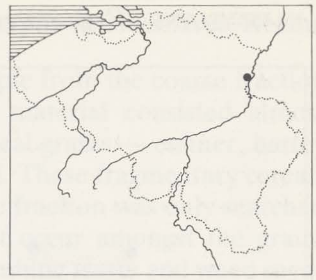
ARCHAEOLOGIA BELGICA I - 1985 - 1, 97-105



N. ROYMANS

Carbonized grain from two Iron Age storage pits at Neerharen-Rekem

INTRODUCTION

Ecological research using carbonized seeds and fruits forms a rich and unique source of information within the context of research into the agricultural sub-system of Iron Age societies in Northern Gaul[1]. In the last decade, the examination of carbonized plant remains of Iron Age date has undergone a rapid development in such regions as the German Lower Rhine-area and the southern Netherlands. The results of this research are already providing a preliminary impression of the diversity and relative importance of the plants cultivated here in the Iron Age. This is in marked contrast to the situation in Belgium, northern France, Luxemburg and the Trier region, where, indeed, the study of carbonized plant material has yet to begin[2].
In Great Britain especially, there is a growing awareness that the information value of carbonized plant material goes beyond the simple registration of the numbers and relative importance of the various cultivated plants[3]. Examination of carbonized material may also shed light on activities such as harvesting, threshing, winnowing, parching, storage and consumption of cereals: in short, on all the aspects of crop processing. Study of storage pits or grain silos is of special relevance in relation to these new developments. Such features are frequently rich repositories of carbonized plant remains and it is often possible to establish at which point in processing the material underwent carbonization. It is this in particular which allows the formation of further hypotheses. Samples of grain from storage pits thus offer exceptional possibilities for the study of the agricultural system of the Iron Age in North Gaul. It is in this context that the analysis of the material from Neerharen-Rekem will be examined.

In 1981, 1982 and 1984, a Roman villa complex was excavated at Neerharen-Rekem (prov. Limburg). In addition to the main dwelling and subsidiary structures of the Roman villa, a large amount of occupation traces was revealed, covering almost every period from the Stone Age to the Middle Ages[4]. Eleven house plans, a dozen granary like structures and a number of deeper pits belong to the Iron Age (fig. 1). Closer dating of the buildings is not at present possible, since little or no pottery has been found in direct relation to them. On the other hand, most pits can be dated by sherds to the Early La Tène period (5th century BC). The various features cannot, however, be regarded as being contemporary. Excavation is to continue in 1985.
Samples were taken from two of the Iron Age storage pits for the analysis of any seeds and fruits they might contain. The volume of the samples was in each case c. 8 litres. A double sample was taken from the pit XI-61. The material was prepared in the usual fashion at the IPP, Amsterdam, by passing through a flotation unit with 2 mm and 0.5 mm sieves. The coarse fraction was kept separate from the fine fraction throughout the analysis[5].

Sample 132

This sample was taken from an almost cylindrical pit with flat bottom and straight sides (feature XI-61), c. 160 cm in diameter and extending 60 cm below the excavated surface. If the disturbed/removed upper level is included, the original depth of the pit will have reached c. 120 cm. Three levels, arranged in the following sequence are distinguishable in the pit fill (fig.

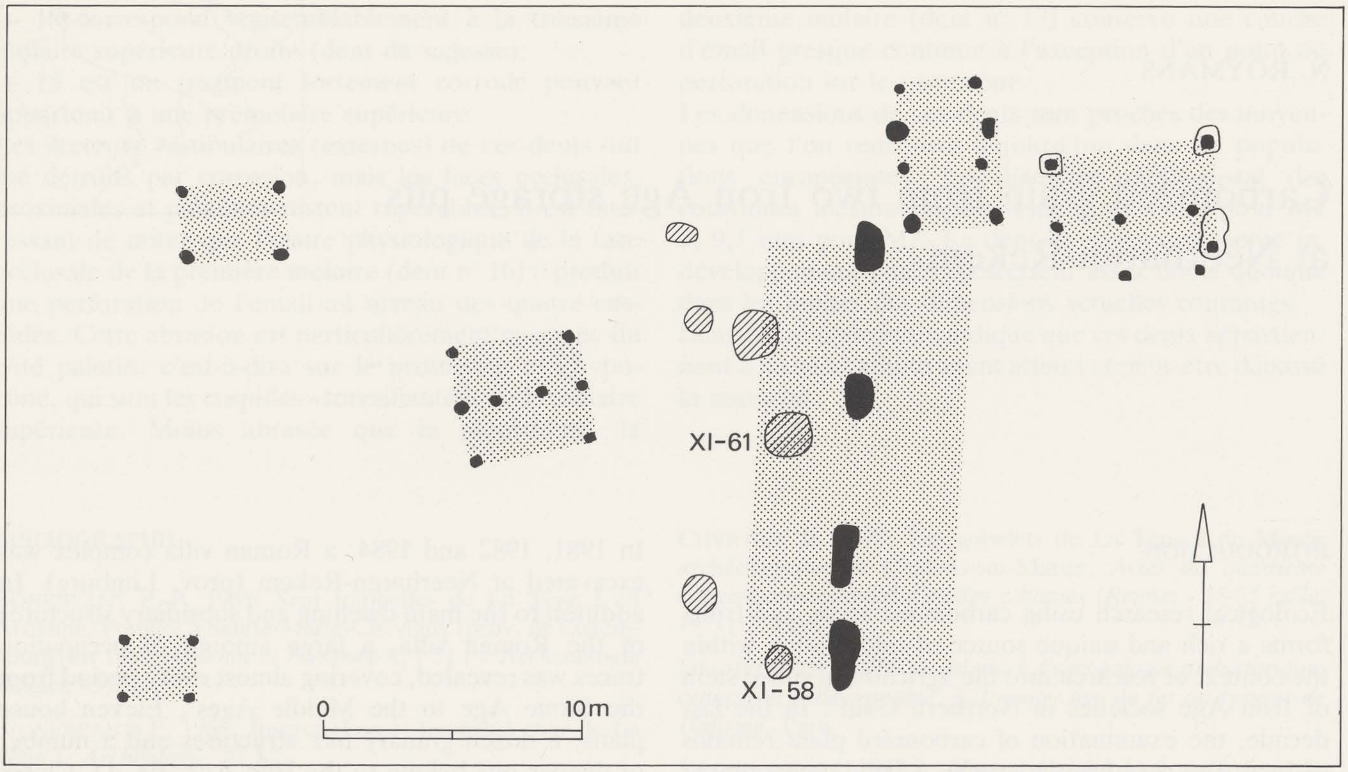
1 The author is preparing his thesis on the Late Iron Age in Northern Gaul (in general terms the region between the North Sea, Seine, Marne and Rhine) in which considerable emphasis is laid on the agrarian subsystem.

