SOME RECENT DISCOVERIES OF MILLET (*PANICUM MILIACEUM* L. AND *SETARIA ITALICA* (L.) P. BEAUV.) AT EXCAVATIONS IN TURKEY AND IRAN

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Although a relatively unimportant crop in the Near East, millet has an especially interesting history that may throw some light on the cultural relationships of the Middle–Late Bronze Ages and the Iron Age. Thus the prompt, separate, publication of a large deposit of foxtail millet (*Setaria italica* (L.) P. Beauv.), recently identified from an Iron Age level at Tille Höyük, seems justified[1]. This is the first find of the cereal in such large quantities—definitely as a crop—from the Near East or Greece. The rest of the plant remains from this level will be published in conjunction with the rich samples that are expected to be found in the massive Late Bronze Age burnt level at Tille. The opportunity is also taken in this paper to present other previously unpublished millet samples, from second millennium B.C. levels at Haftavan Tepe, northwestern Iran, and from Hellenistic, Roman and Medieval levels at Aşvan Kale, eastern Turkey.

Identification criteria

A full discussion of these criteria will be included in the first author's forthcoming publication of the Aşvan plant remains. Knörzer (1971) has published a useful key to millet seeds. Three genera of millets (all belonging to the tribe *Paniceae* of the grass family) have grains of the relatively wide, large embryoed type discussed here. In these three genera the grain is tightly enclosed by the lemma and palea. Fragments of these husks often adhere to the charred caryopses (all the material discussed below is charred), and their appearance is an important characteristic.

Only one species of *Panicum* is likely to be found in archaeological deposits in this region: broomcorn millet, *P. miliaceum* L. Its grains are highly distinctive in dorsal view, owing to their broadly pointed distal ("top") end and relatively blunt proximal ("bottom") end (Fig. 1, a). When charred, the embryo often falls out, leaving a large notch in the bottom edge of the grain. The embryo groove is strikingly short and wide, typically 40–60% of grain length (maximum usually under 70%), and as wide as long. The husk fragments are smooth and glossy, even when charred.

By contrast, the husks of *Setaria* species vary from finely rugose to punctuate, except for the longitudinal edges of the palea, which are smooth (cf. Baytop 1969). *Setaria* grains usually have a very wide furrow down their ventral face, presumably owing to the pressure of the palea, but this character is often not visible in charred material. Both ends of the grain of the cultivated *S. italica* are gently rounded. The embryo often remains in place and, if it does drop out, leaves only a small notch.

[1]Acknowledgements: For the material from Tille Höyük and Aşvan Kale we are grateful to the Directorate-General of Antiquities for permission to excavate at the sites; the directors of Adıyaman and Elazığ museums for their assistance; Dr. David French and the British Institute of Archaeology at Ankara for supporting this work; Caroline Jamfrey for drawing the map, and Anne-Dawn Sutton for drawing the grains. Geoffrey Summers would like to thank Mr. C. A. Burney for permission to publish the Haftavan material, Mrs. Ann Butler, Mr. Gordon Hillman, Dr. Michael Edwards, and Mr. R. N. L. B. Hubbard. Mark Nesbitt would like to thank Gordon Hillman for modern millet samples, and for allowing him to examine the millet from Gordion, and Stephen Mitchell for context information for Aşvan Kale.

The embryo groove is much longer and narrower than in broomcorn millet, almost always over 65% of grain length, usually averaging 70–80%. Using a combination of these characteristics, broomcorn and foxtail millet are usually quite easily distinguishable.

Three wild species of *Setaria* occur in eastern Turkey. The least common, *S. glauca* (L.) P. Beauv., has very distinctive transverse coarsely rugose lemmas and paleas, and is relatively large. *S. viridis* (L.) P. Beauv. and *S. verticillata* (L.) P. Beauv. are both relatively narrow, reflected in an L:W index of (100–)135–60, compared to an index of 100–25 in *Setaria italica.* The grains are often pointed at both ends. In lateral view the grains of these two millets are markedly thin, averaging thicknesses of 0·6–0·75(–0·95) mm., as compared to 0·7–1·1 mm. in *S. italica* . The embryo groove lengths are typically 70–75% of grain length, and the grooves are narrower than those of *S. italica* (widths 50–60% and 60–70% of groove length respectively).

Echinochloa crus-galli (L.) P. Beauv. is not known as a crop in western Asia, but is a common weed throughout the Near East and Europe. Its grains have smooth husks, and have a more truncated end than the wild *Setaria* species. The grains are small and very flat, with a typical T:W index of 40–65, compared to 60–90 for the other millets. The embryo groove is long, averaging 70–90%, and varies considerably in width.

Tille Höyük

The British Institute of Archaeology at Ankara has been excavating at Tille since 1979, in advance of the flooding of the site on completion of the Atatürk Dam. The site lies in the province of Adıyaman, in southeastern Turkey, where the road from Adıyaman to Diyarbakır crosses the Euphrates. No systematic programme for the recovery of botanical remains has been carried out, but in 1986 and 1987 about 10 samples were collected from an Iron Age burnt level. The major feature of this level is a well-constructed Residence, containing an internal courtyard paved with a geometric pebble mosaic. Both the plan and the mosaic have Neo-Assyrian parallels. Part of the defensive wall and a tower also survive. There is good historical evidence for the conquest of Kummuḫ by Sargon II of Assyria in 708 B.C., an event which must predate the building of this level. The destruction by fire might be associated with the activities surrounding the Babylonian capture of Kimuḫi (thought to be the same as Kummuḫ) in 607 B.C. (Hawkins 1980/83: 338–40; Summers, in press).

