Appendix II: Carbonized plant remains from Hienheim

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APPENDIX II

CARBONIZED PLANT REMAINS FROM HIENHEIM

During the first three excavation campaigns in Hienheim, those of 1965, 1967 and 1968, no special attention was paid to plant remains. Only occasional observations were made. Not until 1970 did a systematical botanical investigation take place. This investigation has become standard routine since 1971.

Samples are taken, if possible, from the filling of each well-dated pit, waiting until sections of the pits are available. The finds which appear in the excavation of the sections, date the samples, whereas the section provides information about the fill layers, if any. We take our samples from the section wall, and of course we take layers that are present into account. The sample size usually amounts to 2 dm³. Practice has shown that this quantity is sufficient to determine whether there are plant remains in the pit filling. If seeds and the like are observed already in the field, then the sample is enlarged, if possible. Sometimes we have to remain content with a smaller sample.

The soil is hand-sieved on the spot by means of sieves with a mesh-width of 0.5 mm and ordinary water. Flotation has failed so far as a method of separating plant remains from the loess-loam filling of the pits in Hienheim. Laboratory tests show that, at the most, cereal grains and charcoal fragments come to the surface; pulses practically always sink. The residues from the site are sieved again in the laboratory and subsequently sorted under a microscope at a magnification at 10 times.

In the investigation both carbonized and uncarbonized seeds appear, as well as chaff remains, charcoal fragments, chert splinters and the like. We consider the uncarbonized seeds to be recent, since we think it impossible that uncarbonized plant remains stay intact in the well-drained soil for a long time. Among the uncarbonized seeds, we often find large numbers of Chenopodium album. Besides, Polygonum convolvulus, Melandrium album and Stellaria media occur regularly. These plants are part of the recent weed flora on the excavation site. Especially Chenopodium album and Polygonum convolvulus can present problems, as they can be taken for prehistorical seeds. In our lists, we have only mentioned those seeds* which, after having been broken, appeared to be carbonized inside. Loose seed-coat and pericarp fragments without carbon remains adhering to them, were not included. Our experience in Hienheim is that the recent seeds may even occur on the bottom of very deep pits. In such cases the soil at the top of these pits does not necessarily contain recent seeds. In disagreement with Knörzer, we feel that the distribution of the seeds over the contents of the pits can be no argument for the dubious finds being recent or not (Knörzer 1967a p. 17).

The carbonized remains are listed in tables 15, 16 and 17. The first two lists comprise all seeds (and some other plant remains) found in a LBK context. The third list concerns charcoal fragments. It was composed from the statements by Dr. P. Baas of Leiden (Netherlands) and Dr. F.H. Schweingruber of Birmensdorf (Switzerland). They examined a number of pit fillings which we had selected. Charcoal is a rather rare phenomenon in Hienheim. Most pit fillings, even the dark-coloured

* We often use the word "seeds" when also fruits and the like are meant.

ones, provide but a few fragments. Moreover, these are not larger than a few mm. As a test, Dr. Schweingruber examined the charcoal of 6 pit fillings, in which only very small particles were found. According to him, the conservation condition of the splinters is good. But many pieces are in a very advanced state of carbonization. He thinks it possible that a large part of the burnt wood has carbonized into powder and is therefore no longer recognizable as charcoal (Schweingruber 1975 written information). Moreover, the loess-loam filling of the pits is a very unfavourable sediment as far as the preservation of charcoal is concerned. It appears that a considerable part of the clay fraction has displaced itself in the course of time (van de Wetering 1975a). By the illuviation of the clay particles and the shrinking and swelling of this clay, the structure of the charcoal is gradually lost. Charcoal of hard wood is preserved better in these conditions than charcoal from soft wood (Schweingruber 1973 p. 153). This could explain the fact that Dr. Baas, who identified samples with larger charcoal fragments, could demonstrate only oak.

The charcoal which we found can of course not be considered a true reflection of the wood species which were present around the settlements. Man made the first choice, after which corrosion took care of subsequent selection. But the data are not in contradiction with the picture which we have formed of the vegetation around Hienheim. The plants found among the charcoal can all have stood near the settlement (see p. 43). It is almost impossible to say something about the use which the inhabitants of the settlement made of the different wood species (see further p. 81).

The presence of seeds is independent of the presence of carbonized wood. It is true that the same applies to the seeds as to the charcoal fragments, namely that in most soil samples only few specimens were found, but the larger number of seeds are not necessarily to be found in the pit fillings with much charcoal. When in a single pit both charcoal- and seed-concentrations are observed, as in pit no. 414, then the carbonized wood and the carbonized seeds are not mixed up. Therefore we think that the seeds were carbonized independently of the wood. We have discussed the possible causes of the carbonization in IV.2.

There are few pits in which systematic investigation revealed no seeds at all, but the density of the seeds, fruits, chaff remains and the like is small in most cases. Of the 24 LBK pits or parts of pit complexes which were analyzed in the campaigns of 1971, 1973 and 1974, only three pits provided nothing at all. The greater part of the samples contain some cereal grains or cereal grain fragments, heavily damaged halves of the spikelet forks of Triticum monococcum or Tr. dicoccum and a limited number of seeds of wild plants. We have the impression that this kind of remains is spread over the entire settlement area and must be considered as a widely scattered part of the dirt in the settlement. Concentrations of seeds are rare, as appears from the densities listed in table 15.

It is difficult to compare these data with those from other settlements, because little equivalent research has been done. In Rosdorf, Willerding found a density of 0.5–1.6 with one exception of 11.4 seeds per dm^3 of soil, which corresponds more or less to the figures from Hienheim (Willerding 1965 p. 57). The soil samples from the Rheinland, e.g. from Langweiler–2, provided more carbonized remains. About half the samples contained more than 10 seeds per dm^3, not even including the sometimes numerous chaff remains (Knörzer 1973). These densities might be inflated because Knörzer only received soil samples from dark-coloured layers for his analysis (Knörzer 1973 p. 140), but it is also very well possible that the densities in the Rheinland are indeed higher. It was no rule in Hienheim that dark-coloured fillings contained many seeds. On the other hand it is true that the light samples always provided little.

The sampled pits belong all but one to the types described by Modderman: longitudinal pits and pit complexes (Modderman in press). The exception is no. 415, a post-hole of house 31. Pits that could be interpreted as storage-pits, have not been found. Our results give no reason to distinguish between the fillings of longitudinal pits and the fillings of pits which form the so-called complexes.

As said already in the description of the sampling method, we paid special attention to the layer-structure of the pit-fillings. Only five sections gave us reason to keep different layers separated during the sampling. These are the numbers 1082, 1086, 1089, 1211 and 1259. These layers are indicated in the tables by a cipher behind the find number: 1 is the top and 2 or 3 is the bottom. In the case of 1082, 1086 and 1259 the conclusion must be drawn that the layers have a comparable composition. The layer-structure was far less clear in these pits than in numbers 1089 and 1211. In 1089, the dark-coloured top layer contains mainly peas, whereas the much lighter layer underneath appeared to be sterile. In number 1211 the uppermost part of the pit filling contained little material, whereas the finds were located precisely in a dark layer on the bottom of the pit. This layer might represent the remnant of burnt chaff, which would be the only one in its kind that we found in Hienheim (see p. 62).

The distribution of the finds over the settlement area might provide indications of the location of certain activities on certain places within the settlement. Nothing in our observations suggests that the activities that led to the carbonization of seeds and chaff remains, were concentrated in special places. We think that we may conclude from the fact that most pits contain carbonized remains, that the activities in question took place throughout the settlement, unless the carbon got spread equally over the settlement by the wind. This seems improbable to us, especially as far as the cereal grains are concerned. We do not expect that the investigation of the still unexcavated part of the settlement (60% of the area with traces of LBK occupation) will change our conclusion. The possibility remains that a special working place will be discovered, but we think that chances are small. A similar investigation in Langweiler–2 disclosed no clusters of pits with carbonized remains either (Farruggia et al. 1973).

The largests among the seed assemblages give us information about the nature of above-said activities. We have made a further analysis in IV.2 of the eight suitable assemblages. Five assemblages (325, 701, 764, 1140 and 1420) could be considered as the remains of a crop which was not yet threshed, one could be either the remnant of an unthreshed crop, or a stock (1089), one find (414) is perhaps the discarded remnant of a stock, and one assemblage (1211/2) could pass for burnt threshing-waste.

The further interpretation of the material is given in IV.2. Below we give only the description of the remains listed in tables 15 and 16.

DESCRIPTION OF THE CARBONIZED REMAINS, CHARCOAL EXCLUDED

CULTIVATED PLANTS

Triticum monococcum L. and Triticum dicoccum Schübl.

A large part of the cereal grains was damaged during the carbonization to such an extent, that the species can no longer be determined. The genus to which they belong, can sometimes not be identified either, but in those cases where it was possible, it turned out to be the genus Triticum. As all identifiable caryopses are from Triticum monococcum or Tr. dicoccum, we assume that by far the greater part of, if not all, cereal grains found can be considered to belong to einkorn or emmer. Besides, all chaff remains originate from these wheat species. Hordeum has been demonstrated in Hienheim, but not in a LBK context.

