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# Flotation Samples From the 1992 Excavation at Tell Jouweif

Naomi F. Miller
*University of Pennsylvania*, nmiller0@upenn.edu



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# Flotation Samples From the 1992 Excavation at Tell Jouweif

**Abstract**
Six flotation samples from the cut face of the tell were extracted and examined for this report. The goal of this exploratory analysis is to determine whether there are any observable differences between the Tell Jouweif (SS 8) assemblage and those of nearby Early Bronze Age Tell es-Sweyhat or the other roughly contemporary sites farther downstream (Selenkahiye [T 507, EBA] and Tell Hadidi [T 548, MBA]). A fair amount of previous archaeobotanical research provides the basis for comparisons (Miller 1997b; Hide 1990; van Zeist and Bakker-Heeres 1985).

**Disciplines**
Near Eastern Languages and Societies

Sample *5* 3.9–4.0 below top of section. Gray ashy deposit adjacent to and against mudbrick wall and overlying possible floor. Situated above a series of horizontal layers, mainly of mineral material, apparently forming a series of built-up surfaces. Charred material, although common in section, seems less abundant than in Samples *1–4*.

Sample *6* 2.2–2.4 m below top of section. Gray ashy stratum, ca. 50 cm thick, accumulated against a mudbrick wall that runs behind the section. Charred material, including brushwood, is common in section below an upper phase of mudbrick walls and ovens.

Of these, Sample *1* was an isolated sample from later Early Bronze Age or early Middle Bronze Age deposits near the west end of the section, whereas Samples *2–6* were closely associated with Early Bronze/Middle Bronze and earlier Middle Bronze Age levels within the site center. Of these, Samples *2–5* were from sub-horizontal ashy deposits, apparently associated with or immediately predating the Middle Bronze Age mudbrick walls indicated in figure 8.1. Sample *6* was taken from directly against a mudbrick wall, not illustrated in figure 8.1c.

## 8.B. FLOTATION SAMPLES FROM THE 1992 EXCAVATION AT TELL JOUWEIF

*Naomi F. Miller*

Six flotation samples from the cut face of the tell were extracted and examined for this report (table 8.1).[78] The goal of this exploratory analysis is to determine whether there are any observable differences between the Tell Jouweif (SS 8) assemblage and those of nearby Early Bronze Age Tell es-Sweyhat or the other roughly contemporary sites farther downstream (Selenkahiye [T 507, EBA] and Tell Hadidi [T 548, MBA]). A fair amount of previous archaeobotanical research provides the basis for comparisons (Miller 1997b; Hide 1990; van Zeist and Bakker-Heeres 1985).

### 8.B.1. LABORATORY PROCEDURES

Each flotation sample consists of the material that was extracted from one *zanbil* of earth averaging 8.6 kg in weight. Most of the samples were too large to sort completely and so were split in a cardboard rifflebox. The nonsorted portions of the samples have been kept.

### 8.B.2. THE PLANT REMAINS

With few exceptions, the taxa recovered are known from the other sites along the middle Euphrates Valley. The bulk of the remains, in terms of absolute quantity and frequency of occurrence, both wild and cultivated, come from two families: grasses and legumes; this is also true of Middle Bronze Age samples from Tell Hadidi (T 548). For details about morphology, habitat, and possible economic uses, see van Zeist and Bakker-Heeres 1985, 1984, 1982; Hide 1990; identifications are based on illustrations in these works, other reports and seed atlases, and seeds in the comparative collection housed at MASCA.

78. Revised version of MASCA Ethnobotanical Laboratory Report 12 (Miller 1993). Naomi F. Miller is a Senior Research Scientist at the Museum Applied Science Center for Archaeology (MASCA), The University of Pennsylvania Museum, Philadelphia, Pennsylvania.

