C.C. Bakels

Fruits and seeds from the Linearbandkeramik settlement at Meindling, Germany, with special reference to Papaver somniferum

The crops of Linearbandkeramik Meindling were emmer wheat, einkorn wheat, pea, lentil, linseed and poppy, if the latter was indeed cultivated. The fields were infested with a special weed flora whose composition differed slightly from the classical Bromo-Lapsanetum praehistoricum. The carbonized waste consisted of grain that was not yet been dehusked and discarded chaff. As far as could be ascertained, excess chaff was dumped to the west of the houses. One Hallstatt pit contained gold of pleasure.

1. Introduction

Meindling, Ldkr Straubing-Bogen, is situated in the loess district of Lower Bavaria, Germany (fig. 1). The settlement lies at the edge of a plateau, on ground that slopes gently towards the left bank of the rivulet Ödbach. The distance to the watercourse is 100 m. Most traces of habitation are of the first agrarian settlers of Central Europe: the people of the Linearbandkeramik culture. Even the earliest phase of this culture is represented, which is why P.J.R. Modderman decided to excavate the site. He hoped that he would be able to fill the gap in the information obtained in his large-scale investigations at Hienheim "Am Weinberg", Ldkr. Kelheim, where this earliest phase was not represented (Modderman 1992).

Unfortunately Meindling proved to have been inhabited from the earliest phase up to and including the late phases of the Linearbandkeramik culture; the site contained many intersecting features. This made it rather difficult to distinguish between the various phases of occupation. Nevertheless it proved possible to date some features in relative terms, as early and late in the Linearbandkeramik sequence. Fortunately, occupation remains of other cultures were rare; they were restricted to two pits containing Münchshöfener remains and two pits containing Hallstatt remains. The other remains were all Linearbandkeramik. Four C14 dates are available for this period: 6380 ± 130 BP (GrN-8687), 6190 ± 100 BP (GrN-9139), 6130 ± 40 BP (GrN-8688) and 6030 ± 60 BP (GrN-9138).

2. The samples

During the Meindling excavation sampling for botanical remains was a standard procedure. Samples were taken from pit fills which were found to date from one occupational phase only; no samples were taken from areas of intersection. With one exception (No. 95-1), no samples were taken from the top ten centimetres of the fills, because it was believed that they may have contained secondary sediments, deposited in the depression remaining after the original fill had settled. Samples were taken from different layers in the case of stratified fills; when no clear layers were observed only one sample was taken. Only three pits that were dug for the erection for posts (Nos 75, 138, 166) were investigated because in previous excavations of Linearbandkeramik sites these pits had yielded virtually no evidence of fruits and seeds whatsoever. Three samples were taken from true postholes (Nos 119, 157, 169). All in all 84 Linearbandkeramik samples, three Münchshöfener samples and two Hallstatt ones were obtained for analysis.

The material was sieved by hand in water, using a series of sieves with meshes of 1.0, 0.5 and 0.25 mm. The loess-loam matrix did not allow the use of flotation methods. The size of the samples was therefore restricted to 2 dm^3, with only three exceptions. In one case only one dm^3 was available (No. 179-3), in a second case the layer in question contained so much charred material that the sample size was increased to 4 dm^3 (No. 115-3) and in a third case a sample of 5 dm^3 was sieved for no specific reason (No. 121). The residues were air-dried. The evidence was sorted and identified in the laboratory at Leiden using a microscope with magnifications of up to 50×.

All the fruits and seeds that were not carbonized were considered to be of a relatively late date. Only carbonized matter survives long periods of burial in loess soils. Seeds with a natural dark colour, such as *Chenopodium album* and *Veronica hederifolia*, were sectioned after identification. Some *Chenopodium* and all *Veronica hederifolia* proved to be of recent date. They included all of the 126 *Chenopodium album* seeds obtained from the only secondary top fill layer sampled (No. 95-1). The carbonized remains are listed in tables 1 and 2.

In addition to soil samples, sherds were investigated and silicon rubber casts were made of promising impressions. The search for seed impressions was rewarding (figs 2, 3). The results are given in table 3.

Table 1. The most common carbonized fruits and seeds found at Meindling. 66-1 is the uppermost layer of pit 66 etc; 194a en b are from the same layer. E: Early Bandkeramik, L: Late Bandkeramik.

Feature	Triticum dicoccum	Triticum monococcum	Triticum sp.	Glume bases	Other cultivated plants	Chenopodium album	Bromus secalinus/hordeaceus	Polygonum convolvulus	Setaria viridis/verticillata	Other	Density	Phase
35	-	-	-	-	-	3	1	2	-	-	3.0	
49	-	1	2	4	-	4	-	-	-	-	5.5	
52	1	-	3	22	1	40	4	5	3	2	40.5	
55	-	-	1	-	-	-	-	-	-	-	0.5	
66-1	1	-	-	1	-	2	1	-	1	-	3.0	
66-2	-	-	4	9	-	11	-	1	1	1	13.5	
66-3	-	1	-	-	-	1	-	-	-	-	1.0	
66-4	1	-	2	1	-	2	-	-	-	-	3.0	
67	1	-	-	-	-	-	-	-	-	-	0.5	
74	-	-	2	3	-	3	-	1	-	-	4.9	
75	-	-	2	-	-	1	-	-	-	-	1.5	
83-1	-	-	-	-	-	-	-	2	-	-	1.0	
83-2	-	-	-	-	-	-	-	-	-	-	0.0	
85	-	-	-	-	-	-	-	1	-	-	0.5	E
87	-	-	-	-	-	-	-	-	-	-	0.0	
88	2	-	5	11	-	12	8	2	-	-	20.0	
89	-	-	1	-	-	-	-	-	-	-	0.5	
90	1	-	2	14	-	7	2	2	4	3	17.5	L
91	-	-	-	-	-	-	-	-	-	-	0.0	L
92	-	-	9	7	-	6	-	-	1	-	11.5	L
93-1	1	-	1	9	-	-	2	1	-	-	7.0	L
93-2	1	-	14	21	-	47	4	6	1	1	47.5	L
93-3	-	-	2	10	-	5	-	1	-	-	9.0	L
95-1	1	-	12	19	-	-	13	2	-	3	25.0	
95-2	-	-	4	-	-	-	-	-	-	-	2.0	
96	-	-	-	3	-	-	1	1	-	-	2.5	E
97	-	1	7	13	-	39	2	1	-	3	33.0	L
98	6	7	35	77	1	28	13	4	3	18	96.0	
99	2	-	8	11	-	12	1	-	-	2	18.0	E
100-1	2	1	22	50	-	26	15	6	3	2	63.5	
100-2	2	-	12	17	-	18	21	2	3	2	38.5	
102	1	-	5	17	-	14	2	1	5	-	22.5	
103	-	-	2	6	-	16	1	2	1	-	14.0	E
115-1	-	-	21	42	2	31	7	14	5	14	68.0	L
115-2	-	-	3	-	-	1	-	-	-	1	2.5	L
115-3	10	-	72	259	-	9	5	10	9	8	95.5	L
117	3	2	13	28	-	9	9	1	-	2	33.5	L
119	1	-	-	8	-	-	-	-	-	-	4.5	
121	3	1	15	38	-	21	1	1	-	1	16.2	E
122-1	1	1	3	16	-	61	3	2	4	2	46.5	E
122-2	-	-	1	5	-	7	2	1	-	1	8.5	E
122-3	1	-	4	8	-	15	3	2	-	1	17.0	E
138	1	-	4	9	-	13	6	6	-	1	20.0	E
143	2	-	4	5	2	1	1	-	-	-	7.5	
150	-	-	4	-	-	-	-	1	-	-	2.5	