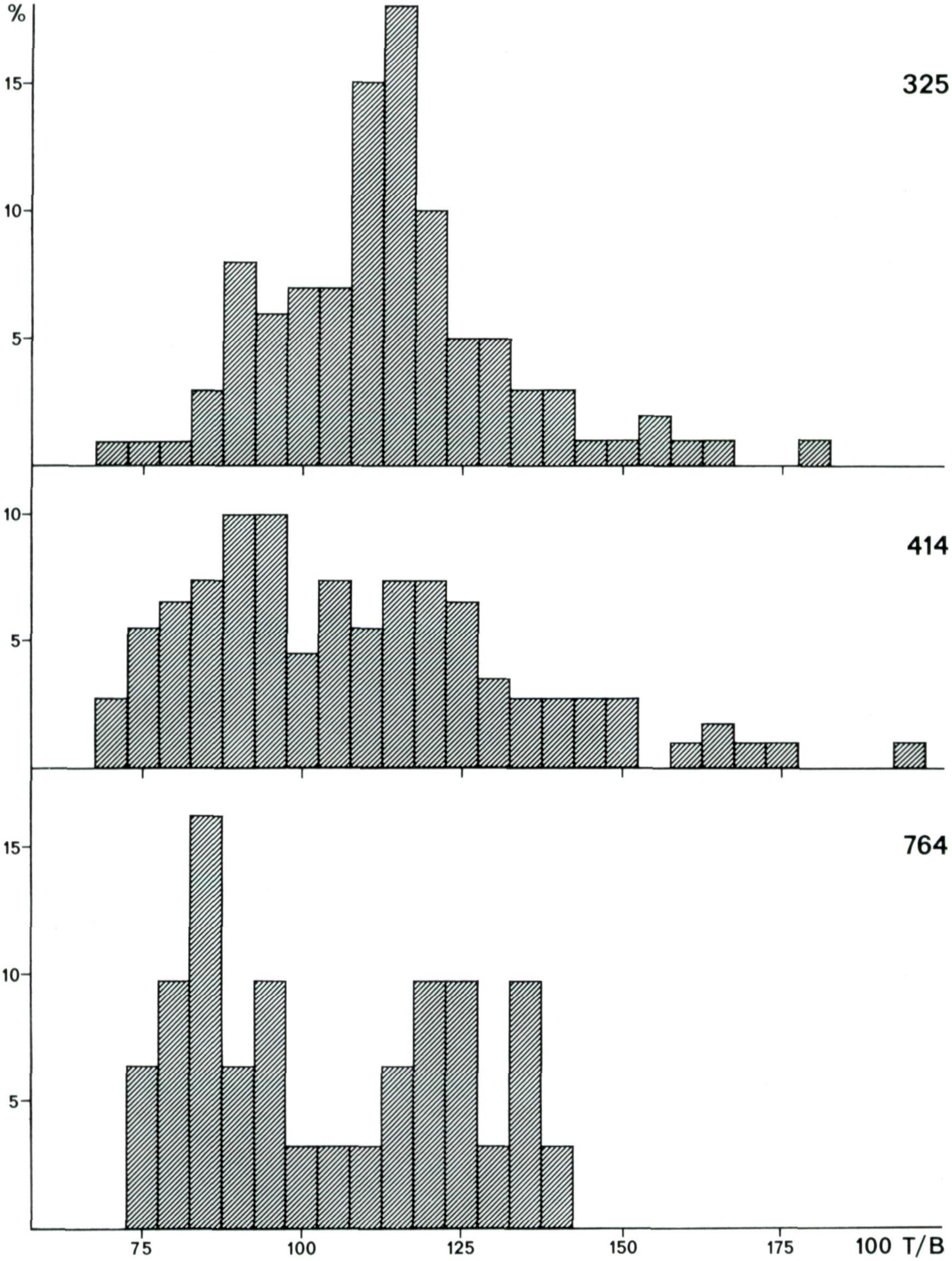

Fig. 23. Thickness : Breadth index for Triticum from the samples Hienheim 325, 414 and 764.

It is often difficult to make a distinction between emmer and einkorn. Both wheat species occur as a mixture in the assemblages. This is illustrated for one identification characteristic in figure 23, where the 100 T/B index of three assemblages is shown. The division is bi-modal. The overlap of the constituting parts makes it difficult to state the exact numbers of emmer and einkorn. We laid the separating line at 100 T/B = 100, as is usual, but this does mean that some grains, which we list as einkorn, are in fact emmer grains, whereas the opposite also occurs. Therefore we can give no histograms of the frequency distribution of the length and the 100 L/B index.

Not only grains, but also chaff remains were found. These comprise spikelet forks and glume bases. They are listed together in table 15. There are two numbers in the column. The first is a statement of the number of spikelet forks + glume bases, which was found in the samples. It is also the maximum number of spikelet forks. The second number is the minimum number. It is the number of spikelet forks that would be found if all glume bases were paired.

The spikelet forks originate partly from emmer, partly from einkorn. An exact separation cannot be made: there are spikelet forks which in all respects are typical for einkorn, as well as specimens which are typical for emmer. The dimensions of spikelet forks from one sample, no. 325, are given in figure 24. The dimensions are the dimensions introduced by Helbaek: breadth of the spikelet forks (dimension A) and breadth of the glume bases (dimension B). The distribution of both dimensions is continuous. There are few specimens with a dimension A larger than 2.0 mm. This appears to be normal for emmer found in a LBK context. At least, Knörzer mentions for the Rheinland no breadths of more than 2.0 mm (Knörzer 1967a p. 10, Knörzer 1974 p. 184).

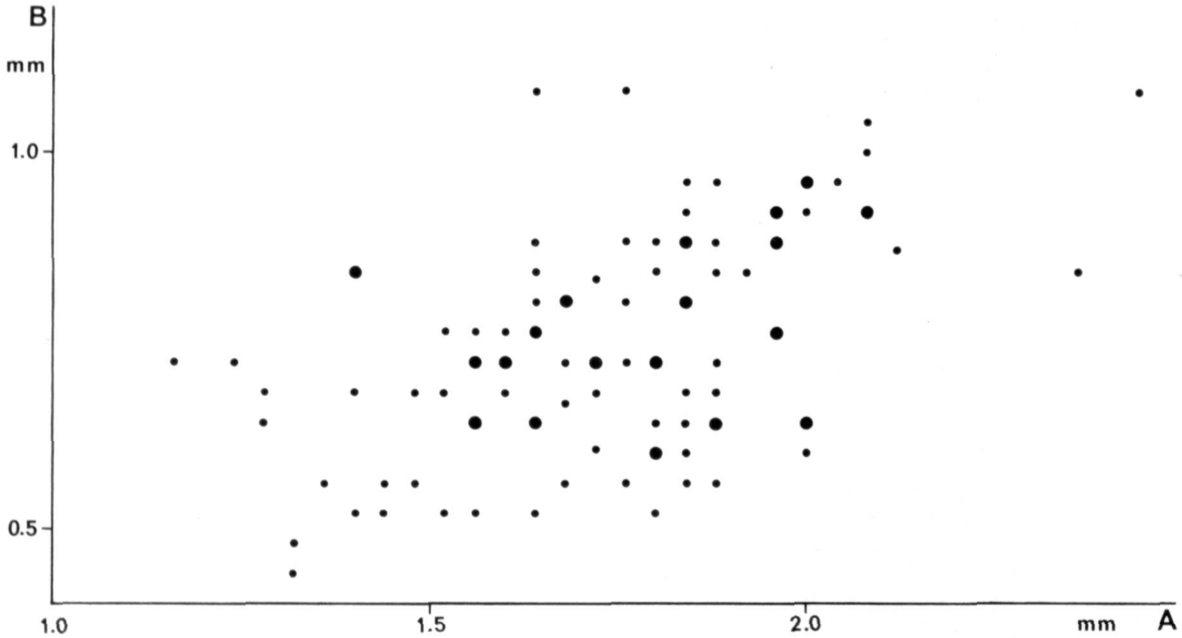

Fig. 24. Dimensions in mm for spikelet forks from Hienheim 325. A = breadth of the fork, B = breadth of the glume base. small dot = one specimen, large dot = several specimens.

Pisum sativum L. (fig. 28, fig. 32)

Whole and half specimens of the pea were found, as well as many fragments. The seeds have a special, ellipsoid or cylindrical shape. Most of them are dented. Of a number of specimens the hilum and the seed-coat remained intact. The hilum is oval: the dimensions of 52 hilums from find no. 414 are 1.05 (0.5–1.4) by 0.67 (0.3–1.2) mm; the ratio length/breadth is 1.66 (1.1–2.7). When slightly magnified, the seed-coat has a smooth surface; a magnification of 50 times shows that it is covered with small warts. The warts are slightly bigger than those of carbonized specimens of recent peas which we studied (Pisum sativum ssp sativum and ssp arvense), but they are finer than the warts of Pisum elatius. Because of the shape of the hilum and the smoothness of the seed-coat, the seeds of Pisum found must be considered to belong to the cultivated species Pisum sativum. Besides, the wild species is not indigenous to the surroundings of Hienheim.

The seeds are small. The dimensions of the specimens from two find numbers are given in the histograms of figure 25. Carbonization tests with recent seeds of Pisum sativum ssp sativum and ssp arvense show that carbonization reduces the size of pea seeds by 2 to 10%. Therefore, the LBK seeds were slightly bigger originally.

The sizes are not different from the dimensions quoted elsewhere for LBK peas. A number of sizes have been collected in figure 26. The data have been taken from Baumann & Schulze-Motel 1968, Knörzer 1967a, Rothmaler & Natho 1957 and Willerding 1965. The site Evendorff is situated in the département Moselle in France and has not yet been published (identification and dimensions by C.C. Bakels). It should be noted that the dimensions are not completely comparable, because the method of measuring was not exactly the same everywhere. For Hienheim and Evendorff we chose the maximum diameter as the dimension to be measured. Since the seeds are often flattened off or indented, we think that measuring the length, the breadth and the thickness does not always make sense. In the other finds we always took that dimension of the quoted dimensions which is the largest: for the peas of Rosdorf for instance, this is the length. In Hienheim, the length and the maximum diameter appear to be close to each other. The difference averages 0.1 mm.