2 M. Hopf analyzed the carbonized seeds and fruits collected from an Early La Tène settlement at Chassemy (Aisne, Fr.): Rowlett, Rowlett & Boureux 1969.

3 Reynolds 1974, 1979; Monk & Fasham 1980; Bowen & Wood 1967.

4 Interim reports: De Boe 1981, 1982, 1983.

5 The author wishes to thank drs. J.P. Pals, IPP Amsterdam, for assistance in identification and interpretation of the carbonized material, Dr. C.C. Bakels, IPL Leiden, for comments on the manuscript and dra. C. van Driel-Murry for translating the article.



1 Partial plan of some of the Iron Age settlement features. Black: building structures; hatched: storage pits. The numbered pits are treated in this article.

2:A): on the floor lies a black, compact layer of carbonized material, varying in thickness between 5 and 14 cm (I). It was already obvious at the time of excavation that this layer was composed almost entirely by pure grain, with only a few lumps of burnt clay and some sand mixed in. It is important to note that the floor and sides of the pit were coloured light red in consequence of fire action. Partially covering the charred grain is a heap of fairly clean yellow sand, running down from the pit sides (II). Finally, the entire centre of the pit is filled with a brown, sandy deposit which contains fragments of burnt daub and charcoal (III). A few sherds of native pottery, dating to the Iron Age, come from the upper level, and a date of 2435 ± 35 BP (i.e. 485 ± 35 B.C.)[6] was obtained from a grain sample. A double sample was taken from the lowest, carbonized, level of this pit. Both samples were processed and the resulting carbonized material was combined to produce a single sample. It was decided to analyze the coarse and fine fractions separately: the coarse fraction to obtain an impression of the relative importance of the cultivated plants present and the fine fraction for any evidence of weeds and threshing debris.

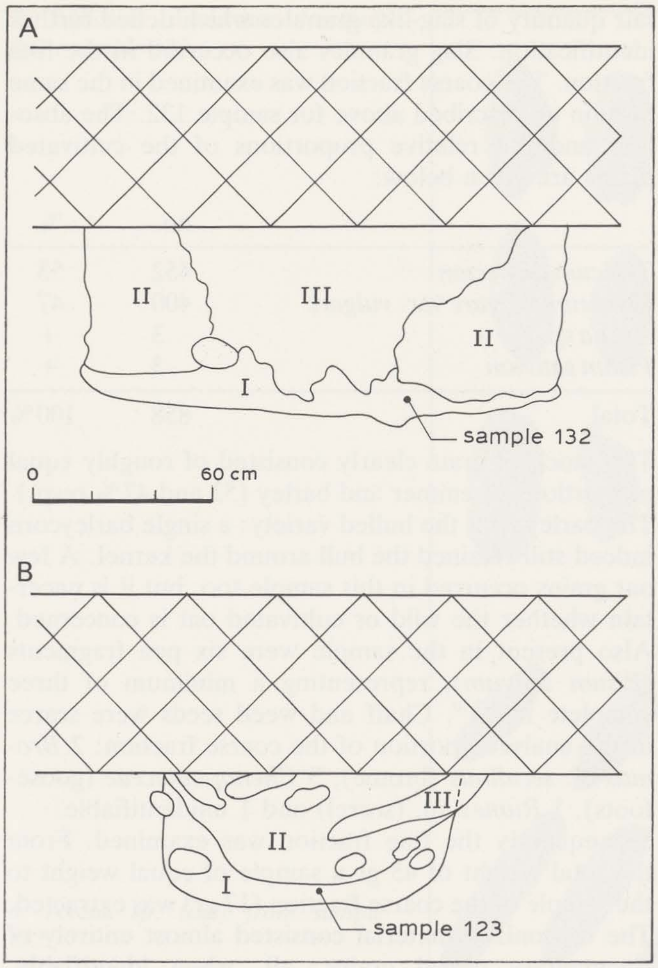
The total weight of the coarse fraction was 425 gr. A cursory inspection indicated that the sample was composed almost entirely of carbonized grain. Since it was not feasible to analyze the entire coarse fraction it was decided to obtain a representative picture of the relative importance of the various cultivated plants by means of sub-samples. The sub-samples were obtained by analysing a saucer of ca. 8.5 gr. of carbonized material and drawing up a table of the absolute and relative proportions (in percentages) of the cereals present. This is repeated until the relative proportions no longer vary significantly from the previous total. Three samples were necessary to achieve this point. The absolute values of the samples were then totalled and the relative proportions established:

	no.	%
Triticum dicoccum	1417	85
Avena sp.	151	9
Hordeum vulgare, var. *vulgare*	92	6
Total	1660	100%