Table 8.1. Overview of Flotation Samples from Tell Jouweif (SS 8)

| *Sample Number* | *1* | *2* | *3* | *4* | *5* | *6* |
|---|---|---|---|---|---|---|
| Soil volume (fraction of *zanbil*) | 0.23 | 1.00 | 0.22 | 0.40 | 1.00 | 0.13 |
| Volume analyzed (cc) | 125 | 75 | 100 | 50 | 100 | 100 |
| Charcoal (g, >2 mm) | 1.35 | 7.54 | 5.40 | 7.79 | 4.91 | 7.69 |
| Seed (g, >2 mm) | 0.69 | 0.16 | 2.13 | 0.37 | 0.57 | 0.27 |
| Other (g, >2 mm) | 0.21 | 0.03 | 0.63 | 0.06 | 0.23 | 0.06 |
| Dung (g, >2 mm) | 3.82 | 0.00 | 3.58 | 0.00 | 1.57 | 3.21 |
| Wild/weedy seed (no.) | 296 | 7 | 166 | 70 | 93 | 34 |
| Charred plant material (>2 mm, g/*zanbil*) | 9.78 | 7.73 | 37.09 | 20.55 | 5.71 | 61.69 |
| Seed/charcoal (g/g) | 0.51 | 0.02 | 0.39 | 0.05 | 0.12 | 0.04 |
| Seed/other (g/g) | 3.29 | 5.33 | 3.38 | 6.17 | 2.48 | 4.50 |
| Other/charcoal (g/g) | 0.16 | 0.00 | 0.12 | 0.01 | 0.05 | 0.01 |
| Weed seed/charcoal (no./g) | 219 | 1 | 31 | 9 | 19 | 4 |

Table 8.2. Charred Remains

| *Sample Number* | *1* | *2* | *3* | *4* | *5* | *6* | *Ubiquity* |
|---|---|---|---|---|---|---|---|
| CULTIGENS | | | | | | | |
| *Hordeum* (g)[1] | 0.12 | 0.10 | 1.45 | 0.14 | 0.16 | 0.20 | 1.00 |
| *Triticum* (g) | — | — | + | — | — | — | 0.17 |
| Cereal, indeterminate (g)[2] | 0.07 | 0.04 | 0.80 | 0.03 | 0.06 | — | 0.83 |
| *Lens* | — | — | 1 | — | 1 | 1 | 0.50 |
| *Lathyrus* | — | — | 2 | — | — | — | 0.17 |
| Fabaceae, large seeds (estimate) | — | 1 | 2 | 1 | — | — | 0.50 |
| WILD AND WEEDY | | | | | | | |
| Cf. *Anthriscus* | 1 | — | — | — | — | — | 0.17 |
| *Bupleurum* | — | — | — | — | 1 | — | 0.17 |
| *Centaurea* | — | — | — | — | — | 1 | 0.17 |
| Asteraceae indet. | — | — | 1 | — | — | — | 0.17 |
| *Heliotropium* | 1 | — | — | — | — | — | 0.17 |
| *Arnebia* | 2 | — | — | — | — | — | 0.17 |
| *Aellenia* (perianth) | 14 | — | — | — | — | — | 0.17 |
| *Atriplex*[3] | 19 | — | — | — | 1 | — | 0.33 |
| Chenopodiaceae | — | — | — | — | — | 1 | 0.17 |
| Cyperaceae | 12 | — | — | — | — | — | 0.17 |
| *Alhagi* | 17 | — | — | 2 | 60 | 4 | 0.67 |
| *Astragalus* | 1 | — | — | 2 | 1 | — | 0.50 |
| Cf. *Onobrychis* | 3 | — | — | — | 1 | 1 | 0.50 |
| *Prosopis* (estimate)[4] | 20 | — | 5 | 4 | 1 | 1 | 0.83 |
| *Trifolium*/*Melilotus*-type | — | 1 | 4 | 8 | 2 | 2 | 0.83 |
| *Trigonella* | 11 | — | 4 | — | — | 2 | 0.50 |
| Fabaceae, miscellaneous | 32 | — | 3 | 18 | — | 1 | 0.50 |
| Cf. *Teucrium* | 1 | — | — | — | — | — | 0.17 |
| Cf. *Glaucium* | — | 1 | 2 | — | — | — | 0.33 |
| *Plantago* | — | — | — | 1 | — | — | 0.17 |
| *Aegilops* | 3 | 1 | 31 | 2 | — | — | 0.67 |
| *Bromus* | — | — | — | 1 | — | — | 0.17 |
| Cf. *Eremopyrum* | 18 | 2 | 69 | 4 | 1 | — | 0.83 |
| *Hordeum* | 1 | — | — | — | — | — | 0.17 |
| *Phalaris* | 1 | — | — | 8 | 2 | — | 0.50 |
| *Secale* | 1 | — | — | — | — | — | 0.17 |
| Cf. *Setaria* | — | — | — | 1 | — | — | 0.17 |
| Poaceae, miscellaneous | 46 | 1 | 15 | 15 | 12 | 5 | 1.00 |
| Polygonaceae/Cyperaceae | 19 | — | — | — | — | — | 0.17 |
| *Androsace* | 2 | — | 1 | — | 1 | — | 0.50 |
| *Adonis* | — | 1 | 3 | — | — | — | 0.33 |
| *Ceratocephalus* | — | — | 18 | — | — | — | 0.17 |