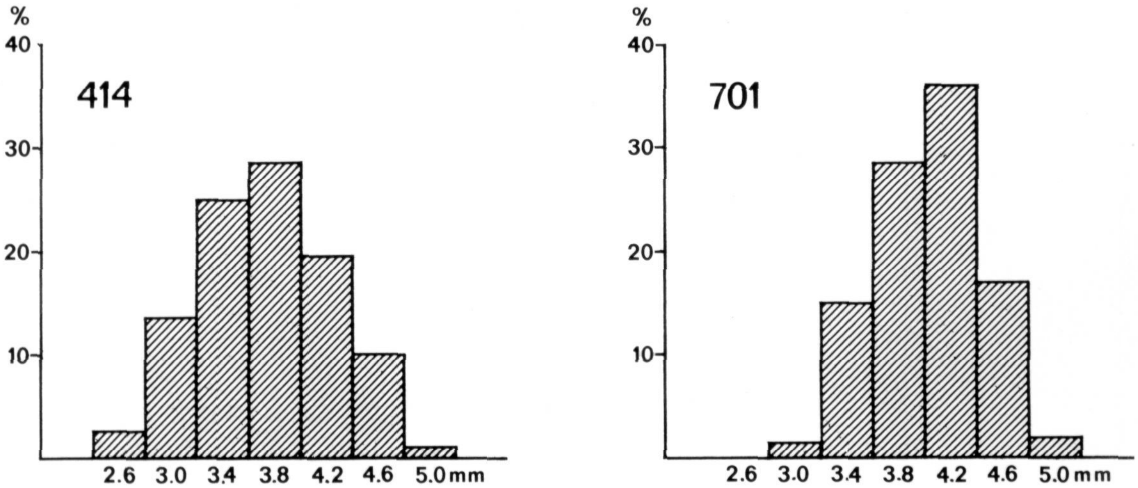

Fig. 25. Maximum diameter of Pisum sativum from Hienheim 414 and 701, N = 200.

The dimensions of carbonized peas appear to be slightly smaller than the dimensions quoted for the impressions. An impression from Hienheim has a diameter of 6.0 mm; four impressions from Nerkewitz Kr. Jena (DDR) have diameters of 6.1, 5.4, 5.0 and 6.4 mm (Tempír & Gall 1972). These peas probably absorbed water, which made them swell.

The pea was a widely spread cultivated plant at the time of the Linearbandkeramik.

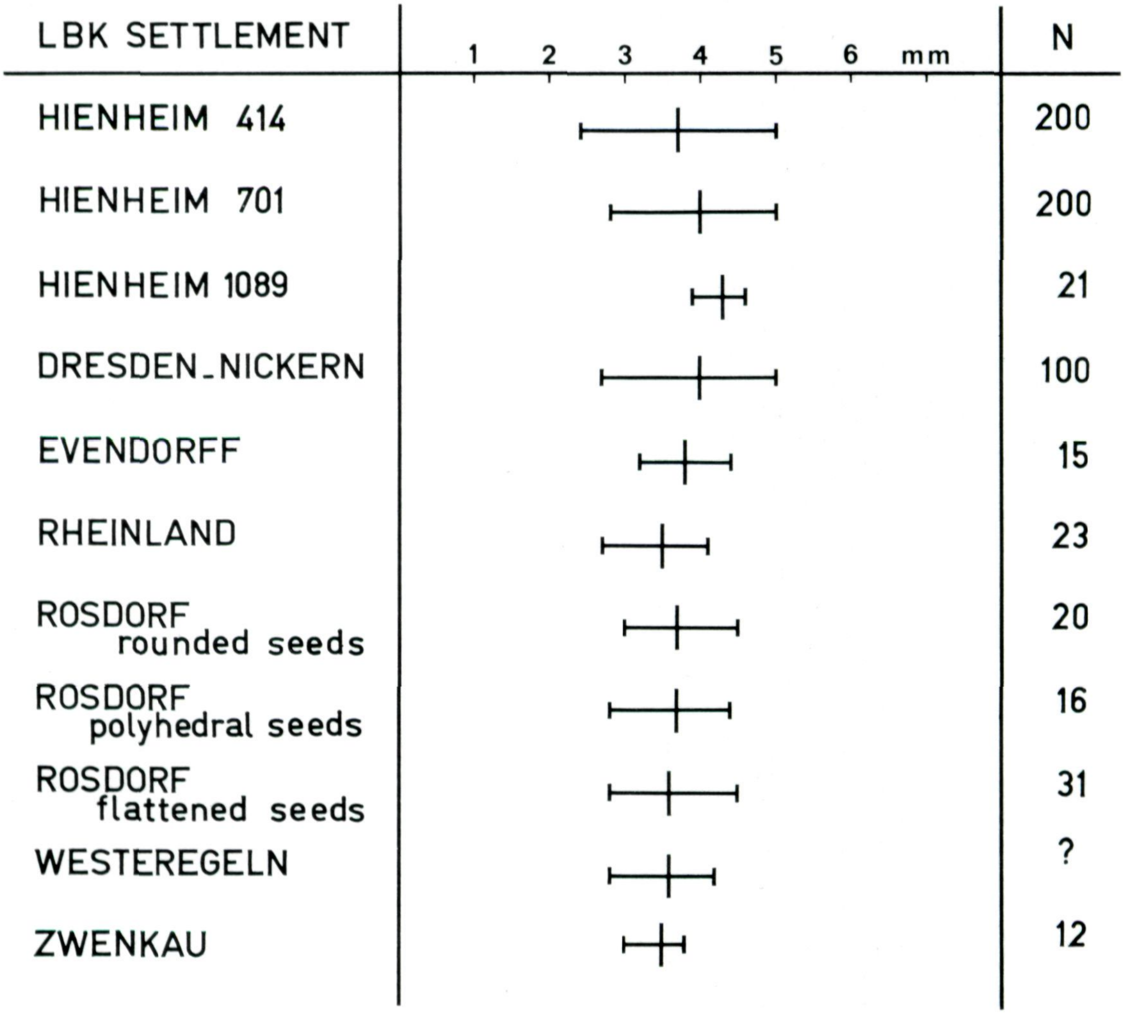

Fig. 26. Sizes of carbonized peas found in LBK context.

Lens culinaris Medik. (fig. 28, fig. 32)

The lentil is represented by only a few specimens, namely by two whole lentils and the fragments of cotyledons of at least four specimens. None of the lentils still has a seed-coat and a hilum. Confusion with other Papilionaceae is not possible, however. The whole specimens have a diameter of 1.9 and 2.8 mm.

The thickness is 1.0 and 1.4 mm respectively. The cotyledons belonged to seeds with a diameter of 2.4, 2.7, 3.1 and 3.2 mm. The thickness of the cotyledons of these specimens is 0.6 mm at the most. The dimensions of the lentils from Hienheim correspond to those of carbonized lentils from other LBK settlements. These are Aldenhoven Ldkr. Jülich (BRD), Lamersdorf Ldkr. Düren (BRD), Rödingen Ldkr. Jülich (BRD) and Langweiler-2 Ldkr. Düren (BRD) (Knörzer 1967a, Knörzer 1973). Knörzer gives the dimensions 2.49 (1.9–3.0) × 1.7 (1.3–2.0) for the lentils from Aldenhoven and Lamersdorf. In Langweiler-2 a fragment of a cotyledon was found with a diameter of ~ 2.4 mm and a thickness of 0.7 mm. We do not mention the lentils from Eisenberg, Heilbronn and Böckingen, because we do not know for sure whether these finds are of uncontested linearbandkeramik age. From Nerkewitz Kr Jena (DDR) the impression of a lentil is known. The diameter of this specimen is 4.3 mm and thus much larger than the diameter of the carbonized speciments (Tempir & Gall 1972). We think that this lentil had absorbed water.

The lentil has never been found in large concentrations so far and apparently does not belong to the usual finds.

Linum usitatissimum L. (fig. 28, fig. 34)

Linseed was observed in three find numbers, each with one damaged specimen. The characteristic beak is absent in all three cases. The keeled edge is clearly visible. The surface of the seeds is smooth with a clear cellular structure. This structure corresponds entirely to that of Linum usitatissimum. The surface of L. austriacum and L. flavum, which look like our Linum, has larger cells. The final determination, however, only followed after we had compared the fragments from Hienheim with Linum usitatissimum from Lamersdorf Ldkr Düren (BRD). The length of the seeds from Hienheim was originally slightly over 2.8 mm. The breadth of the specimens is 1.6, 1.4 and 1.3 mm; the thickness is 0.6, 1.0 and 0.3 mm respectively. In Lamersdorf these dimensions are 3.10 (2.8–3.3) × 1.56 (1.2–2.0) × 0.64 (0.5–0.9) mm. Further parallels are Langweiler-2 Ldkr Düren (BRD) with seeds of ~ 2.3–3.2 × 1.37 (1.2–1.5) × ~ 0.8–1.05 mm and Garsdorf Ldkr Bergheim/Erft (BRD) with seeds of 2.84 (2.6–3.0) × 1.50 (1.4–1.6) × 0.74 (0.7–0.8) mm (Knörzer 1967a, 1973 and 1974). Large concentrations of linseed have been found in above-mentioned Lamersdorf, in Köln-Lindenthal Stkr Köln (BRD) and in Morken-Harff Ldkr Bergheim/Erft (BRD) (Buttler & Haberey 1936, Hinz 1969). No dimensions are known from the latter two find sites.