It is obvious that emmer is by far the most important cereal, forming 85% of the total. In addition there are small quantities of barley (6%) and oats (9%). At first about 70 cereal grains were identified as einkorn (*Triticum monococcum*) on account of their convex ventral side. However, it later became apparent that these were grains of emmer which had developed into single grain spike at the top of the ear[7]. In the case of the

6 GrN-11225. Following the calibration curve developed by Pearson, Pilcher & Baillie 1983, the C14 dates of 2400-2550 BP should be placed in the bracket 800-400 BC, with no further precision possible.

7 van Zeist 1968, 158.



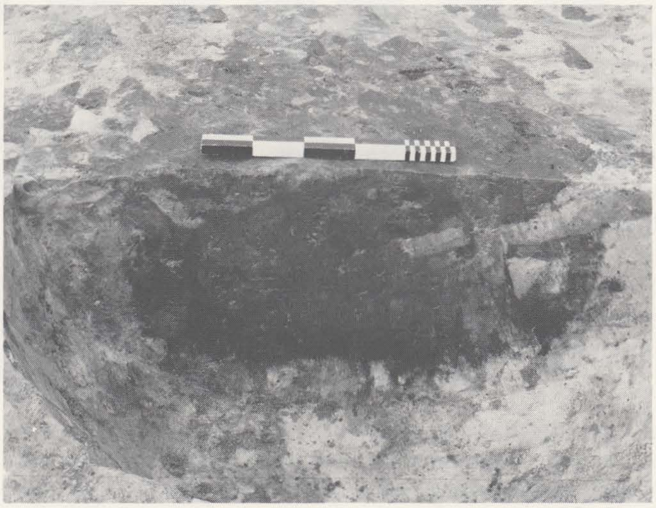
2 Section of pits XI-61 (A) and XI-58 (B).

oats, it is not possible to establish whether these are the fruits of the cultivated form (*Avena sativa*) or of the wild oat *Avena fatua*. That they belong to the cultivated form is suggested by the presence of a glume base of *Avena sativa* in the fine fraction[8] and by the fact that oats are present here in a significant quantity (more than barley). Grains which definitely belong to naked barley are absent, so we may assume that only hulled barley is represented in the sample. Furthermore, no chaff remains were found in the samples analyzed, and virtually no weed seeds either: only nine of *Bromus* cf. *secalinus* (rye brome) and one of *Vicia* cf. *cracca*. Neither was the grain contaminated by any charcoal. The entire remaining of the coarse fraction was searched for the presence of carbonized seeds of weeds or cultigens not yet registered in the fully analyzed sample. The result was meagre with only four seeds of *Vicia sativa* ssp. *angustifolia* (narrow-leaved vetch) and one fragment of a pea (*Pisum sativum*). Subsequently, the fine fraction was examined. The total weight was 575 gr. Of this, a sample was removed equal in weight to the sample from the coarse fraction (25 gr.). The carbonized material consisted almost entirely of fragmentary cereal grains — emmer, barley and oats could be identified. These fragmentary cereals were discarded and the fine fraction was only searched for impurities which might occur amongst the grain. Fragments of charcoal, threshing waste and weed seeds were present in negligible quantities.

Triticum dicoccum (emmer), rachis frags.	14
Avena sativa (oats), glumes	1
Bromus cf. *secalinus* (rye brome)	4
Vicia sativa ssp. angustifolia (narrow-leaved vetch)	15
Echinochloa crus-galli (barnyard grass)	5
Polygonum sp. (bistort)	1
Capsella bursa-pastoris (shepherd's purse)	1
Umbelliferae sp. (umbellifers)	1
not ident.	1

