5. *Scirpus maritimus*, Aswad West 1.80; 6. *Eleocharis*, Ghoraifé 3.40; 7. *Carex divisa*-type, Aswad West 2.00; 8. *Carex divisa*-type, Aswad West 1.80; 9. '*Ornithogalum*', Ramad C8 3.35; 10. *Bellevalia*, Ramad C8 3.90; 11. *Malva*, Ramad C8 5.05.

Table 28. Dimensions and index values of cyperaceous fruits

		L	B	L/B
Scirpus maritimus				
Aswad West 1.40	min.	1.3	0.9	106
N = 71	aver.	1.58	1.15	139
	max.	1.9	1.4	173
Scirpus maritimus				
Modern, Murat River	min.	2.3	1.6	115
N = 12	aver.	2.47	1.87	132
	max.	2.6	2.2	155
Scirpus maritimus				
Modern, Konya Basin	min.	1.9	1.4	118
N = 8	aver.	2.07	1.54	135
	max.	2.2	1.8	144
Carex				
Aswad West 2.20	min.	1.4	1.3	105
N = 56	aver.	1.77	1.51	119
	max.	2.2	1.8	147

minutely granular. In addition to more or less complete nutlets, single fruit contents are quite numerous. The dimensions of *Carex* fruits from Aswad are shown in table 28. The charred *Carex* nutlets compare with those of modern *Carex divisa* Desf. The latter species, which is found in moist places which are inundated, at least during part of the year, is reported for various localities in Syria (Mouterde, vol. I, pp. 174–175). *Carex* is well represented at Aswad and Ghoraifé, but from Ramad only few fruits of this type were recovered.

Eleocharis–type. Only Ghoraifé yielded some *Eleocharis*-type nutlets. The bi-convex fruits are obovate to elliptic in outline, with a keeled margin (fig. 24:6). Finely reticulate surface pattern (epidermis cells). No style base (stylopodium) is present in the subfossil specimens. The dimensions of 5 nutlets range from 1.0×0.75 to 1.1×0.9 mm.

Scirpus maritimus L. (*Scirpus tuberosus* Desf.). Nutlets obovate in outline, tapering towards the base. The ventral side is more or less flat, while the dorsal side is roof-shaped with a rounded median ridge (fig. 24:5). The surface of the carbonized nutlets is usually glossy. As in *Carex*, single *Scirpus* fruit contents occurred. For the dimensions of nutlets from Aswad see table 28. This type is particularly common at Aswad.

As for the species determination of this fruit type, the following has to be remarked. In previous publications (*cf.* van Zeist & Bakker-Heeres, 1979) this type is indicated as *Cyperus* spec. This identification was based upon the similarity with fruits from plants near Elaziğ, in Southeast Anatolia, tentatively identified as *Cyperus* spec. It had already struck us that the charred prehistoric fruits compare morphologically very well with modern and subfossil *Scirpus maritimus* fruits from western Europe. However, the latter fruits are markedly greater. For non-carbonized, waterlogged *Scirpus maritimus* fruits from two Iron Age sites in the Netherlands mean dimensions of 3.03×2.16 and 2.92×2.07 mm were obtained (van Zeist, 1976, table 16). Even if one allows for a certain degree of shrinkage in the charred fruits from Aswad and other Near Eastern sites, the latter remain smaller than *Scirpus maritimus* fruits from western Europe.

Dr. G.C. Hillman (Institute of Archaeology, London) drew the attention of the first author to *Scirpus maritimus* fruits collected by him in several localities in Anatolia and he kindly placed fruits from various proveniences at our disposal. The dimensions of these modern fruits are shown in table 28. The shape of these modern fruits matches perfectly the carbonized prehistoric specimens. Although the latter are still somewhat smaller than the modern *Scirpus maritimus* nutlets from Turkey, the charred fruits from the sites in the Damascus basin are now attributed to this *Scirpus* species. The previous identification as *Cyperus* spec. must be incorrect

According to Mouterde (vol. I, pp. 167–168) the Near Eastern *Scirpus maritimus* should be distinguished as a separate species: *Scirpus tuberosus* Desf. Whether or not this is justified from a taxonomical point of view, is no matter here; but it shows at least that there are differences between the Near Eastern and the European species, and not only in fruit size. Near Eastern *Scirpus maritimus* (*Scirpus tuberosus*) is reported for fresh-water swamps as well as for more or less saline habitats.

Ramad C8 2.25 and C8NW 1.55 yielded nutlets which are reminiscent of those of *Scirpus tabernaemontani* G.C. Gmel. (*Scirpus lacustris L.* ssp. *glaucus* (Sm.) Hartm.). However, this species has so far not been found in Syria or Lebanon, so that it is

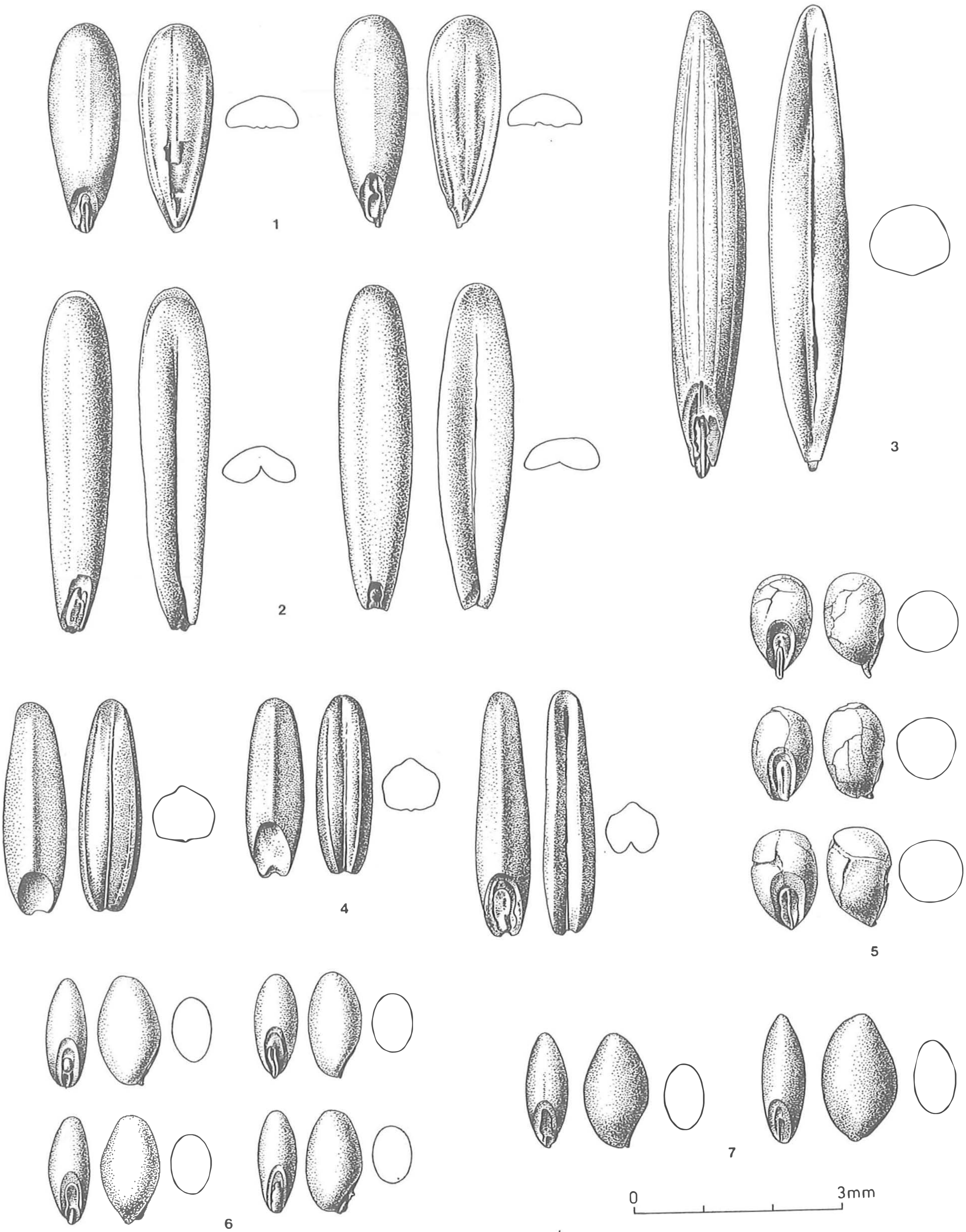

Fig. 25. 1. *Bromus danthoniae*-type, Aswad West 1.80; 2. *Bromus danthoniae*-type, Ramad C8 4.75; 3. *Bromus sterilis*-type, Ramad C8 4.75; 4. *Eremopyron*, Ramad M4 1 75; 5. *Echinaria*, Ramad M4 1.75; 6, *Phalaris*, Aswad West 2.00; 7. *Phalaris*, Aswad West 1.80.

unlikely that the fruits concerned are, indeed, of *Scirpus tabernaemontani*.

5.12. Dipsacaceae

Cephalaria syriaca (L.) Schrad. Two *Cephalaria* fruits were recovered at Ramad (C8NW 1.95 and C8 3.35). The fruits are oblong, tapering towards the base. Characteristic is the whorl of eight bracts tightly enveloping the achene (involucel). The bracts terminate alternately in a long and a short tooth. The subfossil fruits measure 3.6×1.4 and 4.5×1.0 mm.

At present, *Cephalaria syriaca* is a noxious weed in grain fields. Because of the similarity in size and shape to wheat grains, *Cephalaria* fruits are difficult to separate from the crop. The conspicuous scarcity of *Cephalaria* fruits at Ramad suggests that at the time this species was not yet a troublesome grain-field weed.

5.13. Gramineae

The examination of the wild grass caryopses must remain rather unsatisfactory. It is true that most of the charred grass fruits could be attributed to one of the types described below. However, most of these types include a fairly great number of species. Moreover, the numbers of fruits listed as unidentified Gramineae are quite large in some samples. Some of the grass fruits could not be identified because of poor preservation, but most of them had to remain unidentified because no matching type was present in the seed reference collection.

Aegilops. Dorso-ventrally compressed grains, elliptic in outline. The ventral side is flat with a narrow groove; the dorsal side domed. Rounded apical and basal ends (fig. 11:7). A small number of Ramad samples yielded one or at most two *Aegilops* caryopses. For dimensions and index values see table 33. The flatness of the grains finds expression in the low T/B index values.

In addition to the naked fruits, two spikelet bases were found (C8NW 2.45). The caryopses point to a species of the *Aegilops crassa* Boiss. group.

Avena. Caryopses elliptic to oblong in outline. The greatest width is in the middle of the grain, only slightly tapering towards the rounded apical and basal ends. The fruits are dorso-ventrally somewhat compressed. Especially in the lower part of the grain, at both sides a lateral keel is present if the grain is not too much swollen. The hilum in the narrow ventral groove ends at a short distance from the apex. In swollen specimens the groove has often disappeared in which case the hilum is clearly visible on the surface of the grain. Particularly on the dorsal side, remains of the long hairs are sometimes still preserved (the wall of oat caryopses is hairy), suggesting a kind of striate surface pattern. A characteristic feature is the triangular shape of the scutellum which, however, is not equally distinct in all grains (fig. 26:1,2,3).

Only occasionally more than a few oat grains were found. For dimensions and index values see table 29. The species identity of the naked *Avena* caryopses cannot be determined. *Avena barbata* Pott ex Link. and *A. sterilis* L. are both common in fields.

Bromus spec. Flat fruits; the dorsal side is usually domed in cross-section, the ventral side from more or less flat to hollow (channelled). Pointed basal end with a rather small, narrow embryo. The linear hilum does not reach the apex of the fruit. Various caryopses have a glossy surface. The archaeological *Bromus* fruits vary quite markedly in size and shape. Rather narrow, oblong caryopses (4 to 5 times longer than broad) occur, but obovate fruits with a comparatively broad apex are equally present. Examples of both *Bromus* fruit types are depicted in fig. 25:1,2, while in table 30 the dimensions of oblong and obovate type caryopses are presented. In addition, fruits of intermediate shape occur. It is clear that more than one *Bromus* species is involved. A great number of *Bromus* species is reported for Syria (Mouterde, vol. I, pp. 118–130). However, for lack of sufficient seed reference material it was not possible to arrive at a more accurate identification (species or group of

Table 29. Dimensions and index values of *Avena* caryopses from Ramad C8 4.95 and 5.05 (N = 17)

	L	B	T	L/B	T/B
Minimum	3.5	1.1	1.0	275	75
Average	4.73	1.39	1.19	334	85
Maximum	6.0	1.7	1.5	379	95

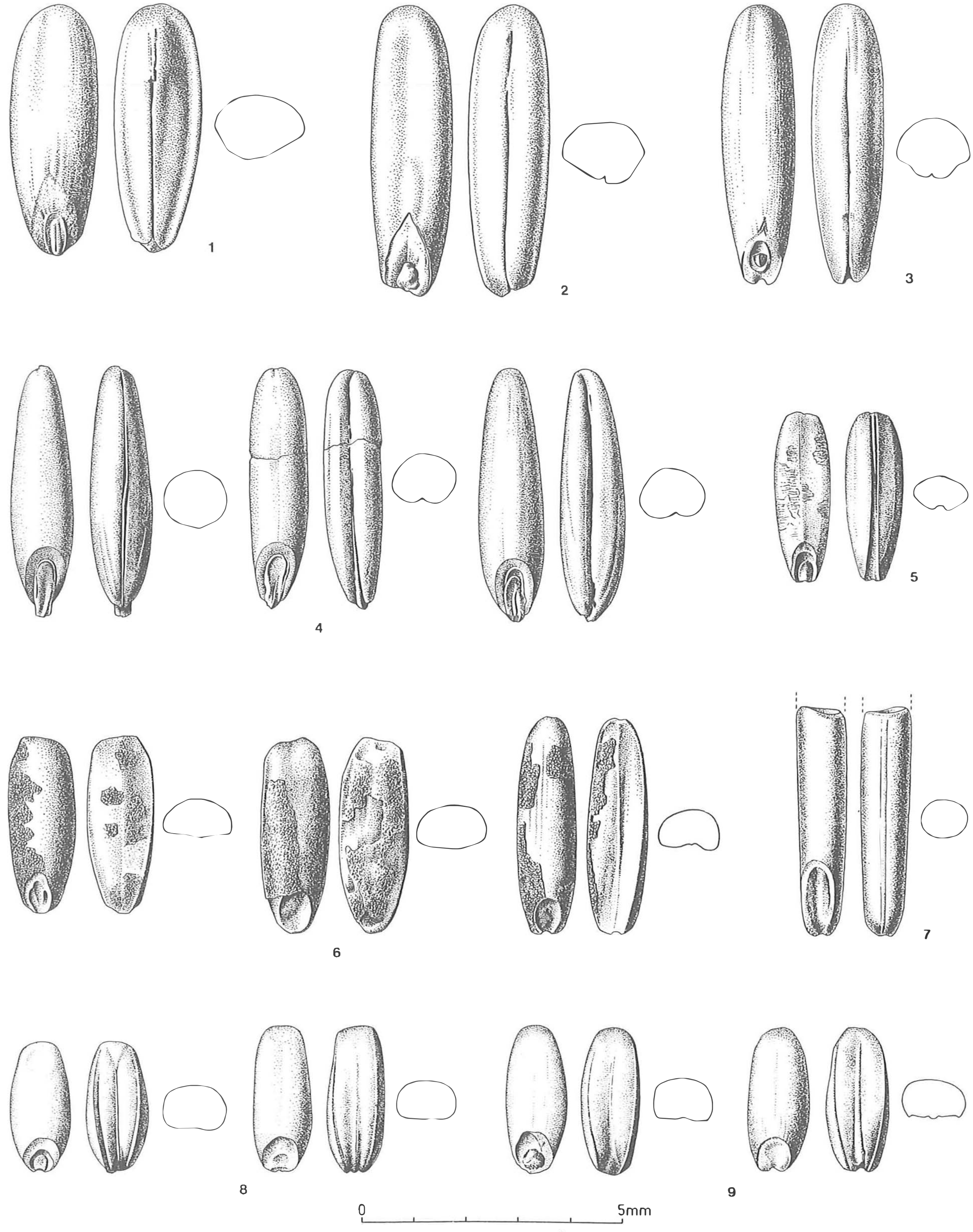

Fig. 26. 1. *Avena*, Ramad C8 3.35; 2. *Avena*, Ramad C8 5.05; 3. *Avena*, Ramad M4 1.75; 4. unidentified type, Ramad M4 1.75; 5. *Hordeum* spec., Aswad West 1.60; 6. *Lolium* spec., Aswad West 1.80; 7. *Stipa*, Ramad M4 2.30; 8. *Lolium remotum*, Ramad C8 5.05; 9. *Lolium remotum*, Ramad C8 4.75.

Table 30. Dimensions and index values of *Bromus* caryopses

		L	B	L/B
Oblong type				
Ramad C8	min.	4.5	1.0	407
N = 6	aver.	4.91	1.09	451
	max.	5.4	1.2	486
Obovate type				
Aswad West 1.80	min.	2.4	0.9	269
N = 15	aver.	2.99	0.99	284
	max.	3.3	1.1	364

species), and for that reason all brome-grass caryopses (except those of *B. sterilis*) have been lumped together here in one group (*Bromus* spec.).

Bromus sterilis L. Linear fruits, pointed at both ends, with longitudinal ribs (fig. 25:3). Only two caryopses of *Bromus sterilis* L. were recovered (Ramad C8 3.35 and 4.75), the dimensions of one of which could be determined (6.9×1.2 mm).

Echinaria. Small, squat fruits, pointed at the lower end and rounded-truncated at the apical end. The radicle shield extends over about ½ of the dorsal side (fig. 25:5). For the dimensions see table 31.

Only one *Echinaria* species is reported for Syria, *viz, E. capitata* (L.) Desf. (Mouterde, vol. 1, p. 91). This wild species is fairly well represented at Ramad, particularly in the phase II samples.

Table 31. Dimensions and index values of *Echinaria* caryopses from Ramad

		L	B	T	L/B	T/B
M4 1.75	min.	1.0	0.6	0.6	129	86
N = 32	aver.	1.28	0.84	0.87	155	104
	max.	1.5	1.1	1.0	189	122
M4 2.30	min.	1.3	0.8	0.9	129	92
N = 21	aver.	1.41	0.96	0.99	149	106
	max.	1.7	1.1	1.2	173	118
C8 3.35	min.	1.4	0.8	0.9	123	86
N = 22	aver.	1.43	0.98	1.00	147	102
	max.	1.5	1.1	1.1	173	120
C8 4.95	min.	1.0	0.7	0.8	140	100
N = 16	aver.	1.32	0.87	0.94	152	107
	max.	1.6	1.0	1.1	190	120

Table 32. Dimensions and index values of *Eremopyron* caryopses from Ramad M4 1.75 (N = 8)

	L	B	T	L/B	T/B
Minimum	2.6	0.7	0.6	320	89
Average	3.05	0.81	0.76	378	94
Maximum	3.6	0.9	0.9	450	100

Table 33. Dimensions and index values of *Aegilops* and *Hordeum* caryopses

	L	B	T	L/B	T/B
Aegilops					
Ramad C8 2.95	4.5	2.6	1.4	175	53
C8 3.35	4.2	2.2	1.3	193	59
C8 3.55	4.6	2.5	1.2	187	48
C8 5.05	4.1	2.3	1.2	176	52
M4 1.80	4.6	2.7	1.4	168	50
Hordeum spec.					
Aswad West 1.40	4.8	1.4	1.0	353	76
	3.6	1.3	0.9	281	69
	3.4	1.1	0.7	300	64
	3.5	1.2	0.8	293	67
West 1.60	3.4	1.0	0.7	331	69

Eremopyron. Lanceolate fruits; the greatest width is in the lower half of the grain, slightly tapering towards the rounded apex. Characteristic of this grass fruit type is the longitudinal keel on the dorsal side (fig. 25:4). The keel is even more pronounced on the finely papillose lemma, parts of which are preserved in some specimens. The dimensions are presented in table 32.