Apart from the above-described find in Hienheim, the presence of linseed has been restricted so far to the Rheinland, at least when we leave Eisenberg and Heilbronn out of consideration. The dates of the latter finds are not mentioned exactly.

OTHER PLANTS

Betulaceae, Corylus avellana L.

Two very small fragments of a hazelnut from a single find number are the only traces of the presence of hazelnuts. The fragments could come from one and the same nut, which is why the table mentions only one specimen.

Caryophyllaceae, Silene cucubalus Wib. (fig. 31, fig. 34)

The two kidney-shaped seeds from 1211/2 are respectively 1.1 and 0.9 mm long, have a breadth of 1.0 and 0.7 mm, whereas the most intact specimen is 0.7 mm thick. The "dorsal side" opposite the hilum is convex, the sides are almost entirely flat. The seed-coat is covered with blunt conical spines of 0.08 mm in length, which are arranged in rows. The hilum has fine stripes. The seeds bear a close resemblance to recent seeds of Silene cucubalus from the surroundings of Hienheim. The seeds of Lychnis flos-cuculi are smaller. The seeds of Melandrium album and M. rubrum look like those of Silene cucubalus, but the spines have a different shape.

Chenopodiaceae, Atriplex sp.

There is only one fragment of Atriplex sp.: a piece of a seed with protruding radicle tip. The seed-coat is smooth, except on the radicle tip where it shows small lengthwise furrows. The fragment was identified by means of the size, the shape of the radicle tip and the sculpture of the surface. It is identical to the corresponding part of seeds of Atriplex patula L. and Atriplex hastata L. from our collection.

Chenopodiaceae, Chenopodium album L.

Seeds of Chenopodium album are found frequently. They completely answer the description which is given of this oft mentioned species. The dimensions of the specimens from Hienheim are 1.11 (1.0–1.3) × 0.64 (0.4–0.8) mm (N = 14). Chenopodium album seeds belong to the most common components of seed assemblages from LBK pits.

Chenopodiaceae, Chenopodium hybridum L. (fig. 31, fig. 34)

In as far as we know, Chenopodium hybridum has not been found before in a LBK context. Apparently the specimen from find number 325 was not ripe yet when it was carbonized. The seed-coat shows folds and the seed is too flat for a fully grown specimen: it measures 1.3 × 0.4 mm. The specimen from find number 1259/1 is also on the smallish side: it measures 1.4 × 0.8 mm. The seeds have pits at both sides. They are distinguished from other Chenopodium species of the same size by this sculpture.

Compositae, Lapsana communis L. (fig. 28, fig. 32)

The three specimens of 1211/2 are heavily damaged. The dimensions of the two still measurable achenes are 2.7 × 0.7 × 0.7 and 2.3 × 0.8 × 0.2 mm. The ribs have disappeared almost completely. The achenes show a good similarity with achenes from LBK sites in the Rheinland.

Cruciferae, Sinapis sp. or Brassica sp. (fig. 34)

A fragment of a seed-coat which comes from a spherical seed with a diameter of circa 1.6 mm, is attributed to Sinapis or Brassica. The coat has a reticulum with meshes of 0.04 mm in diameter. The fragment looks most like Sinapis arvensis, but given the problems encountered in distinguishing between species of the genera Sinapis and Brassica, we consider it impossible to attribute a single fragment.

Equisetaceae, Equisetum sp.

A 3 mm-long fragment of an Equisetum stem cannot be identified to the species-level.

Gramineae, Bromus sp., Bromus cf arvensis L., Bromus secalinus L. or Br. mollis L., Bromus tectorum L. or Br. sterilis L. (fig. 29 fig. 33).

Fragments of Bromus caryopses are the most frequently found, after those of Polygonum convolvulus. The fragments can be recognized by their characteristic longitudinal stripes (see photographs). Undamaged grains are not to be found. Of most fragments it can no longer be determined to which species they belong. On the ground of the shape of loose apices and of the breadth of the fragments, we assume that at least three species are represented in the material. Find no. 1211/2 contains at least 17 fragments which belonged to caryopses with a maximum breadth of 1.10 (0.7–1.3) mm. The apices of these caryopses are more or less round. The edges are rolled inwards in most specimens, so that the grains have a boat-like aspect. They show a great similarity with Bromus arvensis. A second type of caryopses also has rounded-off apices, but the grains are plumper and much broader, namely circa 1.6 mm. We consider these caryopses as Bromus secalinus or Bromus mollis. In find no. 1211/2 three fragments with a pointed apex were found besides the caryopses of Bromus cf arvensis. The breadth of two specimens can be determined: it is 1.0 and 1.2 mm respectively. The apices correspond with the apices of Bromus tectorum and Bromus sterilis. The material of 1280 contains a similar apex.

Gramineae, Echinochloa crus-galli (L.) P.B. (fig. 29)

Three find numbers each contain a single caryopsis of a grass species that could be identified as Echinochloa crus-galli. The grains are plump with a L/B ratio of 1.1, 1.3 and 1.3, the apex is round. The scutellum has disappeared in all three specimens, but the scar can still be seen. It reaches until 2/3 of the length of the seed and has more or less parallel sides. These features make it possible to exclude comparable species. Panicum miliaceum has a shape that is very close to our finds, but the scutellum-scar of Panicum has clearly diverging sides and never reaches further, at least in the samples which we studied, than half the length of the caryopsis. The dimensions of the caryopses are 1.2 × 1.1 × 0.5, 1.0 × 0.8 × 0.5 and 0.9 × 0.7 × 0.5 mm. The dimensions of parallel finds are 1.15 (1.0–1.25) × 0.94 (0.8–1.1) × 0.63 (0.5–0.7) mm for 8 specimens from Lamersdorf Ldkr Düren (BRD), 1.3 × 1.05 × 0.7 mm for a specimen from Langweiler-2 Ldkr Düren (BRD) and 1.15 (1.1–1.2) × 0.88 (0.8–0.9) × 0.59 (0.5–0.7) mm for 10 caryopses from Garsdorf Ldkr Bergheim/Erft (BRD) (Knörzer 1967a, 1973 and 1974).

Gramineae, Setaria viridis (L.) P.B. or Setaria verticillata (L.) P.B. (fig. 29).

In the pit filling of no. 921 we found 22 seeds which on the one hand have a strong similarity with the (L/B index 1.64 (1.5–1.8)). Similar caryopses appeared in four other samples. To some specimens adhere remains of the palea on which cross rows of papillae can be seen. The scutellum scar covers adhere remains of the palea on which cross rows of papillae can be seen. The scutellum scar covers 2/3 to 2/5 of the length of the grain. A hilum can no longer be observed. The features indicate that the caryopses came from a Setaria species. Because of the dimensions, 1.20 (1.1–1.3) × 0.74 (0.6–0.8) × 0.52 (0.4–0.6) mm, this Setaria can only be Setaria viridis or Setaria verticillata. In as far as we know, this is the first Setaria found in a LBK context.

Papaveraceae, Papaver dubium L. or Papaver rhoeas L. (fig. 31)

The kidney-shaped poppy seed measures 0.7 × 0.6 × 0.5 mm. The surface shows a network of isodiametric fields. The fields are arranged in rows. The number of fields per side is circa 40. This gives the seed the features of Papaver dubium or P. rhoeas. We are not able to demonstrate differences between both species. We do not know of parallel finds.

Papilionaceae, Lathyrus tuberosus L. (fig. 28)

Of the two specimens which were found together, one is completely intact. The other one lacks the seed-coat. The seeds have an ellipsoid shape. Their dimensions are 4.0 × 2.9 × 2.5 mm and 3.6 × 2.2 × 2.2 mm respectively. The hilum measures 1.3 × 0.6 mm; it covers approximately 1/8 of the circumference. The seed-coat is smooth. We compared the seeds with all the Lathyrus species that, according to Oberdorfer, are present in Southern Germany (Oberdorfer 1970) and that have a hilum covering less than 1/3 of the circumference. The size and the shape of the seeds and the size and the shape of the hilum appeared to correspond very well with Lathyrus tuberosus. We know of no other find of this species.

Papilionaceae, cf Trifolium sp. (fig. 28, fig. 32)

One seed with a protruding radicle measures 1.1 × 0.6 × 0.5 mm (breadth without radicle). It has a hilum of 0.24 × 0.16 mm. The radicle reaches half the length of the seed. The specimen is slightly deformed at the narrow side opposite of the hilum and the radicle. We can find no identical recent seeds. The seed corresponds best with a Trifolium such as Trifolium dubium, but the radicle is slightly too short. Perhaps it shrunk more than the cotyledons during the carbonization.

Polygonaceae, Polygonum convolvulus L. (fig. 30, fig. 32)

In many assemblages there are fruits or fruit fragments of Polygonum convolvulus. Most fruits are heavily damaged. We could measure only eight specimens. The dimensions of the fruits are 2.21 (2.1–2.6) × 1.67 (1.5–1.9) mm. The carbonized fruits of Polygonum convolvulus are found very frequently in LBK settlements.

Polygonaceae, Rumex acetosella L. (fig. 30)

Sample number 1082/1 contains an undamaged and a heavily damaged specimen of a triangular fruit with rounded edges. The dimensions of the intact specimen are 1.3 × 1.0 mm. A very closely related species, Rumex tenuifolius (Wallr.) Löve, was found by Knörzer in Lamersdorf Ldkr. Düren (BRD), Langweiler-2 Ldkr. Düren (BRD) and Langweiler-6 Ldkr. Düren (BRD) (Knörzer 1967a), 1973 and 1972). The fruits of Rumex tenuifolius are slightly smaller than those of R. acetosella.