Three large samples of millet, totalling perhaps 15 litres, were collected from the same deposit in this burnt level: TH grid 7558 unit 499 sample type 22 batches 005, 006 and 007. This unit consisted of burnt and collapsed roof debris lying on the floor of a room. The grain and a number of broken pottery vessels were interspersed with the burnt remains of the roof and had obviously fallen with it. There is no evidence that the grain was in any form of container. The room forms part of a domestic complex of buildings inside the perimeter wall and was separated from the Residence by the street.

A five ml. subsample was taken from batch 006. This contained about 400 reasonably whole foxtail millet grains (and the fragments of perhaps 1000 more) as well as about 180 wild millet grains. Most of the foxtail millet grains have punctuate husk fragments adhering (Fig. 1, c), although only one intact husk was seen. It is likely that the grain was stored in the husk, which then somewhat disintegrated on charring. These grains are gently rounded, with small notches at the base of empty embryo grooves. The embryo grooves are on average 77% of the length of the grain (range 59–90%). The dimensions of the grains closely match

TABLE 1
Measurements of millet grains from Tille Höyük and Aşvan Kale.

	Period	n	Length	Width	Thickness	Embryo L%	L/W	T/W
Setaria italica								
Tille Höyük								
7758 499 22 006	Iron Age	50	1·2 (1·43) 1·63	1·2 (1·35) 1·5	0·8 (1·06) 1·3	59 (77) 91	93 (106) 120	63 (79) 105
Aşvan Kale								
I5 1806.4 s.6	Roman	20	1·4 (1·58) 1·8	1·2 (1·33) 1·6	0·8 (0·97) 1·3	68 (76) 91	102 (119) 138	63 (72) 89
Setaria viridis/ verticillata								
Tille Höyük								
7758 499 22 006	Iron Age	95	0·7 (1·16) 1·6	0·7 (0·97) 1·2	0·4 (0·63) 0·86	46 (77) 92	97 (120) 159	51 (65) 86
Aşvan Kale								
I5 1806.4 s.6	Roman	5	1·5 (1·64) 1·8	1·2 (1·21) 1·3	0·8 (0·81) 0·9	58 (68) 78	127 (136) 153	65 (67) 78
cf. *Setaria* sp.								
Tille Höyük								
7758 499 22 006	Iron Age	22	0·5 (0·82) 1·3	0·5 (0·69) 0·8	0·4 (0·48) 0·6	—	77 (119) 162	51 (71) 84
Panicum miliaceum								
Aşvan Kale								
H3c 602.24	Hell.	50	1·3 (1·75) 2·0	1·2 (1·52) 1·8	0·9 (1·24) 1·4	26 (47) 66	90 (115) 147	69 (81) 92
H3d 729.19	Hell.	18	1·5 (1·75) 2·1	1·3 (1·45) 1·6	1·1 (1·27) 1·4	36 (48) 60	109 (121) 139	84 (90) 95
H4cd 1507.23	Hell.	49	1·3 (1·74) 2·11	1·3 (1·56) 1·9	1·1 (1·30) 1·7	26 (48) 64	89 (112) 138	63 (84) 118
H4cd 1507.27 s.301	Hell.	50	1·6 (1·83) 2·1	1·4 (1·66) 2·1	1·1 (1·29) 1·5	33 (52) 66	91 (110) 129	60 (78) 89
I5 1806.4 s.6	Roman	3	1·3 (1·45) 1·6	1·1 (1·25) 1·3	0·9 (0·93) 1·0	46 (62) 70	105 (116) 124	66 (71) 76
H3d 714.8 s.191	Med. II	9	1·7 (1·81) 1·9	1·4 (1·55) 1·7	1·2 (1·33) 1·4	36 (48) 60	104 (117) 125	81 (86) 92