Table 8.2. Charred Remains (*cont.*)

| *Sample Number* | *1* | *2* | *3* | *4* | *5* | *6* | *Ubiquity* |
|---|---|---|---|---|---|---|---|
| WILD AND WEEDY (*cont.*) | | | | | | | |
| *Ceratocephalus* | — | — | 18 | — | — | — | 0.17 |
| Cf. *Ranunculus* | 1 | — | — | — | — | — | 0.17 |
| *Rubus* | 4 | — | — | — | — | — | 0.17 |
| *Sanguisorba minor*-type[5] | 1 | — | 2 | 3 | — | — | 0.50 |
| *Galium* | 1 | — | — | — | — | — | 0.17 |
| Cf. *Thymelaea* | 3 | — | — | — | — | — | 0.17 |
| *Valerianella coronata*-type | 2 | — | — | — | — | 2 | 0.33 |
| Unknown, miscellaneous | 59 | — | 8 | 1 | 10 | 14 | n/a |

MISCELLANEOUS CHARRED PLANT PARTS

| *Sample Number* | *1* | *2* | *3* | *4* | *5* | *6* | *Ubiquity* |
|---|---|---|---|---|---|---|---|
| *Aegilops,* glume base | 14 | 4 | 22 | 3 | 3 | — | 0.83 |
| *Hordeum,* internode | 187 | 2 | 49 | 6 | 7 | 23 | 1.00 |
| *Hordeum*, dense-eared internode | 45 | 2 | 21 | — | — | — | 0.50 |
| *Triticum monococcum/ dicoccum,* spikelet fork | 1 | — | — | — | — | 1 | 0.33 |
| Straw nodes | 93 | — | 113 | 9 | 8 | 21 | 0.83 |
| Cf. *Alhagi*, pod segment | 1 | — | — | — | — | — | 0.17 |
| Fabaceae, pod fragments (g) | — | — | — | — | 0.15 | — | 0.17 |
| *Arnebia decumbens*-type, uncharred | — | 1 | 1 | 4 | — | — | 0.50 |
| Thorns, miscellaneous | (several) | — | — | — | 4 | — | 0.33 |
| Leaves (cf. *Alhagi*) | — | — | — | — | 78 | — | 0.17 |

Notes

[1] *Hordeum* count may be estimated using the average weight at Tell Jouweif (SS 8) of 0.007 g/caryopsis.

[2] Cereal count may be estimated using an average weight of 0.007 g/caryopsis, assuming indeterminate cereal to be mostly *Hordeum.*

[3] Sample *5* had a single *Atriplex* only; Sample *1* had closed perianths of both *Atriplex* and *Aellenia* that would contain one seed each.