Polygonaceae, Rumex sp. (fig. 30, fig. 32)

A triangular fruit of a Rumex species from number 1211/2 has sharp edges. Upper and lower end are distinctly pointed. Its dimensions are 1.9 × 1.2 mm. In our opinion it is impossible to identify a single Rumex fruit of these dimensions.

Rubiaceae, Galium spurium L. (fig. 30, fig. 34)

Galium spurium has been noticed in six find numbers. The half fruits measure 1.34 (1.0–2.1) × 1.16 (0.8–2.0) × 1.10 (0.7–2.0) mm (N = 10). The cavity which indicates the place of the hilum, is round in all specimens and relatively small. A number of specimens show two lengthwise furrows (see photograph and drawing). The outer fruit wall has disappeared, the inner fruit wall shows a pattern of ladder-shaped rows of rectangular cells. Galium spurium (or Galium aparine) is found frequently in LBK settlements. We mention the settlements in the Rheinland, Göttingen-Hagenberg Ldkr Göttingen (BRD), Opava-Katerinky (ČSSR) and Sittard (Netherlands) (Knörzer 1971b, Meyer & Willerding 1961, Tempír 1968, Bakels in this publication). In comparison with other finds, the half fruits from Hienheim are on the smallish side.

Scrophulariaceae, Veronica sp. (fig. 31)

One seed of a Veronica sp. has the dimensions 0.9 × 0.7 × 0.4 mm. It is shield-shaped and has a smooth surface. Before the carbonization, it was perhaps flatter. It shows a similarity with seeds of Veronica species such as V. arvensis and V. serpyllifolia.

Solanaceae, Solanum nigrum L. (fig. 31, fig. 34)

Seeds of a Solanum species were found in five pits. One of the find numbers, 1180, contained 34 of these seeds. Considering the find circumstances, these must have come from the same species and perhaps from one and the same plant. Of the 34 seeds 27 specimens could be measured. The dimensions are: 1.75 (1.5–2.0) × 1.41 (1.3–1.6) × 0.85 (0.8–1.0) mm. The contours are shown in figure 27. Some look like the round seeds of Solanum dulcamara, others are more like the seeds of Solanum nigrum. The latter have one round and one more or less pointed end. We consider all seeds as Solanum nigrum. The relatively great thickness indicates that the shape of the seeds can have been modified by the carbonization. This could explain the somewhat round shape of the Solanum dulcamara-like specimens. Besides, recent Solanum nigrum seeds also sometimes have rounded contours. Solanum (cf) nigrum has been found, besides in Hienheim, in Göttingen-Hagenberg (Meyer & Willerding 1961).

Indeterminatae

This group comprises fragments of fruits and seeds, which could no longer be determined.

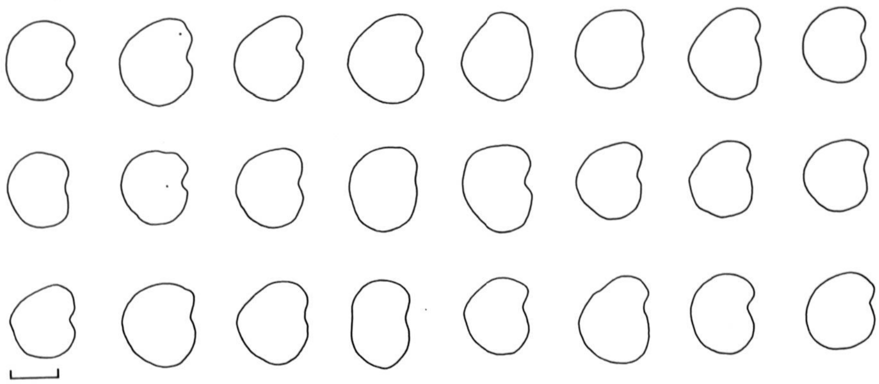

Fig. 27 Contours of Solanum nigrum seeds from Hienheim 1180. scale unit 1 mm

Table 15. Plant remains from the LBK settlement at Hienheim.

Sample number	*sample size, dm³*	*Triticum monococcum*	*Triticum cf monococcum*	*Triticum dicoccum*	*Triticum cf dicoccum*	*Unidentified cereal grains*	*Spikelet forks + glume bases*	*Pisum sativum*	*Lens culinaris*	*Linum usitatissimum*	*Wild fruits and seeds*	*Total number of fruits and seeds*	*Fruits and seeds/dm³*	*Plants remains/dm³*
325	15	120	4	30	5	125	372–238	–	1	–	7	292	19.5	44.3
414	30	76	6	57	26	85	–	2450	–	–	5	2705	90.2	90.2
415	0.25	–	–	2	1	4	–	4	–	–	6	17	68.0	68.0
593	5	–	–	–	–	2	3–2	5	–	–	3	10	2.0	2.6
598	5	–	–	3	–	–	–	–	–	–	3	6	1.2	1.2
701	5	10	–	3	–	62	37–24	723	–	–	5	803	160.6	168.0
764	1.5	23	–	19	3	86	60–37	–	–	–	–	131	87.3	127.3
921	22	9	1	2	–	1	5	–	–	–	24	37	1.7	1.9
1082/1	5	–	–	–	–	3	14–7	–	–	–	6	9	1.8	4.6
1082/2	5	1	–	1	–	17	36–18	–	–	–	4	23	4.6	11.8
1082/3	5	–	–	–	1	16	4	–	–	1	8	26	5.2	6.0
1086/1	2	–	–	1	–	9	3	1	–	–	2	13	6.5	8.0
1086/2	2	–	–	1	4	–	5–3	–	–	–	3	8	4.0	6.5
1086/3	2	–	–	–	–	4	2	–	–	–	–	6	3.0	4.0
1089	5	–	–	–	–	1	7–4	50	–	–	5	56	11.2	12.6
1101	1.5	–	–	5	–	7	22–16	–	–	–	9	21	14.0	28.7
1140	10	16	–	29	–	110	149–76	2	–	–	7	164	16.4	31.3
1143	5	–	–	–	–	6	10–5	–	–	–	4	10	2.0	4.0
1157	2	–	–	–	–	–	1	–	–	–	2	2	1.0	1.5
1180	3	–	–	–	–	4	13–7	–	–	–	40	44	14.7	19.0
1211/1	2	–	–	–	–	–	1	–	–	–	–	–	–	0.5
1211/2	5	15	–	1	–	–	229–121	–	3	–	67	86	17.2	63.0
1212	2	–	–	–	–	3	1	1	–	1	4	9	4.5	5.0
1222	2	–	–	–	–	2	5–4	–	–	–	3	5	2.5	5.0
1228	2	–	–	–	–	3	1	–	–	–	2	5	2.5	3.0
1259/1	2	–	–	–	–	2	2	–	–	–	3	5	2.5	3.5
1259/2	2	–	–	–	–	3	1	–	–	–	–	3	1.5	2.0
1261	2	–	–	–	–	2	–	–	–	–	–	2	1.0	1.0
1269	2	–	–	–	–	3	4	1	–	–	1	5	2.5	4.5
1280	2	–	–	–	–	2	7	–	–	–	9	11	5.5	9.0
1380	2	–	–	–	–	1	2	–	1	–	4	6	3.0	4.0
1384	2	–	–	–	–	–	1	–	–	–	–	–	–	0.5
1387	2	–	–	–	–	–	2	–	–	–	1	1	0.5	1.5
1396	0.2	–	–	–	–	–	1	–	–	–	1	1	5.0	10.0
1397	2	–	–	–	–	3	3–2	–	1	1	6	11	5.5	7.0
1405	2	3	–	3	–	21	27–14	–	–	–	1	28	14.0	27.5
1420	0.2	7	–	4	–	70	42–22	–	–	–	2	83	415.0	625.0

Table 16. Remains of wild plants from the LBK settlement at Hienheim.

Sample number	*Corylus avellana*	*Silene cucubalus*	*Atriplex sp.*	*Chenopodium album*	*Chenopodium hybridum*	*Lapsana communis*	*Sinapis/Brassica sp.*	*Equisetum sp.*	*Bromus sp.*	*Bromus cf arvensis*	*Bromus secalinus/mollis*
325	–	–	–	–	1	–	–	1	1	–	–
414	–	–	–	–	–	–	–	–	–	–	1
415	–	–	–	4	–	–	–	–	–	–	–
593	1	–	–	–	–	–	–	–	–	–	–
598	–	–	–	–	–	–	–	–	–	–	–
701	–	–	–	–	–	–	1	–	–	–	–
921	–	–	–	–	–	–	–	–	–	–	–
1082/1	–	–	–	–	–	–	–	–	1	–	–
1082/2	–	–	–	–	–	–	–	–	–	–	2
1082/3	–	–	1	–	–	–	–	–	1	–	–
1086/1	–	–	–	–	–	–	–	–	1	–	–
1086/2	–	–	–	–	–	–	–	–	2	–	–
1089	–	–	–	–	–	–	–	–	2	–	–
1101	–	–	–	–	–	–	–	–	4	–	–
1140	–	–	–	1	–	–	–	–	3	–	–
1143	–	–	–	–	–	–	–	–	1	–	–
1157	–	–	–	2	–	–	–	–	–	–	–
1180	–	–	–	–	–	–	–	–	–	–	–
1211/2	–	2	–	–	–	3	–	–	25	17	–
1212	–	–	–	3	–	–	–	–	–	–	–
1222	–	–	–	–	–	–	–	–	1	–	–
1228	–	–	–	–	–	–	–	–	–	–	–
1259/1	–	–	–	2	1	–	–	–	–	–	–
1269	–	–	–	–	–	–	–	–	1	–	–
1280	–	–	–	–	–	–	–	–	1	–	–
1380	–	–	–	2	–	–	–	–	1	–	–
1387	–	–	–	–	–	–	–	–	1	–	–
1396	–	–	–	1	–	–	–	–	–	–	–
1397	–	–	–	5	–	–	–	–	–	–	–
1405	–	–	–	–	–	–	–	–	–	–	–
1420	–	–	–	1	–	–	–	–	1	–	–