Feature	Triticum dicoccum	Triticum monococcum	Triticum sp.	Glume bases	Other cultivated plants	Chenopodium album	Bromus secalinus/hordeaceus	Polygonum convolvulus	Setaria viridis/verticillata	Other	Density	Phase
157	-	-	6	8	-	6	6	1	-	1	14.0	E
166	-	-	1	16	-	1	1	1	-	1	10.5	
169	-	-	1	4	-	4	1	1	-	-	5.5	
176	-	-	2	4	-	2	-	1	-	-	4.5	
179-1	-	-	4	4	-	-	1	1	-	-	5.0	
179-2	2	-	7	-	-	-	1	1	-	-	5.5	
179-3	1	-	3	-	-	-	-	-	-	-	4.0	
184	-	-	-	-	-	-	-	-	-	-	0.0	
186	-	-	1	30	-	4	1	1	-	-	18.5	
190	4	2	14	20	2	32	20	1	-	-	47.5	
191	-	-	-	-	-	-	-	-	-	-	0.0	E
193-1	-	-	1	2	-	-	-	-	-	-	1.5	E
193-2	2	-	7	239	-	-	-	1	-	2	125.5	E
193-3	-	-	-	-	-	-	-	-	-	-	0.0	E
194-a	-	-	5	52	-	3	2	1	-	-	31.5	E
194-b	1	-	5	35	-	6	3	-	1	1	26.0	E
197	3	-	4	8	-	-	3	2	-	2	11.0	E
199	-	-	2	12	-	-	2	-	-	1	8.5	
203	1	-	-	-	-	-	-	-	-	-	0.5	
209	1	-	1	31	-	4	9	1	-	-	23.5	
211	-	-	-	2	-	-	-	-	-	-	1.0	
223	-	-	4	8	-	13	-	3	2	-	15.0	L
224	-	-	-	-	-	-	-	-	-	-	0.0	L
228-1	-	-	-	2	-	-	-	1	-	-	1.5	L
228-2	-	-	-	-	-	-	-	-	-	-	0.0	L
235-1	-	-	11	22	1	8	2	5	1	-	25.0	L
235-2	-	-	-	1	1	1	1	-	-	-	2.0	L
235-3	-	-	5	3	1	6	3	1	-	1	10.0	L
238	-	-	-	-	-	-	-	-	-	-	0.0	
239	-	-	-	-	-	1	-	-	-	-	0.5	E
248	1	-	1	6	-	2	-	-	-	2	5.0	
251	-	-	6	20	-	-	-	-	-	1	13.5	
253	1	-	4	4	-	1	-	-	-	1	5.5	
258	-	1	3	6	-	8	1	1	-	-	10.0	
266	-	-	4	7	1	7	1	1	-	1	11.0	
289	-	-	1	10	-	3	3	1	-	-	9.0	
305	4	3	23	38	1	7	47	6	-	4	66.5	L
306	-	-	7	1	1	-	1	2	-	2	7.0	E
307	-	-	3	2	-	2	-	-	-	-	3.5	L
Münchshöfen												
225	-	-	-	2	-	-	-	-	-	-	1.0	
226-1	-	-	-	-	-	-	-	-	-	-	0.0	
226-2	-	-	-	-	-	8	-	-	-	2	5.0	
Hallstatt												
162	-	-	6	6	2	116	-	3	13	19	82.5	
259	-	-	3	-	3	3	-	-	1	-	5.0	

Table 2. Less common fruits and seeds; number of specimens between brackets.

Linearbandkeramik, cultivated:	
Lens culinaris	235-1 (1)
Linum usitatissimum	115-1 (1), 266 (1)
Papaver somniferum	115-1 (1), 305 (1)
Pisum sativum	52 (1), 98 (1), 143 (2), 190 (2), 235-2 (1), 235-3 (1), 306 (1)
Linearbandkeramik, wild:	
Brassica sp./*Sinapis* sp.	99 (1)
Bromus sterilis/tectorum	115-3 (1)
Caryophyllaceae indet.	95-1 (2)
Chenopodium ficifolium	122-1 (1)
Chenopodium polyspermum	98 (1)
Compositae indet.	115-1 (1)
Corylus avellana	122-2 (1)
Echinochloa crus-galli	97 (1), 98 (3), 115-1 (1), 115-3 (1), 166 (1)
Fragaria sp./*Potentilla* sp.	90 (1), 98 (6), 100-1 (1), 115-1 (8), 306 (1)
Galium aparine	115-3 (3), 194-2 (1)
Galium spurium	93-2 (1), 98 (1), 100-2 (1), 115-3 (1), 117 (2), 197 (1), 199 (1), 266 (1), 305 (2)
Galium sp.	115-1 (1)
Gramineae sp.	97 (1)
Knautia arvensis	98 (1), 100-2 (1)
Lotus corniculatus/Trifolium repens	122-3 (1)
Poa sp. *non annua*	98 (1)
Phleum sp.	115-1 (1), 115-3 (1), 253 (1)
Polygonum lapathifolium	66-2 (1), 95-1 (1), 248 (2), 251 (1), 305 (2)
Rumex sp.	97 (1), 98 (3), 197 (1)
Silene vulgaris	90 (1), 98 (2), 99 (1), 115-1 (1)
Solanum nigrum	52 (2), 100-1 (1), 115-2 (1), 157 (1), 193-2 (2), 235-3 (1)
Stipa sp.	122-1 (1), 306 (1)
Vicia hirsuta/tetrasperma	115-1 (1)
Indeterminatae	90 (1), 115-3 (1), 121 (1), 138 (1)
Münchshöfener Gruppe:	
Galium cf *mollugo*	226-2 (1)
Phleum sp.	226-2 (1)
Hallstatt:	
Camelina sativa	259 (1)
Lens culinaris	162 (2)
Pisum sativum	259 (2)
Artemisia sp.	162 (3)
Compositae indet.	162 (1)
Corylus avellana	162 (1)
Galium spurium	162 (2)
Euphrasia sp./*Odontites* sp.	162 (3)
Vicia sp.	162 (3)
Indeterminatae	162 (6)