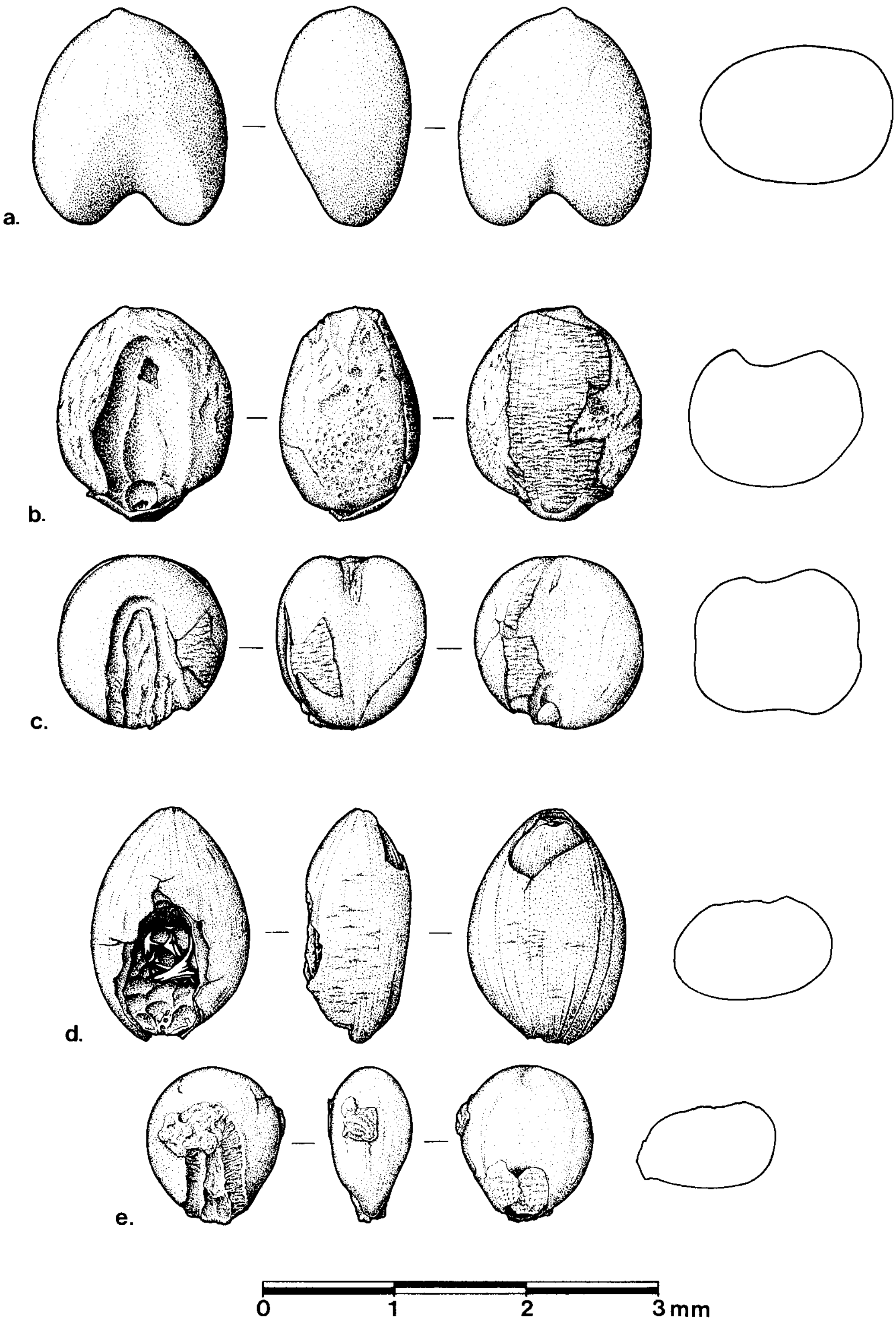

Fig. 1. Millet grains from Aşvan Kale and Tille Höyük. a: *Panicum miliaceum*, AK H3c 602.24; b: *Setaria italica*, AK I5 1806.4 s.6; c: *Setaria italica*, TH 7758 499 22 006; d: *Setaria viridis/verticillata*, AK I5 1806.4 s.6; e: *Setaria viridis/verticillata*, TH 7758 499 22 006.

those of other finds of foxtail millet: quite thick (average 1·06 mm., range 0·8–1·3 mm.), with a minimum length and minimum width of 1·2 mm., and a thickness:width index averaging 79, indicating considerable thickness relative to width.

Although the above identification of the foxtail millet is absolutely certain, problems arise with the wild millet seeds. These could be sorted quite easily by eye from the domesticated grain by their greater flatness (average 0·63 mm., range 0·4–0·9 mm.), lower length and width (maximums 1·57 and 1·22 respectively), and typical T:W index of around 65, indicating flatness. These wild millets divided into two groups. The first, identified as *Setaria viridis/verticillata* (Fig. 1, e), has grains which are sometimes quite slender (but not as slender as *Digitaria sanguinalis* (L.) Scop.), sometimes short and almost square. About half of the grains have clear traces of punctuate husks, indicating *Setaria*. The other grains of this first group, although lacking clear husk remains, were of a similar size and appearance, and there is no reason to believe that *Echinochloa crus-galli* is present, although many of the grains (including those with *Setaria*-type husks) do fall into its thickness range. The other class of grains is smaller still and rather tadpole shaped, with a plump upper part and a long, flat radicle extending downwards (Fig. 2). Again, most of these show the *Setaria*-type husks and perhaps simply represent a continuum of the other wild *Setaria* species present. These seeds have been identified only as cf. *Setaria*. Although the bulk of the wild grains are clearly of *S. viridis/verticillata*, firm identification of all the wild grains will depend on future Scanning Electron Microscope studies.

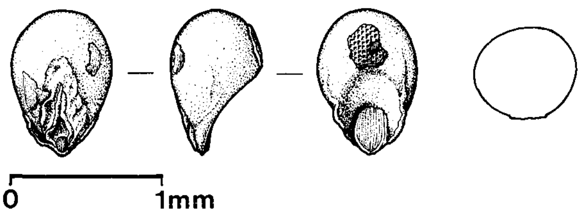

Fig. 2. Millet grain from Tille Höyük: cf. *Setaria* sp., TH 7758 499 22 006.

The purity of the deposit, with no remains of the straw, rachises or sterile florets of the millet, is consistent with its storage after threshing, sieving and winnowing. At least one other sample, of mixed pulses, was also found on a rooftop in this level. The burning of the site can be dated to about September, by the presence of charred, fresh unwrinkled grapes in another sample. Doubtless these crops were placed temporarily on the roof for the usual purposes of hand-picking out of weed-seeds and to ensure full drying. The crops would need to have been taken inside before the beginning of the autumn rains in late October.