Sample 123

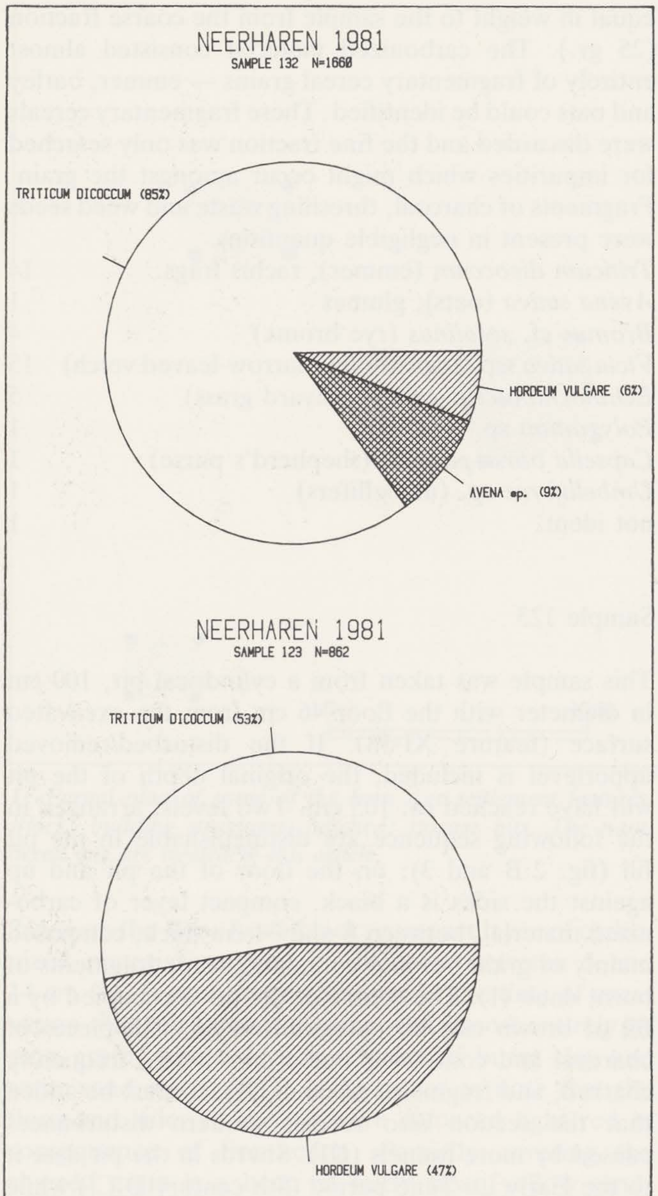
This sample was taken from a cylindrical pit, 100 cm in diameter with the floor 46 cm from the excavated surface (feature XI-58). If the disturbed/removed upperlevel is included, the original depth of the pit will have reached ca. 105 cm. Two levels, arranged in the following sequence are distinguishable in the pit fill (fig. 2:B and 3): on the floor of the pit and up against the sides is a black, compact layer of carbonized material, between 8 and 34 cm thick, composed mainly of grain but also containing some fragments of burnt daub (I). The centre of the pit is occupied by a fill of brown clay-like material mixed with pieces of charcoal and containing numerous sherds, frequently charred, and fragments of daub (II). It must be added that the section also reveals modern disturbances caused by mote tunnels (III). Sherds in the pit date it to the Early La Tène period (5th century B.C.) while



3 View of the section of pit XI-58.

8 For the identification of *Avena sativa* on the chaff bases, cf. van Zeist 1968, 161 and fig. on p. 144. An additional search for chaff of *Avena* in the fine fraction had no positive result.

I.A.P.



4 Relative distribution of cultivated plants in samples 132 and 123.

a sample of grain used for C14 analysis provided a date of 2530 ± 50 B.P., i.e. 580 ± 50 BC[9].
The sample from this pit was taken from the deposit on the floor which was rich in carbonized material. The sample was passed through a flotation unit, after which the carbonized material of the coarse and the fine fraction was examined separately. The total weight of the coarse fraction was 43 gr and it was already obvious to the naked eye that this fraction was composed almost entirely of carbonized grain. The few impurities included some fragments of charcoal and a fair quantity of slag-like granules which defied further identification. Slag granules also occurred in the fine fraction. The coarse fraction was examined in the same fashion as described above for sample 132. The absolute and the relative proportions of the cultivated plants are given below:

	no.	%
Triticum dicoccum	452	53
Hordeum vulgare var. *vulgare*	400	47
Avena sp.	3	+
Pisum sativum	3	+
Total	858	100%

This stock of grain clearly consisted of roughly equal proportions of emmer and barley (53 and 47% resp.). The barley is of the hulled variety: a single barleycorn indeed still retained the hull around the kernel. A few oat grains occurred in this sample too, but it is uncertain whether the wild or cultivated oat is concerned. Also present in the sample were six pea fragments (*Pisum sativum*), representing a minimum of three complete fruits[10]. Chaff and weed seeds were scarce in the analyzed portion of the coarse fraction: 2 *Bromus* cf. *secalinus* (brome), 3 *Chenopodiaceae* (goosefoots), 1 *Rumex* sp. (sorrel) and 1 unidentifiable.
Subsequently the fine fraction was examined. From the total weight of 43 gr a sample of equal weight to the sample of the coarse fraction (17 gr) was extracted. The carbonized material consisted almost entirely of fragmentary cereal grains, all, when identifiable, emmer and barley. These were excluded from the subsequent analysis, and the fine fraction was only examined on the presence of impurities amongst the cereals. The fine fraction contains the same slag like granules as noted in the coarse fraction. A relatively small amount of weed seeds was present and the total absence of chaff is significant:

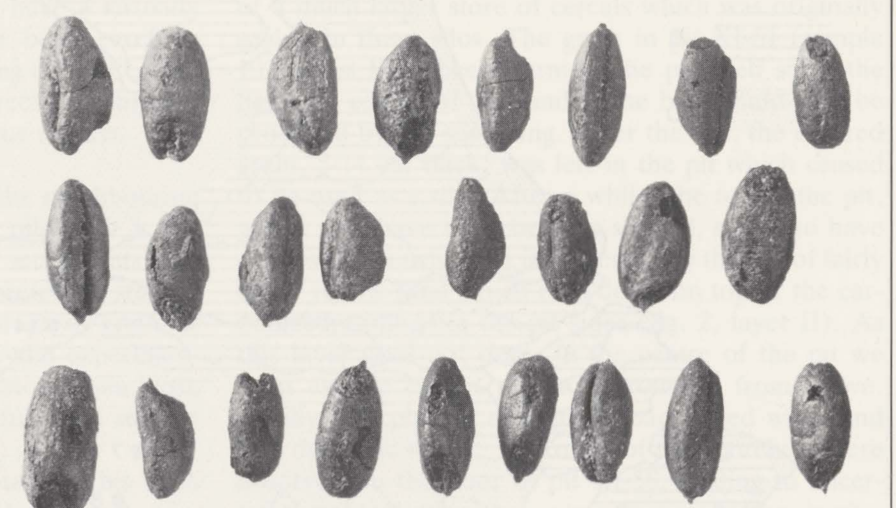
Camelina sativa (gold of pleasure)	1
Chenopodium album (fat hen)	4
Atriplex sp. (oraches)	4
Chenopodiaceae (goosefoots)	14
Echinochloa crus-galli (barnyard grass)	12
Rumex sp. (sorrel)	3
Bromus cf. *secalinus* (rye brome)	1
Polygonum convolvulus (black bindweed)	2
Galium aparine (goosegrass)	2
Gramineae (grasses)	3
Gramineae (grasses) indet.	1
Unidentifiable	12