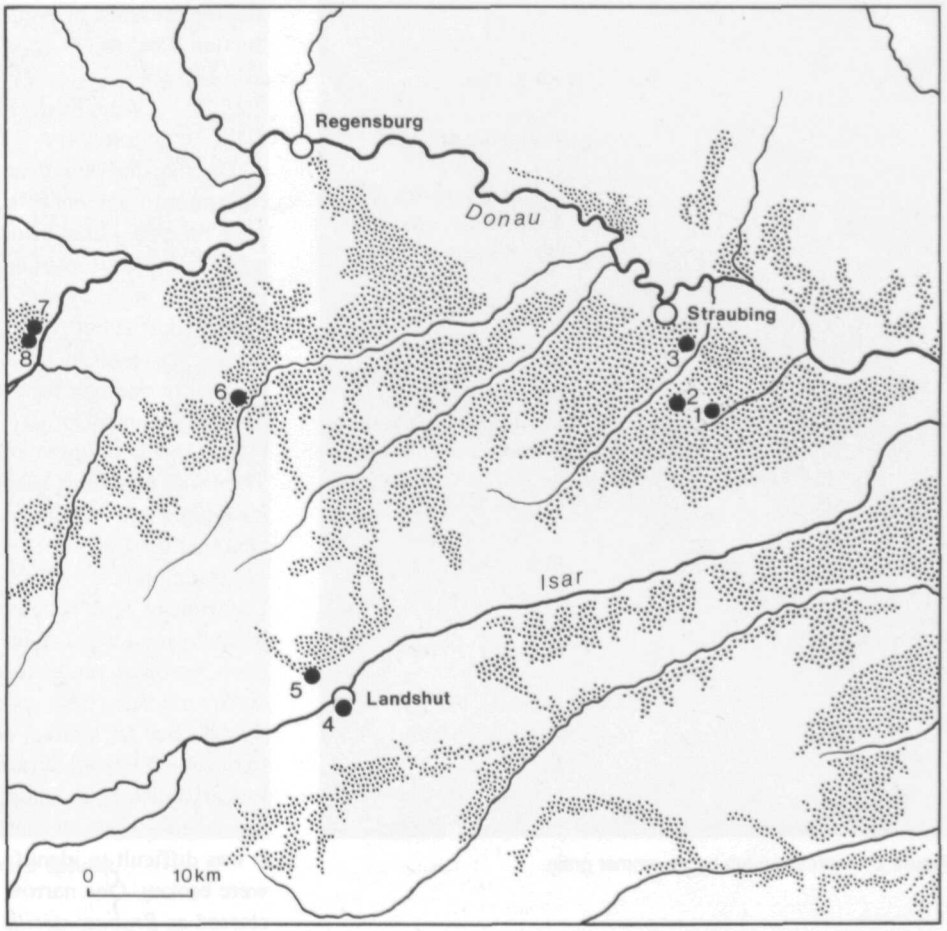

Figure 1. The loess district of Lower Bavaria showing the Linearbandkeramik settlements mentioned in the text: 1. Meindling, 2. Oberpiebing, 3. Aiterhofen, 4. Sallmannsberg, 5. Altdorf, 6. Leitenhausen, 7. Hienheim, 8. Fuchsloch. Shaded areas: loess

Table 3. Species identified from impressions in pottery.

Triticum dicoccum, grain	12
Triticum dicoccum, spikelet	2
Triticum dicoccum, spikelet fork	2
Triticum monococcum, grain	3
Triticum monococcum, spikelet	3
Triticum dicoccum or *Tr. monococcum*, grain	1
Triticum dicoccum or *Tr. monococcum*, spikelet fork	2
Cerealia indet., grain	5
Lens culinaris	1
Pisum sativum	2
Malus sp.	1
Polygonum convolvulus	1

3. Results

As already mentioned above, most of the material is Linearbandkeramik. The Münchshöfener samples contained so few remains that it is not even sure that the remains in question are of Münchshöfener date. The pits also contained stray Linearbandkeramik sherds; the few carbonized particles may be associated with those earlier finds. The Münchshöfener samples will therefore not be discussed any further below. The above may also be true of the Hallstatt evidence, but as one of the pits contained many finds and the other contained a typical Metal Age plant species, they will both be included in the discussion.

3.1. Cultivated plants from Linearbandkeramik contexts

The cultivated plants encountered in Linearbandkeramik contexts comprise six species: emmer wheat (*Triticum dicoccum*), einkorn wheat (*Triticum monococcum*), pea (*Pisum sativum*), lentil (*Lens culinaris*), linseed (*Linum usitatissimum*) and poppy (*Papaver somniferum*). Four of these were encountered both as carbonized specimens and as impressions. Only the oil seeds were not observed in the pottery; in the case of linseed this may be due to mere chance, whereas poppy seeds are so small that they usually remain undetected.

Figure 2. Impression left by an emmer grain.

The carbonized peas were angular in outline with maximum diameters of between 3 and 4 mm. Pea impressions were round and had diameters of 5.8 and 5.9 mm. The carbonized lentil seed measured 2.4 × 1.4 mm, the impression 4.1 × 1.7 mm. This difference may be due to shrinkage during carbonization on the one hand and swelling caused by the absorption of water on the other. Similar dimensions and similar differences were found in the case of the Linearbandkeramik material from Hienheim (Bakels 1978, 176-178). No such differences were observed in the case of the wheats. A carbonized linseed measured 2.9 × 1.7 × 0.8 mm.