This caryopsis type is represented at Ramad and Aswad, but not at Ghoraifé. *Eremopyron buonapartis* (Spreng.) Nevski is common in Syria.

Hordeum spec. Oblong, rather flat fruits, with truncated upper end. The dorsal side shows a median ridge (fig. 26:5). In swollen fruits this ridge and the ventral groove have disappeared. The hilum extends to or almost to the apex. For dimensions and index values see table 33. This type is ascribed to a wild *Hordeum* species other than *Hordeum spontaneum*.

Ramad yielded a few fruits of this type. *Hordeum* is slightly better represented at Aswad.

Table 34. Dimensions and index values of *Lolium* spec. caryopses.

		L	B	T	L/B	T/B
Ramad M4 4.05	min.	3.4	1.2	0.8	253	58
N = 23	aver.	4.01	1.41	1.01	284	72
	max.	4.6	1.6	1.1	312	81
Ramad C8 4.75	min.	3.0	1.0	0.7	242	53
N = 45	aver.	3.85	1.30	0.90	299	70
	max.	5.4	1.6	1.2	408	100
Ramad C8 5.05	min.	2.9	1.0	0.7	235	58
N = 31	aver.	3.69	1.28	0.89	288	70
	max.	4.6	1.6	1.0	367	87
Aswad West 2.20	min.	2.7	1.0	0.6	241	61
N = 73	aver.	3.44	1.21	0.88	286	73
	max.	4.2	1.6	1.1	367	92

Lolium spec. Dorso-ventrally compressed caryopses with flat ventral side and more or less domed dorsal side. The greatest width is in the middle of the grain, slightly tapering towards the upper and lower ends. The apex is rounded to truncated. In many specimens parts of rough enveloping bracts (finely papillose) are still preserved (fig. 26:6). *Lolium* is well represented in all three sites. The dimensions and index values of *Lolium* fruits from Aswad and Ramad are shown in table 34 and fig. 27. *Lolium perenne* L. as well as *L. rigidum* Gaud. come into consideration.

Lolium temulentum L. The distinction between *Lolium perenne/rigidum*-type caryopses and those attributed to *Lolium temulentum* L. presented difficulties. At first no *Lolium temulentum*-type fruits were distinguished, but these fruits were included in the category of *Lolium* spec. An inspection of the *Lolium* caryopses recovered from some of the Ramad samples made it clear that more than one type was present. A subsequent re-examination of all fruits identified as *Lolium* spec. showed that those from Aswad and Ghoraifé are of uniform shape and may confidently be attributed to the *Lolium perenne/rigidum*-type. On the other hand, at Ramad *Lolium temulentum*-type grains are quite common. *Lolium temulentum* caryopses from Ramad (fig. 26:8, 9) are as a rule smaller and plumper than those of *Lolium* spec. This finds expression in the comparison of the dimensions and L/B index values of both types (tables 34 and 35). In addition, the fruit wall of the *L. temulentum* caryopses is more glossy. As in *L. perenne/rigidum*, parts of the finely papillose bracts may still adhere to the grains. The hilum ends at some distance from the apex. *L. temulentum* (darnel) is a widespread weed in grain fields.

The failure to recognize at first the *Lolium temulentum* caryopses as such must partly be ascribed to the small size of these grains. Charred darnel fruits from other archaeological sites are usually considerably larger, with an average length of 3.5 to 4 mm (*e.g.* Kislev, 1980, table 8; van Zeist & Heeres, 1973, table 5).

N.B. After the manuscript had gone to the printer, the publication of H.J., Kroll (*Kastanas. Ausgrabungen in einem Siedlungshügel der Bronze-und Eisenzeit Makedoniens 1975-1979. Die Pflanzenfunde.* Berlin, 1983) appeared. From Kroll's paper it became evident that the *Lolium temulentum*-type grains from Ramad should be attributed to *Lolium remotum* Schrank.

Phalaris. Laterally compressed fruits, with longitudinally curved ventral and dorsal sides

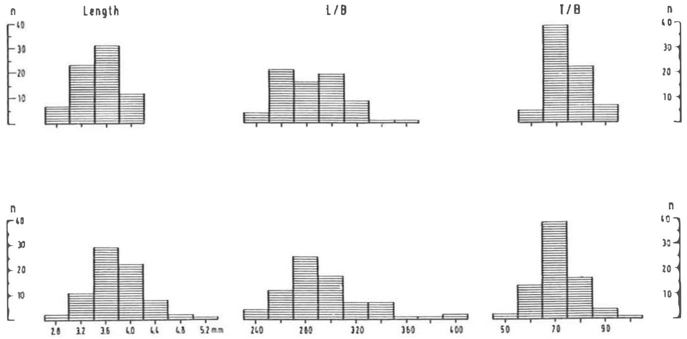

Fig. 27. Frequency distribution histograms for *Lolium* spec. Upper row: Aswad West 2.20 (N=73); lower row: Ramad C8 4.75+5.05 (N=76).

(fig. 25:6,7). There is no ventral groove. A hilum cannot be observed in the carbonized grains. The radicle shield is relatively large, extending over 1/4 to 1/3 of the dorsal side. The *Phalaris* caryopses found at Ramad, Ghoraifé and Aswad are all of the same size class (table 36). The lateral compression finds expression in the high T/B index values. Only Aswad yielded fairly great numbers of *Phalaris* fruits. Most likely the caryopses are of *Phalaris paradoxa* L., which is common in fields and on roadsides (Mouterde, vol. 1, p. 49).

Stipa. Of the linear-cylindrical caryopses of *Stipa*, a few broken specimens were found at Ramad (fig. 26:7). The estimated length of the caryopses is 8 to 9 mm, the greatest diameter about 1 mm.

Table 35. Dimensions and index values of *Lolium temulentum* caryopses from Ramad

		L	B	T	L/B	T/B
C8 3.90	min.	2.2	1.0	0.8	187	58
N = 18	aver.	2.74	1.28	0.97	215	75
	max.	3.0	1.4	1.1	238	82
C8 4.75	min.	2.6	1.0	0.8	206	63
N = 13	aver.	2.95	1.27	0.90	233	71
	max.	3.4	1.4	1.1	254	79
C8 5.05	min.	2.6	1.1	0.7	211	60
N = 17	aver.	2.93	1.24	0.90	236	72
	max.	3.5	1.5	1.1	264	93

Table 36. Dimensions and index values of *Phalaris* caryopses from Aswad

		L	B	T	L/B	T/B
West 2.20	min.	1.4	0.5	0.7	200	100
N = 28	aver.	1.56	0.65	0.89	242	139
	max.	2.0	0.9	1.0	367	183
West 2.00	min.	1.4	0.6	0.7	162	91
N= 47	aver.	1.68	0.75	0.95	227	128
	max.	2.2	1.0	1.1	338	163

Table 37. Dimensions and index values of Gramineae type A caryopses from Ramad M4 1.75 (N = 35)

	L	B	T	L/B	T/B
Minimum	2.8	0.8	0.8	292	63
Average	3.84	1.01	0.93	384	93
Maximum	5.0	1.3	1.2	500	110

Gramineae type A. Oblong fruits, the greatest width in the middle or lower part of the grain. Slightly tapering towards the rounded apex. In various specimens the lateral sides are almost parallel over the greater part of the grain. In some fruits a rather narrow ventral groove is present; in most of the grains the groove has disappeared as a result of swelling. The hilum ends at a short distance from the apex. The scutellum margin enfolding the germ is conspicuously broad (fig. 26:4). In some of the fruits, remains of the finely papillose bracts are preserved. For dimensions and index values see table 37.

The identity of this grass fruit-type, which is well represented at Ramad, is still puzzling.

5.14. Labiatae

Teucrium-type. Only Ramad yielded fruits of this type. Fruits obovate in outline. The hilar scar covers 1/2 to 2/3 of the ventral side. The dorsal side is domed. On the surface a reticulate pattern (fig. 23:2). The distinction between the fruits of *Teucrium* and *Ajuga* may be rather arbitrary. The Ramad specimens have been attributed to *Teucrium* because of the surface structure: the lumina are not longitudinally elongated towards the base of the fruit. Dimensions of 8 fruits: 1.65(1.5–1.8)×1.08(1.0–1.2) mm.

Ziziphora. Fruits obovate in outline, apical end rounded, pointed at the base, with prominent basal depressions. Only few *Ziziphora* fruits were recovered. Dimensions: 1.4×0.65 and 1.3×0.65 mm for 2 fruits from Ramad, and 1.55×0.7, 1.5×0.6 and 1.3×0.6 mm for 3 specimens from Aswad. *Ziziphora* fruits from Erbaba (Turkey) are depicted in van Zeist & Buitenhuis (1983, fig. 10:1).

A few *Ziziphora* species occur in Syria (Mouterde, vol. 3, pp. 181–183; Post & Dinsmore, vol. 2, p. 347) of which *Z. tenuior* L. is reported for fields and waste places.

5.15. Leguminosae

Astragalus. Seeds attributed to *Astragalus* are variable as to shape and size (table 38). Typical specimens are laterally compressed, obliquely quadrangular in outline. Most

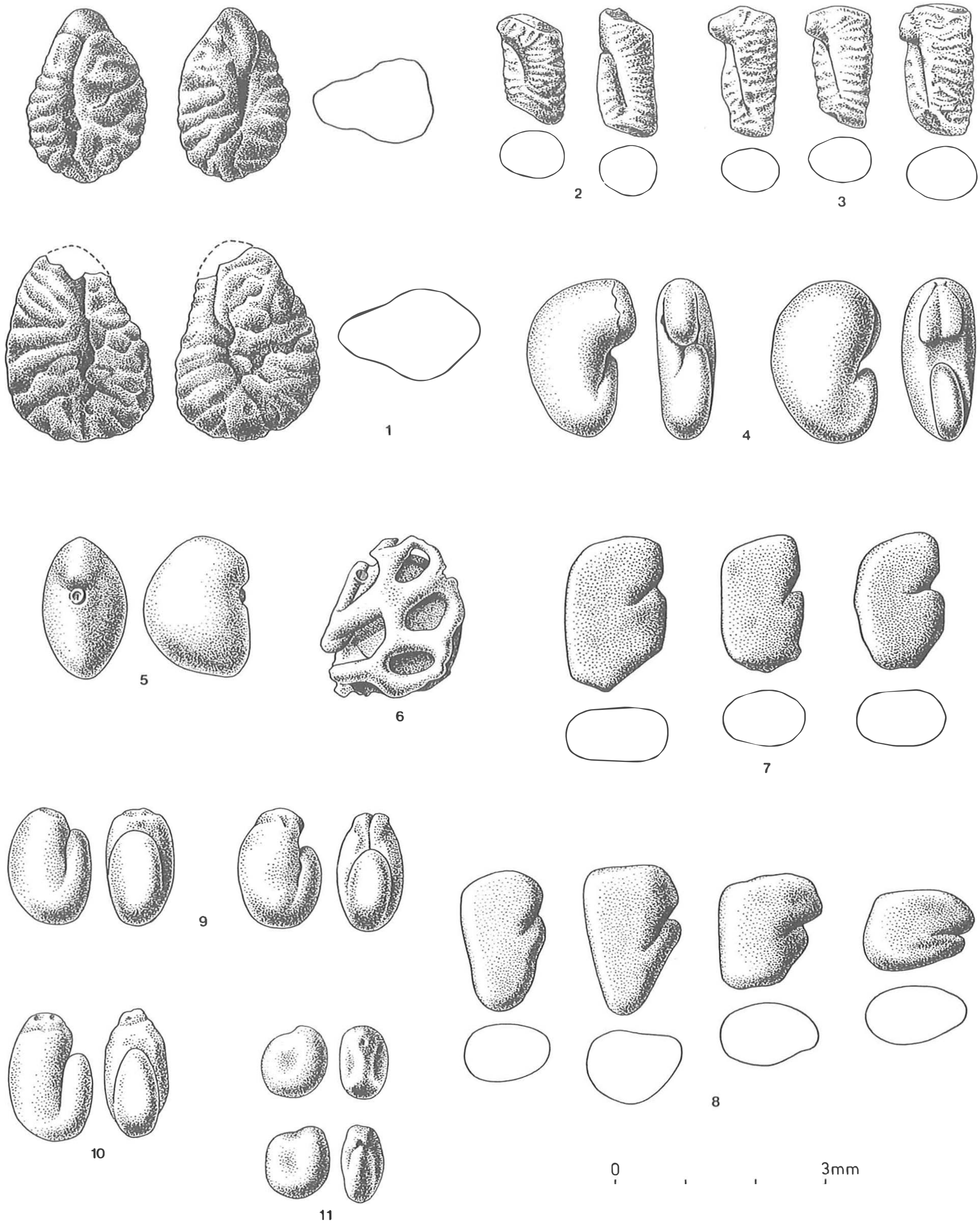

Fig. 28. 1. *Medicago radiata*, Aswad West 1.60; 2. *Trigonella astroites*-type, Ramad C8 2.95; 3. *Trigonella astroites*-type, Ramad M4 2.80; 4. *Medicago* spec., Ramad C8 4.75; 5. *Onobrychis*, Ramad C8 3.70; 6. *Onobrychis*, Ramad C8 5.05; 7. *Astragalus*, Aswad East 2.00; 8. *Astragalus*, Ramad C8 3.70; 9, 10. *Melilotus*, Ramad C8 5.05; 11. *Trifolium*-type, Ghoraifé 3.60.

Table 38. Dimensions and index values of *Astragalus* seeds from Ramad

		L	B	L/B
C8 3.35	min.	1.3	1.0	105
N = 80	aver.	1.73	1.21	143
	max.	2.6	1.8	192
C8 3.70	min.	1.4	1.0	105
N = 100	aver.	1.79	1.30	138
	max.	2.3	1.7	179
M4 2.80	min.	1.3	1.0	107
N = 100	aver.	1.80	1.34	136
	max.	2.6	2.0	186

characteristic is the hilar notch, the indentation with the hilum, on one of the long sides (fig. 28:7,8). Ramad yielded large numbers of *Astragalus* seeds, but in Ghoraifé this type is scarcely represented. Aswad is in an intermediate position in this respect.

A great number of *Astragalus* species is reported for lowland Syria (*cf.* Post & Dinsmore, vol. I, pp. 373–408; Mouterde, vol. 2, pp. 315–374). Representatives of this genus occur particularly in steppe vegetations, but field weeds include also various *Astragalus* species.

Coronilla. Baculiform seeds, with rounded upper and lower end. Smooth surface. Ramad yielded a small number of *Coronilla* seeds. In only one seed a circular hilum could be observed; of various seeds the wall had disappeared completely. Dimensions of three seeds (with wall); 3.1×1.0, 2.7×0.65 and 2.6×0.65 mm.

Medicago radiata L. (*Trigonella radiata* (L.) Boiss.). Laterally compressed seeds, ovate to almost circular in outline. A conspicuous feature are the prominent ridges and grooves on the seed surface (fig. 28:1). The dimensions are shown in table 39. Fairly common in Aswad and Ramad, but absent in Ghoraifé. *Medicago radiata* is a species from steppe and desert-steppe vegetations (Davis, vol. 3, p. 486; Zohary & Feinbrun-Dothan, vol. 2, p. 139).

Medicago spec. Crescent-shaped seeds, laterally compressed (fig. 28:4), Only occasionally the wall and the circular hilum, which in *Medicago* is found on the intruded inner side, have been preserved in the charred seeds. Moreover, most carbonized seeds are swollen to some extent. For the dimensions see table 40. The shape of the seeds of various *Medicago* species conforms to that of the prehistoric specimens, so it is not possible to determine the species of the latter ones. *Medicago*-type seeds are quite common in Ramad, but rare in Aswad and Ghoraifé.

Various *Medicago* species occur as weeds in fields (Zohary & Feinbrun-Dothan, vol. 2, pp. 139–153).

Melilotus. Seeds elliptic in outline. The shape of the seeds conforms to that of modern *Melilotus* seeds, although the latter are laterally more compressed. The carbonization resulted in some degree of puffing of the seeds (increase in thickness). The radicle is clearly recognizable which is due to the fact that the seed wall had usually disappeared (fig. 28:9, 10). *Melilotus* seeds were found in all three sites, in a few samples in considerable

Table 39. Dimensions of *Medicago radiata* seeds

		L	B
Ramad			
C8 3.70	min.	1.7	1.0
N = 9	aver.	1.88	1.42
	max.	2.1	1.7
C8 4.75	min.	1.5	1.4
N = 12	aver.	2.17	1.69
	max.	2.6	1.9
M4 2.80	min.	1.5	1.2
N = 17	aver.	1.99	1.52
	max.	2.4	1.8
Aswad			
East 2.00	min.	2.0	1.6
N = 12	aver.	2.33	1.88
	max.	2.7	2.2

Table 40. Dimensions of *Medicago* spec. seeds from Ramad

		L	B
C8 3.35	min.	1.8	0.8
N = 15	aver.	2.18	1.07
	max.	2.7	1.4
C8 4.75	min.	1.7	0.8
N = 24	aver.	2.21	1.14
	max.	2.6	1.4

Table 41. Dimensions and index values of *Melilotus* seeds

		L	B	L/B
Ramad				
C8 4.75	min.	1.3	0.8	130
N = 33	aver.	1.78	1.16	154
	max.	2.2	1.4	185
C8 5.05	min.	1.4	1.0	127
N = 39	aver.	1.79	1.18	152
	max.	2.1	1.4	179
Ghoraifé 1974				
3.50	min.	1.3	0.9	119
N = 76	aver.	1.66	1.15	145
	max.	2.1	1.4	175

Table 42. Dimensions of *Trigonella astroites*-type seeds

		L	B
Ramad			
C8 2.95	min.	1.4	0.6
N = 65	aver.	1.67	0.78
	max.	2.1	1.1
M4 2.80	min.	1.4	0.6
N = 67	aver.	1.68	0.79
	max.	2.2	1.1
Aswad			
East 2.00	min.	1.4	0.7
N = 73	aver.	1.66	0.85
	max.	1.9	1.0

numbers. There are no great differences in the dimensions of the *Melilotus* seeds from Ghoraifé and Ramad (table 41).

The wall, which in a few charred seeds had partly been preserved, has a somewhat rough (finely papillose) surface, such as is found in *Melilotus indicus* (L.) All. However, no attempt has been made here to attribute the *Melilotus* seeds to a particular species, nor is it suggested that *e.g. Melilotus indicus* is represented in the charred seeds. Moreover, some of the leguminous seeds may incorrectly have been assigned to *Melilotus*. The distinction between small *Melilotus*-type seeds and the seeds of some *Trifolium* species must remain rather arbitrary in charred material.

Onobrychis. Seeds laterally compressed, obliquely semi-circular in outline (fig. 28:5). The hilum which in some seeds has been preserved is round; the seed wall is smooth. One *Onobrychis* seed was found in Aswad; Ramad yielded a few more seeds of this type. For 7 seeds from various samples the dimensions were obtained: 2,10(2.0–2.2.)× 1.57(1.5–1.6) mm. One seed is still partly enveloped by the remains of the pod (fig. 28:6).

Trifolium. Only Ghoraifé yielded a small number of *Trifolium* seeds. The seeds are obovate in outline (fig. 28:11). The circular hilum is on the upper side. Rough seed wall. Dimensions of 7 seeds: 1.15 (1.0–1.3)×0.99 (0.9–1.2) mm.