Sample number	*Bromus tectorum/sterilis*	*Echinochloa crus-galli*	*Setaria viridis/verticillata*	*Papaver dubium/rhoeas*	*Lathyrus tuberosus*	*cf Trifolium sp.*	*Polygonum convolvulus*	*Rumex acetosella*	*Rumex sp.*	*Galium spurium*	*Veronica sp.*	*Solanum nigrum*	*Indeterminatae*
325	–	–	–	–	–	–	3	–	–	–	–	–	2
414	–	–	–	–	2	–	–	–	–	1	–	–	1
415	–	–	–	–	–	–	2	–	–	–	–	–	–
593	–	–	–	–	–	–	–	–	–	–	–	–	2
598	–	–	–	–	–	–	1	–	–	2	–	–	–
701	–	–	–	–	–	–	2	–	–	1	–	–	1
921	–	1	22	1	–	–	–	–	–	–	–	–	–
1082/1	–	–	–	–	–	1	2	2	–	–	–	–	–
1082/2	–	–	–	–	–	–	1	–	–	1	–	–	–
1082/3	–	–	4	–	–	–	1	–	–	–	–	–	1
1086/1	–	–	–	–	–	–	1	–	–	–	–	–	–
1086/2	–	–	–	–	–	–	1	–	–	–	–	–	–
1089	–	–	–	–	–	–	1	–	–	–	–	1	1
1101	–	1	–	–	–	–	1	–	–	1	–	1	1
1140	–	–	–	–	–	–	2	–	–	–	–	1	–
1143	–	–	–	–	–	–	2	–	–	–	1	–	–
1157	–	–	–	–	–	–	–	–	–	–	–	–	–
1180	–	1	–	–	–	–	2	–	–	–	–	34	3
1211/2	3	–	–	–	–	–	8	–	1	6	–	2	–
1212	–	–	–	–	–	–	1	–	–	–	–	–	–
1222	–	–	1	–	–	–	1	–	–	–	–	–	–
1228	–	–	1	–	–	–	–	–	–	–	–	–	1
1259/1	–	–	–	–	–	–	–	–	–	–	–	–	–
1269	–	–	–	–	–	–	–	–	–	–	–	–	–
1280	1	–	5	–	–	–	2	–	–	–	–	–	–
1380	–	–	–	–	–	–	1	–	–	–	–	–	–
1387	–	–	–	–	–	–	–	–	–	–	–	–	–
1396	–	–	–	–	–	–	–	–	–	–	–	–	–
1397	–	–	–	–	–	–	1	–	–	–	–	–	–
1405	–	–	–	–	–	–	1	–	–	–	–	–	–
1420	–	–	–	–	–	–	–	–	–	–	–	–	–

Table 17. Wood remains from the LBK settlement at Hienheim.

Sample number	*Quercus*	*Pinus*	*cf Prunus avium*	*Pomoideae*	*Alnus*	*Identification by*
166	15	–	–	–	–	Baas
324	15	–	–	–	–	Baas
325	16	2	2	–	1	Schweingruber
333	15	–	–	–	–	Baas
414	76	–	–	–	–	Baas
593	60	14	1	1	–	Schweingruber
598	26	4	–	2	–	Schweingruber
714	100	–	–	–	–	Baas
911	25	–	–	–	–	Schweingruber
921	15	–	–	–	–	Baas
1086/3	60	2	–	–	–	Schweingruber
1222	2	–	–	–	–	Schweingruber

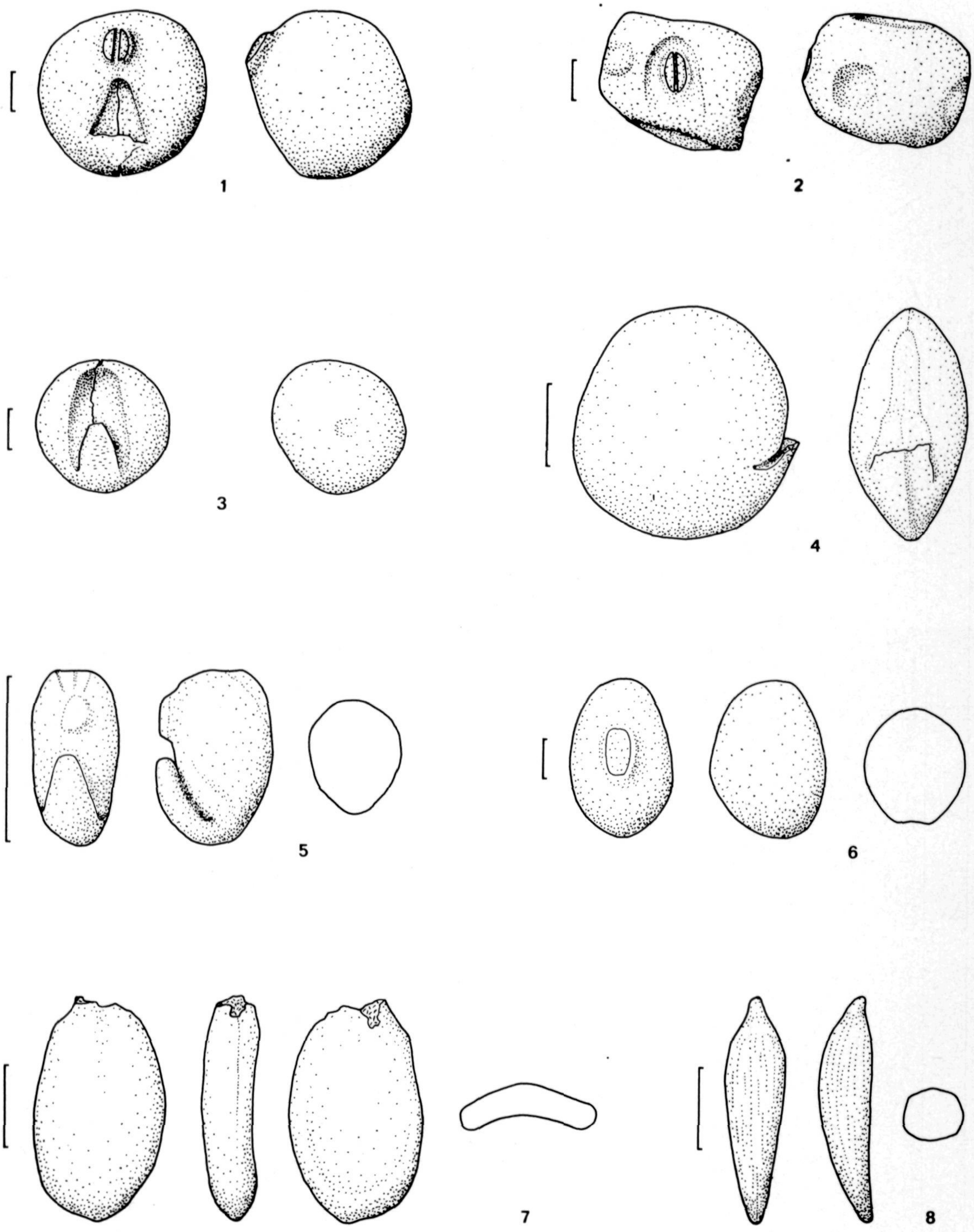

Fig. 28. Carbonized fruits and seeds from Hienheim; scale unit 1 mm. 1, 2 and 3: Pisum sativum 4: Lens culinaris 5: cf Trifolium sp. 6: Lathyrus tuverosus 7: Lnum usitatissimum 8: Lapsana communis.