The large amount of einkorn in relation to emmer suggests the presence of both wheat species. Einkorn types of grains are formed in some spikelets of an emmer ear, but in normal crops they represent a minority. The two types may be represented in more or less equal proportions in samples of poor emmer crops. However, it is not to be assumed that all of the Meindling crops were of inferior quality. Emmer and einkorn were common in the Linearbandkeramik culture. The same holds for pea, lentil and linseed. Poppy is a different story and the presence of poppy will be commented on in Section 4 below.

3.2. Wild plants from Linearbandkeramik contexts

The remains of gathered wild plants are limited to one carbonized fragment of a hazelnut shell (*Corylus avellana*) from an early phase of occupation and one impression of an apple pip (*Malus*, presumably *sylvestris*). Wild strawberry (*Fragaria* sp.) may also have been collected if the seeds identified as either *Fragaria* or *Potentilla* are of the first genus. The seeds had a badly damaged surface and could therefore no longer be identified with certainty (fig. 4). The large number of unripe seeds suggests that fat hen (*Chenopodium album*) was also collected for consumption. The seeds may have been thrown away during vegetable cleaning, as K.-H. Knörzer (1967) has suggested. In the area that he studied he found concentrations of these seeds, suggesting that the plant was appreciated for its own worth. Unfortunately, no such concentrations were encountered at Meindling, so we have no evidence to support the hypothesis that *Chenopodium album* was gathered as a vegetable.

Nevertheless, *Chenopodium album* was the most common wild herb at Meindling, not only in numbers but also in frequencies. The plant was encountered in 52 out of 84 Linearbandkeramik samples (tab. 4). Next came *Polygonum convolvulus*, a *Bromus* and *Setaria viridis* or *S. verticillata*. It was difficult to identify *Bromus* species because the seeds were broken. One narrow fragment with a pointed apex was classed as *Bromus sterilis* or *Br. tectorum*. All the other fragments were broader and had rounded apices. The only virtually complete specimen is shown in figure 4. Ten measurable fragments from sample No. 1190 had widths of 1.48 (1.2 - 1.7) mm, which is too wide for *Bromus arvensis*. The seeds were therefore classed as *Bromus secalinus* or *Br. hordeaceus*, although they were fairly narrow.

Chenopodium album, *Polygonum convolvulus*, *Bromus secalinus/hordeaceus* and *Setaria viridis/verticillata* are also the herb species most frequently found at other Lower Bavarian sites. This is apparent from table 4, in which the frequencies of their occurrence in the Meindling samples are compared with their frequencies at other sites where samples were taken from several features. Their frequencies of occurrence at all Lower Bavarian sites investigated are shown in table 5. Similar investigations have been published for the northwestern area of Linearbandkeramik occupation: the German Rhineland, Belgium and the Netherlands (Bakels/Rousselle 1985). *Chenopodium album*, *Bromus secalinus/hordeaceus* and *Polygonum convolvulus* also feature at the tops of the lists for this area, but otherwise there are a few striking differences. *Setaria viridis/verticillata* and *Solanum nigrum*, which scored high

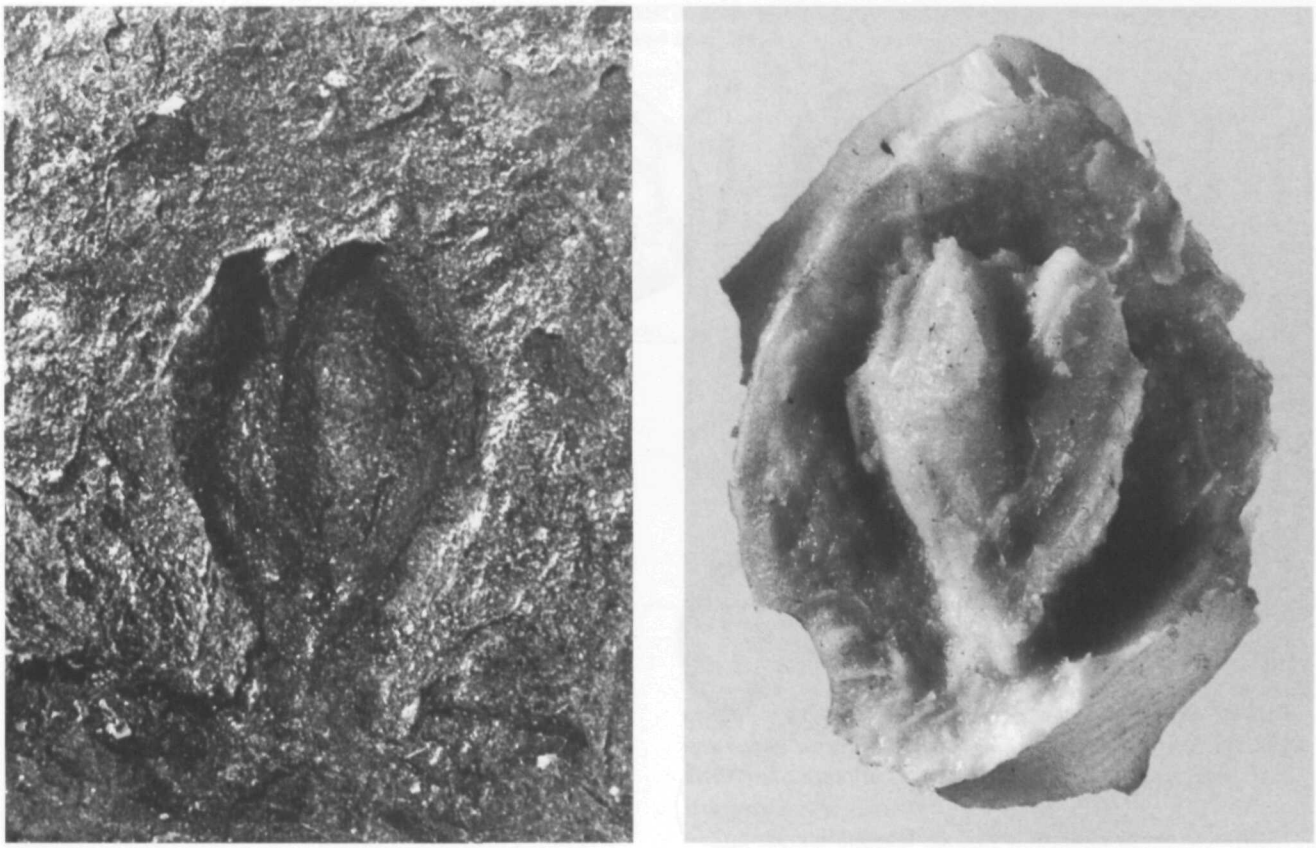

Figure 3. Impression and cast of an emmer spikelet.