This is the first occurrence of foxtail millet as a certain crop in the Near East and Greece. Given the slender amount of currently published archaeobotanical data from Iraq, it is by no means impossible that foxtail millet was being grown there along with broomcorn millet, and that its cultivation was imported to Tille from the south. However, within the context of the available evidence, archaeobotanical reports of millet in Iraq are meagre, and there are only a few references to the crop in the cuneiform sources. It is more likely, therefore, that the cultivation of millet was introduced from the north, and it will be interesting to see whether millet occurs in the pre-Assyrian Iron Age and Late Bronze Age levels at Tille.

Aşvan Kale

This site is in Elazığ province, eastern Turkey, some 150 kilometres north of Tille. It was excavated by the British Institute of Archaeology at Ankara between 1968 and 1972, as part of the Keban Dam rescue excavations, and a final report has been published by Stephen Mitchell (1980). A full report on the plant remains is in preparation. The occupation of the site spans the period from the later Early Bronze Age (2500–2000 B.C.) to the Late Medieval (14th–16th century A.D.).

A wide range of plant remains was recovered from a burnt suite of Hellenistic rooms (*c.* 66 B.C.). All the millet from these Hellenistic samples is broomcorn millet. In room III sample *H3c 602.24* contained about 400 millet grains (Fig. 1, a). Sample *H3d 729.19*, in room IV, contained 34 millet grains. In room VIII sample *H3d 1507.23* contained over 20,000 millet grains and sample *H4cd 1507.27 s.301* a further 800 grains. There were two later occurrences in floated samples. The first was from a Roman (first century A.D.) fill, *I5 1806.4 s.6*, which included three grains of broomcorn millet, 20 grains of foxtail millet (Fig. 1, b), and five grains of *Setaria viridis/verticillata* (Fig. 1, d). The second, from a pit, *H3d 714.8 s.191*, of the Medieval II period (12–13th century A.D.), contained 18 broomcorn millet grains. No difficulty was experienced in identifying this material. Again, many grains retained traces of husks. No rachis or sterile floret remains were seen. All of the samples were thoroughly mixed in with hulled barley, naked wheats, pulses, etc.

Millet is absent from the 12 Early Bronze Age samples examined from one trench and from the two small Late Bronze Age samples. The absence of millets from the Early Bronze Age appears to be confirmed by van Zeist and Bakker-Heere's (1975) analysis of a representative number of samples from this period at Korucutepe. Millet is also absent from the relatively few Late Bronze Age and Medieval samples that they studied. None of the Iron Age strata at Aşvan Kale were excavated, and it is not possible to pin-point the period during which millet arrived in the region. Millet could well have made its appearance during the Middle Iron Age when the Elazığ region had close contacts with the Urartian kingdom. This embraced Transcaucasia, where both foxtail and broomcorn millet were certainly cultivated by the 7th century B.C., as shown by finds at Karmir-blur (Piotrovsky 1966: 200).

Too few grains of millet were recovered from the Roman and Medieval samples to make any definite statements about its cultivation. The total absence of foxtail millet from the Hellenistic samples and the presence of 20 grains in the Roman sample suggests that it may have been introduced later than broomcorn millet.

Haftavan

In 1975 a limited programme of flotation was initiated at Haftavan Tepe, in the province of West Azerbaijan, northwestern Iran. Samples were selected from two periods: Haftavan VIII, which belongs to the late Early Transcaucasian II period (mid-third millennium), and VIB (first half of the second millennium). VIB has been divided into two major phases, Early VIB (*c.* 1900–1550 B.C.) and Late VIB (*c.* 1600–1450 B.C.). Both of these VIB levels appear to have been destroyed by fire. Stratigraphy and dating are discussed by Charles Burney (1970, 1975) and Michael Edwards (1983, 1986), and a preliminary list of the plant remains is given by Summers (1982). Identifications were made by Richard Hubbard.

Broomcorn millet was found in three samples from the Early VIB destruction level:

Locus BB1/3/3 A large quantity of broomcorn millet, with much hulled barley, and caper seeds. Stratigraphy: Edwards (1983: 74, fig. 45).

Locus BB1/3/4 Some grains of broomcorn millet, but soil more weathered than previous locus, and much poorer in plant remains (Edwards 1983: 74, fig. 45).

Locus CCB1/3/3 A large quantity of broomcorn millet (Edwards 1983: 66, 67, 72, fig. 48).

These samples came from very well defined layers of ashy debris that contained large quantities of vitrified clay. The millet had almost certainly been stored on roofs, either in heaps or in combustible sacks. As at Tille, it seems likely that the catastrophic fire occurred late in the year, after the harvest, but before the coming of the rainy season in October.

The absence of millet from the two Late VIB samples that were floated is not adequate evidence for its absence in this period, but the absence of millet from the Early Transcaucasian II (i.e. Early Bronze Age) levels is perhaps more convincing, since a larger number of samples from diverse contexts, such as hearths and courtyards, was taken.

Archaeobotanical records of millet from the Near East

Reliable records are summarized in Table 2. A number of records from Greece are dubious, and are not included in this table: Argissa, Aceramic Neolithic (Hopf 1962), only one, battered, grain of cf. *Panicum miliaceum*; Achilleion, Ceramic Neolithic (Gimbutas 1974: 285); Olynthos, Neolithic; and Marmariani, Middle Helladic, "millet bread" (Vickery 1936: 55). In Table 2 an attempt has been made to distinguish definite crop occurrences, where the millet has been found in large quantities, from possible occurrences only as a weed.