Trigonella astroites-type. Oblong seeds with obliquely truncated upper and lower ends. The latter feature may not be present in charred seeds due to deformation. The surface is tuberculate, *i.e.* covered with low, rounded processes (fig. 28:2, 3). For the dimensions see table 42. The prehistoric seeds conform to those of *Trigonella astroites* Fisch. et Mey. However, it is very well possible that other *Trigonella* species have similar seeds, so the prehistoric seeds are indicated here as *Trigonella astroites*-type. *Trigonella astroites* itself occurs in steppe vegetations as well as on cultivated land, and other *Trigonella* species show a similar behaviour.

Great numbers of *Trigonella astroites*-type seeds were found in Aswad and Ramad, but this type is conspicuously absent in Ghoraifé.

From Ghoraifé a damaged *Trigonella* seed, with a finely granular surface structure (1.45× 0.75 mm), was recovered. This seed has tentatively been identified as *Trigonella caelesyriaca* Boiss.

Vicia spec. Vetch seeds were found regularly, in some samples in fairly great numbers. *Vicia* seeds show a large variation in shape: almost spherical to compressed (bi-convex) types occur, some specimens are rounded-cubical, while other seeds have one or two flat sides. In a few seeds the hilum or part of it was still preserved. The size of the seeds is also quite variable, which finds expression in the measurements (table 43). It has already been mentioned (4.9. and 4.10.) that in some instances it was difficult to make a distinction between lentiform vetches and lentil seeds and between small peas and large, spherical vetch seeds. No attempt has been made to arrive at a

Table 43. Greatest dimension of seeds of *Vicia* spec.

Ramad		
C8 3.35	min.	1.5
N = 49	aver.	2.23
	max.	3.0
C8 4.75	min.	1.7
N = 18	aver.	2.35
	max.	2.7
M4 1.90, 2.30	min.	1.7
N = 16	aver.	2.12
	max.	2.6
Aswad		
West 2.00	min.	1.6
N = 18	aver.	2.10
	max.	2.6
West 2.20	min.	1.5
N = 31	aver.	2.16
	max.	3.0

species identification of one or more of the vetch-seed types. Various *Vicia* species must be represented in the charred seed record.

A considerable number of *Vicia* species is found in Syria (Post & Dinsmore, vol. 1, pp. 416–425; Mouterde, vol. 2, pp. 396–414). Vetches form part of the natural vegetation, but they are also found in and along fields and in other disturbed habitats.

Unidentified Leguminosae. A fairly great number of leguminous seeds remained unidentified. This is partly due to poor preservation (serious deformations). Other seeds are in principle identifiable but no matching reference seeds were available. The very large number of leguminous species in the Near Eastern flora reduces in no small measure the ecological information provided by the charred seeds. Most of the types distinguished include species from different habitats.

5.16. Liliaceae

Bellevalia. Almost globular seeds, somewhat irregularly shaped. Characteristic of the carbonized seeds is a hole which in some specimens runs from the apex to the base. In other seeds the remains of the embryo are visible in the hole (fig. 24:10). The smooth seed wall has mostly disappeared.

Bellevalia is represented in various samples, occasionally by a great number of seeds. The

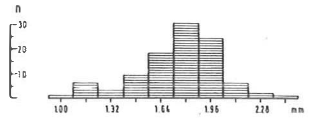

Fig. 29. Frequency distribution of the greatest dimension of *Bellevalia* seeds from Ramad C8 3.90 (N=100).

seeds display a fairly large variation in size: the greatest dimension of 100 seeds from Ramad C8 3.90 varies from 1.0 to 2.5 mm (mean 1.76 mm). The frequency distribution of the dimensions (fig. 29) does not suggest that more than one species is represented. *Bellevalia ciliata* (Cyr.) Nees and *B. trifoliata* Boiss. occur as weeds in fields.

cf. Ornithogalum. Irregularly shaped seeds: elliptic to ovate to semi-circular/triangular in outline, often with one or more flattened faces (fig. 24:9). The seed wall has an alveolate-reticulate surface pattern. In various seeds a hole is visible at the apex, whereas a round to elliptic, hollow hilar scar is frequently present at the base. The dimensions are shown in table 44.

The identity of this seed type is still enigmatic. The hole at the apex points to Liliaceae. The best match among Liliaceae seeds are those of *Ornithogalum.* It should, however, be emphasized that there is by no means a sufficiently close match, so that the fossil seeds may very well be of another liliaceous genus or even of another family. For that reason the indication as *cf. Ornithogalum* is not wholly justified as it may too easily suggest that this seed type is of *Ornithogalum* or a closely related genus.

The seed type is represented in all three sites in the Damascus basin. Various Ramad samples yielded great numbers of *cf. Ornithogalum* seeds, indicating that the species con-

Table 44. Dimensions of cf. *Ornithogalum* seeds from Ramad

		L	B
C8 3.35	min.	1.4	1.0
N =.100	aver.	1.71	1.37
	max.	2.4	1.8
C8 5.05	min.	1.3	1.0
N = 100	aver.	1.71	1.38
	max.	2.2	1.8

cerned must have been quite common in the vicinity of the site.

5.17. Malvaceae

Malva. Only one *Malva* seed was recovered (Ramad C8 5.05). The reniform seed has a deep hilar notch; the surfaces are slightly concave. The seed is thinnest at the inner (ventral) side (fig. 24:11). Smooth seed wall. Dimensions: 1.4×1.3×1.0 mm. The shape and the size of the carbonized seed point to *Malva aegyptica* L.

5.18. Moraceae

Ficus. Laterally compressed pips, ovate in outline, pointed at the apex. The small circular hilum below the apex has often not been preserved in the charred pips (fig. 30:1). Surface smooth. Fig is well represented at Aswad and Ramad; Ghoraifé yielded only a few pips. One must assume that wild fig is concerned here. There are no significant size differences between the pips from Aswad and Ramad (table 45).

In addition to the pips, one fruit base of fig was found (Ramad C8 5.05). In evaluating the role of fig as a wild food plant the great number of pips per fruit should be taken into consideration. Fig is reported for Pre-Pottery Neolithic A Jericho (Hopf, 1969).

Table 45. Dimensions of *Ficus* pips

		L	B
Ramad			
C8 3.35	min.	1.1	0.9
N = 15	aver.	1.19	1.00
	max.	1.3	1.1
C8 4.75	min.	1.1	0.9
N = 13	aver.	1.22	1.01
	max.	1.3	1.1
C8 5.60	min.	1.0	0.9
N = 12	aver.	1.13	0.96
	max.	1.2	1.1
Aswad			
East 2.40	min.	1.0	0.9
N = 15	aver.	1.23	1.00
	max.	1.4	1.1
East 2.90	min.	1.0	0.9
N = 20	aver.	1.22	1.02
	max.	1.4	1.2
West 0.80	min.	1.0	0.9
N = 7	aver.	1.19	1.00
	max.	1.4	1.2

5.19. Papaveraceae

Fumaria. Bi-convex fruits, almost circular in outline, sharp (slightly winged) margin. A characteristic feature are two rounded holes at the base of the fruit (fig. 30:2). The surface is rough. Altogether three fruits of this type have been recovered, one from Aswad and two from Ramad (1.7–1.8 mm). The subfossil fruits resemble those of *Fumaria densiflora* DC., but other species may likewise come into consideration.

Glaucium aleppicum-type. Only one *Glaucium* seed was found (Ramad C8 3.70). The seed is semi-circular in outline, with rounded dorsal side and straight ventral side. Reticulate surface pattern: concentric rows of luminae (fig. 30:3). Size: 1.3×1.1×1.0 mm. The shape and the surface structure conform to those of *Glaucium aleppicum* Boiss. et Hausskn., but *G. corniculatum* (L.) J.N. Rud. may likewise come into consideration.

5.20. Plantaginaceae

Plantago. Seeds elliptic in outline, with rounded upper and lower ends. Dorsal side in cross-section domed; at the ventral side a broad furrow. Smooth surface. *Plantago* is represented at Ramad by a small number of seeds. Two types have been distinguished.

Plantago lagopus-type: in the ventral furrow is a longitudinal ridge (fig. 30:5). Three samples yielded each one seed (1.45×0.75, 1.9×0.7, 1.75×0.6 mm).

Plantago psyllium-type: no longitudinal ridge; near one end the seed is somewhat broader than near the other end (fig. 30:4). In two samples one seed (1.95×0.9, 2.25×0.95 mm).

Both plantain species are found in disturbed habitats, such as fallow fields.

Two *Plantago* seeds from Ramad (M4 1.80 and M4 2.10) and one from Ghoraifé (1.60 m) have not been attributed to a particular type. Plantain is not represented at Aswad.

5.21. Polygonaceae

Polygonum. Triquetrous nutlets, ovate in outline, pointed at the apex. Near the apex

Table 46. Dimensions of *Polygonum* fruits from Aswad

West 1.60	min.	1.0	0.7
N = 12	aver.	1.17	0.82
	max.	1.3	1.0
East 2.00	min.	1.1	0.6
N = 16	aver.	1.30	0.87
	max.	1.5	1.0

Table 47. Dimensions of *Androsace maxima* seeds from Ramad

		L	B
C8 2.95	min.	1.3	0.7
N = 64	aver.	1.52	0.95
	max.	2.0	1.2
M4 2.80	min.	1.3	0.8
N = 84	aver.	1.51	0.99
	max.	1.9	1.2

rather sharp edges (fig. 30:7). Surface smooth, in some of the carbonized fruits still glossy. This type is well represented at Aswad, whereas Ramad yielded only a few *Polygonum* fruits. The dimensions are shown in table 46.

The species identification of the *Polygonum* nutlets poses some problems. The shape of the subfossil specimens conforms to that of the fruits of *Polygonum venantianum* Clem. (Mouterde, vol. 1, p. 401) present in the seed reference collection. However, this species is not mentioned in Post & Dinsmore (vol. 2, pp. 469–475) and according to Davis (vol. 2, pp. 278–279) the status of *P. venantianum* (= *P. arenarium* Waldst. et Kit.) is very uncertain. According to Mouterde *P. venantianum* is found in disturbed habitats.

Rumex. Various Ramad samples yielded one or a few *Rumex* nutlets. One *Rumex* fruit was recovered from Aswad (West 2.00) and none from Ghoraifé. Most of the *Rumex* nutlets have been attributed to *Rumex pulcher* L. The three-sided fruits have ridged margins. Triangular in outline, acute at the apex and with a broad base (fig. 30:6). The fruit wall has a fine, but distinct striate surface pattern. Dimensions for 8 fruits: 1.60(1.4–2.0)× 1.29(1.0–1.6)mm. *Rumex pulcher* is common in disturbed habitats and damp places.

Rumex nutlets that differ in shape and surface pattern from those of *R. pulcher* are indicated here as *Rumex* spec. It should in principle be possible to determine the species of at least some of the *Rumex* spec. fruits.

5.22. Primulaceae

Androsace maxima L. Three-sided seeds with sharp margins, elliptic in outline, rather pointed at upper and lower end. A characteristic feature are the prominent, transversal ridges and grooves on the surface of the seed (fig. 30:8). Average length and breadth are about 1.5 and 1.0 mm, respectively (table 47). The carbonized seeds are identical to those of *Androsace maxima* L., a steppe plant which is also found in fields.

Androsace maxima is fairly well represented at Ramad, a few samples yielded rather large numbers of seeds. For Ghoraifé, on the other hand, no *Androsace* could be established, while Aswad yielded only a few seeds of this type.

5.23. Ranunculaceae

Adonis. Bi-convex fruits, margin with a keel. Ovate to almost circular in outline. Rugose-reticulate surface pattern, with usually prominent ribs (fig. 30:9, 10). Small numbers of *Adonis* fruits were recovered from Aswad, Ghoraifé and Ramad samples. Differences in size and surface structure suggest that more than one *Adonis* species may be involved. As for the size, typical small specimens measure 1.3×1.3×1.2 mm, whereas for large-sized *Adonis* fruits dimensions of 2.5×2.3×1.9 mm were obtained. The majority of the nutlets measure from 1.6×1.4×1.2 to 2.0×1.8×1.6 mm.

Some *Adonis* species are common weeds in fields.

5.24. Rosaceae

Amygdalus. Only fragmented almond fruit stones were recovered. The thick-walled fragments have a pitted and grooved surface. The fragments are too small to provide an indication of the dimensions of the whole fruit stones. One must assume that wild almond is concerned here. *Amygdalus communis* L. as well as *A. korschinskii* (Hand.-Mazz.) Bornm. come into consideration (see also 7.4.1.).

For estimating the numbers of fruits stones represented by the fragments the average

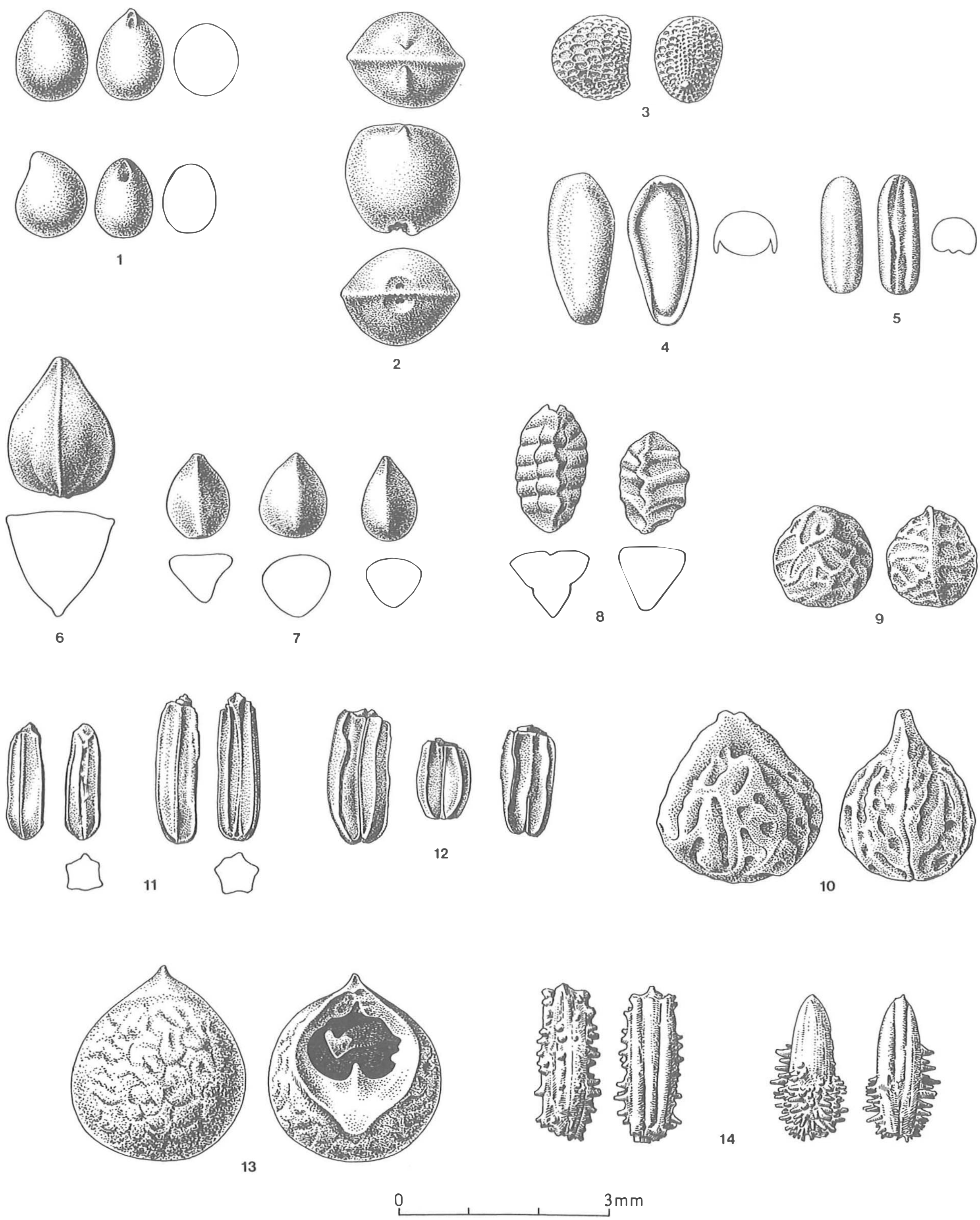

Fig. 30. 1. *Ficus*, Ramad C8 4.75; 2. *Fumaria densiflora*, Ramad C8 5.60; 3. *Glaucium aleppicum*-type, Ramad C8 3.70; 4. *Plantago psyllium*-type, Ramad C8 4.35; 5. *Plantago lagopus*-type, Ramad C8 2.25; 6. *Rumex pulcher*, Ramad C8 5.05; 7. *Polygonum*, Aswad West 1.60; 8. *Androsace maxima*, Ramad C8 4.35; 9. *Adonis*, Ramad M4 2.30; 10. *Adonis*, Ramad C8 4.55; 11. *Ammi majus*, Ramad C8 3.35; 12. *Ammi majus*, Ramad M4 1.80; 13. *Bifora testiculata*, Ramad C8NW 2.45; 14. *Torilis*-type, Ramad C8 3.35.

weight of non-carbonized, completely dry, wild almond fruit stones was taken as a measure (0.9 gram: based upon 5 specimens). If the fragments equal less than half an almond, this is indicated in tables 5, 6 and 7 with a plus-sign (+). *Amygdalus* is well represented at Ramad, but of the other two sites, only Aswad yielded one fragment.

Crataegus. Hemispherical to three-faced fruit stones. In most of the fruit stones the domed dorsal side has longitudinal grooves; the ventral side is flat or roof-shaped (fig. 21:1, 2, 3). Dimensions of 10 fruit stones from Ramad C8 4.75: 7.02(6.3–7.8)×5.74(5.0–6.6)× 4.37(3.8–5.3) mm. *Crataegus* fruit-stone fragments have been converted to whole specimens on the basis of 0.06 gram per stone (the average weight of 29 complete, carbonized specimens). A plus-sign (+) indicates that less than half a hawthorn fruit stone is represented by the fragments.

Crataegus remains are quite common at Ramad, but scarce at Aswad and Ghoraifé. Most likely the fruit stones are of *Crataegus aronia* (L.) Bosc. ex DC. This is not only the most common hawthorn species of the area, but the fact that the fruit stones are hemispherical as well as three-faced points also to *C. aronia* (Zohary & Feinbrun-Dothan, vol. 2, pp. 19–20).

Pyrus. Ramad C8 3.35 yielded a few larger fragments of a pear pip. *Pyrus syriaca* Boiss. is the only wild pear species in the Syro-Palestinian region.

Rubus. Only one *Rubus* fruit stone was recovered (Aswad West 2.20). The stone is half-circular in outline, with a coarse reticulate-rugulate surface pattern. Dimensions: 2.3×1.4 mm. Raspberries may have grown in the thickets along streams.

5.25. Rubiaceae

Crucianella. Only one, slightly damaged *Crucianella* fruit was recovered (Ramad M4 1.75). The fruit is elliptic in outline, rounded at one end and more pointed at the other end. The dorsal side is domed in cross-section. At the ventral side a broad furrow, in which is a longitudinal ridge (the fruit shows resemblance to *Plantago* seeds). The surface is finely papillose (partly preserved in the subfossil specimen). On the ventral side of the charred fruit, short white lines are present. Size: c. 2.2×0.85 mm.

Galium spec. Hemispherical fruits, with a round concavity on the ventral side indicating the position of the hilum. Some fruits show a finely reticulate surface pattern, whereas in other fruits no distinct pattern can be observed. Moreover, there is a large variation in fruit size: from 1.2 to 3.0 mm (mean greatest dimension of 36 fruits from Ramad: 2.14 mm). The dimensions of the Aswad and Ghoraifé fruits are within the limits of those from Ramad. Probably more than one *Galium* species is represented. No attempt has been made to arrive at a species identification.