Interpretation

The cereals represented in the samples from Neerharen-Rekem are all already familiar from other Iron Age settlements in the area of Northern Gaul as well

9 The principal sherds significant to dating come from a vessel with a high, funnel-shaped neck and short shoulder and from a bowl with a short, sharp carination. These forms, closely related to the north french "Marne pottery" can be placed in the 5th century B.C. For the interpretation of the C14 date (GrN-12257) see note 6.

10 Six fragments of peas also occurred in the portion of the coarse fraction which was not analyzed.



5 Triticum dicoccum *(emmer) from sample 123.*

6 Avena *sp. (oat) from sample 132.*

7 Hordeum vulgare *(barley) from sample 123. (photos F. Gijbels, IPP).*

8 The distribution of Iron Age storage pits in the southern Netherlands, North Belgium and the German Lower Rhine-area. (a = holocene marine clay, river clay and peaty soils; b = pleistocene coversand and loess areas; holocene dune sands along the coast). 1. Huise-Lozer; 2. Donk; 3. Neerharen-Rekem; 4. Rosmeer-Staberg; 5. Rosmeer-Diepestraat; 6. Vlijtingen; 7. St. Oedenrode; 8. Son en Breugel; 9. Dommelen; 10. Riethoven; 11. Eschweiler-Lohn; 12. Grevenbroich-Gustorf; 13. Weeze-Baal; 14. Wijchen-De Pas; 15. Jülich-Welldorf; 16. Bedburg; 17. Niederzier; 18. Eschweiler-Laurenzberg.

as outside. Hulled barley and emmer are especially favoured cereals in the Iron Age. Of rather lesser importance is the domesticated oat (probably present in sample 132), which is known from sites such as Eschweiler[11].

Apart from the cereals, two other cultivated plants are present at Neerharen-Rekem, though in minimal quantities. A few fragments of peas occur in samples 132 and 123, and a single seed of gold of pleasure in sample 123. The pea (*Pisum sativum*) is already familiar from Iron Age settlements at Son en Breugel (Nl.), Nettesheim/Butzheim, Grevenbroich-Gustorf, Langweiler, Eschweiler, Frixheim-Anstel (all GFR) and at Chassemy (Fr.)[12]. Gold-of-pleasure (*Camelina sativa*) is a plant cultivated for its small, oil-bearing seeds. In carbonized condition, these have also been recovered at Son en Breugel, Vlaardingen, Bergheim, Frixheim-Anstel, Langweiler, Eschweiler, Nettesheim/Butzheim and Grevenbroich-Gustorf[13].

In addition, the seeds of non-cultivated plants also occur in both samples from Neerharen-Rekem. Most of these come from plants which could have been consumed and which may even have been deliberately collected, as for example the goosefoots, the knotweeds, the sorrels, wild millets and rye brome[14]. However, the quantities of these seeds (as the pea and gold-of-pleasure) are so small that they should be regarded here as accidental impurities amongst the cereals.

Both samples 123 and 132 contain exceptionally large proportions of grain for archaeological standards. The grain occurred in a compact layer on the floor of the cylindrical pits. The almost total absence of any impurities in the grain is of importance for the further inter-

11 Knörzer 1980-a.

12 Bakels & van der Ham 1980; Knörzer 1971, 1974, 1979 and 1980-a; Göbel & Knörzer e.a. 1973; Rowlett, Rowlett & Boureux 1969.

13 Bakels & van der Ham 1980; Knörzer 1978 and 1979.

14 Bakels & van der Ham 1980, 85-86; van Zeist 1968, 165-167; Knörzer 1967.

pretation; chaff and weed seeds are present in only minute quantities. In both cases, we have a virtually pure grain stock, which must have been carefully threshed and winnowed (little threshing debris)[15]. This store would have been suitable for direct consumption had it not become carbonized and thus useless.

In the region of Northern Gaul and the neighbouring Rhineland, more or less cylindrical pits with a flat floor are found regularly in Iron Age settlements (fig. 8)[16]. Such features are usually interpreted as storage pits (silos) used primarily for the storage of grain. It appears from historical, ethnographic and experimental research that it is quite feasible to store grain loose in such pits[17]. Conditions for successful grain storage in pits are[18]:

a. the pits must lie above the water-table. This form of storage is impossible on wet, poorly drained soils. From the distribution of the Iron Age storage pits in the northern part of North Gaul (fig. 8) it is clear that they are restricted to the pleistocene sand and loess soils and are totally absent in the areas of holocene sediment;

b. the pits must be provided with an impermeable seal to restrict the action of bacteriae and moulds. Ideal seems to be a sealing of clay and/or dung;

c. a relatively low temperature, especially in the winter months, to restrict bacterial action and mould growth still further;

d. sufficient replacement of oxygen by carbondioxide (CO_2) within the pit to prevent the grain from respiring.