[4] *Prosopis* count estimates based on 0.019 g/seed (average from Tell Jouweif samples).

[5] *Sanguisorba minor*-type (= *Poterium lasiocarpum*) is equivalent to SLK 67–S157 illustrated in van Zeist and Bakker-Heeres 1985, fig. 4.8.

## CULTIGENS

Cereals, primarily barley (*Hordeum vulgare*), predominate in the samples (table 8.2). Unfortunately, most of the material is fragmented or greatly distorted by puffing; some of the seeds look (literally) chewed. Although a few grains look twisted, the barley at Tell Jouweif (SS 8) appears to be the two-row type (*H. vulgare* var. *distichum*), as at the other Bronze Age sites in the upper Lake Assad area.

In addition to the barley grains, two types of barley internodes were observed. The "dense-eared" type has very little space between glume bases. A single internode could be from the six-row type (*H. vulgare* var. *hexastichum*).

One grain that resembles bread/hard wheat (*Triticum aestivum*/*durum*) was also observed. As is the case at the other sites, wheat would seem to have been a minor crop at best.

A small number of pulses was encountered — three lentils (*Lens*) and two grass peas (*Lathyrus*). Both of these types are known from other sites in the area, where they occur in similar low proportions.

## WILD AND WEEDY PLANTS

Plants of fields, other disturbed ground, steppe, and moist areas are represented in the wild and weedy plant assemblage (table 8.3). Few types are restricted to one or another habitat. For example, *Alhagi* and *Prosopis* are native steppe plants, but they are also persistent weeds in cultivated fields because it is difficult to destroy their deep taproots.

Most of the wild plants are grasses or forbs (herbaceous broad-leaved plants), though a few shrubs are represented. Table 8.3 provides summary information about the plant types. Some of the plants warrant separate discussion here; for more detailed information on individual taxa, read the reports of van Zeist cited above.

*Aellenia*

A plant part enclosing a seed or achene has been identified as *Aellenia* (Chenopodiaceae) based on its "hard bony perianth, 5-pitted at base" (Zohary 1966: 167). The specimens are consistent with *A. autrani*. Many members of the genus are steppe and desert plants; *A. autrani* also grows in cultivated ground.

*Atriplex*

*Atriplex* has many representatives in the Middle East. Members of this Chenopodiaceae genus occur in steppe and cultivated ground, and many are salt tolerant as well (Davis 1967: 305 ff.). *Atriplex* seeds are reported from the much earlier sites of Mureybit (T 502–504) and Tell Aswad (van Zeist and Bakker-Heeres 1984, 1982). At Tell Jouweif (SS 8), in addition to a single seed in Sample 5, nineteen fruiting perianth segments were seen that most closely resemble *A. turcomanica* collected near Malyan, Iran. McCorriston (1995) reports a related type, *A. leucoclada* from sites in the Khabur Valley. As there is one seed per flower, I have added the *Atriplex* fruits to the seed counts.

*Alhagi*

*Alhagi* (camelthorn) is a spiny perennial. It has not yet been reported from the middle Euphrates sites, but there is no reason to doubt its presence. In addition to the seed, a pod fragment and leaves that probably belong to the genus were observed.

*Secale*

One fairly large grass caryopsis that resembles rye was encountered. Although not reported from the Bronze Age sites, Hillman did find some wild rye at Abu Hureyra (T 545; Hillman, Colledge, and Harris 1989).

*Ceratocephalus*

Seeds of this small member of the Ranunculaceae are identified. I have also seen it at Umm al-Marra (Miller 1996 as Umm-10) and at Tell es-Sweyhat (Miller 1997b).

*Sanguisorba minor*

Three samples yielded seeds that look like those seeds depicted in van Zeist's articles: from Selenkahiye (T 507; SLK 67-S157, illustrated in fig. 4.8) or Mureybit (T 502–504; Mb'73, G9, illustrated in fig. 5.14). Joy McCorriston (pers. comm.) suggests the type to be *Sanguisorba minor*/*Poterium lasiocarpum*, which seems likely. The type is a good grazing plant (Townsend and Guest 1966: 141).