Galium fruits are not particularly numerous in the sites under discussion. Some Ramad samples yielded more than only a few fruits of this type.

Galium mollugo-type. One *Galium* fruit (in Ramad C8 4.95) is very different from the others. The fruit is elliptic in outline. The domed dorsal side shows some longitudinal grooves. The greater part of the ventral side is taken up by a broad, elliptic furrow in which a longitudinal ridge is found. Size: 1.6×0.9 mm. This fruit type is strongly reminiscent of that of *Galium mollugo* L. without the wrinkled outer fruit wall (which may easily disappear through carbonization).

5.26. Thymelaeaceae

Thymelaea. Fruits acuminate (tapering to a long point), rounded at the base. *Thymelaea* fruits from Erbaba in Turkey are depicted in van Zeist & Buitenhuis (1983, fig. 10:7). The fruit wall is smooth; at a magnification of 50 times a finely reticulate surface pattern is visible. Aswad and Ghoraifé each yielded one fruit of this type: 1.9×1.05 and 1.85×0.95 mm. The subfossil fruits could be of *Thymelaea pubescens* (L.) Meissn., which species is found in dry fallow fields.

5.27. Umbelliferae

Ammi majus L. Oblong fruits, laterally compressed, with prominent, winged ribs (fig. 30:11). The surface is smooth. Dimensions of 12 fruits from various samples (remains of style base not included): 2.01 (1.6–2.2)× 0.62 (0.5–0.75) mm. The subfossil fruits conform to those of *Ammi majus* L., a species from disturbed habitats, such as fields and roadsides (Zohary & Feinbrun-Dothan, vol. 2, pp. 417–418; Mouterde, vol. 2, p. 628).

Various *Ammi* fruits were unripe and connate, *i.e.* two fruits still joined together (fig. 30:12). Among modern seed reference material of *Ammi majus* a fairly great proportion of unripe, connate fruits was noted.

Bifora. Only three characteristic fruits of *Bifora* (but at first sight not particularly reminiscent of umbelliferous fruits!) have been found. Almost globular fruits. The flat inner or ventral side (the surface of contact between two fruits before maturity) is rather small, with a large hole, pointed at the upper end (fig. 30:13). The surface is considerably wrinkled. Dimensions of the Ramad fruits: 2.4×1.9, 2.6×2.2 and 3.0×2.6 mm. Most likely the fruits are of *Bifora testiculata* Roth., although modern fruits of this species are larger (c. 4.3×3.5 mm) than the subfossil specimens.

Bupleurum spec. Only one fruit in Ramad C8 2.95. The fruit is laterally compressed, with 5 narrow ridges. Surface tuberculate. Size: 1.7×0.7 mm.

Torilis nodosa-type. Fruits elliptic in outline; on each of the four valleculae at the dorsal side (the areas between the primary ribs) 2 to 3 rows of bristles. In the carbonized fruits the bristles have largely disappeared (fig. 30:4). Many specimens show no more remains of bristles, which at first seriously hampered the identification. Fruits without bristles are oblong in outline. The dimensions of the subfossil fruits are shown in table 48.

Table 48. Dimensions of *Torilis nodosa*-type fruits from Ramad. Dimensions without (remains of) bristles

		L	B
C8 3.35	min.	2.0	0.6
N = 8	aver.	2.35	0.69
	max.	2.8	0.8
M4 1.75	min.	1.8	0.6
N = 9	aver.	2.07	0.68
	max.	2.6	0.7

The Ramad fruits show some resemblance to those of *Torilis nodosa* (L.) Gaertn., a species from fields, waste places and roadsides (Zohary & Feinbrun-Dothan, vol. 2, p. 397). As other species may likewise come into consideration this fruit type is indicated as *Torilis nodosa*-type.

5.28. Verbenaceae

Verbena. Only one *Verbena* fruit was found (Ramad M4 1.75). The fruit (0.95×0.5 mm) is oblong in outline with rounded upper and lower end. On the dorsal side longitudinal ribs which in the upper part of the fruit coalesce into a coarse reticulate pattern. Most likely *Verbena officinalis* L., a common plant of roadsides and fallow fields, is concerned here.

5.29. Vitaceae

Vitis. Aswad West 2.20 yielded 4 carbonized grape pips. The pips are of the plump type, with a very short stalk, indicative of wild grape: *Vitis vinifera* L. ssp. *silvestris* Gmelin. Two pips measure 3.6×3.3 and 3.6×3.0 mm. Wild grape could have grown along the streams in the area.

6. THE NATURE OF THE SAMPLES

6.1. The limitations of the material studied

A great number of questions can be put to the archaeobotanist about the vegetable material recovered from settlement sites, such as:

– Which plant species were cultivated, what was the importance of plant growing in the economy of the site and what was the relative importance of each of the crop plants?

– What was the role of wild plants in the diet of the inhabitants of the site?

– For what other purposes than as human food were wild and cultivated plants used (animal fodder, fuel, roof thatching, floor litter, *etc.*)?

– Do the plant remains provide information on the tillage of the fields (ploughing, weeding, irrigation, fallowing) and on harvesting methods?

– What can be concluded about crop processing (such as threshing, dehusking, crop cleaning) and food preparation?

– Is there a relation between archaeological features observed in the field and the composition of plant remains recovered from those features?

– What was the vegetation in the vicinity of the site?

Although this enumeration is far from exhaustive, it will already be clear that usually only a minor part of these questions can be solved satisfactorily. One should guard against too high expectations. The extent to which the botanical examination of a particular site can provide information on the plant husbandry depends, among other things, on the nature of the samples. The best results are to be expected from samples of which the botanical content represents one specific activity or one specific stage in crop processing. Also in that case it should be taken into consideration that the burning of the plant material must have affected the composition of the charred remains.

It has already been mentioned (3.1.) that the samples discussed in this paper have usually not been taken from particular features. The Aswad and Ghoraifé samples are from exposed sections. Most of the Ramad samples (C8SE series) were collected in extending a square excavated the previous season. Only from Ramad square M4, samples were taken during excavation, but with one exception the features from which these samples originate were rather vague, such as ashy soil. Sample M4 2.10 was collected from what is described as 'a basin filled with carbonized seeds and delimited by a brown line, probably a wooden box for storing food' (*une cuvette remplie de graines carbonisées et délimitée par une ligne brune, probablement un réceptacle en bois pour conserver les provisions* (de Contenson & van Liere, 1966, p. 169)). However, the results of the examination of this sample suggest that there is no possibility here of a cereal grain supply stored for food preparation. The mixed seed content and particularly the great numbers of spikelet forks and glume bases indicate that at least part of the sample represents the residue of crop-processing activities, such as dehusking.

Thus, the samples are not from particular features which could provide indications on the possible nature of the plant remains (storage products, kitchen refuse, crop-processing products and by-products). The examination of the samples has made it clear that the plant remains are generally of mixed origin, in other words, that they originated from various types of domestic activities. It goes without saying that this circumstance is a serious handicap in the interpretation of the palaeobotanical data beyond establishing which domesticated and wild species are present and commenting upon their possible economic and ecological implications. Only for Ramad would it have been possible, in principle, to collect samples from distinct features if somebody had done this during field campaigns after 1965. However, the need for this kind of samples was felt only after excavations at Ramad had come to an end (3.2.1.).

6.2. The deposition of plant remains in settlement sites

How did the seeds, fruits and other plant remains arrive in the settlement? For the crop plants the answer is obvious. After harvesting and probably also threshing on the field, the products were brought to the site for further processing. Carbonization of crop plant seeds and fruits could have been brought about by a conflagration or less dramatically in the preparation of food, grains may have fallen into the fire and thus have become carbonized. An accident during parching of glume wheat spikelets prior to dehusking may also have resulted in charred grains and chaff. Chaff may also have been used for kindling the fire. Hillman (1984) has drawn attention to the fact that only those items which, when exposed to fire, are small and dense enough to drop into the ashes may become charred rather than being burned to ash themselves. The sturdy spikelet forks and glume bases comply with this requirement.

There can be no doubt that wild fruits, such as pistachio, almond and fig, were collected purposely and brought to the settlement. But what about the remains of other wild plant species? Some of the seeds and fruits may have arrived at the site by accident, *e.g.* attached to the skin of domestic animals or to the clothes of man. It is tempting to assume that the plants of which the seeds occur in great numbers were brought in purposely or that the seeds themselves were collected by prehistoric man. Unfortunately, of many wild species ascertained for Ramad, Ghoraifé and Aswad their role in the economy of ancient man is obscure, or at least various hypotheses are possible or have already been brought forward. Thus, the great numbers of seeds and fruits of some wild legumes (*Astragalus, Melilotus, Trigonella astroites*) and grasses (*Lolium*) could point to intentional harvesting for human consumption (see also 7.4.2.). At least the numerous *Astragalus* seeds could also be explained in another way. In steppe areas various perennial woody plants, so-called dwarf shrubs, such as *Noaea, Artemisia* and *Astragalus*, are collected for fuel. It is not likely that *Artemisia* and *Noaea* seeds would escape from being burned to ash, but *Astragalus* seeds are more likely to be charred. Thus, the anomalously great number of *Astragalus* seeds in Ramad M4 2.80 could point (but not necessarily!) to the use of this plant as fuel. One could imagine that also annual plants from the steppe and the fields were collected for fuel. However, the presence of sometimes great numbers of seeds of a particular species remains difficult to interpret as the result of some kind of domestic activities.

Attention has been drawn to the possible contribution of dung fuel to the charred seeds and fruits in archaeological deposits. Particularly Miller (1982) has stressed this potential source of charred seeds. In areas with a scarcity of wood, dung is generally used for heating purposes. The examination of fresh dung has demonstrated that various seeds pass through the digestive tract of sheep and cattle undamaged (see also Bottema, 1984). The animal dung may be burned as such (sheep, goat, camel), but of cattle dung so-called dung cakes are made. Part of the seeds in these dung cakes may have been attached to the straw or other vegetable material used in the manufacture of the cakes. The burning of dung and dung cakes may result in the charring of cereal grains and other seeds and fruits incorporated in this kind of fuel. As a consequence the presence of quite considerable numbers of charred seeds in archaeological sites may have been due to this practice.

Wood must have been a scarce commodity in the vicinity of Aswad and Ghoraifé. Although more wood was available near Ramad, that was situated in the almond-pistachio forest-steppe, it may not have been enough to meet the demands for fuel. Moreover, excessive cutting of pistachio and almond would have deprived the inhabitants of the site of valuable sources of wild food (vegetable fats and proteins). It is tempting to assume that also in the sites under discussion dung fuel was commonly used and that an unknown proportion of the charred seeds recovered from these sites was brought to the settlement in the digestive tract of domestic animals. This could, for example, explain the exceptionally great numbers of cyperaceous fruits (sedge and bulrush) in Aswad. In grazing the nearby marshes (the only green fodder in the middle of the summer) the animals must have eaten many fruits attached to these common marsh plants and subsequently excreted part of them in their droppings. However, curiously enough no domestic animals would have been kept by the inhabitants of aceramic Aswad, Ghoraifé and Ramad (2.2., 2.4.), so that animal dung would not or hardly have come into consideration as a source of fuel.

In the following discussion of the archaeobotanical data (section 7) the way the plant remains may have arrived in the settlement will not or hardly be taken into consideration. For uncontested human food plants this is clear, whereas for the other species it remains a matter of speculation.

6.3. Seed frequencies

The numbers of seeds and fruits per sample vary greatly (tables 5 to 10). This is not particularly astonishing as the deposition of charred vegetable material in a settlement did not occur randomly. Some places will regularly have been cleaned, whereas other places served as refuse dumps. However, in addition to the varying numbers of seeds per sample, it turned out that there are consistent differences in seed frequencies between sites and between areas and/or levels (phases) within one site. As the volumes of the samples that have been floated are not the same for all sites, the numbers of seeds have been converted to 10 litre samples (table 49). This should facilitate the comparison of seed frequencies per unit of soil volume.

It goes without saying that the figures shown in table 49 are approximations. The volume of the Ghoraifé and of the Aswad West samples was 13 litres (the contents of one rubber basket), but for some samples it may have been somewhat less. The same applies to Aswad East, with 26 litre samples

Table 49. Estimated numbers of seeds and fruits per 10 litres of soil

Ramad					
C8, phase II	1.10	161	C8, phase I	5.25	175
	1.20	9		5.35	56
	1.55	55		5.40	46
	1.65	182		5.55	95
	1.70	69		5.60	48
	1.90	99		5.70	28
	2.25	251		Mean	75
	2.45	206			
	2.70	557			
	2.95	793			
	3.15	57			
	3.35	2 291			
	3.55	1 491			
	3.60	469			
	3.70	1 276			
	3.90	979			
	4.05	482			
	4.35	404			
	4.55	211			
	4.75	2 057			
	4.95	2 052			
	5.05	1 789			
	Mean	725			
M4, phase II	1.75	2 102	M4, phase I	2.80	2 998
	1.80	761		3.00	37
	1.90	697		3.10	74
	2.10	783		3.45	79
	2.30	431		3.65	152
	Mean	955		4.05	201
				4.30	116
				Mean	522
					110*
Aswad					
East, phase II	0.20	63	West, phase II	0.40	137
	0.40	68		0.60	280
	0.60	118		0.80	149
	0.80	197		1.00	103
	1.00	261		1.20	348
	1.20	208		1.40	945
	1.40	203		1.60	2 309
	1.60	101		1.80	829
	Mean	152		2.00	3 057
				2.20	3 487
				2.40	806
				2.60	103
				2.80	7
				Mean	966
East, phase I	1.80	40			
	2.00	251			
	2.20	14			
	2.40	54			
	2.70	172			
	2.90	138			
	3.10	53			
	3.30	15			
	3.60	29			
	Mean	85			

Table 49 (continued).

Ghoraifé					
Phase II	1.20	49	Phase I	3.80	8
	1.40	30		4.00	8
	1.60	69		4.20	12
	1.80	13		4.40	33
	2.00	58		4.60	8
	2.20	61		4.80	6
	2.40	78		5.00	10
	2.60	176		5.20	8
	2.80	48		5.40	8
	3.00	62		5.60	17
	3.20	59		5.80	7
	3.40	123		6.00	12
	3.60	130		Mean	11
	Mean	74			

* 2.80 m excluded

(two baskets). The numbers of seeds per 10 l of soil at Ghoraifé and Aswad are minimum values: for samples of less than 13 or 26 litres of soil the seed frequencies are higher than indicated in table 49, but not very much higher. The least accurate are the seed frequency figures for Ramad. The soil volumes here ranged from 10 to 20 litres, but no actual volumes have been recorded. The calculation of the Ramad seed frequencies is based upon the average soil volume of 15 litres. The deviations from the figures given in table 49 are at most −25% (if the sample was 20 l) and +50% (if the sample was only 10 l). For instance, the number of seeds per 10 litres of soil of C8 2.70 is between 557−25% is 418 and 557+50% is 836.

It is needless to remark that the seed frequency figures refer only to the soil that was collected and that they do not give a kind of mean value for the whole of the layer or feature. In addition to the seed frequency figures per sample, mean figures are given per area and per phase.

Compared to Ramad and Aswad, the Ghoraifé samples show consistently low seed frequencies. What could this mean? Was only relatively little vegetable material brought to the site or has there been a more rapid accumulation of soil than at Ramad and Aswad? One should also take into consideration that the seed frequencies per 10 l of soil established for Ghoraifé may not be representative for the whole of the site. In other areas of the site the concentration of charred seeds in the occupational fill may be quite different. In this connection the seed frequencies in Aswad East and Aswad West are illustrative. Phase II samples from Aswad West give a mean seed frequency of 966, whereas at Aswad East, on average, only 152 seeds were recovered from 10 litres of soil of the same archaeological phase. This difference in mean numbers of seeds could be due to differences in soil accumulation rates. The phase II levels in both areas do not necessarily cover the same time span. Unfortunately, there is no way of determining rates of seed deposition per unit of time. Other hypotheses could be brought forward to explain the differences in seed frequencies in both areas, but that would be sheer speculation, which does not bring us any further.

At Ghoraifé, there are also marked differences in seed concentration in the lower and upper levels. The seed frequencies in the phase II deposits are, on average, about 6.5 times higher than those in phase I samples. Ramad shows the same phenomenon. At Ramad C8, the average seed frequency in the phase II samples is 9–10 times higher than in the phase I samples. For phase I at Ramad M4 the average seed frequency is biassed by the anomalously great numbers of *Astragalus* and *Helianthemum* seeds in M4 2.80. If this sample is left out, the seed frequencies of phases I and II differ by a factor 8 to 9. At Aswad East, the difference in mean seed frequencies between phases I and II is less pronounced.

Which significance should be attached to the lower seed frequencies in the phase I levels of the sites under discussion? Lower frequencies are not bound to a particular time period. Phases I at Aswad, Ghoraifé and Ramad differ in time by many hundreds of years. Was the habitation perhaps more scattered in the early stages of a site, with a smaller number of inhabitants, which could account for the lower numbers of seeds deposited? Could these lower seed frequencies in one way or another not be of primary but of secondary nature? The crop plant proportions in the phase I levels give occasion to think of differential preservation (7.1.2.). Be this as it may, no satisfactory explanation for the lower seed frequencies in the phase I levels can yet be proposed.

7. THE PLANT HUSBANDRY

7.1 Cultivated plants

7.1.1. *Mean percentages*

The aceramic Neolithic habitation of Aswad, Ghoraifé and Ramad covers about 2000 years and the ecological conditions in the vicinity of the sites were not identical (2.1.1., 2.1.2., 2.1.3.). Consequently one could expect differences in the crop plants grown and/or in the proportions of the crop plants between the three sites. Moreover, there may be differences between habitation phases within one site. In section 4 attention has already been devoted to the behaviour of the individual crop plant species; in this section emphasis will be laid on the crop plant assortment. In order to obtain some insight in possible changes in the composition of the crop plant remains, the samples of one phase are taken together. In this connection it should be remembered that in each of the sites two main aceramic habitation phases are distinguished. The correlation of these phases in shown in fig. 6.

For a comparison of the proportions of crop plant remains mean percentages seem most appropriate. As has been discussed in an earlier paper (van Zeist & Buitenhuis, 1983) a suitable way to determine the mean percentages is as follows. For each sample of the phase concerned the percentages are calculated on the basis of the total number of crop plant seeds and fruits in that particular sample. Thereupon, for each of the seed types the percentages are added and the mean percentages are determined by dividing the total percentage by the number of samples of the particular group. Samples with less than 20 crop plant seeds are left out, so that the number of samples included in this operation may be less than the total number of samples of the phase concerned.

The above method of determining mean percentages was also applied for the sites under discussion (table 50). However, for the Ghoraifé phase I samples it did not work because none of the samples of this group yielde
In this case no other choice was left than adding the actual numbers of crop plant seeds and fruits in the samples of this group and subsequently determining the percentages. As here the numbers of crop plant seeds per

sample are always low the result should be satisfactory: the percentages are not affected by an extraordinarily great number of seeds of a particular species in one of the samples. That this method seems to be justified in the case of not too greatly varying numbers of seeds per sample is also suggested by the phase I samples at Aswad East. Of the nine samples of this group only five have more than 20 crop plant seeds and fruits. The mean percentages based upon the percentages in each of the five samples are shown in table 50. The mean percentages calculated on the basis of the total numbers of seeds and fruits in all nine samples are also presented in table 50. The mean percentages obtained in both ways show only slight differences, indicating that under certain circumstances the latter method leads to results comparable to those of the 'percentage-based' method.