Table 4. Frequencies of plants present in Lower Bavarian Linearbandkeramik settlements where samples were taken from several features. Not mentioned are species with frequencies of less than 2. After Bakels 1983/84 and 1986.

	Meindling	Hienheim	Fuchsloch	Aiterhofen
number of samples	84	40	7	7
Chenopodium album	52	9	4	5
Polygonum convolvulus	49	21	3	5
Bromus secalinus/hordeaceus	45	18	1	2
Setaria viridis/verticillata	17	5	3	1
Galium spurium	9	6	-	-
Polygonum lapathifolium	5	-	-	-
Solanum nigrum	5	5	1	1
Echinochloa crus-galli	5	3	1	-
Fragaria/Potentilla	5	-	-	-
Silene cucubalus	4	1	-	-
Phleum sp.	3	-	-	1
Knautia arvensis	2	-	-	-
Rumex sp.	2	1	-	-
Galium aparine	2	-	-	-
Stipa sp.	2	-	-	-
Chenopodium hybridum	-	2	-	-
Bromus tectorum/sterilis	1	2	-	-

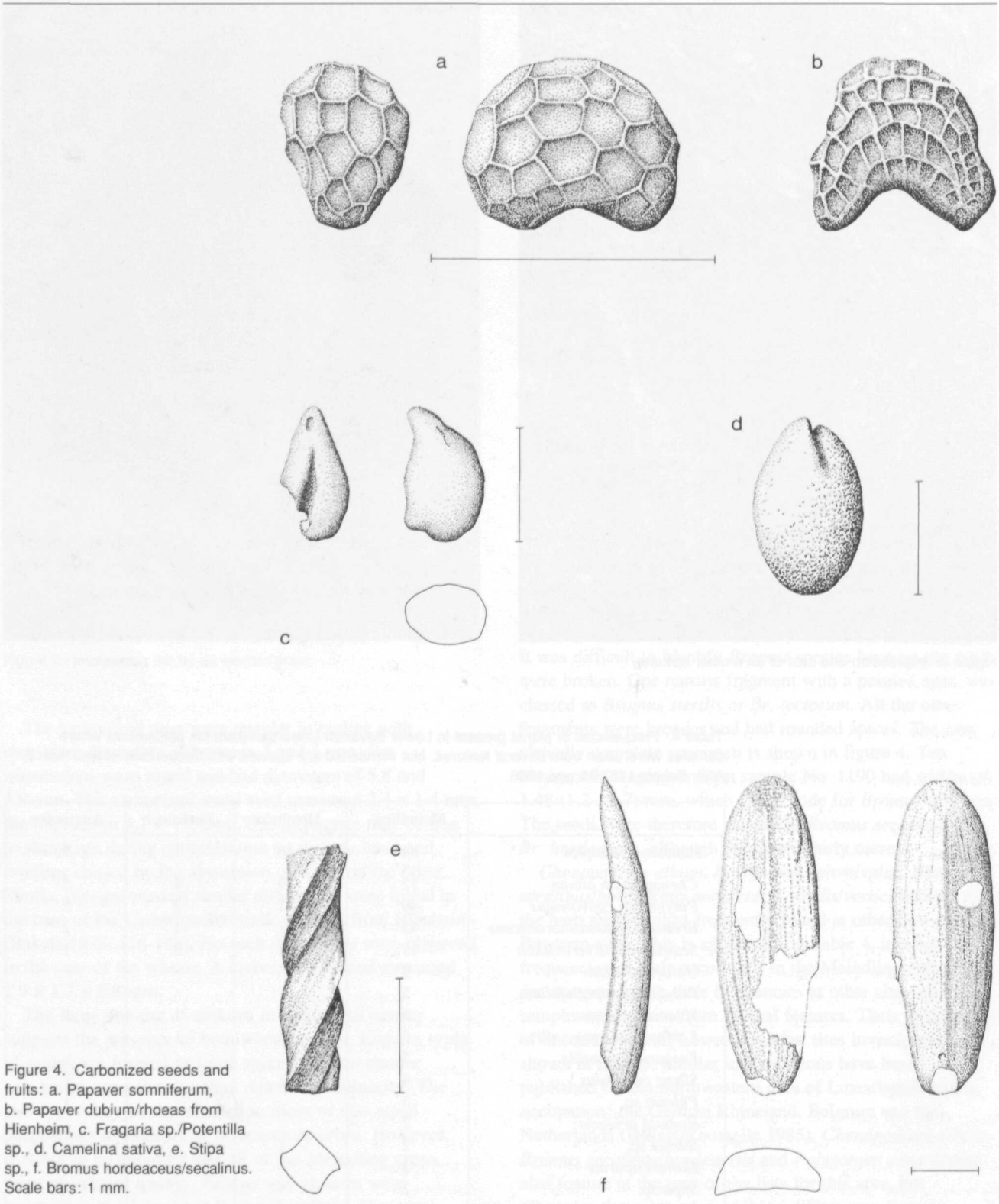

Figure 4. Carbonized seeds and fruits: a. Papaver somniferum, b. Papaver dubium/rhoeas from Hienheim, c. Fragaria sp./Potentilla sp., d. Camelina sativa, e. Stipa sp., f. Bromus hordeaceus/secalinus. Scale bars: 1 mm.

Table 5. Frequencies of the most common plants found in Lower Bavarian Linearbandkeramik settlements. After Bakels 1983/84 and 1986.

	Meindling	Hienheim	Fuchsloch	Aiterhofen	Altdorf	Sallmannsberg	Leitenhausen	Oberpiebing	Frequency
Chenopodium album	+	+	+	+	+	+	-	+	7
Polygonum convolvulus	+	+	+	+	+	+	+	+	8
Bromus secalinus/hordeaceus	+	+	+	+	+	+	+	+	8
Setaria viridis/verticillata	+	+	+	+	+	+	-	-	6
Galium spurium	+	+	-	-	-	-	-	-	2
Polygonum lapathifolium	+	-	-	-	+	-	-	-	2
Solanum nigrum	+	+	+	+	-	+	-	-	5
Echinochloa crus-galli	+	+	+	-	-	-	-	-	3
Silene cucubalus	+	+	-	-	-	-	-	-	2
Phleum sp.	+	-	-	+	+	-	-	-	3
Rumex sp.	+	+	-	-	-	-	-	-	2
Bromus tectorum/sterilis	+	+	-	-	-	-	-	-	2

in Lower Bavaria, are scarce in northwestern Linearbandkeramik contexts. On the other hand, *Lapsana communis* was almost completely absent at the Lower Bavarian sites; the species has been encountered in only one sample from Hienheim so far. Moreover, whereas *Polygonum persicaria* was common in the northwest, *Polygonum lapathifolium* occurred in the south. On the basis of the finds from the northwest K.-H. Knörzer (1971) introduced the *Bromo-Lapsanetum praehistoricum*, a plant community characteristic of Linearbandkeramik fields. It would seem that this *Bromo-Lapsanetum praehistoricum* looked somewhat different in Lower Bavaria.