Table 8.3. Summary Descriptions of Wild and Weedy Taxa from Tell Jouweif (SS 8)

| *Taxon* | *Life Form** | *Common Name; Habitat (if restricted)* |
|---|---|---|
| Apiaceae | — | Carrot family |
| Cf. *Anthriscus* | h | — |
| *Bupleurum* | h | — |
| Asteraceae | — | Daisy family; typically plants of open ground |
| *Centaurea* | h | — |
| Asteraceae indet. | — | — |
| Boraginaceae | — | Borage family |
| *Arnebia* | h | (Only charred specimens included in totals) |
| *Heliotropium* | h | — |
| Chenopodiaceae | — | Goosefoot family |
| *Aellenia* | h, w | — |
| *Atriplex* | h, w | — |
| Cyperaceae | h | Sedges; usually associated with moist areas (stream sides, irrigation ditches, high water table) |
| Fabaceae | — | Legume, pea family |
| *Alhagi* | w | Camelthorn; deep taproot, common in degraded steppe and fields |
| *Astragalus* | h, w | — |
| Cf. *Onobrychis* | h | — |
| *Prosopis* | w | Deep taproot, common in degraded steppe and fields |
| *Trifolium/Melilotus* | h | Clover; fields and fairly moist areas |
| *Trigonella* | h | — |
| Fabaceae miscellaneous | — | — |
| Lamiaceae | — | Mint family |
| Cf. *Teucrium* | h | Sub-shrub |
| Papaveraceae | | Poppy family |
| Cf. *Glaucium* | h | — |
| Plantaginaceae | — | — |
| *Plantago* | h | Plantain; typically associated with agricultural disturbance or moist area |
| Poaceae | h | Grass family; typically plants of open ground |
| *Aegilops* | h | Goat-face grass |
| *Bromus* | h | Brome grass |
| Cf. *Eremopyrum* | h | — |
| *Hordeum* | h | Wild barley |
| *Phalaris* | h | — |
| *Secale* | h | Wild rye |
| Cf. *Setaria* | h | — |
| Poaceae miscellaneous | h | — |
| Polygonaceae/Cyperaceae | — | Buckwheat family/Sedge family |
| Primulaceae | — | Primrose family |
| *Androsace* | h | — |
| Ranunculaceae | — | Buttercup family |
| *Adonis* | h | — |
| Cf. *Ceratocephalus* | h | Open places |
| Cf. *Ranunculus* | — | Buttercup |
| Rosaceae | — | Rose family |
| *Rubus* | w | Bramble; would grow along the river |
| Rubiaceae | — | — |
| *Galium* | h | Cleavers |
| Thymeleaceae | — | — |
| Cf. *Thymelaea* | h | — |
| Valerianaceae | — | — |
| *Valerianella* | h | — |

* Life form: h = herbaceous, w = woody

### WOOD CHARCOAL

For this preliminary study, five pieces of charcoal from each of the flotation samples were examined (table 8.4). In identifying wood charcoal, it is generally a good idea to consider only those pieces that have at least one growth ring, so as not to underestimate the types that are difficult to identify from tiny fragments. There are a few shrubs (e.g., sagebrush [*Artemisia*]) that do not have distinct growth rings, which renders the rigid application of this rule problematic, and many of the pieces selected for identification did not have complete growth rings. Identification also requires adequate reference and comparative material, which was not readily available. Thus, despite the fact that many of the pieces are relatively large (caught in 4.75 mm mesh), I could not identify most of the pieces I picked out.

Among the identified pieces were taxa that are known from the other sites in the area: poplar or willow (*Populus* or *Salix*), tamarisk(?) (cf. *Tamarix*), elm family (Ulmaceae), oak (*Quercus*), and at least one shrub taxon, the goosefoot family (Chenopodiaceae). The first three would have grown in riparian forest. Oak might have drifted downstream (van Zeist and Bakker-Heeres 1985), or scattered oaks may have grown nearby. The member of the Chenopodiaceae would have grown out on the steppe.