7.1.2. *Crop plant proportions*

For the oldest Neolithic habitation phase attested for the Damascus basin, *viz.* for phase I at Aswad, only one domesticated cereal species, *Triticum dicoccum*, could be established with certainty. As for *Hordeum*, the kernels are not particularly informative whether *H. distichum* or *H. spontaneum* is concerned. Some of the barley grains are distinctly of the wild barley type, but it is likely that the other barley grains include *H. spontaneum* as well (4.5). Only one of the barley rachis internodes in an Aswad phase I sample is of the non-brittle type (East 1.80). Even if most of the barley was of the morphologically wild type, it is tempting to assume that it was cultivated. Of lentil and field pea it cannot be ascertained whether they are of the wild or of the domesticated type, but it is assumed that they were already cultivated by the earliest farmers at Aswad. No remains of free-threshing wheat (*Triticum durum/aestivum*), naked barley (*Hordeum vulgare* var. *coeleste*) or einkorn wheat (*Triticum monococcum*) were found, but in view of the rather small numbers of crop plant seeds and fruits in Aswad phase I, this is no absolute proof that these species were not grown there during that time. In this connection attention is drawn to phase I at Ghoraifé in which the species mentioned above are likewise absent, although for the contemporaneous Aswad phase II levels einkorn wheat, free-threshing wheat and naked barley have been established. On the other hand, it must be admitted that for Ghoraifé phase I only 8 identifiable cereal grains were found, which number is markedly higher at Aswad phase I (table 50). With some reserve it may be assumed that it was not until phase II at Aswad that *Triticum monococcum, Triticum durum/aestivum* and *Hordeum vulgare* var. *coeleste* were introduced and became part of the crop plant assortment of the Neolithic farmers in the Damascus basin. Linseed cultivation did not start either until phase II at Aswad, that is to say, not until the beginning of the seventh millennium B.C.

Comparison of the percentages in phases I and II at Aswad suggests a quite considerable decrease in pulse crop proportions. It looks as if in the early stages of the habitation pea and lentil were proportionally of much more importance than afterwards. However, some caution in drawing this kind of conclusion should be observed. A similar decrease in pulse crop proportions is seen between phases I and II at Ghoraifé and phases I and II at Ramad C8. Consequently, one wonders whether this behaviour of the pulse crop percentages could in one way or another be an artifact of the charred seed preservation. In this connection it is perhaps not without significance that in the levels with high pulse crop proportions the numbers of seeds and fruits of cultivated as well as of wild plants are comparatively small.

Among the cereals, emmer wheat usually shows the highest percentages. Only at Aswad phase I does barley have the mean percentage value equal to that of emmer wheat. It is self-evident that the predominant emmer wheat percentages do not necessarily imply that this was quantitatively the most important cereal crop plant. However, we can only deal with crop plant seed frequencies and possible differences in proportions. As for differences in crop plant proportions between sites or between phases within one site, again the necessary caution should be observed. Differences between sites or between phases of one site may be of the same magnitude as differences between two areas in the same site. The mean percentages in phase II at Aswad East and Aswad West are largely similar, but squares C8 and M4 and Ramad show some distinct differences in the crop plant proportions. Thus, in phase I free-threshing wheat has a much higher proportion in C8

Table 50. Mean percentages of crop plant seeds and fruits per archaeological phase. For the calculation of the mean percentages, see 7.1.1. Σ % = total percentage per archaeological phase, N = total number of seeds or fruits per archaeological phase.

	Aswad East				Aswad East		Aswad West		Ghoraifé	
Phase	I				II		II		I	
Number of samples	5		9		8		12		12	
	Σ %	Mean %	N	Mean %	Σ %	Mean %	Σ %	Mean %	N	Mean %
Triticum monococcum	–	–	–	–	2.2	0.3	1.5	0.1	–	–
Triticum dicoccum	43.0	8.6	23½	6.2	142.7	17.8	196.0	16.3	5	8.3
Triticum durum/aestivum	–	–	–	–	6.4	0.8	11.3	0.9	–	–
Hordeum distichum/spontaneum	42.4	8.5	32	8.4	18.9	2.4	51.7	4.3	3	5.0
Hordeum vulgare var. coeleste	–	–	–	–	0.6	0.1	2.8	0.2	–	–
Cereal grain fragments	359.6	71.9	281	73.8	622.6	77.8	916.9	76.4	27	45.0
Σ Cereals		89.0		88.4		99.2		98.2		58.3
Pisum	44.5	8.9	38½	10.1	4.7	0.6	8.9	0.7	16	26.7
Lens	10.6	2.1	6	1.6	0.8	0.1	7.2	0.6	3	5.0
Cicer	–	–	–	–	–	–	–	–	3	5.0
Σ Pulses		11.0		11.7		0.7		1.3		37.7
Linum (usitatissimum)	–	–	–	–	–	–	4.1	0.3	3	5.0
Sum of seeds and fruits			381						60	

than in M4 (2.8 and 0.4%, respectively), whereas in phase II the reverse can be observed: nearly four times higher in M4 than in C8. Both squares show marked differences in emmer wheat proportions in phase I and in hulled barley values in phase II. It will be clear that if between areas in one site already considerable differences in crop plant proportions can occur, differences between sites may not be of much significance. Had the samples been taken in another area the results may have been different.

The data obtained for Aswad, Ghoraifé and Ramad seem to justify the following conclusions. From Aswad phase II (early seventh millennium B.C.) on 5 cereal species, field pea, lentil and linseed were cultivated in the Damascus basin. Chick-pea (*Cicer*) appears later in the charred seed record, but its role in the plant husbandry was most probably of minor importance. The percentages suggest that einkorn wheat and naked barley were grown on a smaller scale than emmer wheat and hulled barley. *Triticum durum/aestivum* seems to have been of less importance at Aswad phase II than it was in phase II levels at Ghoraifé and at Ramad. This could point to an increased appreciation of free-threshing wheat in later periods. As explained above, it may be wise to refrain from drawing more conclusions from the crop plant seed proportions in the seventh millennium B.C. levels (Aswad II to Ramad II).

The palaeobotanical data do not allow conclusions on the quantitative contribution of cultivated plants in the food economy of the sites concerned. Low numbers of crop plant remains (and also those of wild plants) do not so much point to lower production of crop plants per head of the population (6.3.), but are due rather to more rapid accumulation of occupational debris and/or less dense habitation. On the other hand, one wonders whether it would be possible to say something on the importance of wild plant collecting relative to plant cultivation. This aspect of the plant husbandry will be discussed in section 7.4. First some remarks will be made on possible indications of agricultural practices.

7.2. The fields

The present-day annual precipitation in the area of Aswad and Ghoraifé is below 200 mm. This is considered too low to rely on for dry-farming. If in early-Holocene times, 8th and 7th millennia B.C., precipitation was not appreciably higher, plant cultivation under dry-farming conditions must have been very marginal at Aswad and Ghoraifé. Whether or not the early Holocene climate of the Levant was moister than at present is still a controversial issue (2.1.4.). For Ramad a

Ghoraifé				Ramad C8		Ramad M4		Ramad C8		Ramad M4		Ramad C8NW	
II				I		I		II		II		III	
10		13		6		6		21		5		6	
Σ %	Mean %	N	Mean %	Σ %	Mean %	Σ %	Mean %	Σ %	Mean %	Σ %	Mean %	Σ %	Mean %
29.2	2.9	13	2.9	–	–	14.8	2.5	11.7	0.6	4.6	0.9	5.4	0.9
198.9	19.9	94½	21.2	68.6	11.4	165.9	27.7	399.8	19.0	95.0	19.0	101.3	16.9
119.1	11.9	48	10.8	9.1	1.5	2.5	0.4	103.5	4.9	82.7	16.5	22.7	3.8
25.8	2.6	10½	2.4	17.3	2.9	22.7	3.8	68.1	3.2	33.9	6.8	50.7	8.5
6.1	0.6	3	0.7	0.7	0.1	–	–	3.5	0.2	0.7	0.1	4.6	0.8
570.2	57.0	256	57.5	291.3	48.6	355.7	59.3	1335.0	63.6	250.6	50.1	322.7	53.8
	94.9		95.5		64.5		93.7		91.5		93.4		84.7
11.6	1.2	6	1.3	65.7	11.0	–	–	58.0	2.8	4.0	0.8	26.7	4.5
–	–	–	–	136.7	22.8	16.0	2.7	99.0	4.7	17.5	3.5	61.0	10.2
–	–	–	–	–	–	–	–	1.3	0.1	1.7	0.3	2.1	0.4
	1.2		1.3		33.8		2.7		7.6		4.6		15.1
39.4	3.9	14½	3.3	10.5	1.8	22.4	3.7	19.4	0.9	8.7	1.7	2.4	0.4
		445½											

mean annual precipitation of c. 250 mm is inferred; at present dry-farming as well as irrigation farming is practised in the area.

7.2.1. *The possible exploitation of surface water*

In a previous paper (van Zeist & Bakker-Heeres, 1979) the possible implications of the unusually great numbers of *Carex* and *Scirpus maritimus* fruits at Aswad have already been discussed. The great numbers of fruits of these species point to marsh vegetations at a short distance from the site. At present no marshes occur in the vicinity of the site, but two freshwater lakes, Bahret Hijjâné and Bahr el Aateibé, are found c. 15 km to the south-southeast and to the north-northeast of Tell Aswad, respectively (fig. 1). Up to the middle of the last century Lake Aateibé extended up to the site of Aswad as is also indicated in fig. 31. The extent of the lake around A.D. 1850 is shown on the Map of Damascus, Hauran and the Lebanon Mountains published by Porter (1855). In addition, Porter who visited the area in November 1852, gives an accurate travel account which confirms the extent of the lake as shown on his map. Porter's observations point to the presence of extensive marsh vegetations interspersed with patches of open water.

It is likely that also in early Neolithic time the lake and the marshes extended as far as the site of Aswad, in other words, that Aswad had been established near the edge of the marshes of Lake Aateibé. It cannot be excluded that *Carex* and *Scirpus* fruits were gathered for human consumption. Some of these fruits may have arrived in the settlement adhering to rushes and sedges used for thatching or as litter. It would be attractive to assume that most of the charred cyperaceous fruits at Aswad were due to the burning of dung, that the marsh vegetation was grazed by domestic animals, but, alas, no domestic animals are attested for Aswad (2.2.).

The nearby marshes offered the Aswad farmers an opportunity to compensate for insufficient precipitation. They could have laid out their fields in the marshy zone, thus providing the crop with several weeks of extra moisture at the beginning of the dry season. A similar exploitation of surface water has been suggested by Helbaek (1969) for the Bus Mordeh phase at Ali Kosh in Southwest Iran. It should be emphasized that there is no proof for the utilization of the marshy zone for plant cultivation by the inhabitants of Tell Aswad. The palaeobotanical record indicates only that here conditions must have been favourable for this.

Precipitation at Ghoraifé is about the same as at Aswad, implying that also at Ghoraifé dry farming may have been marginal. Fruits

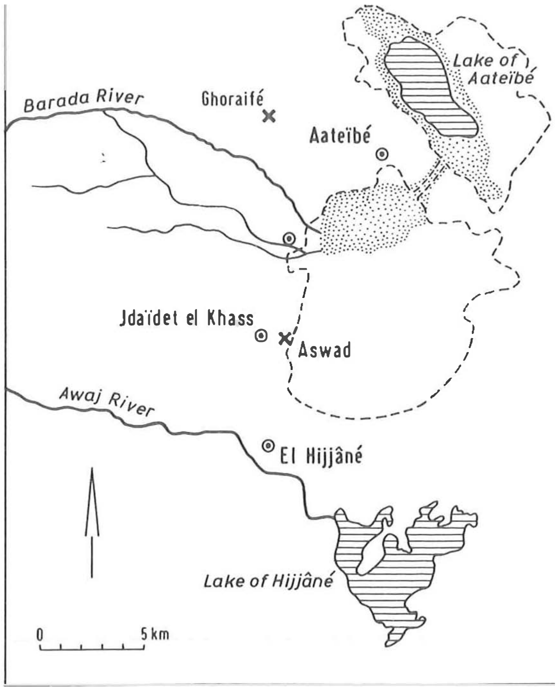

Fig. 31. On this map the extent of Lake Aateibé around A.D.1850 is indicated by a broken line. Tell Aswad is situated near the former lake border.

of marsh plant species, *viz. Carex, Eleocharis* and *Scirpus maritimus*, were recovered at Ghoraifé, although in much smaller numbers than at Aswad. However, in this respect it should be taken into account that in general the numbers of seeds and fruits recovered from the Ghoraifé samples are much smaller than those from the Aswad samples. The charred seed concentration in the Ghoraifé deposits is usually low. Relative to the numbers of crop plant seeds and fruits, cyperaceous fruits are not less numerous at Ghoraifé than they are at Aswad. Extensive marshes were not present in the immediate vicinity of Ghoraifé. The marshes of Lake Aateibé were at least 5 kilometres away. In spite of this considerable distance, marsh vegetations must nevertheless have played a part in the economy of the site as is attested by the cyperaceous fruits.

In contrast to Aswad and Ghoraifé, at Ramad only small numbers of *Carex* and *Scirpus* fruits were found. The Ramad farmers had no opportunity of growing their crop plants in soil with a high groundwater table. It is possible that the water of the small stream at the foot of the site was used for irrigating fields, as is done at present. Similarly the inhabitants of Ghoraifé may have diverted water from the Barada river to their fields. Whether small-scale irrigation farming was already practised by Neolithic farmers in the Damascus basin remains questionable.

7.2.2. *Field weeds*

At least some of the weeds in cultivated fields are indicative of soil conditions and/or agricultural practices. Consequently, it is self-evident that attempts are made to draw inferences from the seeds and fruits of weeds in archaeological sites about agricultural practices of the past. Unfortunately, but on second thoughts not very astonishingly, the farther one goes back in time the less informative wild plant species are with respect to questions such as tilling of the soil, fallowing, *etc.* In the case of the Neolithic sites in the Damascus basin, various wild plants may have been present in the fields while at the same time they formed part of the natural steppe and forest-steppe vegetation. In this connection it should be remembered that most of the field weeds originate from steppe vegetations. Various steppe plants intruded the fields of the Neolithic farmers and adapted themselves to the particular conditions in cultivated fields by natural selection of mutants most suitable for the new environment. However, some reserve in this respect may not be amiss. M. Zohary (1973, p. 648) mentions that of a great number of segetal plants which are often referred to as of East Mediterranean or Southwest Asian origin, no natural habitats are known. They are exclusively found in secondary habitats, *i.e.* on disturbed soil, in ruderal places, on roadsides, *etc.*

An additional problem is created by the fact that a great number of seeds and fruits of wild plants could not be identified to the species level. No ecological conclusions can be drawn from seed types which may include species from different habitats. Undeniable field weeds are not particularly numerous in the seed record of the sites under discussion. Of *Vaccaria pyramidata*, a weed in winter crops, rather small numbers of seeds were found in the three sites. *Cephalaria syriaca*, which in many areas of the Near East is a noxious weed in grain fields, is represented at Ramad by only two fruits. *Aegilops* cf. *crassa* is also scarcely represented: a small number of caryopses in Ramad. The fruits of *Lolium temulentum*, which in Near Eastern primitive grain fields is one of the most common weeds, were found only in Ramad, but in this case in quite considerable numbers. One can only speculate why darnel is not represented at Aswad and Ghoraifé. Were the climatic conditions there not suitable for this species or was it not until the last centuries of the 7th millennium B.C. that *Lolium temulentum* had arrived in the area? See, however, note under 5.13.

It is likely that *Bellevalia* occurred in the fields; particularly at Ramad it must have been a common weed. *Androsace maxima* must have occurred frequently in the fields of the Ramad farmers. *Helianthemum* cf. *ledifolium*, another potential field weed, is also confined to Ramad. *Ammi majus, Torilis* and *Convolvulus* are other taxa which could have formed part of the weed flora of the Ramad fields, but they may also have been found in other disturbed habitats. *Lolium* (*rigidum*) and *Phalaris* (*paradoxa*) can both occur in fields. Ryegrass must have been a widespread weed, undoubtedly not confined to fields. In the vicinity of Aswad conditions for *Phalaris* seem to have been particularly favourable. *Avena barbata* and/or *Avena sterilis* were probably also present in the fields of the Neolithic farmers in the Damascus basin, especially at Ramad. Other probable field weeds include *Adonis* and *Silene*.

The role of the leguminous taxa in the field weed flora is rather obscure. *Medicago radiata* seems to occur only in steppe and desert-steppe vegetations, but the other leguminous seed types include species which at present are found in fields. Thus, vetches (*Vicia*) are common field weeds, *Medicago* and *Melilotus* species are frequently found in fields, and various *Astragalus* species, particularly annual types, are well adapted to the ecological conditions in cultivated fields. Whether, and if so to what extent, wild legumes were constituents of the field weed flora must remain undecided. The charred seed record suggests that some leguminous species must have been quite common in the vicinity of the sites, but this does not necessarily imply that they were field weeds.

From the field weeds no other conclusion can be drawn than that (part of) the crop was autumn sown, which is not surprising. This rather meagre information on agricultural practices may in part be due to our ignorance in defining proper questions and to insufficient information on the ecology of the species. It is striking that at Ramad, field weeds and potential field weeds are much better represented than at Ghoraifé and Aswad; various taxa occur only in Ramad. It is true that from Ramad considerably greater numbers of seeds have been recovered than from the other sites, implying that the chances of finding rare types are better, but, on the other hand, it seems justified to conclude that Ramad had a richer field weed flora than Ghoraifé and Aswad. This could be due to the more favourable climatic conditions at Ramad (higher precipitation), but it also is tempting to suggest that with the development of agriculture the number of field weed species in the Damascus area increased. This could have been brought about by the immigration of weeds from other areas. Direct and indirect contacts between farming communities must have facilitated the migration of synanthropic species.

7.3. Tail grain or prime grain

Quite a lot of time has been invested in measuring great numbers of cereal grains. The dimensions of the kernels should inform us about the quality of the grain in terms of size, and the dimensions and index values should permit comparisons between samples from the same site as well as comparisons between sites. However, one may wonder whether irrespective of the effect of the carbonization on the dimensions, the size ranges established for the cereal grains from Ramad, Ghoraifé and Aswad provide a correct picture of the quality of the crop. The same applies to lentil and pea, but this discussion will remain confined to cereals.

In the sites mentioned above no traces were found of any grain storage pits or other deposits of almost pure grains indicative of the storage of grain ready for food preparation or being sown. Nearly all charred grains are from refuse layers and ashy deposits or from occupational fill without any particular characteristics. This leaves us with the question whether perhaps the majority of these grains may represent the waste fraction. In a rather far advanced stage of crop processing, the product is passed through a sieve which separates the prime grain from the smaller tail grain, weed seeds and most other contaminants. The traditional crop processing of cereals has been described expertly and clearly (by means of flow diagrams) by Hillman (1981; 1984). For further details the reader is referred to Hillman's papers.

The grains from storage supplies, either found in primary position, *e.g.* in a storage pit or vessel, or in secondary position, *e.g.* shovelled in a pit or spread out over some area after the conflagration (more or less pure charred grain deposits), will primarily represent prime grain. One could argue that the cereal grains from refuse layers, where they are mixed with great numbers of seeds of field weeds and other wild plants, with rachis remains and chaff, should exclusively or for the most part consist of tail grain. On the other hand, the tail grain, the by-product of crop processing, was not merely a waste product, to be thrown away or burned, but it served as animal fodder (also as famine food for humans). Consequently, tail grain did not automatically end up in refuse deposits and the cereal grains in the Ramad, Ghoraifé and Aswad samples may for the greater part be prime grain. Could the size distribution of the carbonized grains provide indications as to the class of grain (prime grain or tail grain)?