Archaeobotanical records of millet in other regions

The evidence to the north, around the Black Sea, is ambiguous, as identification criteria and illustrations are all too rarely published for work in this area. Lisitsina (1984) records "*Panicum* sp." from Chokh in the Caucasus, dating from the beginning of the sixth millennium B.C., and broomcorn millet from several sites of the "Shulaveri-Shomutepe" culture of the fifth millennium, also in this region. She records only one site of this culture where foxtail millet was found. Further west, broomcorn millet was found at the site of Sorocki in southwest Russia, dating from the first half of the fifth millennium B.C. (Janushevitch 1976). Both broomcorn and foxtail millet were found at the Urartian site of Karmir-blur (Piotrovsky 1966). In addition to charred and uncharred grains, bread made from coarsely ground millet and a jar of millet in the course of being malted were found.

Elsewhere the earliest finds of millet are from northern China, where jars of foxtail millet have been found at the Neolithic Yang-shao period site of Pan-pho (Chang 1973), dating to about 4000 B.C. Foxtail millet was the mainstay of the northern Chinese Neolithic, although broomcorn millet may have been found at one site (Bray 1984). The routes by which the millets spread from Russia and China are unclear, although in at least some instances broomcorn millet spread independently from foxtail millet.

Neither millet occurs in prehistoric deposits in the Indian subcontinent. The millets are a separate, later addition to European agriculture, from a different centre to the "package" of crop plants that arrived from the Near East. The millets appear to have made a two-phase entry into Europe, presumably from Russia. Broomcorn millet is present in central Europe in the second half of the fifth millennium B.C., and then both species appear in the Swiss lake-dwelling settlements on the Alpine foothills in the Late Neolithic period (3rd millennium B.C.)

TABLE 2

Records of millet from the Ancient Near East and Greece.

Period	Site	Status of Millet	Reference
Early Bronze Age (3rd mill. B.C.)	Kastanas, Macedonia, N. Greece	Broomcorn millet a scarce weed. No foxtail millet.	Kroll 1983, 1984a
Early Bronze Age Jamdat Nasr (3rd mill. B.C.)	Jamdat Nasr, Iraq	One imprint in pottery, of broomcorn millet.	Helbaek 1966:615
Kaftari Malyan (2400–1800 B.C.)	Malyan, SW Iran	A few grains of broomcorn millet: weed.	Miller 1982:171
Early Haftavan VIB (1900–1550 B.C.)	Haftavan, NW Iran	Large quantities broomcorn millet in burnt level of *c*. 1550 B.C.: crop.	This paper
Late Bronze Age	Kastanas	Broomcorn millet a crop; foxtail millet a scarce weed.	
Late Bronze Age	Assiros Toumba, Macedonia, N. Greece	Bulk storage of broomcorn millet: crop. Foxtail millet not recorded.	Jones 1981 Halstead and Jones 1980 Jones *et al.* 1986
Mycaenean and Late Bronze Age	Tiryns Argolis, S. Greece	Only a few samples examined; A few grains broomcorn millet, no foxtail millet.	Kroll 1982, 1984b
Iron Age (9–8th C. B.C.)	Iolkos, Thessaly, N. Greece	Only a few samples; one grain of broomcorn millet.	Jones 1982
Iron Age	Kastanas	As in LBA. Number of grains of foxtail millet larger in the LBA/IA transitional period but not enough to suggest cultivation.	
Iron Age (7th C. B.C.)	Nimrud Fort Shalmaser, N. Iraq	A large sample of broomcorn millet from each of these sites: crop.	Helbaek 1966: 615
Iron Age	Hasanlu, NW Iran	One large sample of broomcorn millet: crop. Helbaek gives no precise reference to the provenance of the material.	Helbaek 1966: 615
Iron Age (*c*. 607 B.C.)	Tille Höyük, SE Turkey	One large sample of foxtail millet: crop.	This paper
Iron Age Phrygian	Gordion, central Turkey	Large deposit uncharred broomcorn millet: crop.	Unpublished
Hellenistic (*c*. 66 B.C.)	Aşvan Kale, eastern Turkey	Large deposits broomcorn millet: crop.	This paper
Roman (1st C. A.D.)	Aşvan Kale	Small number of samples; a few grains of foxtail and broomcorn millet.	This paper
Medieval (12–13th C. A.D.)	Aşvan Kale	Some foxtail millet grains.	This paper
Medieval 13th C. A.D.	Qal'eh Ismail Aqa	Some broomcorn millet grains.	Costantini and Biasini 1984