Experiments by Reynolds have shown that underground silos can be used for several years consecutively[19]. If storage failed then this was due not to the pit itself, but to factors such as incorrect sealing, rodent damage and especially excessive rainfall which resulted in the percolation of water through the sides.

When pits are exposed by excavation they are usually filled with household refuse — sherds, daub, charcoal etc. — which is evidence of a secondary use as a rubbish dump. Consequently, carbonized plant remains from such secondary fills must be regarded as refuse and are in no way related to the primary function of the pit. The two pits at Neerharen-Rekem also contain what is obviously domestic rubbish in the upper levels, with charcoals, daub and some sherds (figs. 2 and 3). However, on the floor of both pits lays a compact deposit of grain which must be interpreted differently because it belongs to a primary context. The grain contains hardly any impurities and was (prior to being carbonized, at least) ready for direct consumption. This grain deposit is probably the carbonized remnant of a much larger store of cereals which was originally sealed in these silos. The grain in pit XI-61 (sample 132) must have been burnt in the pit itself since the light red colour of the sand at the base could only be produced by fire scorching. After the fire, the charred grain, 5-14 cm thick, was left in the pit which ceased to be used as a silo. After a while, the top of the pit, which may have been beehive-shaped, seems to have collapsed inwards. This is suggested by the fan of fairly clean yellow sand which runs down on top of the carbonized grain from the pit sides (fig. 2, layer II). As this layer does not occur in the centre of the pit we must assume that it was not thrown in from above. Finally, the pit was completely back filled with sand and domestic refuse. No traces of fire scorching were observed on the floor of pit XI-58, leading to uncertainty as to whether the grain was charred here *in situ*. However, the fact that we are concerned with a virtually pure deposit of grain on the base of a storage pit tends to support this possibility.

The carbonized condition of the grain at the bottom of the two pits at Neerharen-Rekem is presumably to be associated with the practise of cleaning out storage pits by fire to make them suitable for future use[20]. This sterilizes any remnants of rotten or mildewed grain still remaining against the floor and sides of the pit. Normally the burnt debris would have been carefully cleared out, but for some reason this was not done here and the charred remains were buried under domestic rubbish. Fig. 9 presents a diagrammatic summary of the crop processing activities and especially the storage of grain. The probable position of the Neerharen-Rekem samples in the sequence is indicated.

A further point of interest is the storage capacity represented by the Neerharen-Rekem pits. Pit XI-58 is 100 cm in diameter and was originally some 105 cm deep, which corresponds to a volume of 8240 cm^3. In the case of pit XI-61, with a diameter of 160 cm and an original depth of 120 cm, the maximum storage capacity reaches 24110 cm^3 or nearly 2.5 cubic metres. A considerable area of arable land would be required to fill pits of such size, especially if we consider the relatively lower yields per ha in the Iron Age[21].

A final aspect which merits comment is the occurrence of mixed cereals in the Neerharen-Rekem pits and, just as noteworthy, the totally different composition of the two samples (see fig. 4). Since in both cases the cereals come from primary contexts it can be assumed that the cereals were stored as mixed batches and were intended to be consumed in this state too — probably

15 According to Monk & Fasham 1980, 328-329, 333, samples with an extremely low cereal/weed seed ratio and a low cereal/chaff ratio may be regarded as forming part of a grain store.

16 Some examples are: van den Broeke 1980; Reichmann 1979; De Boe & Van Impe 1979; Simons 1983 a-b-c; Roymans 1985; van der Sanden 1981.