Most of the herbs are rather common species. There are, however, two interesting exceptions. The first is *Stipa* sp., which was encountered as awn fragments in two early Linearbandkeramik features (fig. 4). *Stipa* awns were also found in the settlements at Eitzum and Niedereschbach, both dating from the earliest Linearbandkeramik (Phase I), and Bruchenbrücken (Phase I or later) (Kreuz 1990). The grass is typical of steppe vegetations. Steppe-like conditions therefore may have occurred in the surroundings of Meindling, or at least in Lower Bavaria, that is, if the possibility of long-distance transport can be excluded. There may have been areas with steppe-like conditions on the steep slopes of hills and on cliffs where no trees could grow, for instance in the Fränkische Alb. Ethnographic evidence led A. Kreuz to the hypothesis that *Stipa* awns may have been used as personal adornment and we should therefore not rule out the possibility of import. Luxury articles tend to be widely distributed; we know of several examples of such articles that were imported from sources more than several hundreds of kilometres away. If the Stipa awns were imported, they even may have come from Hungary.

The second unusual species is *Knautia arvensis*, which was encountered in two not very early, but also not very late contexts. This is an early occurrence of this species. The plant grows at the fringes of woods, along roadsides, in fields, but nowadays mostly in meadows.

3.3. The nature of the Linearbandkeramik waste

The subject of the origin of the carbonized seeds has already been touched upon in Section 3.2. with, for instance, the suggestion of a Bavarian facies of the *Bromo-Lapsanetum praehistoricum*. The question is whether most of the carbonized remains indeed made their way into the settlement as parts of crops. The analysis of the assemblages of seeds found may yield an answer to this question.

Most samples had low find densities (see tab. 1). It is most improbable that the carbonized seeds found in them were thrown away together. They form part of the scattered waste encountered everywhere that has been described elsewhere as "settlement noise" (Bakels 1991). These low densities show a Poisson distribution.
A calculation of the best fitting Poisson distribution for all Meindling samples together reveals that samples with densities of 20 or more carbonized seeds and fruits per dm^3 of soil do not show this distribution. They are possibly not the result of chance.

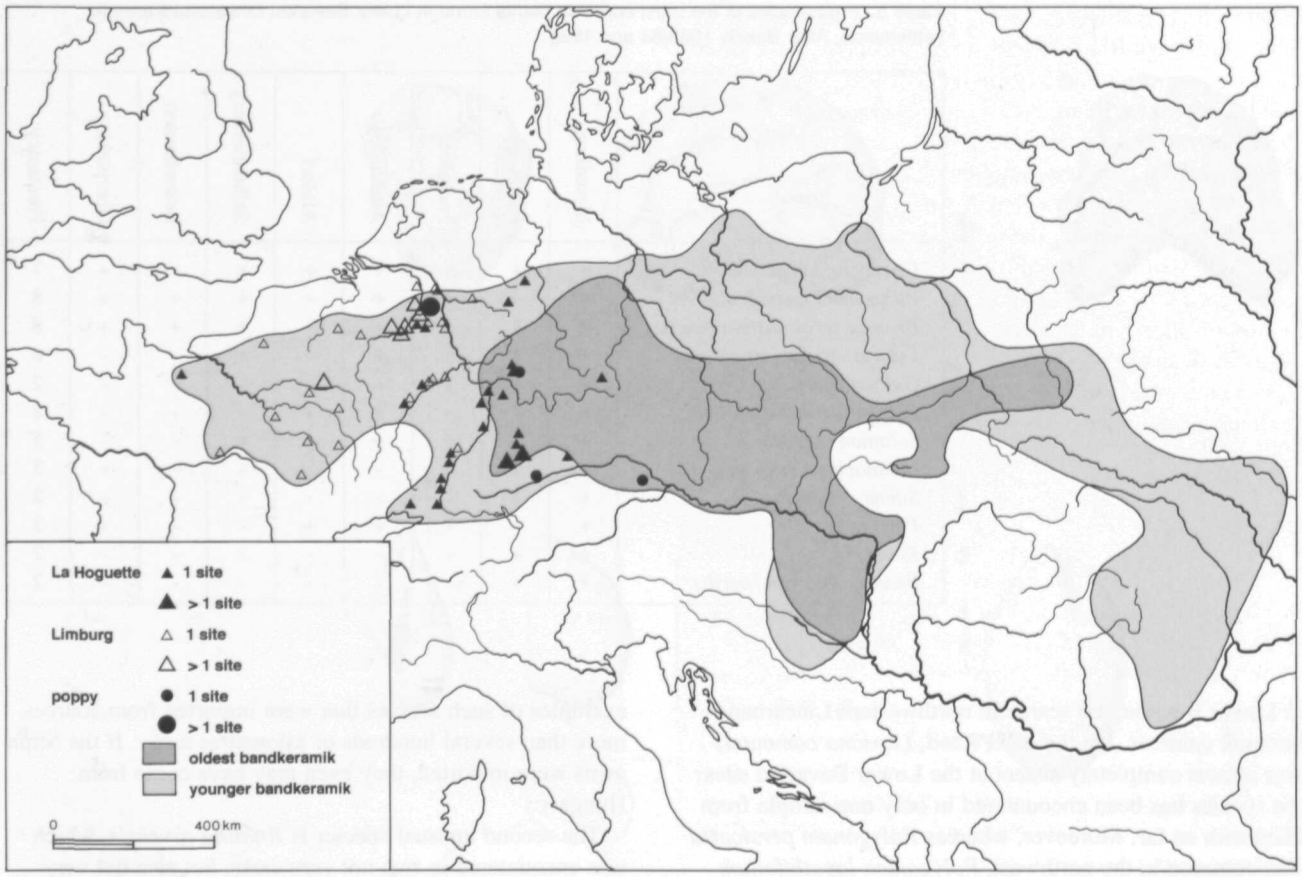

Figure 5. Distribution of La Hoguette pottery, Limburg pottery and poppy seeds. Map mainly after Bakels 1982 and Lüning *et al.* 1989.