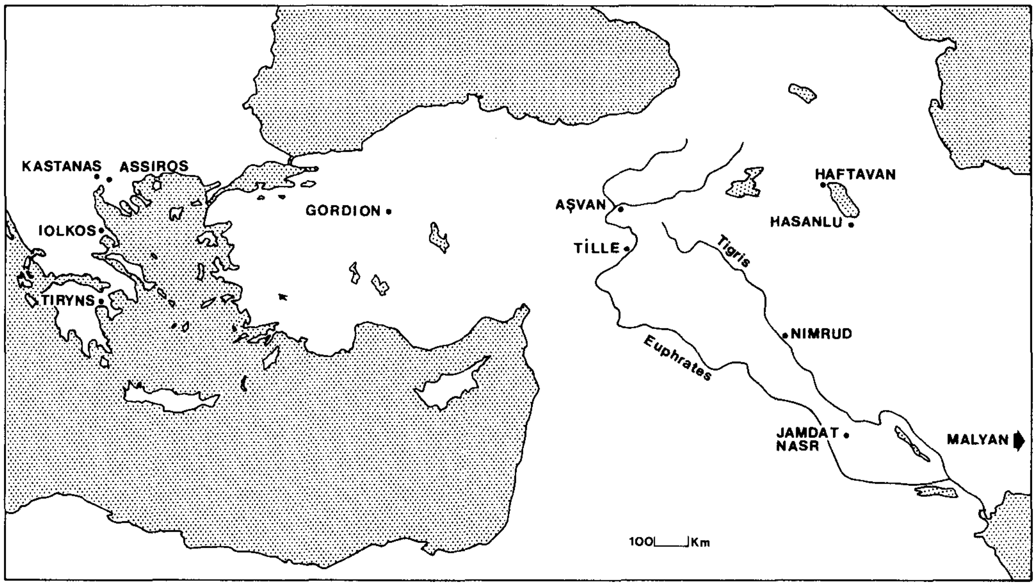

Fig. 3. Locations of archaeobotanical records of millet in the Near East and Greece.

(Körber-Grohne 1987; van Zeist 1980). In succeeding millennia one or other of the millets spread through much of the rest of Europe.

To the south there is no evidence for the use of foxtail or broomcorn millets in Pharaonic Egypt (Germer 1985), and records from other parts of North Africa are very scanty. It seems unlikely that this area had any part in the spread of millets to the Near East.

Other sources of evidence

The evidence of genetics is ambiguous. The wild ancestor of broomcorn millet is not known. The closest wild relative of foxtail millet is *Setaria viridis*, a ubiquitous weed that grows in much of temperate Eurasia. Morphological and cytogenetic studies by de Wet *et al.* (1979) have not enabled any more precise conclusions to be drawn as to the area of origin.

The linguistic evidence has been summarized by Ho (1977). Of special interest is the fact that the Persian name for broomcorn millet is closely derived from the Chinese name for this cereal. Documentary evidence for the millets is scarce in the Middle East, confirming the archaeobotanical evidence for the relative unimportance of the millets compared to the other cereals.

Uses of millet

The uses of millet have always been very varied, and Pliny's descriptions in the *Natural History* (written in Italy in the mid-first century A.D.) are a fair summary of the possibilities (see Spurr 1983 for full references). He records the use both of broomcorn millet and foxtail millet for bread-making either in a pure state, producing a flat heavy bread best consumed when hot, or mixed with beans; for gruel, mixed with barley; for leaven, in the form of dough mixed with wine; as an "artificial" wine, and for various medicinal purposes. Columella in his *De Re Rustica* recommends millet as green fodder and as feed for calves, hens and pigeons. In Turkey today the seeds of broomcorn millet (*darı*) are sold as bird food and are used to make a sweet, fermented (but essentially non-alcoholic) cold drink called *boza*. In the recent past millet was apparently used in the Çukurova region of S. Turkey to make the best quality *bulgur* (David Oates, pers. com., in Hillman 1985).

One major reason for taking up the cultivation of millets is that they are a "summer crop" that must be sown in warm weather (i.e. in the late spring) and have a growing season that can be as little as 40 days. Much of the cultivation of millet can, therefore, take place at a slack season in the agricultural year. It is odd that sesame (*Sesamum indicum* L.), which is also a summer crop, has not yet been recovered at those Near Eastern sites where millet has been found. Sesame was grown at Karmir-Blur and, perhaps, in ancient Mesopotamia (Bedigian 1985).

Little ethnographic data from the Near East is available on the processing of millets after harvest (but see Gunda 1983). Once threshed and sieved or winnowed, the grains can be stored in their husks, and dehusked on a day-to-day basis. As Pliny (18:158) points out, owing to their thick husks, millet stores well and is virtually immune to consumption by insects and rodents. It is not surprising, therefore, to find so many husk remains attached to the Aşvan grains, as they were probably stored in husks until shortly before use. Although the husks are very tough, they are brittle and can be easily crushed with a mortar or quern. The loose husks could be removed by small-scale winnowing.

Conclusions

It is clear that the available records are inadequate to trace accurately the spread of the millets, but some trends are apparent. There are no reliable records in the Near East for the Chalcolithic or earlier periods. Millet is also completely absent from most of the (relatively) numerous Early Bronze Age sites that have been studied, but it appears in small quantities, probably as a minor weed at several places. By the middle of the first half of the second millennium broomcorn millet is well established as a crop in northwestern Iran. Broomcorn millet is then recorded as a crop at two Late Bronze Age sites in northern Greece, accompanied by opium poppy, spelt wheat and gold of pleasure, but does not appear in the rather meagre Late Bronze Age samples available elsewhere, except in small quantities at Tiryns. By the Middle Iron Age (*c.* seventh to sixth centuries B.C.), broomcorn millet is well established as a crop over much of the Near East, although archaeobotanical evidence from the Levant is still lacking. The large deposit of foxtail millet at Tille is quite aberrant, but it is likely that more will be found when adequate techniques for the recovery of plant remains are applied to other Iron Age sites. Very little archaeobotanical evidence is available for the Classical and Medieval periods, but millet still seems to have been cultivated, if on a reduced scale. This decline has continued to the present day, and the millets are now very minor crops in the Near East.

The spread of millet into the Near East and Greece appears to have been via a number of routes. The evidence from other areas suggests that the two millet species spread separately in many instances. Given the small number of records of foxtail millet from the ancient Near East, speculations on the introduction of millets to this area can only be in general terms. If the apparent scarcity of millet in southern Greece and Thessaly is not merely a result of inadequate archaeobotanical work, it may be that the millets came from the northwest to Greece, first as weeds, then as crops. The contemporaneous introduction of crops such as spelt wheat, opium poppy and gold of pleasure, may support this, as these crops are better attested from Europe than from the Near East (cf. Merlin 1984: 179–89).