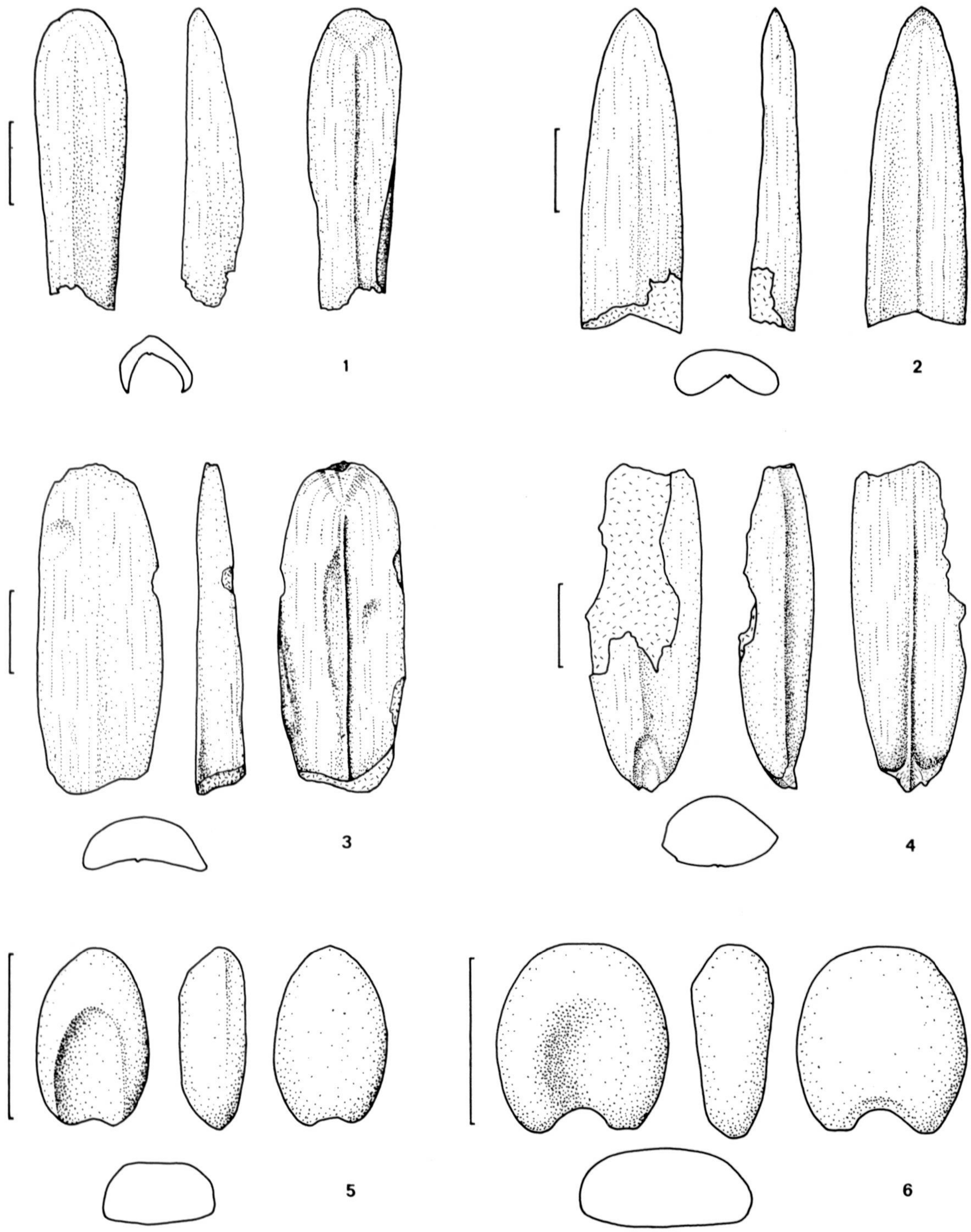

Fig. 29. Carbonized fruits and seeds from Hienheim; scale unit 1 mm. 1: Bromus cf arvensis 2: Bromus tectorum/sterilis 3 and 4: Bromus secalinus/mollis 5: Setaria viridis/verticillata 6: Echinochloa crus-galli.

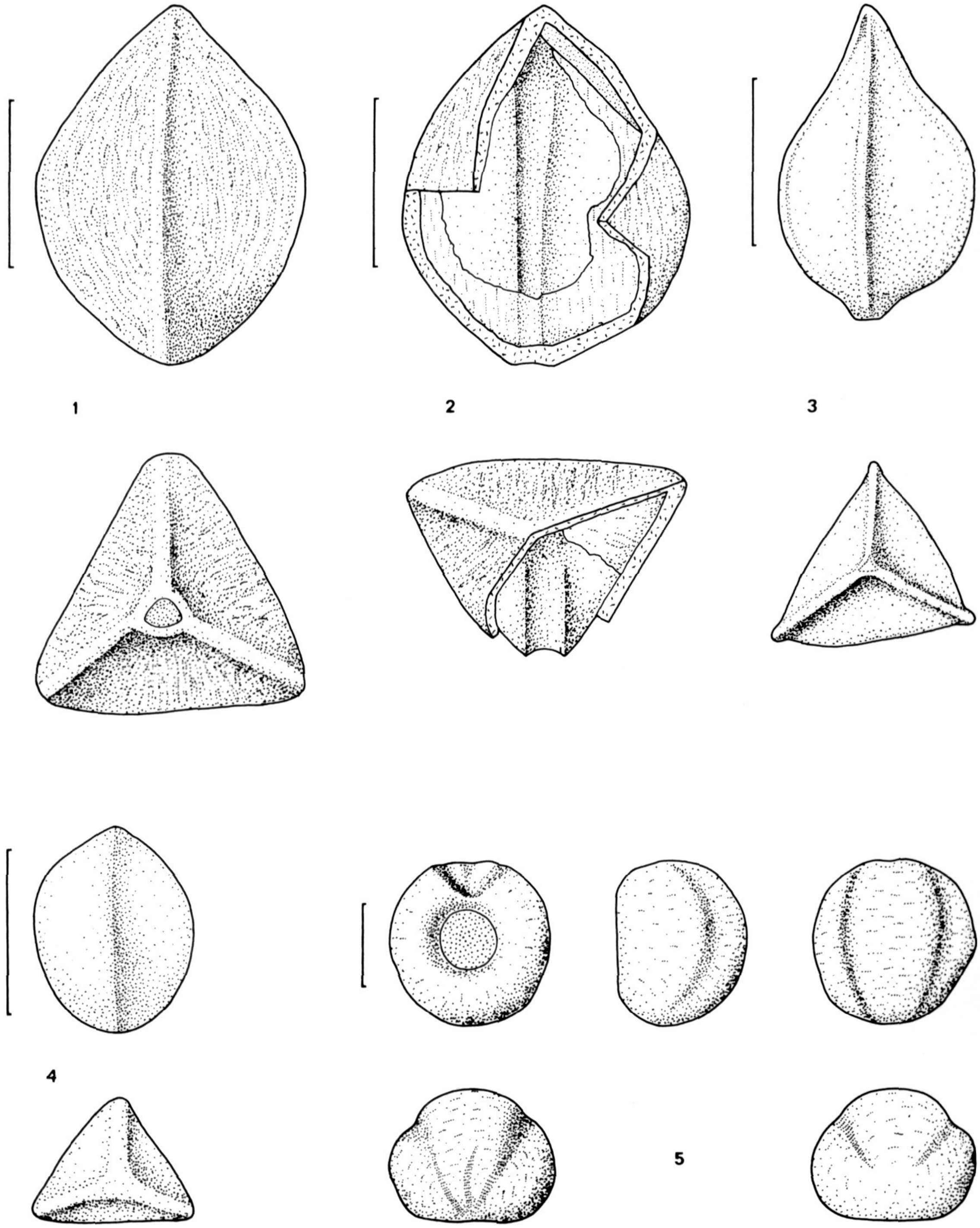

Fig. 30. Carbonized fruits and seeds from Hienheim; scale unit 1 mm. 1: Polygonum convolvulus 2: Polygonum convolvulus, damaged, true seed visible 3: Rumex sp. 4: Rumex acetosella 5: Galium spurium.

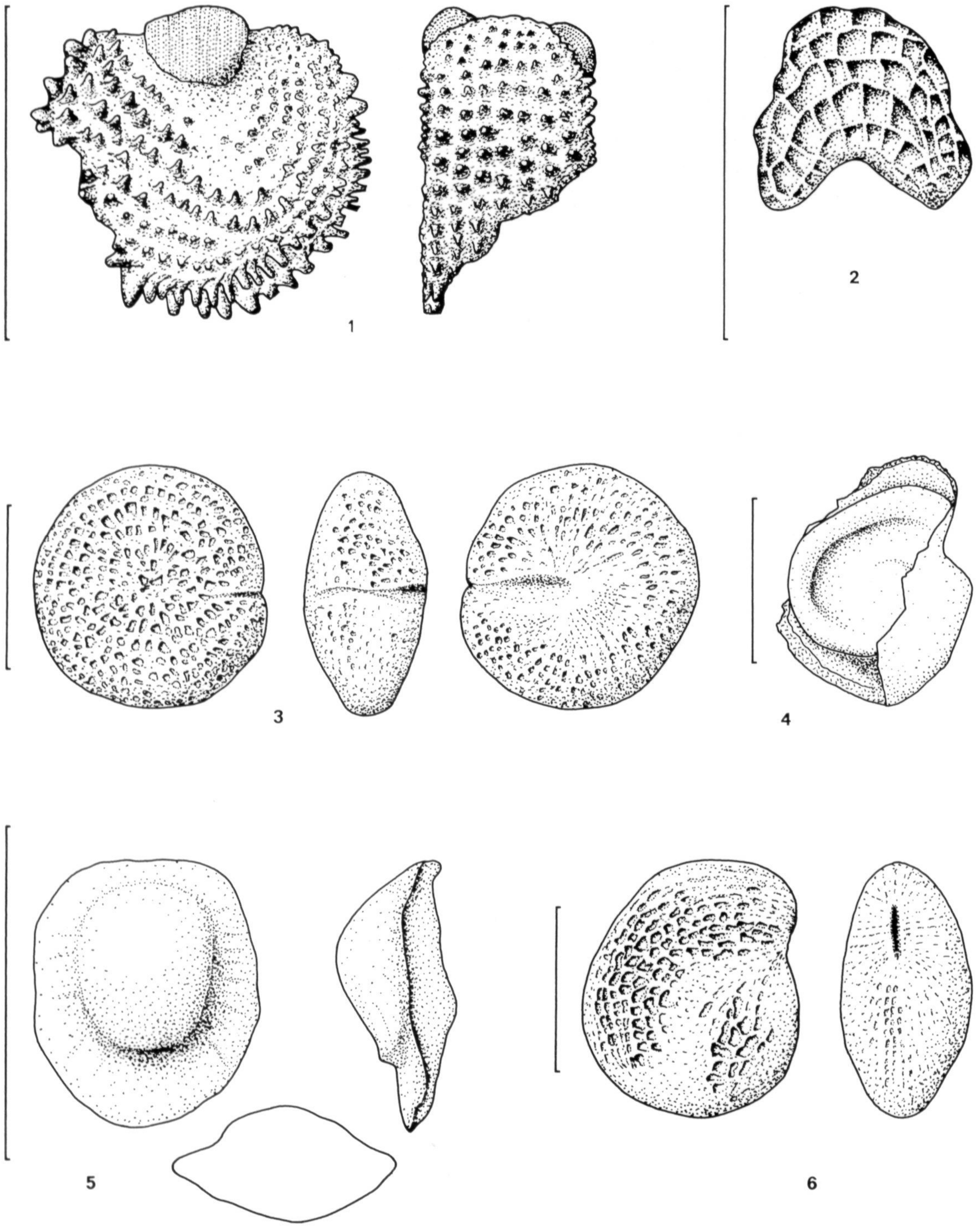

Fig. 31. Carbonized fruits and seeds from Hienheim; scale unit 1 mm. 1: Silene cucubalus 2: Papaver dubium/rhoeas 3: Chenopodium hybridum 5: Veronica sp. 4 and 6: Solanum nigrum, in 4 coiled embryo visible.