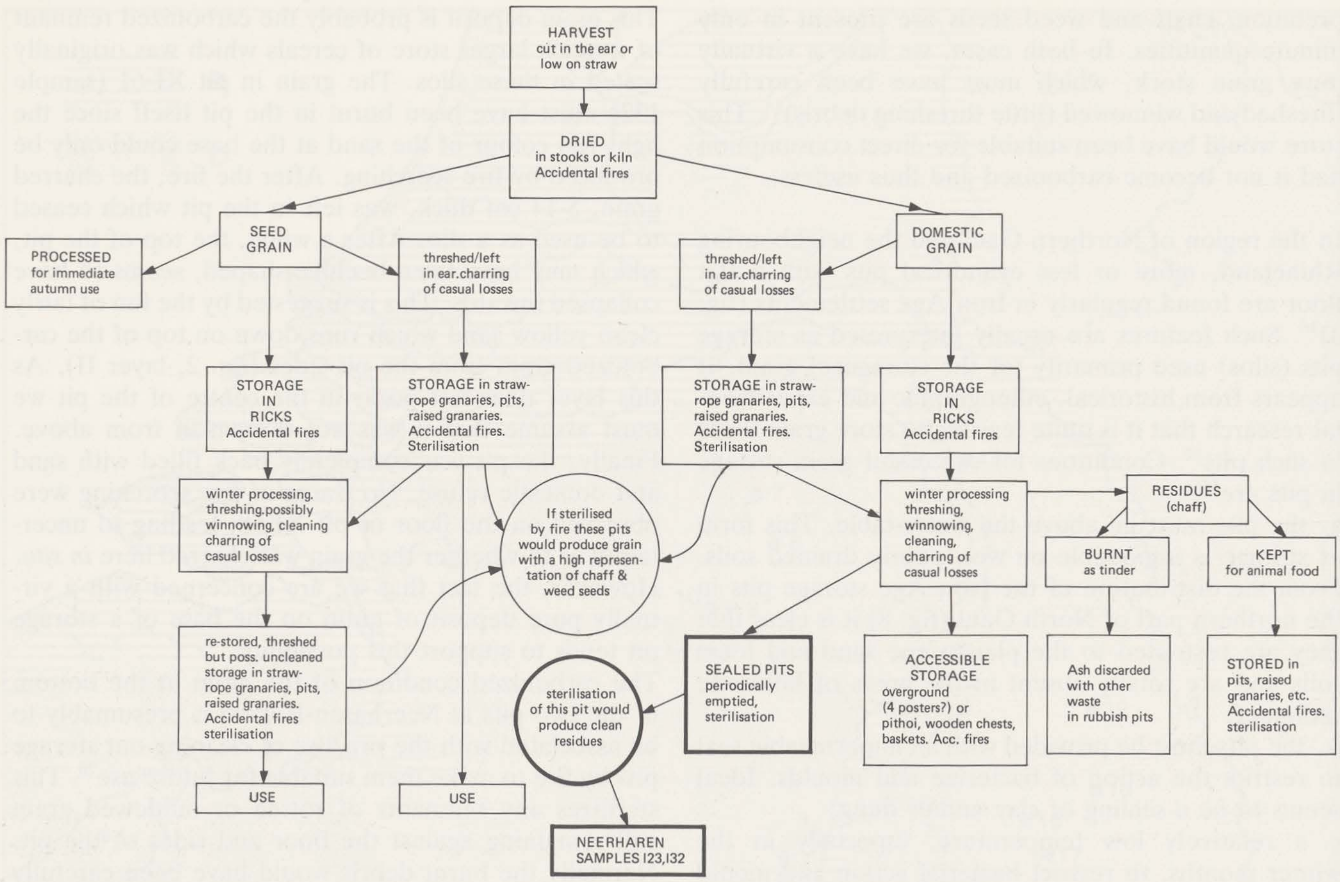
17 See the following summaries with their bibliographies: Reynolds 1974 and 1979; van den Broeke 1980: Monk & Fasham 1980, 334 ff.

18 Reynolds 1979, 75-76.

19 Reynolds 1979, 76.

20 Reynolds 1974, 128 and 1979, 57; Monk & Fasham 1980, 334.

21 For evidence on possible Iron Age cereal yields see Reynolds 1979, 76-77 and 1981, 104 ff.



9 Process model of activities associated with grain storage, with possible position taken by the Neerharen-Rekem samples marked (after Monk & Fasham 1980, fig. 8).

as a sort of gruel or muesli. The mixed nature of both grain stores might be a consequence of the mixed cultivation of diverse cereal types in the same field or the mixture of different grains after the harvest. The first explanation would seem to be the most reasonable, though the alternative should be born in mind. Slicher van Bath states that the mixed cultivation of cereals was common practise in Medieval Europe. Wellknown mixtures were wheat and rye, spelt and rye, barley and oats, wheat and barley[22]. Knörzer also considers it likely that certain cereals were grown mixed in the same fields and were also harvested together[23]. This might have been conscious policy as in the case of Medieval mixed cultivation, but mixture could also have occurred indirectly in a system of crop rotation where grain scattered during the harvest germinates and forms part of the ensuing crop. This might explain the occurrence or relatively small quantities of barley and oats in sample 132, which consists predominantly of emmer[24]. In the case of sample 123, made up of both emmer and barley in almost equal proportions, there may have been a conscious attempt to achieve a 50:50 cereal mixed in cultivation.

Further analysis of primary samples of carbonized grain from storage pits is, however, essential to test and to enlarge on the hypothesis suggested here.

Summary

During the 1981 excavations at Neerharen-Rekem, two Iron Age storage pits were cleaved which contained a compact layer of carbonized grain on the floor. Analysis of the samples taken from these layers resulted in important evidence for the system of arable farming in the Iron Age. This is the first recorded instance in Northern Gaul of pure grain stocks in silos in a context primary to the function of this type of pit. As such, the samples confirm the suggestion that flat floored cylindrical pits were used for the underground storage of grain[25]. The carbonized condition of the grain in the Neerharen-Rekem pits is probably to be associated

22 Slicher van Bath 1960, 288-289; see also van Zeist 1968, 154.

23 Knörzer 1980-a, 446-451.

24 Tiesing 1974, 210, mentions that ripe oat grains fall to the ground easily in strong winds and at harvesting. These germinate later and are difficult to plough out.

25 Other potential functions of large Iron Age pits are listed by Reynolds 1979. They may have been used for meat salting, tanning and storage of animal fodder (e.g. accorns).

with the regular burning out of the silos in order to sterilize them and prepare them for continued use. From the analysis of the grain samples it is evident that certain cereals were consumed in a mixed state, probably as gruel. It is, furthermore, possible that the cereals were also cultivated as a mixed crop.

REFERENCES

BAKELS C.C. & VAN DER HAM R.W.J.M. 1980: Verkoold graan uit een Midden-Bronstijd en een Midden-IJzertijd nederzetting op de Hooidonksche Akkers, gem. Son en Breugel, prov. Noord-Brabant, *Analecta Praehist. Leidensia* 13, 81-91.

BOWEN H.C. & WOOD P.D. 1967: Experimental storage of corn underground and its implications for Iron-Age settlements, *Bull. London Institute of Archaeology* 7, 1-14.