Given the small number (as yet) of records of crops such as spelt wheat and gold of pleasure from the Near East, it seems more likely that the millets entered the region from the north or east rather than from the west. Although the Chinese origins of the Persian name for millet point to its introduction from the east, this could represent the re-introduction of this crop, from China. In any case, millet may well have been introduced separately into Iraq and Turkey from the north. It is tempting to see the millets arriving from Russia via Transcaucasia and the same northern origin may apply to northwest Iran, given the connections between the painted "Urmia Ware" of Haftavan Early VIB and pottery from the Araxes valley and Transcaucasus (Edwards 1981: 109–11; 1986: 72). The archaeobotanical record at Haftavan (where work has of necessity ceased) is, as at so many other sites, tantalizingly incomplete, and it is not possible to rule out the arrival of millet during, for example, the earlier IVC period when cultural connections with the south were stronger (Burney 1976: 157). However millet is apparently absent from the nearby Solduz plain during Hasanlu periods X–V (6th to 2nd millennia B.C.) (Tosi 1975, Voigt 1983: 275–7), although it is present at Hasanlu at some point in the Iron Age (Helbaek 1966).

Clearly at present any attempt to chart the spread of the millets is hampered not only by the dearth of archaeobotanical reports, especially for the relatively recent periods, but by the chronological gaps. Results from earlier levels at Tille will thus be of considerable interest.

POSTSCRIPT

Three further records of ancient millets have come to our attention: broomcorn and foxtail millets from Urartian (seventh century B.C.) and medieval levels at Bastam, in northwest Iran (M. Hopf and U. Willerding, 1988: Chapter IX, "Pflanzenreste", in W. Kleiss, ed., *Bastam II* [Berlin: Gebr. Mann], pp. 263–318, plates 44–46); broomcorn and foxtail millet provisionally identified from a medieval deposit (*c.* 900 A.D.) at Qantara, southern Iraq (H. Helbaek, 1982: Appendix 3, "Preliminary identifications of the Qantara deposit (*c.* 900 A.D.)", in T. Jacobsen, *Salinity and irrigation agriculture in antiquity* [Malibu, CA: Undena, Bibliotheca Mesopotamica 14], p. 21), and broomcorn millet from Tepe Yahya, southeast Iran (L. Costantini and L. C. Biasini, 1985: "Agriculture in Baluchistan between the 7th and the 3rd Millennium B.C.", *Newsletter of Baluchistan Studies* 2 pp. 16–37). Although broomcorn millet is listed in the preliminary Tepe Yahya score-sheet (table 4, p. 34) from period VI (3800–4500 B.C.) and later periods, it is not mentioned in the text, and assessment of this evidence must await its full publication.

REFERENCES

Baytop, A. 1969. "The genus *Setaria* in Turkey." *Istanbul Üniversitesi Eczacılık Fakültesi Mecmuası* (*Journal of Faculty of Pharmacy of Istanbul University*) 5(1): 34–45.
Bedigian, D. 1985. "Is še-giš-i sesame or flax?". *Bulletin on Sumerian Agriculture* 2: 159–78.
Bray, F. 1984. *Science and civilization in China, Volume 6. Biology and biological technology. Part II. Agriculture.* Cambridge: Cambridge University Press.
Burney, C. A. 1970. "Excavations at Haftavan Tepe 1968: first preliminary report." *Iran* 8: 157–71.
——— 1975. "Excavations at Haftavan Tepe 1973: fourth preliminary report." *Iran* 13: 149–64.
——— 1976. "Haftavan Tepe." *Iran* 14: 157–8.
Chang, K. C. 1973. "Radiocarbon dates from China: some initial interpretations." *Current Anthropology* 14(5): 525–8.
Columella. *De re rustica.* Volumes I–III. London: Heinemann, Loeb Library. 1941–1955.

Costantini, L. and L. Biasini. 1984. VI. 2. resti vegetali dei saggi a Qal'eh Ismail Aqa e a Tappeh Giljar. In (P. E. Pecorella and M. Salvini) *Tra lo Zagros e L'Urmia: ricerche storiche ed archeologiche nell'Azerbaigian Iraniano*. Rome: Edizioni dell'Ateneo, pp. 397–402.

Edwards, M. 1981. "Pottery from Haftavan VIB (Urmia Ware)." *Iran* 19: 101–40.

——— 1983. *Excavations in Azerbaijan (North-western Iran). Haftavan, period VI.* Oxford: BAR International Series 182.

——— 1986. "'Urmia ware' and its distribution in North-western Iran in the second millennium B.C.: a review of the results of excavations and surveys." *Iran* 24: 57–77.

Germer, R. 1985. *Flora des pharaonischen Ägypten*. Mainz: Philipp von Zabern. Deutsches Archäologisches Institut Abteilung Kairo, Sonderschrift 14.

Gimbutas, M. 1974. "Achilleion: a Neolithic mound in Thessaly; preliminary report on 1973 and 1974 excavations." *Journal of Field Archaeology* 1: 277–302.

Gunda, B. 1983. "Cultural ecology of old cultivated plants in the Carpathian area." *Ethnologia Europaea* 13: 146–79.

Halstead, P. and G. Jones. 1980. "Bio-archaeological remains from Assiros Toumba." *BSA* 75: 265–7.