Table 8.4. Charcoal from Tell Jouweif (SS 8)

| *Sample Number* | *1* | *2* | *3* | *4* | *5* | *6* |
|---|---|---|---|---|---|---|
| COUNT | | | | | | |
| *Populus/Salix* | — | 2 | — | (1) | 1 | 2 |
| Cf. *Tamarix* | — | — | — | 3 | — | 2 |
| Ulmaceae | — | 2 | 1 | — | — | — |
| *Quercus* | — | — | — | — | 2 | — |
| Chenopodiaceae | 2 | — | — | — | — | — |
| Unknown | 3 | 1 | 4 | 2 | 2 | 1 |
| WEIGHT EXAMINED (G) | | | | | | |
| *Populus/Salix* | — | 0.19 | — | (noted) | 0.05 | 0.13 |
| Cf. *Tamarix* | — | — | — | 0.68 | — | 0.36 |
| Ulmaceae | — | 0.24 | 0.20 | — | — | — |
| *Quercus* | — | — | — | — | 0.43 | — |
| Chenopodiaceae | 0.35 | — | — | — | — | — |
| Unknown | 0.20 | 0.08 | 0.32 | 0.62 | 0.39 | 0.10 |
| Amount analyzed | 0.55 | 0.51 | 0.52 | 1.30 | 0.87 | 0.59 |
| Total weight of sample | 1.35 | 7.54 | 5.40 | 7.79 | 4.91 | 7.69 |

## 8.B.3. THE SIGNIFICANCE OF INDIVIDUAL TAXA FOR ENVIRONMENTAL OR ECONOMIC RECONSTRUCTION

Quantifying archaeobotanical data in a meaningful way is not easy, especially when few samples are available. Even if a seed type is numerous, it may occur in only one or two samples. At Tell Jouweif (SS 8) more than half of the genera appear in only one sample. For example, a single *Bupleurum* seed occurs in Sample *5* and none other. Only one type, domesticated barley, occurs in all six samples. Absolute quantities of seeds are therefore best interpreted in conjunction with a ubiquity analysis of the assemblage as a whole. For example, the nineteen *Atriplex* fruits in Sample *1* could come from a single branch tossed into a fire, whereas the *Eremopyrum* is found in five out of six samples, occurring in some quantity in two of them. At least for the deposits analyzed to date, one might conclude that *Eremopyrum* was the more significant or useful plant.

At this preliminary stage in the research, it is advisable to interpret the data with some caution. A quick glance at the results from other sites shows that Tell Jouweif (SS 8) fits well within the normal range of taxa.

## 8.B.4. THE SAMPLES

Because the flotation samples were taken from deposits cut by the river, it is more difficult to fit them into a functional cultural space than if they had been excavated from a horizontal exposure. Nevertheless, based on the descriptions furnished in *Section 8.A: Introduction*, Wilkinson suggests that the samples were associated with surfaces (probably external) that were accumulating debris as sub-horizontal layers adjacent to mudbrick buildings. The deposits were charcoal-rich but not necessarily burned in situ. The deposits may therefore represent a wide range of debris — fuel, crop-processing remains, other trash (cf. Miller 1984; Hillman 1984, 1981).

An analysis of the composition of the samples compared to that of other sites in the region can, however, narrow the range of possibilities. In contrast to Tell Jouweif (SS 8), the deposits from the northwest terrace and the lower town of Tell es-Sweyhat excavated in 1989 yielded very few cultigens, generally under 10% of the total, whether or not the problematic uncharred borages are included (Hide 1990). Neither are the Tell Jouweif samples comparable to those identified by van Zeist and Bakker-Heeres at Tell es-Sweyhat because the latter are virtually pure crop samples from a burnt building; even the samples with the highest proportions of cultigens at Tell Jouweif do not exhibit the crop purity of those samples. Though the Tell Hadidi (T 548) samples are somewhat more mixed than the Tell es-Sweyhat crop samples, they too seem to have primarily crop plant remains. On the other hand, sample composition of Tell es-Sweyhat trashy deposits excavated in 1991 and 1993 (Miller 1997b), from the Selenkahiye (T 507) "refuse deposits near the town wall" (van Zeist and Bakker-Heeres 1985: 272), and the "cultural fill" deposits (ibid., p. 276) bear a striking resemblance to those from Tell Jouweif: barley predominates, but substantial numbers of wild seeds and rachis fragments are present.