All the samples in question contained wheat grains, wheat chaff (mostly lemma bases) and seeds of wild herbs. Table 6 gives the chaff and grain ratios. Emmer wheat has a chaff/grain ratio of 1, einkorn has 2. Most of the values in table 6 are of the same order of magnitude and lead to the conclusion that the wheat was carbonized before it had been dehusked. The fact that grain and chaff no longer adhere to one another is not incongruous because the chaff will have been quite loose after carbonization and will have been separated from the grain during any rough handling of the grain, which, being carbonized, will have been treated as waste. The wild herbs in the samples, most of them potential field weeds, are interpreted as weeds that were harvested together with the crop plants and were discarded together with the spoiled grain. Dehusking is thought to have been done on a day-to-day basis (Hillman 1984). If the wheat was a little damp, dehusking could be facilitated by roasting it lightly. If this accidentally went too far, some of the wheat may have been burnt or carbonized. Small household accidents could account for the presence of most of the waste. As the "noise" has a similar composition, that, too, may be the, scattered, result of the same food-processing activity. However, the common occurrence of this kind of domestic waste should not lead to the assumption that food was wasted every day. A few accidents per year may have led to the effect observed. The presence of sherds does not imply that people broke their pots every day either.

Three samples, Nos 193-2, 194a and 209, contained too much chaff for the explanation presented above. Sample 193-2 had the highest density of all the samples (125.5 specimens per dm^3) and this is almost completely due to the presence of chaff. It was taken from a very black layer in the pit fill.

Concentrations of burnt chaff are a common kind of Linearbandkeramik "fruit and seed" concentration. Such concentrations are encountered in almost all large excavations. They are interpreted as residues of the burning of superfluous material. Some chaff was used for instance for the tempering of clay but there seems to have been a

certain excess that had to be discarded. At Langweiler 8, a settlement in the Rhineland, K.-H. Knörzer found the burnt chaff exclusively in the western and northern parts of the farm yard. This led him to the conclusion that this is the special activity area where the grain was dehusked and the chaff was burnt. The choice might have been influenced by the prevailing westerly or southwesterly winds (Knörzer 1988). Similar studies at the settlements at Schwanfeld Ldkr. Schweinfurt, Germany, and Geleen, the Netherlands, also revealed such activity areas, only there the chaff was found exclusively in the eastern parts of the yards (Bakels 1995). A plausible explanation for the difference has not yet been found. Winds were westerly or southwesterly in all of the three cases mentioned above; they cannot have been solely responsible for the pattern observed.

Meindling constitutes a second example of chaff deposition to the west of the house. Pit No. 193 was situated to the west of house 6 and its contents are thought to have derived from this household. Pits 194 and 209 may also be associated with this house; they also lay to the west of the house. In spite of this evidence, Meindling is not entirely comparable with Langweiler 8, because the three pits belonged to a system of pits dug along the wall of the house. Such pits, which are interpreted as the sources of loam for the wattle-and-daub walls, never contained chaff remains at the Langweiler 8 settlement, nor at Schwanfeld for that matter. The chaff was found in pits of the type "isolated pit in yard". At Geleen, on the contrary, pits dug along the walls were used for dumping chaff, but, as indicated above, in this case the eastern ones. It is possible that there was an activity area for the disposal of excess chaff, and its position within the yards of an individual Linearbandkeramik settlement may have been fixed, but there seem not have been general, culturally prescribed, rules (tab. 7).

The assemblage from pit 193 is conspicuous for a different reason, too: weeds are almost absent. It is inconceivable that the weed seeds were already discarded during an earlier stage of crop processing. Weeds with heavy seeds or with seeds having the same dimensions as cereal grains are not easily discarded. Examples are *Polygonum convolvulus* and *Bromus secalinus/hordeaceus*. The crop must have been clean already when it arrived in the settlement. Such a clean crop may have been obtained by carefully harvesting the ears by hand, by thoroughly weeding the fields or by sowing well cleaned sowing grain in soil not yet infested with weeds, *i.e.* virgin forest soil.

Analyses of Linearbandkeramik assemblages from the Rhineland, the Netherlands and Belgium have yielded some evidence supporting the last hypothesis (Bakels 1991). Finds from the pioneer phase of a newly settled area contained less weeds than those from later phases.

Table 6. Chaff/grain and chaff/weed seed ratios in samples with densities of 20 specimens or more per dm^3 of pit fill.
E: Early Bandkeramik, L: Late Bandkeramik.

Feature	Chaff : Grain	Chaff : Weeds	Phase
122-1	3.2	0.22	E
138	1.8	0.35	E
193-2	26.6	79.67	E
194a	10.4	8.67	E
194b	5.8	3.12	E
52	5.5	0.41	
88	1.6	0.50	
95-1	1.5	1.06	
98	1.6	1.17	
100-1	2.0	0.96	
100-2	1.2	0.37	
102	2.8	0.77	
190	1.0	0.38	
209	15.5	2.21	
93-2	1.4	0.80	L
97	1.6	0.29	L
115-1	2.0	0.59	L
115-3	3.2	6.32	L
117	1.6	1.33	L
235-1	2.0	1.38	L
305	1.3	0.59	L

Table 7. The positions of carbonized chaff concentrations in relation to the house. The pits marked 'W' and 'E' indicate isolated pits in the western and eastern parts of the farm yard, respectively. Those marked 'WL' and 'EL' are elongated pits running parallel to the western and eastern walls of the house, respectively

	W	E	WL	EL
Langweiler 8	+	-	-	-
Schwanfeld	-	+	-	-
Geleen	-	+	-	+
Meindling	-	-	+	-

However, the comparison of Meindling chaff/weed ratios of assemblages early in the sequence with those of late assemblages does not reveal a convincing trend (tab. 6). At first sight the early assemblages seem to have the highest ratios, but the list of these five assemblages is headed by Nos 193-2, 194a and 194b. Pits 193 and 194 are near neighbours and their contents may not be entirely unconnected. When they are considered together, the difference between "early" and "late" ratios is not very great.