Hawkins, J. D. 1980/83. Kummuḫ. *RLA* 6: 338–40.

Helbaek, H. 1966. Appendix 1. The plant remains from Nimrud. In (M. E. L. Mallowan) *Nimrud and its remains, Volume II*. London: Collins, pp. 613–20.

Hillman, G. C. 1985. "Traditional husbandry and processing of archaic cereals in recent times: the operations, products and equipment that might feature in Sumerian texts. Part II: the free-threshing cereals." *Bulletin on Sumerian Agriculture* 2: 1–31.

Ho, Ping-Ti. 1977. The indigenous origins of Chinese agriculture. In (C. A. Reed, ed.) *Origins of agriculture*. The Hague: Mouton, pp. 412–84.

Hopf, M. 1962. Bericht über die Untersuchung von Samen und Holzkohlenresten von der Argissa-Magula aus den präkeramischen bis mittelbronzezeitlichen Schichten. In (V. Milojcic, J. Boessneck and M. Hopf), *Die Deutschen Ausgrabungen auf der Argissa-Magula in Thessalien I*. Bonn: Rudolf Habelt, pp. 101–10.

Janushevitch, Z. V. 1976. *Cultivated plants in the southwestern USSR according to palaeobotanical investigations*. Moscow. (Cited by van Zeist 1980).

Jones, G. 1981. "Crop processing at Assiros Toumba—a taphonomic study." *Zeitschrift für Archäologie* 15: 105–11.

——— 1982. "Cereal and pulse remains from Protogeometric and Geometric Iolkos, Thessaly." *Anthropologika* 3: 75–8.

——— 1987. "Agricultural practice in Greek prehistory." *BSA* 82: 115–23.

———, K. A. Wardle, P. Halstead and D. Wardle. 1986. "Crop storage at Assiros." *Scientific American* 254: 84–91.

Knörzer, K-H. 1971. "Eisenzeitliche Pflanzenfunde im Rheinland." *Bonner Jahrbücher* 171: 40–58.

Körber-Grohne, U. 1987. *Nutzpflanzen in Deutschland: Kulturgeschichte und Biologie*. Stuttgart: Theiss.

Kroll, H. 1982. "Kulturpflanzen von Tiryns." *AA:* 467–85.

——— 1983. *Kastanas: Ausgrabungen in einem Siedlungshügel der Bronze- und Eisenzeit Makedoniens 1975–1979: die Pflanzenfunde*. Berlin: Volker Spiess.

——— 1984a. Bronze Age and Iron Age agriculture in Kastanas, Macedonia. In (W. van Zeist and W. Casparie, eds.) *Plants and ancient man*. Rotterdam: Balkema, pp. 243–6.

——— 1984b. "Zum Ackerbau gegen Ende der Mykenischen Epoche in der Argolis." *AA:* 211–22.

Lisitsina, G. N. 1984. The Caucasus—a centre of ancient farming in Eurasia. In (W. van Zeist and W. Casparie, eds.) *Plants and ancient man*. Rotterdam: Balkema, pp. 285–92.

Merlin, M. D. 1984. *On the trail of the ancient opium poppy*. London and Toronto: Associated University Presses.

Miller, N. F. 1982. *Economy and environment of Malyan, a third millennium B.C. urban center in southern Iran*. Ph.D. thesis, University of Michigan, Department of Anthropology.

Mitchell, S. 1980. *Aşvan Kale: Keban rescue excavations, eastern Anatolia*. Oxford: BAR International Series 80, British Institute of Archaeology at Ankara Monograph No. 1.

Piotrovsky, B. B. 1966. *Il regno di Van Urartu*. Rome: Edizioni dell'Ateneo.

Pliny. *Natural History*. Volumes I–X. London: Heinemann, Loeb Library. 1938–62.
Spurr, M. S. 1983. "The cultivation of millet in Roman Italy." *PBSR* 51: 1–15.
Summers, G. D. 1982. *A study of the architecture, pottery and other material from Yanik Tepe, Haftavan Tepe VIII and related sites*. Ph.D. thesis submitted to the Department of Archaeology, University of Manchester (England).
——— in press. Tille Höyük: control of an Euphrates crossing. 34th Rencontre Assyriologique Internationale, Istanbul 1987.
Tosi, M. 1975. "Hasanlu Project 1974: palaeobotanical survey." *Iran* 13: 185–6.
Vickery, K. F. 1936. *Food in early Greece*. Illinois.
Voigt, M. M. 1983. *Hajji Firuz Tepe, Iran: the neolithic settlement*. Pennsylvania: University Museum.
de Wet, J. M. J., L. L. Oestry-Stidd and J. I. Cubero. 1979. "Origins and evolution of foxtail millets (Setaria italica)." *Journal d'Agriculture Traditionnelle et de Botanique Appliquée* 26: 53–64.
van Zeist, W. 1980. Aperçu sur la diffusion des végétaux cultivés dans la region méditerranéenne. In *Colloque de la Fondation L. Emberger sur "la mise en place, l'évolution et la caractérisation de la flore et la végétation circumméditerranéenne"*. Naturalis Monspeliensia, No. Hors Série, pp. 129–45.
——— and J. A. H. Bakker-Heeres. 1975. Prehistoric and early historic plant husbandry in the Altınova plain, southeastern Turkey. In (M. N. van Loon, ed.) *Korucutepe I*. Amsterdam: North Holland, pp. 225–57.