As for distinguishing the two classes of grain in charred remains, Hillman (1984) has drawn attention to the following. As has already been mentioned, tail grain and prime grain are separated by sieving. The mesh diameters of the sieves used determine the size of the grains which pass through. It is the maximum breadth (or height) of the grain and not the length which determines whether or not the grain can pass through the sieve. The maximum diameters (breadth or heights) of a grain sample before sieving will show a normal distribution (Gaussian curve). In sieving some of the small grains which in theory could pass through will be retained on the sieve together with the prime grain. Nevertheless, the theoretical frequency distribution of the maximum diameters of tail grains should show a distinctly asymmetrical curve with a long tail to the left and rather

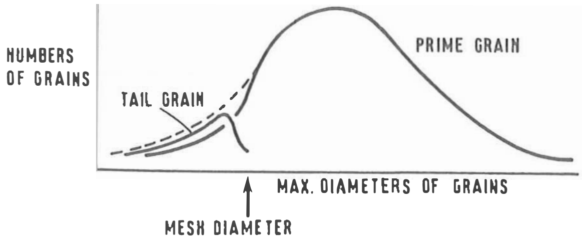

Fig. 32. The frequency distribution of the maximum diameter (greatest width or height) of unsorted cereal grains is of Gaussian form. Sieving results in the separation of prime grain and tail grain (the grains that pass through the sieve). As some of the small grains will usually remain with the prime grain, the prime grain curve extends to beyond the sieve mesh diameter (indicated by an arrow). After Hillman (1984).

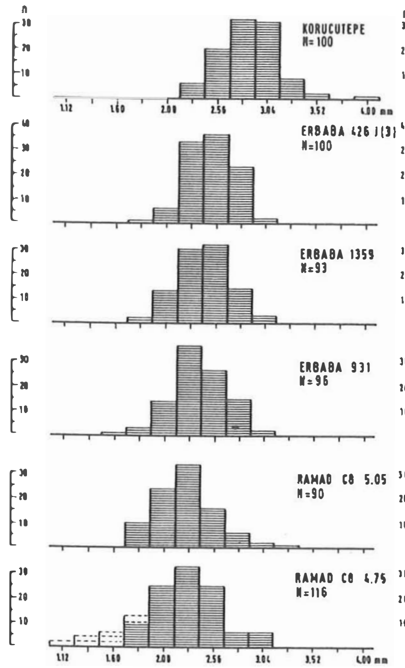

Fig. 33. Frequency distribution histograms for the maximum diameter of *Triticum dicoccum* grains from various sites.

abruptly curtailed to the right. This is illustrated in fig. 32.

The frequency distributions of the maximum diameters of emmer wheat and naked wheat grains from Ramad are shown as histograms in figs. 33 and 34. The distributions obtained differ distinctly from the theoretical frequency distribution of the maxi-

Table 51. Dimensions in millimeters and index values of *Triticum durum/aestivum* and *T.dicoccum* from various Near Eastern sites

	Date	Length	Breadth	Thickness	100L:B	100T:B	N	Sample context
Triticum durum/aestivum								
Korucutepe[1]	2600-2300 BC	4.87 (3.6-6.2)	3.14 (2.2-3.7)	2.55 (1.8-3.2)	156 (122-196)	81 (65-98)	100	Charred grain deposit
Tepecik[1]	Early Bronze	4.18 (3.3-5.5)	2.62 (2.0-3.3)	2.17 (1.5-2.9)	160 (134-197)	83 (69-97)	100	Almost pure naked wheat sample
Erbaba 931[2]	c.5800 BC	5.21 (3.4-6.3)	2.86 (2.0-3.6)	2.36 (1.7-3.0)	183 (150-232)	83 (58-107)	100	Mixed sample from occupational fill
Erbaba 1318[2]	c.5800 BC	5.31 (4.0-6.6)	2.97 (2.1-3.6)	2.44 (1.6-3.0)	180 (135-221)	82 (64-103)	99	Mixed sample from occupational fill
Erbaba 1359[2]	c.5800 BC	5.12 (3.6-6.3)	2.82 (2.2-3.4)	2.38 (1.6-3.1)	183 (131-242)	85 (56-113)	88	Mixed sample from occupational fill
Hacilar[3]	c.5250 BC	4.89 (2.5-6.3)	3.06 (1.5-3.8)	2.46 (1.5-3.3)	~ 160	~ 80	50	Mixed cereals and pulses
Beycesultan IV[4]	13th cent. BC	3.62 (2.3-5.2)	2.26 (1.3-3.2)	1.84 (1.2-2.6)	~ 160	~ 81	100	Contents of pithos
Beycesultan VI[4]	13th cent. BC	5.48 (3.7-6.8)	2.98 (2.2-3.7)	2.54 (1.7-3.0)	~ 184	~ 85	100	Contents of wooden bin
Lachish[5]	700 BC	4.76 (3.7-5.9)	3.18 (2.6-3.7)	2.56 (2.2-3.3)	149 (116-192)	82 (68-100)	50	Predominantly naked wheat sample
Deir‘Allā F612[6]	1200-1150 BC	4.29 (3.4-5.2)	2.09 (1.4-2.6)	1.93 (1.5-2.3)	206 (161-272)	92 (71-111)	100	Almost pure naked wheat sample
Deir‘Allā M204a[6]	1200-1150 BC	4.86 (4.2-5.4)	3.17 (2.4-3.8)	2.81 (2.2-3.4)	154 (128-186)	89 (71-98)	100	Almost pure naked wheat sample
Deir‘Allā BB418b[6]	7th-5th cent. BC	4.16 (3.4-4.9)	2.86 (2.2-3.6)	2.50 (1.9-3.1)	146 (121-177)	88 (75-100)	100	Almost pure naked wheat sample
Ramad C8 3.35		4.34 (3.4-5.4)	2.66 (2.0-3.3)	2.20 (1.6-2.9)	162 (127-204)	83 (67-100)	78	
Ramad C8 4.75, 5.05		4.31 (3.4-6.0)	2.73 (1.9-3.4)	2.28 (1.6-2.9)	159 (124-238)	84 (71-97)	57	
Triticum dicoccum								
Korucutepe[1]	2600-2300 BC	6.20 (4.9-7.4)	2.87 (2.3-3.9)	2.54 (2.0-3.2)	217 (174-263)	89 (69-107)	100	Almost pure emmer wheat sample
Erbaba 931[2]	c.5800 BC	5.57 (4.2-6.7)	2.40 (1.5-3.0)	1.99 (1.2-2.6)	234 (188-300)	83 (62-110)	96	Mixed sample from occupational fill
Erbaba 426J(2)[2]	c.5800 BC	5.62 (4.7-6.4)	2.54 (2.0-3.1)	2.04 (1.5-2.6)	223 (175-280)	83 (61-100)	99	Mixed sample from occupational fill
Erbaba 426J(3)[2]	c.5800 BC	5.63 (4.0-6.3)	2.51 (1.9-3.1)	2.05 (1.6-2.6)	225 (186-268)	82 (63-103)	100	Mixed sample from occupational fill
Erbaba 1359[2]	c.5800 BC	5.54 (4.0-6.6)	2.45 (1.9-3.0)	2.04 (1.4-3.0)	228 (164-285)	84 (56-111)	93	Mixed sample from occupational fill
Hacilar[3]	c.5050 BC	6.37 (5.5-7.3)	2.92 (1.8-3.3)	2.43 (1.8-2.8)	~ 218	~ 83	25	Well deposit
Ramad C8 4.75		5.12 (4.1-6.3)	2.31 (1.8-3.1)	2.16 (1.6-2.6)	224 (153-283)	94 (73-115)	101	
Ramad C8 5.05		5.02 (4.0-6.0)	2.27 (1.8-3.4)	2.11 (1.5-3.0)	222 (161-291)	93 (71-115)	90	

1. Van Zeist & Bakker-Heeres, 1975b
2. Van Zeist & Buitenhuis, 1983
3. Helbaek, 1970
4. Helbaek, 1961
5. Helbaek, 1958
6. Van Zeist & Heeres, 1973

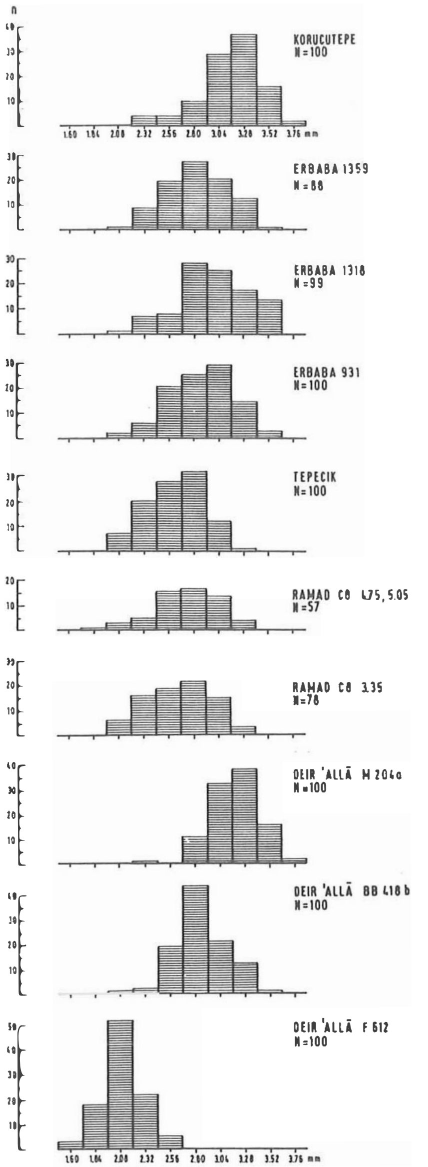

Fig. 34. Frequency distribution histograms for the maximum diameter of *Triticum durum/aestivum* grains from various sites.

mum diameters of tail grain; they show a more or less normal distribution. For comparison the frequency distribution graphs of emmer wheat and naked wheat samples from other Near Eastern sites are shown in figs. 33 and 34. For the latter samples it may safely be assumed that the grains are from stored supplies which were burned. Some particulars about the contexts of the samples are given in table 51 which presents the dimensions and index values of the grains concerned. The maximum diameters of the Ramad emmer wheat grains do not differ significantly from those in Erbaba 931. Similarly the maximum diameters of the Ramad naked wheat are not smaller than those of various naked wheat samples from other sites. Very striking are the differences in the maximum diameters of naked wheat in the three Deir 'Alla samples. These samples are almost pure naked wheat deposits, indicating that they are the charred remains of fully processed wheat supplies ready for consumption. The maximum diameters of the Ramad emmer wheat and naked wheat grains do not suggest that most of it is tail grain. On the contrary, the Ramad grains may give a fair picture of the product of the farmers of this site.

The Ramad emmer wheat is, on average, shorter than that from Korucutepe, Erbaba and Hacilar (table 51). As for the free-threshing wheat, the Ramad grains are rather small, on average, but samples from other sites yielded grains of about the same length or are even smaller. It must be left undecided whether the size differences are due to different strains of wheat, to differences in soil conditions or to differences in climate (particularly precipitation). The Ramad wheat samples may give an average picture, perhaps covering various years, whereas the samples from grain supplies represent the crop of one particular year, maybe even of one field.

In conclusion, it seems justified to assume that the Ramad crop plant seeds and fruits–and the same applies to Ghoraifé and Aswad–are not the waste fraction, the cleanings from fine sieving, but that they are representative of the crop of the Neolithic farmers in the Damascus basin.

7.4. Wild food plants

In addition to cultivated plants, various wild plant species may have played a part in the diet of Neolithic man in the Damascus area. Only wild plants of which the seeds were consumed by prehistoric man have a fair chance of being represented in the occupational deposits. Unfortunately, for most of the potential wild food plants it is not possible to demonstrate whether or not they were consumed by the inhabitants of the site concerned.

7.4.1. *Wild fruit trees and shrubs*

In contrast to the other wild plants represented in the sites under discussion, for wild fruit trees and shrubs it is almost certain that their fruits were collected for human consumption. Let us first have a look at the wild fruits at Ramad. *Pistacia* and *Amygdalus* must have been of considerable economic importance because of their highly nutritive fruits. It is likely that both wild fruits could be collected in the vicinity of Ramad. As has been discussed in section 2.1.3., an open forest-steppe vegetation with *Crataegus aronia, Pyrus syriaca, Amygdalus korschinskii, Rhamnus palaestinus* and *Pistacia atlantica* is assumed to be the climax vegetation in the Ramad area under the present-day climatic conditions. Thus, if the climate of 8000 years ago did not differ too much from that of to-day, wild almond and pistachio were present in the area.

It has been mentioned (5.2.) that the pistachio nutshells recovered at Ramad could be of *Pistacia atlantica* as well as of *P. palaestina*. The fruits of both species are edible and are at present still sold in the markets (Zohary & Feinbrun-Dothan, vol. 2, p. 298). *Pistacia palaestina*, which is one of the most important constituents of the *Quercus calliprinos-Pistacia palaestina* maquis association of the Levant, could only have been found in the vicinity of Neolithic Ramad if the climate had been considerably more humid. Consequently, it is assumed here that the pistachios collected by the inhabitants of Ramad were of *P. atlantica*. As for the almonds, one could at most wonder whether in addition to *Amygdalus korschinskii* and *A. webbii*, wild *A. communis* occurred in the area, although according to M. Zohary (1973, p. 373) this is the most mesic wild almond species. As this species is widely cultivated and grows subspontaneously in maquis, as an escape from cultivation, its indigeneity in various areas is questionable.

Wild almond and pistachio must have been a valuable source of vegetable fats. Almonds contain up to over 50% of fats. No figure of the oil content of the fruit flesh of *Pistacia atlantica* or *palaestina* could be found.

Hawthorn fruits could also be collected in the surroundings of the site. *Crataegus aronia* formed part of the forest steppe of the Ramad area. Formerly this hawthorn species was generally indicated as *C. azarolus*, but at present a separate species, *C. aronia*, is distinguished (5.24.). According to Davis (vol. 4, pp. 139–140), *C. azarolus* is an European species, whereas the closely related *C. aronia* is typically Near Eastern. The fact that the hawthorn fruit stones at Ramad are hemispherical as well as three-faced would also point to *C. aronia*. The fruits of the latter species contain 2 to 3 stones (pyrenes) and those of *C. azarolus* usually 2 (according to Zohary & Feinbrun-Dothan, vol. 2, pp. 19–20). The yellow fruits of *C. aronia* are edible and are still sold in the markets. Wild pear, *Pyrus syriaca*, of which only a few pip fragments were recovered, must also have been a constituent of the forest steppe.

Wild fig, probably wild *Ficus carica* L., must likewise have been an appreciated fruit. For many thousands of years fig has been cultivated, which has resulted in a large number of different forms. Except for the size and the succulence of the fruits, cultivated figs generally do not differ morphologically from wild forms. Therefore true wild figs cannot be distinguished from those escaped from cultivation. At present fig grows in a wide range of environmental conditions: in damp forest along river banks, in open sunny and dry localities and in rock crevices (Davis, vol. 7, p. 644). This indicates that in the Damascus area wild fig could have occurred on the dry uplands as well as in stream valleys.

It is not possible to evaluate the absolute economic importance of wild fruit collecting. On the other hand, one could attempt to determine whether possible differences in the importance of fruit collecting relative to plant cultivation existed between sites and/or between archaeological phases of one site. To that end the proportions of crop plants and wild fruits have been calculated per site and per archaeological period (table 52). The percentages are based upon the total numbers of seeds and fruits of cultivated plants and wild fruit trees and shrubs. As in one fig fruit a very great number of pips are found, 25 pips have arbitrarily been counted as one fig. Thus, the fig pips in the samples of one archaeological phase have been added up and subsequently divided by 25. The numbers of *Amygdalus* shown in table 52 are somewhat higher than one would obtain in adding up the numbers presented in tables 5–7. In *Amygdalus* the weights of the shell fragments

Table 52. Numbers and mean percentages of wild fruit types. For discussion, see 7.4.1.
N = total number of seeds or fruits per archaeological phase. % = mean percentage.

	Aswad East		Aswad East		Aswad West		Ghoraifé		Ghoraifé		Ramad C8		Ramad M4		Ramad C8		Ramad M4		Ramad C8NW	
Phase	I		II		II		I		II		I		I		II		II		III	
Number of samples	9		8		13		12		13		6		7		22		5		7	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Σ Cultivated plants	381	83.0	2491½	99.7	8873	99.5	60	95.2	445½	100	342	95.4	764	98.1	14473	97.5	4854	98.6	844½	94.9
Pistacia	64	13.9	5½	0.2	20	0.2	2	3.2	+	+	6½	1.8	3½	0.4	232½	1.6	36	0.7	38	4.3
Amygdalus	+	+	–	–	–	–	+	+	–	–	+	+	2½	0.3	11	0.07	3	0.06	3½	0.4
Crataegus	–	–	1	0.04	+	+	1	1.6	–	–	5	1.4	8	1.0	115	0.8	27½	0.6	3½	0.4
Ficus	8	1.7	+	+	4½	0.05	–	–	+	+	5	1.4	½	0.05	5	0.03	1½	0.03	½	0.05
Capparis	6	1.3	–	–	19	0.2	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Rubus	–	–	–	–	1	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Vitis	–	–	–	–	4	0.05	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Pyrus	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	+	–	–	–	–
Σ Wild fruits	78	17.0	6½	0.3	48½	0.5	3	4.8	+	+	16½	4.6	14½	1.9	363½	2.5	68	1.4	–	–
Sum	459		2498		8921½		63		445½		358½		778½		14836½		4922		890	

in each of the samples have first been added up and then the number of almond shells was determined (on the basis of 0.9 gram per almond). The weights which in the individual samples resulted in a plus-sign contributed to the total weight.

Compared to the crop plants, wild fruit percentages are quite low at Ramad. In the phase I levels the total wild fruit proportions are somewhat higher than in the phase II levels. However, this may not mean anything, particularly because the differences between C8 and M4 are greater. A decline of pistachio yields as a result of the cutting of these trees for fuel seems to have been out of the question.

The Aswad wild fruit record differs from that of Ramad in that almond and hawthorn are hardly represented. This should be no surprise as these arboreal species do not form part of the steppe vegetation which is supposed to be the present-day natural vegetation of the Aswad area. However, *Pistacia* (*atlantica*) is equally no constituent of the steppe vegetation, but nevertheless the proportion of pistachio is conspicuously high in phase I levels at Aswad. During phase I time was *Pistacia* quite common in the Aswad area, or was this fruit so highly valued that it was collected in great quantities at quite some distance from the site? *Pistacia* could only have grown in the Aswad area if the early Holocene climate was different from that of to-day, that is to say, if precipitation was markedly higher (2.1.4.). For the time being the question of where pistachio fruits could have been collected by the inhabitants of Aswad must remain unanswered.

As at Ramad, wild fig was collected by the Aswad people. *Rubus* (blackberry) and *Vitis* (grape), which are both scarcely represented at Aswad, could have been found in the thickets along streams. The presence of *Capparis* seeds at Aswad could point to the collecting of the fruits of this species. Two species come into consideration, *viz. Capparis spinosa* L. and the closely related *C. ovata* Desf. *Capparis* is a thorny shrub, with pear-shaped fleshy fruits which are red when ripe. The flower buds of *Capparis spinosa* are collected and consumed as pickles. The species is even cultivated for that purpose. The fruits are not particularly tasty, but they are eaten by children and others who pass by. In ancient times the fruits may have been collected more intensively and brought home. *Capparis* grows well in disturbed habitats.

Both at Aswad West and Aswad East, the proportions of wild fruits in phase II levels are very low, this in contrast to that in phase I (only at Aswad East). This difference is largely accounted for by *Pistacia*. This could indicate that after phase I time *Pistacia* disappeared from the area as a result of a change in climate. It is also possible that an intensification of crop plant growing reduced the necessity of large-scale collecting of the nutritive pistachio fruits.