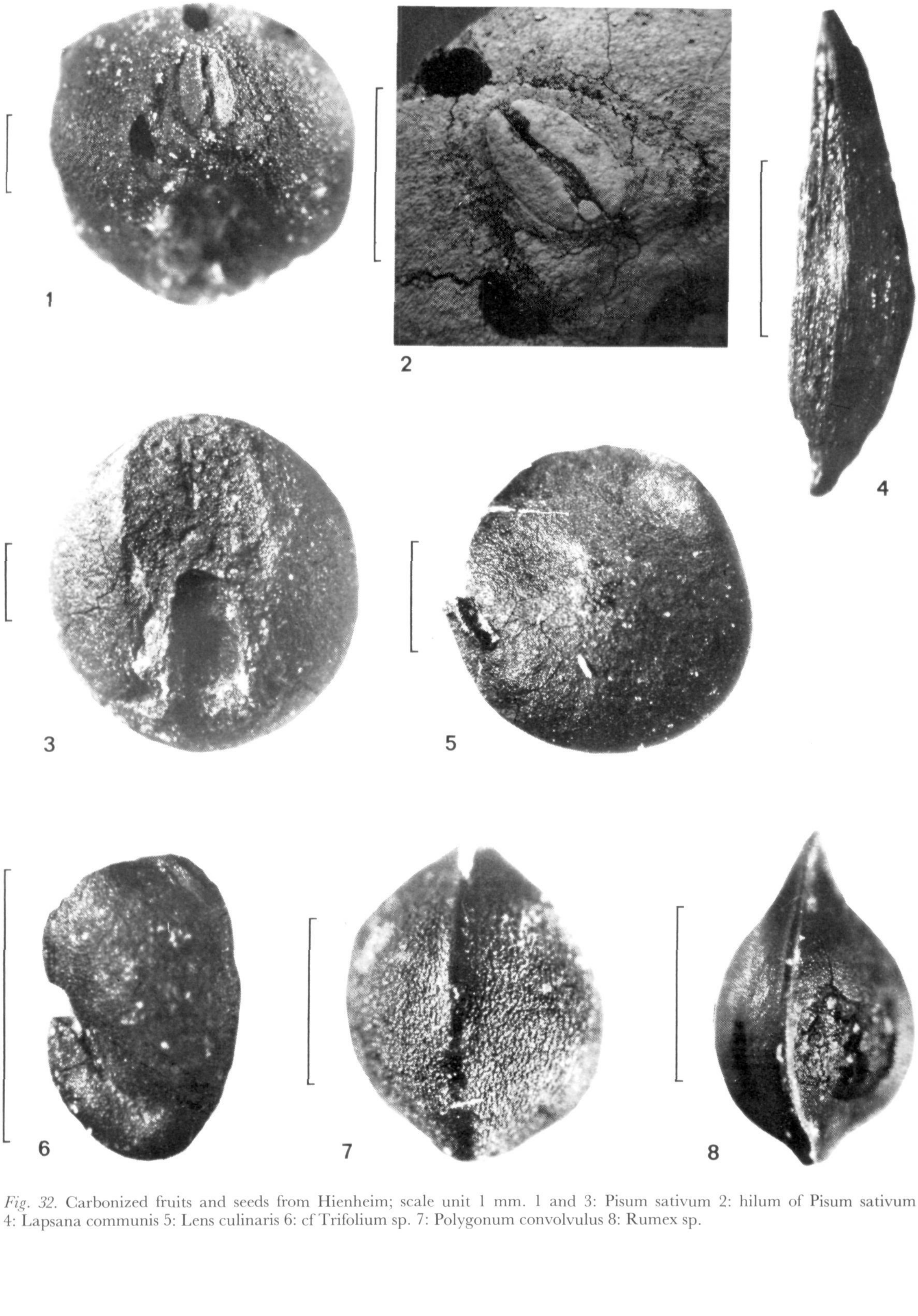

Fig. 32. Carbonized fruits and seeds from Hienheim; scale unit 1 mm. 1 and 3: Pisum sativum 2: hilum of Pisum sativum 4: Lapsana communis 5: Lens culinaris 6: cf Trifolium sp. 7: Polygonum convolvulus 8: Rumex sp.

Fig. 33. Carbonized fruits and seeds from Hienheim; scale unit 1 mm. 1 and 2: Bromus secalinus/mollis 3: Bromus tectorum/sterilis.

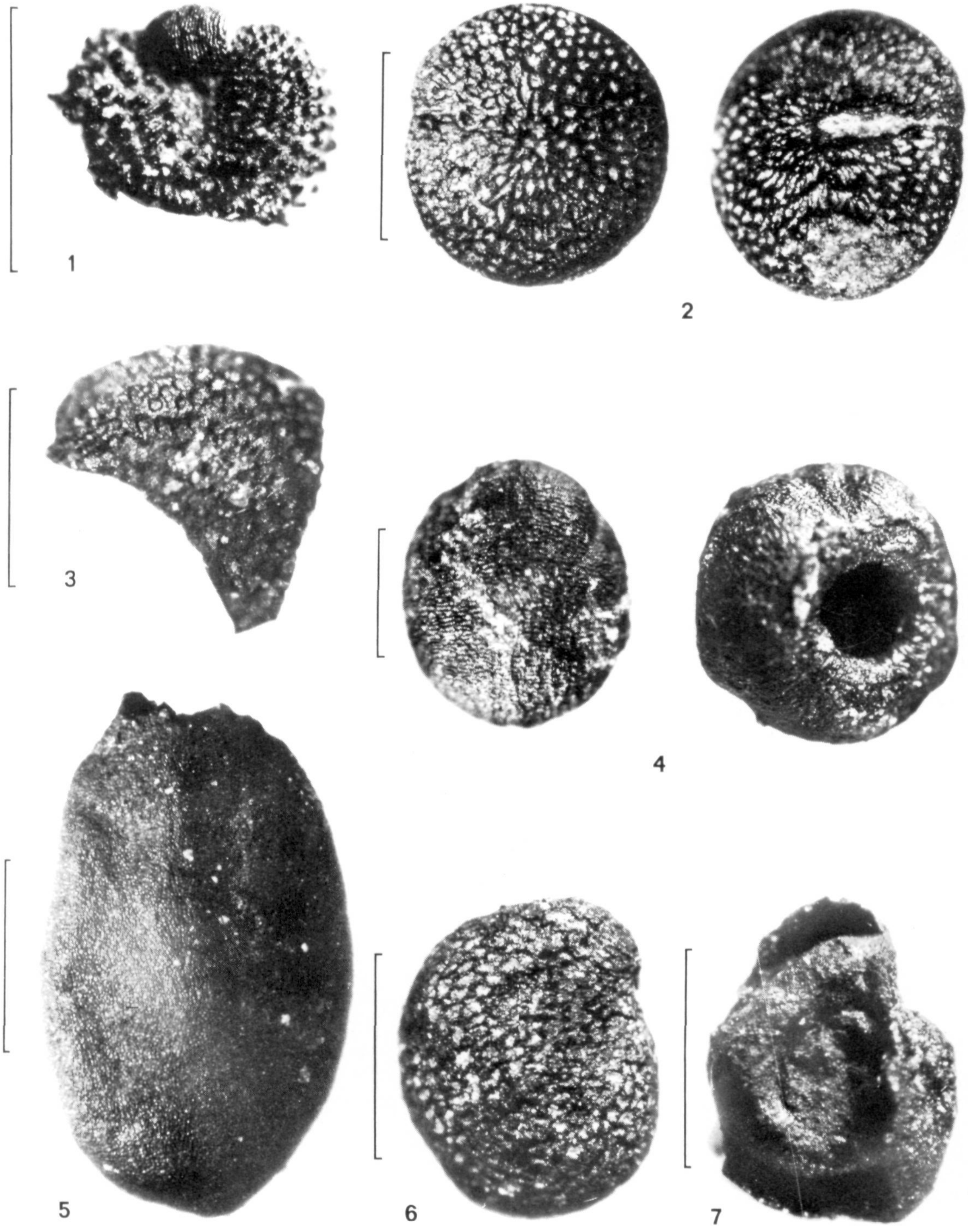

Fig. 34. Carbonized fruits and seeds from Hienheim; scale unit 1 mm. 1: Silene cucubalus 2: Chenopodium hybridum 3: Sinapsis/Brassica sp. 4: Galium spurium 5: Linum usitatissimum 6 and 7: Solanum nigrum, in 7 coiled embryo visible.