The question remains, of course, what is the nature of that settlement debris. As I have discussed elsewhere, barring convincing contextual evidence to the contrary, one's first assumption in characterizing charred debris is that it comes from fuel — charcoal, dung, or brush (Miller 1991, 1984). Charcoal from settlement debris is almost certainly fuel remains. Four of the Tell Jouweif (SS 8) samples also contain significant quantities of dung — a few are intact, readily recognizable carbonized sheep/goat pellets — and relatively high quantities of a substance that has the fibrous texture of dung (see table 8.5). Furthermore, a dung-like residue coats many of the charred remains. The ratio by weight of dung to charcoal is also rather high.

Seeds are most likely to come from intentional burning of dung or brush fuel, or from burnt crop-processing debris. It is not obvious in mixed samples how one might distinguish these sources. For now, I only deal with dung and brush. Much of the charcoal in Samples *1* and *5* consists of twiglet fragments, which might be from brush fuel. Brush fires would presumably be fueled by otherwise non-useful plants. In the Tell Jouweif (SS 8) samples, *Alhagi*, with its sharp-tipped branches, is the most obvious candidate. The other genera in the assemblage are for the most part suitable fodder plants. Aside from dung itself, the use of dung fuel may be inferred from the seeds of fodder plants.

If seeds originated in dung fuel, one might expect seeds and dung to co-occur. As Bottema (1984) demonstrates, however, sheep dung does not always contain many seeds. At Tell Jouweif (SS 8), even though a large amount of dung is in the samples, dung fragments and wild/weedy seeds are totally unassociated. Nevertheless, and without going into all the arguments here, I maintain that many seeds are likely to have originated in dung fuel (Miller 1996, 1984); variation between individual samples can mask regularities that characterize entire assemblages. If this reasoning is valid, seed to charcoal ratios could indicate relative proportions of dung and wood fuel in comparisons between sites.

In Miller 1997b, I provide some quantitative information that allows comparison between the Tell es-Sweyhat and the Tell Jouweif (SS 8) samples with respect to seeds and charcoal. The seed/charcoal ratio (by weight) of seventeen samples from Tell es-Sweyhat Operation 1 averages 0.70 (Miller 1997b). Seventeen other Tell es-Sweyhat debris samples analyzed by Christine Hide (1990) yield an average of 0.67 (1.52 if one includes an outlier). At Tell Jouweif, with only six samples, the comparable figure is 0.19, which is quite a bit lower. This lower sampling could support the hypothesis that wood fuel (presumably from riverine sources) was more available at Tell Jouweif than at Tell es-Sweyhat. The difference between the sites is probably real because a major determinant of fuel use is availability, and even 3 or 4 km would make a difference to the person carrying the fuel. (See also Miller 1990a: 82 for a discussion of firewood use in the city and the countryside.) Similarly, the weed seed count to charcoal weight is higher on average at Tell es-Sweyhat than at Tell Jouweif.

Note further that at Tell Jouweif (SS 8) the average ratio of wild seeds (count) to cereal (weight) is 447, at Tell es-Sweyhat it is more than twice that (Miller 1997b). If the seeds reflect animal fodder, a speculative but plausible explanation may be proposed: Tell es-Sweyhat, heavily dependent on pastoral production, sent animals out to graze in steppe pasture. Tell Jouweif is located more favorably for agriculture (Wilkinson, pers. comm.) and is geographically constrained by the Euphrates River on the west and the territory of Tell es-Sweyhat on the east. Its animals were therefore more likely to be fed straw and graze on field stubble, and the proportion of wild seeds relative to cereal is relatively low. This line of argument is more fully developed in Miller 1997a.