The hypothesis that the drastic decline in pistachio percentages at Aswad could have been due to the disappearance of this tree from the area is invalidated by the comparatively high pistachio percentage in Ghoraifé I, largely contemporaneous with Aswad II. Admittedly the numbers of seeds and fruits in phase I at Ghoraifé are very low (see also table 9) which should call for some caution in drawing conclusions. The proportion of fruits in phase II levels at Ghoraifé is negligible.

7.4.2. *Other potential wild food plants*

One may safely assume that some of the wild plant species demonstrated for the sites under discussion were exploited for food, for medicinal purposes, as kitchen herbs, and so on. It is, however, very difficult to prove the use of wild herbaceous plants for particular purposes. Only circumstantial evidence can provide indications in this respect, *e.g.* an accumulation of the seeds of a potential wild food plant in a storage pit or in (the remains of) a vessel. Only the use of the seeds of wild plants for human consumption, as a condiment or as a spice can under favourable circumstances be demonstrated or at least be made likely. For plants of which the vegetative parts, such as leaves, roots and bulbs, were consumed, the chances of finding indications of their actual exploitation by ancient man are very small, except in areas with an extremely dry climate, such as Egypt, where plants are preserved in a desiccated condition.

Even for wild plants the seeds of which could have been consumed there is no convincing evidence that they were used as such by the inhabitants of Aswad, Ghoraifé and Ramad. Various potential wild food plant seeds occur in appreciable numbers in more than one sample, but this is still no proof of their intentional harvesting. Although *Carex* and *Scirpus* fruits, which are rich in starch, are not reported as being used for human consumption, one should consider the possibility that these fruits played a part in the diet of the inhabitants of Aswad. The discussion of the possible role of wild food plants will remain confined here to grasses and legumes. Both groups of plants are rather well represented in the sites under discussion and particularly Helbaek (1969) has stressed the potential importance of the seeds of wild grasses and legumes in the diet of ancient man.

Just as for the crop plant species (7.1.1., table 50), for the wild grass and leguminous seed types the mean percentages per site and per archaeological phase have been determined. However, in this case no percentages but the numbers of seeds in each of the samples were added up, whereupon the percentages were calculated upon of sum of all grass or leguminous seeds in the group of samples concerned (table 53). Because of the anomalously large number of *Astragalus* seeds in M4 2.80 this sample has been left out here. The dominant percentages are underlined. From table 50 it is clear that among the leguminous seed types, those of *Trigonella astroites* are most common at Aswad, whereas at Ghoraifé and Ramad the dominant legumes are *Melilotus* and *Astragalus*, respectively. Irrespective of the possible economic importance of the wild legumes, it seems reasonable to conclude that there were apparently considerable differences in the frequencies of the various Leguminosae taxa in the vicinity of the sites concerned. It is unlikely that the conspicuous differences in the dominant seed type are wholly due to differences in preference for particular species by the inhabitants of the sites. As has already been mentioned (7.2.2.) most of the leguminous taxa shown in table 53 could have formed part of the natural (semi-)steppe vegetation as well as of the field weed flora. If the small leguminous seeds were from plants of the natural vegetation, one could speculate that they were deliberately brought to the site and the same could be true for field weeds. It cannot be excluded that field weed remains arrived in the site as an admixture to the harvested crop and that the leguminous seeds constitute crop cleaning residues. However, if cereals were reaped by cutting or breaking off the ears or by uprooting and pulses by picking the pods or pulling up the whole plants, not many field weed seeds would have ended up in the crop. It is tempting to assume that at least some of the charred leguminous seeds are the remains of food waste, but again there is no convincing evidence for the intentional harvesting of these seeds. If wild leguminous species were already gathered by the inhabitants of the sites we do not know for what purpose.

Among the wild grass caryopses, those of *Lolium* spec. are dominant in all sites (the high proportion of unidentified grasses in phase I at Aswad East is due to poor preservation). *Phalaris* is fairly common in phase II levels at Aswad, whereas *Lolium temulentum* could only be established for Ramad, where it must have been a common grain field weed. One may well doubt whether *Lolium* fruits were attractive as human food. The dehusking must have been a tedious and strenuous task. On the other hand, the freeing of wild leguminous seeds from the hard-walled pods must equally have required much pounding. As with the leguminous seeds, it must again be remarked that wild grass fruits could have been collected for human consumption, but that the presence of sometimes quite considerable numbers of these fruits can also be explained in other ways.

Admittedly the discussion of wild grasses and legumes as possible food plants of the inhabitants of Aswad, Ghoraifé and Ramad is disappointing in that the seeds themselves and/or the seed frequencies do not give any clues in this respect. As wild legumes and gramineous plants are nevertheless a valuable potential source of food, the frequencies of these seed types have been compared with those of the crop plants. For each of the samples the proportions of crop plants, wild Gramineae and wild Leguminosae relative to the sum of the seeds and fruits of these categories were determined. The results are presented in the triangular diagrams of figs. 35–38. If the total number of seeds of these classes of plants was less than 20, the proportions were not determined and the sample was rejected. The purpose of this operation was to establish whether there are differences in the range of these proportions (the distribution of circles and triangles in the

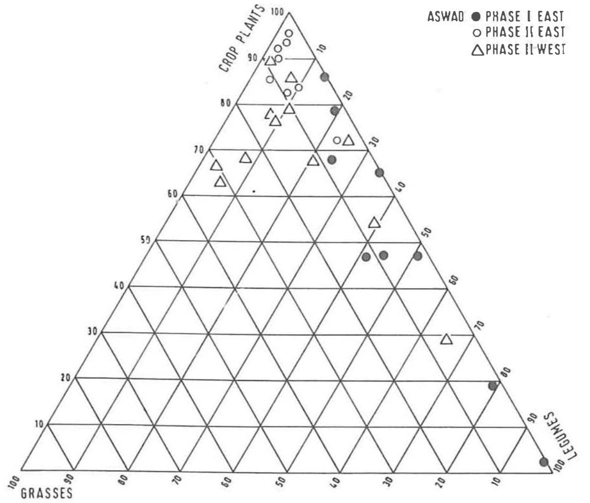

Fig. 35. Triangular diagram showing the relative proportions of crop plants, wild grasses and wild legumes for samples from Aswad.

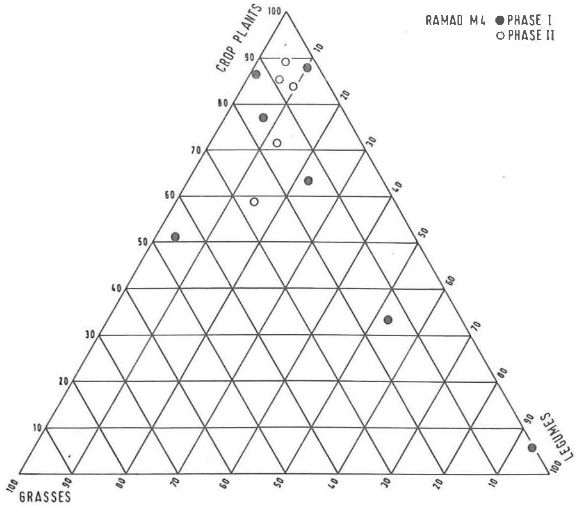

Fig. 37. Triangular diagram showing the relative proportions of crop plants, wild grasses and wild legumes for samples from Ramad M4.

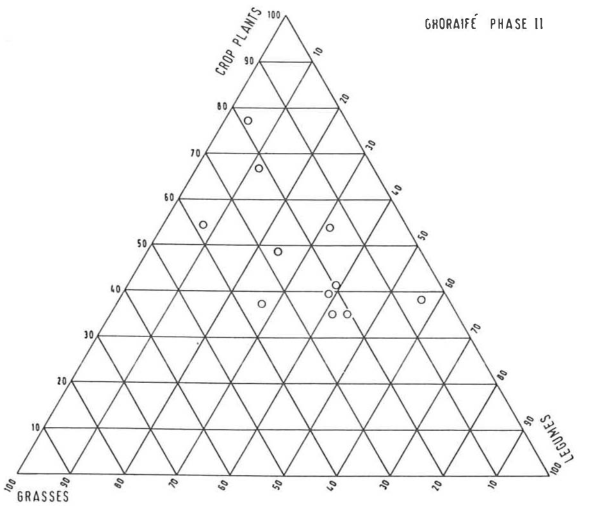

Fig. 36. Triangular diagram showing the relative proportions of crop plants, wild grasses and wild legumes for samples from Ghoraifé.

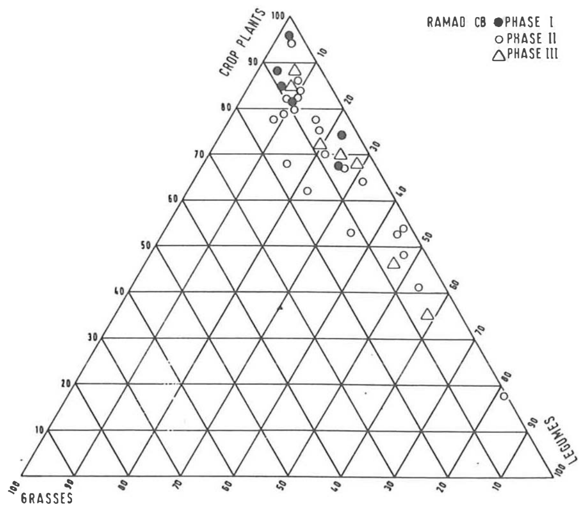

Fig. 38. Triangular diagram showing the relative proportions of crop plants, wild grasses and wild legumes for samples from Ramad C8.

diagrams) between sites and between phases and/or squares in one site. There was also a faint hope that some more insight could be gained into the actual use of wild grasses and legumes as food plants.

Although, as could be expected, the proportions between crop plants, grasses and legumes display a rather wide scatter, some distinct patterns can be observed. Most consistent are the proportions in the Ramad C8 samples, that is to say, the circles cluster nicely in one section of the diagram (fig. 38). Grass seed proportions are always below 20% and mostly below 10%. The proportions of crop plants are up to over 90% and rarely below 50%. Wild legumes are well represented, with values of over 20%, in about 2/5 of the samples. In the phase I samples, crop plant proportions are certainly not lower than in the phase II samples, so that at least these

Table 53. Numbers and mean percentages of wild leguminous and gramineous seed types. For discussion, see 7.4.2.
N = total number of seeds or fruits per archaeological phase. % = mean percentage.

	Aswad East		Aswad East		Aswad West		Ghoraifé		Ramad C8		Ramad M4*		Ramad C8		Ramad M4		Ramad C8NW**	
Phase	I		II		II		II		I		I		II		II		III	
Number of samples	9		8		13		13		6		6		22		5		7	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Astragalus	41	4.6	12	6.1	75	6.2	4	1.1	45	54.9	54	68.4	2782	66.6	290	58.7	111	33.9
Coronilla	–	–	–	–	–	–	–	–	–	–	–	–	10	0.2	–	–	5	1.5
Lathyrus cf. cicera	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	0.2	–	–
Medicago radiata	29	3.3	18	9.2	66½	5.5	–	–	4	4.9	1	1.3	185	4.4	12	2.4	8	2.4
Medicago spec.	–	–	1	0.5	1	0.1	5	1.4	6	7.3	–	–	89	2.1	17	3.4	40½	12.4
Melilotus	3	0.3	34	17.3	23	1.9	291	80.7	7	8.5	11	13.9	189	4.5	4	0.8	16	4.9
Onobrychis	1	0.1	–	–	–	–	–	–	–	–	–	–	16	0.4	2	0.4	4	1.2
Trifolium	–	–	–	–	–	–	5	1.4	–	–	–	–	–	–	–	–	–	–
Trigonella astroites	757	85.3	107	54.6	879	72.9	–	–	4	4.9	1	1.3	602	14.4	68	13.8	82	25.0
Vicia (incl. V.ervilia)	50½	5.7	21	10.7	150½	12.5	29½	8.2	13	15.9	12	15.2	262	6.3	83	16.8	41	12.5
Unidentified	6	0.7	3	1.5	11	0.9	26	7.2	3	3.7	–	–	41	1.0	17	3.4	20	6.1
Σ Leguminosae	887½		196		1206		360½		82		79		4176		494		327½	
Aegilops	–	–	–	–	–	–	–	–	–	–	–	–	6	0.3	1	0.2	+	+
Avena	–	–	1	0.6	9	0.3	1	0.5	3½	12.3	–	–	68½	4.0	22	3.5	4	3.7
Bromus spec.	1½	4.4	22¾	14.4	83½	3.2	1½	0.8	–	–	1	0.5	38½	2.2	4½	0.7	1	0.9
Bromus sterilis	2	5.9	–	–	–	–	–	–	–	–	–	–	2½	0.1	–	–	–	–
Echinaria	–	–	–	–	24	0.9	11	5.6	1	3.5	1	0.5	101	5.8	90	14.3	12	11.2
Eremopyron	1½	4.4	2½	1.6	8½	0.3	–	–	–	–	–	–	18	1.0	22	3.5	6	5.6
Hordeum spec.	–	–	1	0.6	30	1.2	–	–	–	–	–	–	5	0.3	1	0.2	–	–
Lolium spec.	1	2.9	78½	49.6	1763½	67.8	167	85.2	20	70.2	141	71.9	964½	55.8	41	6.5	33	30.8
Lolium temulentum	–	–	–	–	–	–	–	–	1	3.5	42	21.4	324	18.8	183	29.0	16	15.0
Phalaris	5	14.7	40	25.3	595	22.9	7	3.6	–	–	2	1.0	15	0.9	3	0.5	5	4.7
Stipa	–	–	–	–	–	–	–	–	–	–	–	–	2	0.1	½	0.1	4	3.7
Type A	–	–	–	–	14	0.5	–	–	1	3.5	5	2.6	93	5.4	101½	16.1	2	1.9
Unidentified	23	67.6	12½	7.9	73½	2.8	8½	4.3	2	7.0	4	2.0	90	5.2	161	25.5	24	22.4
Σ Gramineae	34		158¼		2601		196		28½		196		1728		630½		107	

* M4 2.80 not included
** Numbers corrected for sample at 2.15 m (see 7.5.)

proportions do not point to an increasing importance of plant cultivation in the course of time. Curiously the proportions in the Ramad M4 samples (fig. 37) scatter much more widely than those in the C8 samples, which demonstrates again that the data obtained from the investigation of one area (sounding) of a site are not necessarily representative for the whole of the site.

The Aswad phase I samples (triangular symbols) give a picture which differs from that of the phase II samples (open and black circles) (fig. 35). The grass seed proportions are nearly always below 10% and those of the wild legumes over 20% in most of the phase I samples. Crop plant proportions are comparatively low. In contrast, the majority of the phase II samples have crop plant proportions of over 70%. The phase II samples of both soundings (Aswad West and East) show no identical distribution, but nearly all of them are plotted in the upper part of the triangular diagram, above the 60% crop plant frequency line. The Aswad data could suggest that in phase I, crop plant cultivation was of less economic importance than in phase II and that the collecting of wild leguminous seeds played an important part. In this connection it may be remembered that the proportion of wild pistachio fruits is conspicuously high in phase I levels at Aswad (7.4.1.).

Because of the low numbers of seeds and fruits no proportions could be determined for the Ghoraifé phase I samples. The phase II samples give a picture which is almost complementary to the Ramad C8 distribution pattern (fig. 36). Compared to the Ramad samples, wild grass proportions are high at Ghoraifé and those of crop plants generally low. In the majority of the samples crop plants score less than 50%. Could this imply that at Ghoraifé the collecting of wild legumes as well as of wild grasses was of considerable economic importance? Has plant cultivation always been somewhat marginal at Ghoraifé? Anyhow, the distribution patterns in the triangular diagrams suggest that the plant husbandry of the latter site differed quite markedly from that at Ramad and Aswad.

7.5. Ramad phase III

So far the Ramad phase III samples have not yet been included in the discussion. In contrast to the aceramic phase I and II levels, phase III is pottery Neolithic, dated to the end of the 6th millennium B.C. (2.4). Thus, there is a hiatus of 700 to 800 years between the end of the phase II habitation and the phase III occupation of Ramad. Phase III levels have been uncovered only in square C8, where pits in the phase II deposits have been dug by the phase III occupants. It has already been mentioned that the fill of these pits consists, at least in part, of reworked phase II material. A radiocarbon determination of charcoal from phase III gave a phase II date (GrN-4823: 5930±55 B.C., table 1). This does not necessarily imply that all plant remains in phase III levels are of phase II origin. In this connection it may be pointed out that the animal bones in phase III levels differ from those in phase II levels in that domestic animals are represented (2.4.). At least some of the charred seeds and fruits in the phase III deposits may date from the pottery Neolithic habitation.

It will be clear that the examination of samples containing vegetable remains of different periods can be of only limited value. It is possible that in phase III levels crop plants and/or wild plants occur not represented in the aceramic levels. Conspicuous differences in the proportions of crop plants and/or wild plant taxa between phase III and II levels could point to differences in plant exploitation and/or to differences in environment. Instead of speculating what kind of information could be extracted from the mixed seed record, we will take the practical line and examine whether the phase III samples give occasion to particular conclusions or comments.

It is most obvious to compare the seed and fruit proportions in the phase III samples (C8NW) with those of phase II at C8SE. The mean crop plant percentages for phase III differ from those of phase II in that in phase III pulse crops are better represented: 15.1 against 7.6% (table 50). This could possibly indicate that the phase III occupants laid more emphasis on the cultivation of pea and lentil. There are no indications that the phase III occupants grew plants not cultivated by the aceramic Neolithic inhabitants of Ramad. On the other hand, it is possible that some of the crop plants of the phase II farmers were not grown by the pottery Neolithic people. There is even no absolute proof that any plants were cultivated.

It is striking that the mean *Pistacia* value in phase III is higher than in any of the other Ramad levels (C8 as well as M4). Could this indicate that the phase III occupants utilized much larger quantities of pistachio nuts than the aceramic inhabitants (table 52)?

With respect to the wild grass and leguminous mean percentages (table 53) the following should be remarked. As of C8NW 2.15 only 1/4 of the sample had been examined, the numbers of wild grass and leguminous seeds in this sample were multiplied by four before the sums on which the percentages are based were determined (7.4.2.). Among the wild legumes, *Astragalus* is predominant, but the mean percentage is lower than that for the C8 phase II samples. On the other hand, *Trigonella astroites*-type and *Medicago* spec. score higher in the phase III levels. Mean wild grass percentages show also some differences between both phases. Thus, the phase III samples show higher *Phalaris* and *Echinaria* values than those of phase II. The wild legume and grass proportions seem to support the hypothesis that the seeds and fruits in the phase III levels are not exclusively of secondary origin, but that the pottery Neolithic habitation also contributed to the seed content.

The distribution of the proportions between crop plants, wild legumes and grasses in the phase III samples falls within the scatter of the phase II proportions (triangular diagram of fig. 38). In this respect there is no clear distinction between the phase III samples and those of phase II.

A weak point in the above discussion is the fact that the mean values for the phase III samples have been compared with those for the whole of phase II, whereas it might have been better to compare them with the mean values for phase II samples from only the upper 2.50 m, from where the redeposited material originated. However, relatively few phase II samples from between 1.00 and 2.50 m and none from above 1.00 m (3.2.1.) are available.

In conclusion, due to the mixed origin of the samples very little can be said about the plant husbandry of the phase III occupants. The utmost reserve should be maintained in drawing inferences from the comparison between phase III and II samples.