The question may even be asked whether the crops were perhaps always brought into the settlement clean, which leads to the question whether the weeds observed are to be considered ordinary byproducts of cereal cleaning as was

already assumed above. There may very well be no immediate connection whatsoever between the herbs and cereal processing. As a matter of fact, the majority of the seeds are of four species, *Chenopodium album*, *Bromus secalinus/hordeaceus*, *Polygonum convolvulus* and *Setaria viridis/verticillata*, which may have been collected for food to supplement the cultivated products. An objection to this hypothesis is that these plants have not been found separate; they are always associated with chaff. That is why it is most probable that most herbs are indeed byproducts of crop processing. The background of the clean harvest is therefore not yet clear.

Almost all of the herbs found are tall plants or climbers. The exceptions are *Fragaria/Potentilla* and *Trifolium repens/Lotus corniculatus* and, with *Stipa*, these are the only ones which do not occur in fields and may not be connected with crop processing. The former could be gathered wild strawberry and the latter grows on grassy patches. The others can be found in fields or gardens and the fact that they are tall species can be explained by assuming the use of a certain harvesting method with which the culms are cut high above the ground.

Unfortunately the weed species provide no good clues as to the sowing season. The *Bromus* species indicate autumn-sown crops, but others are usually associated with spring-sowing, at least nowadays. Some plants are even perennials. Fields or gardens may have been sown both in the autumn and in the spring, depending on the crop. The soils seem to have been quite ordinary, certainly not acid or poor.

3.4. The Hallstatt period

The Hallstatt samples contained a hulled wheat, which might be emmer, einkorn or both, lentil and the plant referred to above, gold of pleasure, *Camelina sativa* (fig. 4). Gold of pleasure is not known from the Linearbandkeramik. The oldest example of this species found in Central Europe is that from Auvernier in Switzerland (Villaret-von Rochow 1971), of late Neolithic date. The species became more common during the Bronze Age; in the Iron Age it was grown all over the northern parts of Central and Northwest Europe (Knörzer 1978). Finds from southern Germany are still very scarce; so far no finds whatsoever have been reported for Lower Bavaria (Hofmann 1983/1984). The nearest evidence of its occurrence is an impression in pottery from the Heuneburg Ldkr. Sigmaringen, in southern Württemberg (Hopf/ Blankenhorn 1983/1984), which also dates from the Hallstatt period. The Meindling specimen measures 1.55 × 1.00 × 0.95 mm and is therefore considered to be a cultivated gold of pleasure.

Hazelnuts were gathered. Of the herbs *Artemisia* sp., *Euphrasia* sp./*Odontites* sp. and an unidentified Compositae should be mentioned.

4. Poppy (*Papaver somniferum*)

The discovery of two poppy seeds was a big surprise. They were found in two totally unrelated pits lying far apart from one another and have to be interpreted as separate finds. Their date is Younger Bandkeramik. Only one was complete enough to be measured (0.7 × 0.55 × 0.4 mm) and drawn (fig. 4). The poppy is thought to be of the variety *setigerum*. The contemporaneous *Papaver dubium/rhoeas* from Hienheim is shown next to it to enable comparison (fig. 4).

The surprise was that Meindling lies further to the east than all of the other Linearbandkeramik settlements where poppy has been found. The concentration of finds is situated between the Rhine and the Meuse, in the northwestern part of the distribution area of this culture. The only sites at which poppy has been found east of the Rhine are Bruchenbrücken (Kreuz 1990) and Ulm (Gregg 1989). Here too, the *Papaver somniferum* did not date from an early phase of the culture, whereas in the northwest it is known from phase II ("Flomborn") onwards. The earliest Linearbandkeramik phase, Phase I, is not represented in this region.

Poppy has drawn special attention because it is the only crop plant whose origin cannot be traced back to the Near East. Its source is to be sought in the surroundings of the Western Mediterranean Basin (Bakels 1982). It is questionable whether the plant is a crop plant; it may have been a crop weed, but even as a weed it must have had a Western Mediterranean origin. The discovery of a pot made from clay purposefully tempered with poppy seeds however suggests that the plant was not considered to be an everyday weed. Its oily seed is not particularly suitable for use as temper (Bakels/Constantin/Hauzeur 1992).

It has been suggested that the plant was introduced into Linearbandkeramik agriculture through cultural contacts with contemporaneous farmers with roots in France (Bakels 1982). The La Hoguette Group has been mentioned in this context, a group only known from its pottery. It is possible that the La Hoguette people had contacts with the Cardium culture or its "aura" and hence indirectly with the Western Mediterranean agricultural world (Lüning/Kloos/Albert 1989). Unfortunately, so far no poppy seeds have been found in Cardium contexts, but this may be due to the small number of thorough investigations carried out.

The distribution of La Hoguette finds is shown in figure 5. Sites have been found east of the Rhine, but not yet as far east as Meindling. However, in view of the late date of the Meindling poppy seeds, the La Hoguette distribution area need not have extended that far east. If the poppy travelled from the west to the east there need not have been any direct contact. If La Hoguette passed the poppy on to the phase II farmers in the northwest, the latter may in turn

have passed on the new plant to the later Linearbandkeramik occupants of other regions.

Another group that may have been involved is that of the so-called Limburg Pottery. The status of this cultural group is not very clear either. It is contemporaneous with the Linearbandkeramik, but apparently not with its earliest phase. Its has a western distribution area, but the group is thought to be less associable with the Neolithic of southern France (Lüning/Kloos/Albert 1989).

5. Conclusions

The main motive for starting an excavation at Meindling was to investigate the Linearbandkeramik Phase I, the founding phase of the Linearbandkeramik, in Lower Bavaria. Unfortunately, Meindling proved not to be the ideal site for this purpose. It was not possible to follow the development of Linearbandkeramik agriculture at this site either. Nevertheless, the botanical investigations yielded some interesting results. One of these is the conclusion that the field weed vegetation of Linearbandkeramik Lower Bavaria was different from that of the Rhineland and its adjacent area. Much research has been carried out in the latter areas and the evidence obtained has always been regarded as representative of the Linearbandkeramik as a whole. This now proves not to be the case. A second interesting discovery was the presence of *Stipa* sp., a plant from steppe environments, which may indicate either the existence of steppe environments in the neighbourhood or import from more eastern regions with such an environment. Thirdly, the occurrence of poppy seeds so far east must be mentioned. To conclude, as is usual at this kind of sites, the waste concentrations encountered are the results of the domestic activities of dehusking grain and dumping excess chaff.

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