Unfortunately, it is next to impossible to eliminate all other factors, and crop-processing debris could be mixed in with fuel debris samples. That we are not dealing with pure crop-processing debris tossed onto a wood-fueled fire is, however, suggested by the fact that the samples contain a range of seed sizes (cf. Hillman 1984).

Table 8.5. Charred Dung from Tell Jouweif (SS 8)*

| *Sample Number* | *1* | *2* | *3* | *4* | *5* | *6* |
|---|---|---|---|---|---|---|
| Sheep/goat pellets (no.) | 10 | — | — | — | 1 | — |
| Sheep/goat pellets (g) | 0.87 | — | — | — | 0.06 | — |
| Sheep/goat pellet fragments (g) | 1.31 | — | — | — | — | — |
| Other dung(?) fragments (g) | 1.64 | — | 3.58 | — | 1.51 | 3.21 |
| Dung/charcoal (g/g) | 2.83 | — | 0.47 | — | 0.32 | 0.42 |

*Weight in grams of pieces larger than 2 mm.

### 8.B.5. SUMMARY OF MAIN RESULTS

The Tell Jouweif (SS 8) assemblage fits comfortably within the range of materials and deposits found at other Bronze Age sites in the region. The six samples can probably best be characterized as burnt settlement debris, primarily fuel remains. Located directly on the river, Tell Jouweif may have had broader access to wood fuel than Tell es-Sweyhat, though the taxa collected were the same. Arguing against this conclusion is the relatively large amount of dung relative to charcoal.

## 8.C. LONG-TERM TRENDS IN THE PLANT AND ANIMAL ECONOMY

*Tony J. Wilkinson*

It is now possible to place the results from Tell Jouweif (SS 8) within a broader framework. In order to obtain a long-term perspective on the changing agricultural environment, particular emphasis is placed upon Tell es-Sweyhat and nearby sites, or on those with a similar mean annual rainfall (table 8.6).

The closest evidence for the Early Holocene plant economy comes from Jerf al-Ahmar (T 559) and Halula, two small aceramic Neolithic sites dated to the Pre-pottery Neolithic A, and early Pre-pottery Neolithic B, respectively. Jerf al-Ahmar is ca. 12 km northwest of Tell es-Sweyhat and Halula is some 18 km northwest; both were within the area to be flooded behind the new Tishrin Dam. Carbonized plant remains from levels dated between 9,800 and 9,200 B.P. (uncalibrated radiocarbon years) indicate that wild cereals (einkorn wheat, rye, and barley) and pulses (lentils, pea, and bitter vetch) were exploited (Willcox 1996). In addition, grains of morphologically domestic emmer (*Triticum dicoccum*), naked wheat (*Triticum durum*), and two-row barley (*Hordeum distichum*) were found at Pre-pottery Neolithic B Halula. The two-row barley was also recorded from earlier Pre-pottery Neolithic B and Pre-pottery Neolithic A Djaʿde, located farther upstream. Interestingly, pulses such as lentil, pea, and bitter vetch were common at all three sites, and although it is not clear whether they were cultivated or gathered, they appear to have formed a significant part of the plant economy (Miller 2002). Similarly, wild vine and even parts of olive stones were noted at Halula and Djaʿde. These data supplement the information from Mureybit (T 502–504) and Abu Hureyra (T 545), both of which are located within the more arid areas to the south of Tell es-Sweyhat.

The presence of wild einkorn and wild rye suggests cooler, moister conditions (Willcox 1996: 150). This observation is supported by the analysis of charcoals that indicate ash, vine, elm, plane, and perhaps olive, all of which today are found significantly farther north. Furthermore, almond, *Pistacia* type *atlantica*, and deciduous oak at present only