7.6. Other uses of wild plants

As has been stated above, it is difficult to evaluate the role of potential wild vegetable food resources other than wild fruit trees on the basis of the charred seed record. The same applies to most other forms of exploitation of the wild flora. Only the use of wood as fuel can satisfactorily be attested by the charcoal remains. No systematic determinations of charcoal have been carried out, but for Ramad the following wood types could be established: *Prunus*-type, *Pyrus*/ *Malus*/ *Crataegus*, other Rosaceae, *Quercus, Fraxinus, Celtis*/ *Ulmus* and a type which could be of *Pistacia*. *Amygdalus* is included in the *Prunus*-type. *Fraxinus* and *Ulmus* could have occurred in the river bank forest (2.1.3). *Celtis* is less likely because no fruit remains of this species were found. Somewhat puzzling is the oak charcoal (*Quercus*). Oak is no constituent of the almond-pistachio forest-steppe and at present the nearest oaks occur at quite some distance from Ramad, on the east-facing flanks of the Anti-Lebanon. Oak could only have grown in the surroundings of Neolithic Ramad if precipitation was considerably higher than nowadays.

It is likely that chaff was burned, but it cannot be determined to what extent annual species and ligneous perennials, such as *Astragalus* and *Artemisia*, were used for heating.

One may assume that reeds and rushes were utilized. At Aswad, lumps of baked clay with impressions of reed stems, apparently fragments of the walls of huts, have been found (see 2.2). No impressions of mats or charred mat remains are reported.

The healing properties of various plants must certainly have been known, but indications for the actual collecting of medicinal wild plants are non-existent. The single fruit of *Verbena officinalis*, a well-known medicinal plant recovered from Ramad, can hardly be adduced as evidence of its being collected for the preparation of folk medicine. There is little sense in enumerating more possible uses of wild plants, if for each case the conclusion must be that the archaeobotanical record is inconclusive in this respect. Admittedly, this is somewhat disappointing, but one should be well aware of the limitations of this field of research.

8. SUMMARY

In the present study the results of the palaeobotanical examination of the Neolithic sites of Aswad, Ghoraifé and Ramad, in the Damascus basin (fig. 1), are presented. In each of the sites two aceramic phases are distinguished. The time span covered by the pre-pottery Neolithic habitation is radiocarbon dated from c. 7800 B.C. (basal levels of Aswad I) to c. 5950 B.C. (phase II at Ramad). The chronological correlation between the sites is shown in fig. 6. Aswad and Ghoraifé, with mean annual precipitation of less than 200 mm, are situated in the steppe zone. The natural vegetation of the Ramad area, with 250 mm precipitation annually, is an almond-pistachio forest-steppe.

Samples for palaeobotanical research were taken mainly from exposed sections; only at Ramad part of the samples are from surfaces exposed during the 1965 excavation campaign. Charred plant remains were recovered in the field by means of manual water flotation. The results of the analyses are shown in tables 5–10.

Crop plant remains were found in all levels examined (figs. 11, 14–16, 18–20). In addition to the grains of *Triticum dicoccum* and *T. monococcum*, large quantities of spikelet forks and glume bases of hulled wheat were recovered. On the basis of the morphology and size frequency distribution no einkorn wheat spikelet remains could be distinguished. The identity of the free-threshing wheat, *T. durum* or *T. aestivum*, could not be determined. Brittle- as well as tough-rachised two-rowed hulled barley is represented (*Hordeum spontaneum* and *H. distichum*). Pedicellate lateral florets occur also in *H. distichum*. There is a discrepancy between the proportions of wild barley-type rachis internodes and wild barley-type grains (table 18). The naked barley is ascribed to the six-rowed species *H. vulgare* var. *coeleste*.

The Ramad linseeds are attributed to *Linum usitatissimum*. The identity of the *Linum* seeds from Aswad and Ghoraifé, which are smaller, is not certain (wild or cultivated). The lentil seeds at Ramad certainly belong to the domesticated type. Those at Aswad are, on average, smaller which could imply an early stage of lentil cultivation. Peas are, with some reserve, attributed to *Pisum sativum*. Bitter vetch (*Vicia ervilia*) is hardly represented suggesting that this species was not cultivated.

In section 5 the seeds and fruits of the wild plant species found in the sites under discussion are described. The descriptions are supplemented by drawings (figs. 21-26, 28, 30).

There are marked differences in average numbers of seeds and fruits per volume of soil between the sites and between phases within one site (table 49). Seed frequencies at Ghoraifé are lower than at Ramad and Aswad. In all three sites, phase I samples yielded, on average, considerably lower numbers of seeds than phase II samples. These differences in seed deposition are difficult to explain. Moreover, at Aswad phase II samples from two soundings differ conspicuously in mean seed frequencies.

The earliest Neolithic inhabitants of the Damascus basin (Aswad, phase I) grew *Triticum dicoccum* and probably *Hordeum distichum*, *Pisum* and *Lens*. In phase II at Aswad, *Triticum monococcum*, *T. aestivum/durum*, *Hordeum vulgare* var. *coeleste* and probably *Linum (usitatissimum)* were added to the crop plant assortment. *Cicer* (chick-pea) appeared later in the charred seed record and remained of minor importance. Emmer wheat was probably the most common cereal. The proportion of free-threshing wheat increased in later periods (phase II at Ghoraifé and Ramad). In all three sites, phase I levels have markedly higher pulse crop proportions than phase II levels (table 50).

The Aswad farmers may have laid out their fields in the marshy zone of Lake Aateibé, thus compensating for the low precipitation. A fairly great number of wild plants attested for Aswad, Ghoraifé and Ramad could have occurred as field weeds while at the same time forming part of the natural vegetation. Typical field weeds, such as *Vaccaria pyramidata*, *Cephalaria syriaca* and *Aegilops* cf. *crassa*, are scarcely represented. Ramad seems to have had a richer field weed flora than Aswad and Ghoraifé. Although most of the samples are from refuse deposits, it is likely that the cereal grains are mainly not tail grain of the waste fraction but prime grain.

Of the wild fruit trees, *Pistacia* (*atlantica*) and *Ficus* (*carica*) are represented in all three sites. *Amygdalus* and *Crataegus* (*aronia*) remains were hardly found at Ghoraifé and

Aswad, but are fairly common at Ramad. *Capparis* is confined to Aswad. Wild fruit percentages are very low in phase II levels at Aswad and Ghoraifé (table 52).

Mean wild grass and leguminous seed percentages have been determined per sounding and per archaeological phase (table 53). Among the wild legumes, *Astragalus* is most common at Ramad, whereas at Ghoraifé phase II and Aswad the dominant leguminous seed types are *Melilotus* and *Trigonella astroites*-type, respectively. Among the wild grasses, *Lolium* spec. is usually the dominant type.

The proportions between crop plants, wild legumes and wild grasses in each of the samples are plotted in the triangular diagrams of figs. 35–38. There are marked differences in the distribution patterns of the proportions between sites and sometimes also between phases and/or soundings at one site. The possible role of the seeds and fruits of wild grasses and wild legumes in the diet of the aceramic Neolithic inhabitants of the sites cannot be determined.

The seed content of the Ramad phase III levels (pottery Neolithic) is at least in part redeposited phase II material. This fact makes it very difficult to draw conclusions on the plant husbandry of the phase III occupants. There is no evidence of crop plants that had not been grown already by phase II farmers.

9. REFERENCES

BOTTEMA, S., 1975–77. A pollen diagram from the Syrian Anti Lebanon. *Paléorient* 3, pp. 259–268.

BOTTEMA, S., 1984. The composition of modern charred seed assemblages. In: W. van Zeist & W.A. Casparie (eds.), *Plants and ancient man*. Rotterdam, pp. 207–212.

BOTTEMA, S. & Y. BARKOUDAH, 1979. Modern pollen precipitation in Syria and Lebanon and its relation to vegetation. *Pollen et Spores* 21, pp. 427–480.

BRAIDWOOD, R.J., 1975. *Prehistoric men*, 8th ed. Glenview, Ill.

BROUWER, W. & A. STÄHLIN, 1955. *Handbuch der Samenkunde*. Frankfurt a.M.

CAUVIN, M.-C., 1974. Outillage et chronologie à Tell Aswad (Damascène, Syrie). *Paléorient* 2, pp. 429–436.

CAUVIN, M.-C., 1979. Etude comparative d'après l'outillage lithique. *Paléorient* 5, pp. 157–160.

CONTENSON, H. DE, 1971. Tell Ramad, a village of Syria of the 7th and 6th millennia B.C. *Archaeology* 24, pp. 278–285.

CONTENSON, H. DE, 1972. Tell Aswad. Fouilles de 1971. *Annales Archéologiques Arabes Syriennes* 22, pp. 75–84.

CONTENSON, H. DE, 1973. Chronologie absolue de Tell Aswad (Dasmascène, Syrie). *Bulletin de la Société Préhistorique Française* 70, pp. 253–256.

CONTENSON, H. DE, 1974. Huitième campagne de fouilles à Tell Ramad en 1973. Rapport préliminaire. *Annales Archéologiques Arabes Syriennes* 24, pp. 17–24.

CONTENSON, H. DE, 1975a. Les fouilles à Ghoraifé en 1974. *Annales Archéologiques de Syrie* 25, pp. 17–32.

CONTENSON, H. DE, 1975b. Ghoraifé et la chronologie du Néolithique damascénien. *Annales Archéologiques de Syrie* 25, pp. 183–184.

CONTENSON, H. DE, 1976a. Nouvelles données sur le Néolithique précéramique dans la région de Damas (Syrie) d'après les fouilles à Ghoraifé en 1974. *Bulletin de la Société Préhistorique Française* 73, pp. 80–82.

CONTENSON, H. DE, 1976b. Précisions sur la stratigraphie de Tell Aswad (Syrie), *Bulletin de la Société Préhistorique Française* 73, pp. 198–199.

CONTENSON, H. DE, 1978. Recherches sur le Néolithique de Syrie (1967–1976). *Comptes rendues de l'Académie des Inscriptions et Belles-Lettres* 1978, pp. 820–825.

CONTENSON, H. DE, 1979. Tell Aswad (Damascène). *Paléorient* 5, pp. 153–156.

CONTENSON, H. DE & W.J. VAN LIERE, 1964. Sondages à Tell Ramad en 1963. Rapport préliminaire. *Annales Archéologiques de Syrie* 14, pp. 109–124.

CONTENSON, H. DE & W.J. VAN LIERE, 1966. Seconde campagne à Tell Ramad, 1965. Rapport préliminaire. *Annales Archéologiques Arabes Syriennes*, 16, pp. 167–172.

DAVIS, P.H. (ed.), 1965-. *Flora of Turkey and the East Aegean Islands*. Vol. 1, 1965; vol. 2, 1967; vol. 3, 1970; vol. 4, 1972; vol. 5, 1975; vol. 6, 1978; vol. 7, 1982. Edinburgh.

FRENCH, D.H., G.C. HILLMAN, S. PAYNE & R.J. PAYNE, 1972. Excavations at Can Hasan III 1969–1970. In: E.S. Higgs (ed.), *Papers in economic prehistory*. Cambridge, pp. 181–190.

HELBAEK, H., 1952. Early crops in southern England. *Proceedings of the Prehistoric Society* 18, pp. 194–233.

HELBAEK, H., 1958. Plant economy in ancient Lachish. In: O Tufnell, *Lachish IV (Tell ed-Duweir). The Bronze Age*. London-New York-Toronto, pp. 309–317.

HELBAEK, H., 1959a. Domestication of food plants in the Old World. *Science* 130, pp. 365–372.

HELBAEK, H., 1959b. Notes on the evolution and history of *Linum*. *Kuml* 1959, pp. 103–129.

HELBAEK, H., 1961. Late Bronze Age and Byzantine crops at Beycesultan in Anatolia. *Anatolian Studies* 11, pp. 77–97.

HELBAEK, H., 1964. First impressions of the Çatal Hüyük plant husbandry. *Anatolian Studies* 14, pp. 121–124.

HELBAEK, H., 1966. Pre-pottery Neolithic farming at Beidha. *Palestine Exploration Quarterly* 98, pp. 61–66.

HELBAEK, H., 1969. Plant collecting, dry-farming and irrigation agriculture in prehistoric Deh Luran. In: F. Hole, K.V. Flannery & J.A. Neely (eds.), *Prehistory and human ecology of the Deh Luran Plain* (= Memoirs of the Museum of Anthropology, University of Michigan, 1). Ann Anbor, pp. 382-426.

HELBAEK, H., 1970. The plant husbandry of Hacilar. In: J. Mellaart (ed.), *Excavations at Hacilar*. Edinburgh, pp. 189-244.

HELBAEK, H., 1972. Samarran irrigation agriculture at Choga Mami in Iraq. *Iraq* 34, pp. 35-48.

HILLMAN, G.C., 1978. On the origins of domestic rye-*Secale cereale*: the finds from aceramic Can Hasan III in Turkey. *Anatolian Studies* 28, pp. 157-174.

HILLMAN, G.C., 1981. Reconstructing crop husbandry practices from charred remains of crops. In: R. Mercer (ed.), *Farming practice in British prehistory*. Edinburgh, pp. 123-162.

HILLMAN, G.C., 1984. Interpretation of archaeological plant remains: the application of ethnographic models from Turkey. In: W. van Zeist & W.A. Casparie (eds.), *Plants and ancient man*. Rotterdam, pp. 1-41.

HOPF, M., 1969. Plant remains and early farming in Jericho. In: P.J. Ucko & G.W. Dimbleby (eds.), *The domestication and exploitation of plants and animals*. London, pp. 355-359.

HOPF, M., 1978. Plant remains, Strata V-I. In: R. Amiran, Early Arad I. The chalcolithic settlement and Early Bronze city. *Israel Exploration Journal* 28, pp. 64-77.

JARRIGE, J.-F. & R.H. MEADOW, 1980. The antecedents of civilization in the Indus Valley. *Scientific American* 243, No. 2, pp. 102-110.

KAISER, K., E.K. KEMPF, Arl. LEROI-GOURHAN & H. SCHÜTT, 1973. Quartärstratigraphische Untersuchungen aus dem Damaskus-Becken und seiner Umgebung. *Zeitschrift für Geomorphologie* N.F. 17, pp. 263-353.

KEELEY, H.M.C., 1978. The cost-effectiveness of certain methods of recovering macroscopic organic remains from archaeological deposits. *Journal of Archaeological Science* 5, pp. 179-183.

KISLEV, M.E., 1979/80. *Triticum parvicoccum* sp. nov., the oldest naked wheat. *Israel Journal of Botany* 28, pp. 95-107.

KISLEV, M.E., 1980. Contenu d'un silo à blé de l'époque du fer ancien. In: J. Briend & J.-B. Humbert. *Tell Keisan (1971-1976), une cité phénicienne en Galilée*. Fribourg-Göttingen-Paris, pp. 361-379.

KISLEV, M.E., 1981. The history of evolution of naked wheats. *Zeitschrift für Archäologie* 15, pp. 57 64.

KNÖRZER, K.-H., 1967. Subfossile Pflanzenreste von bandkeramischen Fundstellen im Rheinland. *Archaeo-Physika* 2, pp. 3-29.

KNÖRZER, K.-H., 1971. Pflanzliche Grossreste aus der rössenerzeitlichen Siedlung bei Langweiler, Kreis Jülich. *Bonner Jahrbücher* 171, pp. 9-33.

LIERE, W.J. VAN, 1960-61. Observations on the Quaternary of Syria. *Berichten van de Rijksdienst voor het Oudheidkundig Bodemonderzoek* 10-11, pp. 7-69.

MILLER, N.F., 1982. *Economy and environment of Malyan, a third millennium B.C. urban center in southern Iran*. Ph.D. dissertation (Anthrop.), The University of Michigan, Ann Arbor, Univ. Microfilms, Ann Arbor.

MOUTERDE, P., 1966-. *Nouvelle Flore du Liban et de la Syrie*. Vol. 1, 1966; vol. 2, 1970; vol. 3, 1978- Beyrouth.

PORTER, J.L., 1855. *Five years in Damascus. Including an account ... with travels and researches in Palmyra, Lebanon and the Hauran*. 2 vols. London.

POST, G.E. & J.E. DINSMORE, 1932. *Flora of Syria, Palestine and Sinai*. 2 vols. Beirut.

SCHIEMANN, E., 1948. *Weizen, Roggen, Gerste. Systematik, Geschichte und Verwendung*. Jena.

VILLARET-VON ROCHOW, M., 1967. Frucht- und Samenreste aus der neolithischen Station Seeberg, Burgäschisee-Süd. In: H.-G. Bandi & H. Müller-Beck (eds.), *Seeberg, Burgäschisee-Süd*. IV. *Chronologie und Umwelt* (=Acta Bernensia 2), Bern, pp. 21-64.

VOGEL, J.C. & H.T. WATERBOLK, 1967. Groningen Radiocarbon Dates VII. *Radiocarbon* 9, pp. 107-155.

WIRTH, E. 1971. *Syrien, Eine geographische Landeskunde*. Darmstadt.

ZEIST, W. VAN, 1970. The Oriental Institute excavations at Mureybit, Syria: Preliminary report on the 1965 Campaign. Part III: The palaeobotany. *Journal of Near Eastern Studies* 29, pp. 167-176.

ZEIST, W. VAN, 1972. Palaeobotanical results of the 1970 season at Çayönü, Turkey. *Helinium* 12, pp. 3-19.

ZEIST, W. VAN, 1974. Palaeobotanical studies of settlement sites in the coastal area of the Netherlands. *Palaeohistoria* 16, pp. 223-383.

ZEIST, W. VAN, 1976. On macroscopic traces of food plants in southwestern Asia (with some reference to pollen data). *Philosophical Transactions of the Royal Society London* B 275, pp. 27-41.

ZEIST, W. VAN & J.A.H. BAKKER-HEERES, 1975a. Evidence for linseed cultivation before 6000 b.c. *Journal of Archaeological Science* 2, pp. 215-219.

ZEIST, W. VAN & S. BOTTEMA, 1982. Vegetational history of the Eastern Mediterranean and the Near East during the last 20,000 years. In: J.L. Bintliff & W. van Zeist (eds.), *Palaeoclimates, palaeoenvironments and human communities in the Eastern Mediterranean region in later prehistory* (= B.A.R. International Series 133). Oxford, pp. 277-323.

ZEIST, W. VAN & H. BUITENHUIS, 1983. A palaeobotanical study of Neolithic Erbaba, Turkey. *Anatolica* 10, pp. 47-89.

ZEIST, W. VAN & W.A. CASPARIE, 1968. Wild einkorn wheat and barley from Tell Mureybit in northern Syria. *Acta Botanica Neerlandica* 17, pp. 44-53.

ZEIST, W. VAN & J.A.H. HEERES, 1973. Palaeobotanical Studies of Deir 'Alla, Jordan. *Paléorient* 1, pp 21-37.

ZOHARY, D., 1969. The progenitors of wheat and barley in relation to domestication and agricultural dispersal in the Old World. In: P.J. Ucko & G.W. Dimbleby (eds.), *The domestication and exploitation of plants and animals*. London, pp. 47-66.

ZOHARY, D., 1971. Origin of south-west Asiatic cereals: wheats, barley, oats and rye. In: P.H. Davis (ed.), *Plant life of south-west Asia*. Edinburgh, pp. 235–263.
ZOHARY, D., 1973. The origin of cultivated cereals and pulses in the Near East. *Chromosomes Today* 4, pp. 307–320.
ZOHARY, D. & M. HOPF, 1973. Domestication of pulses in the Old World. *Science* 182, pp. 887–894.
ZOHARY, M. 1973. *Geobotanical foundations of the Middle East*. 2 vols. Stuttgart-Amsterdam.
ZOHARY, M. & N. FEINBRUN-DOTHAN, 1966- . *Flora Palaestina*. Vol. 1, 1966; vol. 2, 1972; vol. 3, 1978 Jerusalem.

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