DE BOE G. 1981: Prehistorisch en Romeins te Neerharen-Rekem. In *Conspectus MCMLXXX,* Archaeologia Belgica 238, Brussel, 37-41.

DE BOE G. 1982: Meer dan 1.500 jaar bewoning rond de Romeinse villa te Neerharen-Rekem. In: *Conspectus MCMLXXXI,* Archaeologia Belgica 247, Brussel, 1982.

DE BOE G. 1983: Prehistorische vondsten te Neerharen-Rekem; De Romeinse villa te Neerharen-Rekem; De Laat-Romeinse «Germaanse» nederzetting te Neerharen-Rekem. In: *Conspectus MCMLXXXII,* Archaeologia Belgica 253, Brussel, 34-37, 56-60, 69-73.

DE BOE G. & VAN IMPE L. 1979: *Nederzetting uit de IJzertijd en Romeinse villa te Rosmeer,* Archaeologia Belgica 216, Brussel.

GÖBEL W., KNÖRZER K.-H. e.a. 1973: Naturwissenschaftliche Untersuchungen an einer späthallstattzeitlichen Fundstelle bei Langweiler, *Bonner Jahrbücher* 173, 289-315.

KNÖRZER K.-H. 1967: Die Roggentrespe (Bromus secalinus L.) als prähistorische Nutzpflanze, *Archaeo-Physika* 2.

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

KNÖRZER K.-H. 1974: Eisenzeitliche Pflanzenfunde aus Frixheim-Anstel, Kr. Grevenbroich, *Rheinische Ausgrabungen* 15, 405-414.

KNÖRZER K.-H. 1976: Späthallstattzeitliche Pflanzenfunde bei Bergheim, Erftkreis, *Rheinische Ausgrabungen* 17, 151-185.

KNÖRZER K.-H. 1978: Entwicklung und Ausbreitung des Leindotters (Camelina sativa s.l.), *Berichte der deutschen botanischen Gesellschaft* 91, 187-195.

KNÖRZER K.-H. 1979: Pflanzliche Grossreste des latènezeitlichen Siedlungsplatzes Grevenbroich-Gustorf, Kr. Neuss, *Rheinische Ausgrabungen* 19, 601-610.

KNÖRZER K.-H. 1980-a: Subfossile Pflanzenreste aus der jüngerlatènezeitlichen Siedlung bei Laurenzberg, Gem. Eschweiler, Kr. Aachen, *Bonner Jahrbücher* 180, 441-457.

KNÖRZER K.-H. 1980-b: Neue metallzeitliche Pflanzenfunde im Rheinland, *Archaeo-Physika* 7, 25-34.

MONK M.A. & FASHAM P.J. 1980: Carbonized plant remains from two Iron Age sites in central Hampshire, *Proc. Prehist. Society* 46, 321-344.

PEARSON G.W., PILCHER J.R. & BAILLIE M.G.L. 1983: High-precision 14C measurements of Irish oaks to show the natural 14C variations from 200 BC to 4000 BC, *Radiocarbon* 25, 179-186.

REICHMANN Chr. 1979: Ein mittellatènezeitliches Gehöft bei Grevenbroich-Gustorf, Kr. Neuss, *Rheinische Ausgrabungen* 19, 561-599.

REYNOLDS P.J. 1974: Experimental Iron Age storage pits: an interim report, *Proc. Prehist. Society* 40, 118-131.

REYNOLDS P.J. 1979: *Iron-Age Farm. The Butser experiment,* London.

REYNOLDS P.J. 1981: Deadstock and livestock. In: MERCER R. (ed.), *Farming practice in British prehistory,* Edinburgh, 104 ff.

ROWLETT R.M., ROWLETT E.S.-J. & BOUREUX M. 1969: A rectangualar Early La Tène Marnian house at Chassemy (Aisne), *World Archaeology* 1, 106-135.

ROYMANS N. 1985: Nederzettingssporen uit de Midden-IJzertijd op de Kerkakkers te Dommelen. In: SLOFSTRA J. e.a., *Het Kempenprojekt 2. Een regionaal archeologisch onderzoek in uitvoering,* 11-17.

SIMONS A. 1983-a: Die eisenzeitlichen Funde der Siedlung Hambach 260, *Rheinische Ausgrabungen* 24, 299-305.

SIMONS A. 1983-b: Siedlungsreste vom Übergang Späthallstatt/Frühlatène aus Bedburg, Erftkreis, *Rheinische Ausgrabungen* 24, 307-316.

SIMONS A. 1983-c: Eine spätlatènezeitliche Siedlung von Niederzier-Hambach, Kr. Düren, *Rheinische Ausgrabungen* 24, 317-329.

SLICHER VAN BATH B.H. 1960: *De agrarische geschiedenis van West-Europa 500-1850,* Utrecht/Antwerpen.

TIESING H. 1974: *Over landbouw en volksleven in Drenthe* I, Assen.

VAN DEN BROEKE P.W. 1980: Bewoningssporen uit de IJzertijd en andere perioden op de Hooidonkse Akkers, gem. Son en Breugel, prov. Noord-Brabant, *Analecta Praehist. Leidensia* 13, 7-80.

VAN DER SANDEN W. 1981: The Urnfield and the Late Bronze Age settlement traces on the "Haagakkers" at St. Oedenrode (Prov. of North Brabant), *Berichten R.O.B.* 31, 307-328.

VAN ZEIST W. 1968: *Prehistoric and early historic food plants in the Netherlands,* Palaeohistoria XIV, 41-173.