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Carbonised Cereal from Three Late Neolithic and Two Early Bronze Age Sites in Western Norway

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Abstract

Carbonised cereals were found in three Late Neolithic and two Early Bronze Age sites in western Norway. One site, Hjelle is located in northwestern Norway with no close connection to the sea. The Skrivarhelleren site is located in the mountains of the inner Sognefjord. The Voll, Sørbø and Ystabø sites are located on two islands in the middle of a fjord area north of Stavanger, SW Norway. Primarily Hordeum vulgare var. nudum (naked barley) were found. A few grains of Hordeum vulgare (hulled barley) were present in samples from two of the sites. Triticum dicoccum (emmer), Triticum sp. (wheat) and remains of collected plants were also found. The data produced for this article showed that by the end of the Neolithic/beginning of the Bronze Age there must have been an established agricultural economy in parts of western Norway.

Keywords: CARBONISED CEREALS, LATE NEOLITHIC, EARLY BRONZE AGE, WESTERN NORWAY, TWO-AISLED HOUSE, POSTHOLES

Introduction

When did people settle down and begin a new way of living that was totally different from that of the nomadic hunters and gatherers, who lived in western Norway during the Mesolithic and the Early Neolithic? When did the "generally accepted" introduction of a Neolithic agro-pastoral economy in western Norway actually occur? These questions have long been discussed (Bjerck 1988, Olsen 1995, Glørstad 1996 and Prescott 1996) and are still the subject of an ongoing debate. In Scandinavia the introduction and establishment of farming was a long term process.

The archaeobotanical data from the five different sites presented here (Fig.1) make a contribution to the discussion of early agriculture in western Norway. Previously carbonised grains have been reported from only two Late Neolithic contexts in Norway (Bakkevig 1995, Nærøy 1993).

Early cereal cultivation, by Norwegian standards, has been reported from other countries around the North Sea. In Great Britain sparse finds of *Triticum dicoccum* (emmer) and *Triticum monococcum* (einkorn) have been reported from Neolithic localities (Mofett *et al.* 1989) with the exception of an early Neolithic investigation that recovered large assemblages of carbonised cereals (Fairweather and Ralston 1993). In Orkney and in the Hebrides *Hordeum vulgare* var. *nudum* (naked barley) are reported from Late Neolithic sites. This pattern, with wheat in the south and barley in the north, becomes more clear in reports from the Early Bronze Age and may be explained by the colder climate in the north (Greig 1991). In the Netherlands *Triticum dicoccum* (emmer) and *Triticum monococcum* (einkorn) are found in Early Neolithic sites (Bakels 1991).

In Denmark, only a few, modest finds of carbonised cereals are reported from the Early Neolithic.

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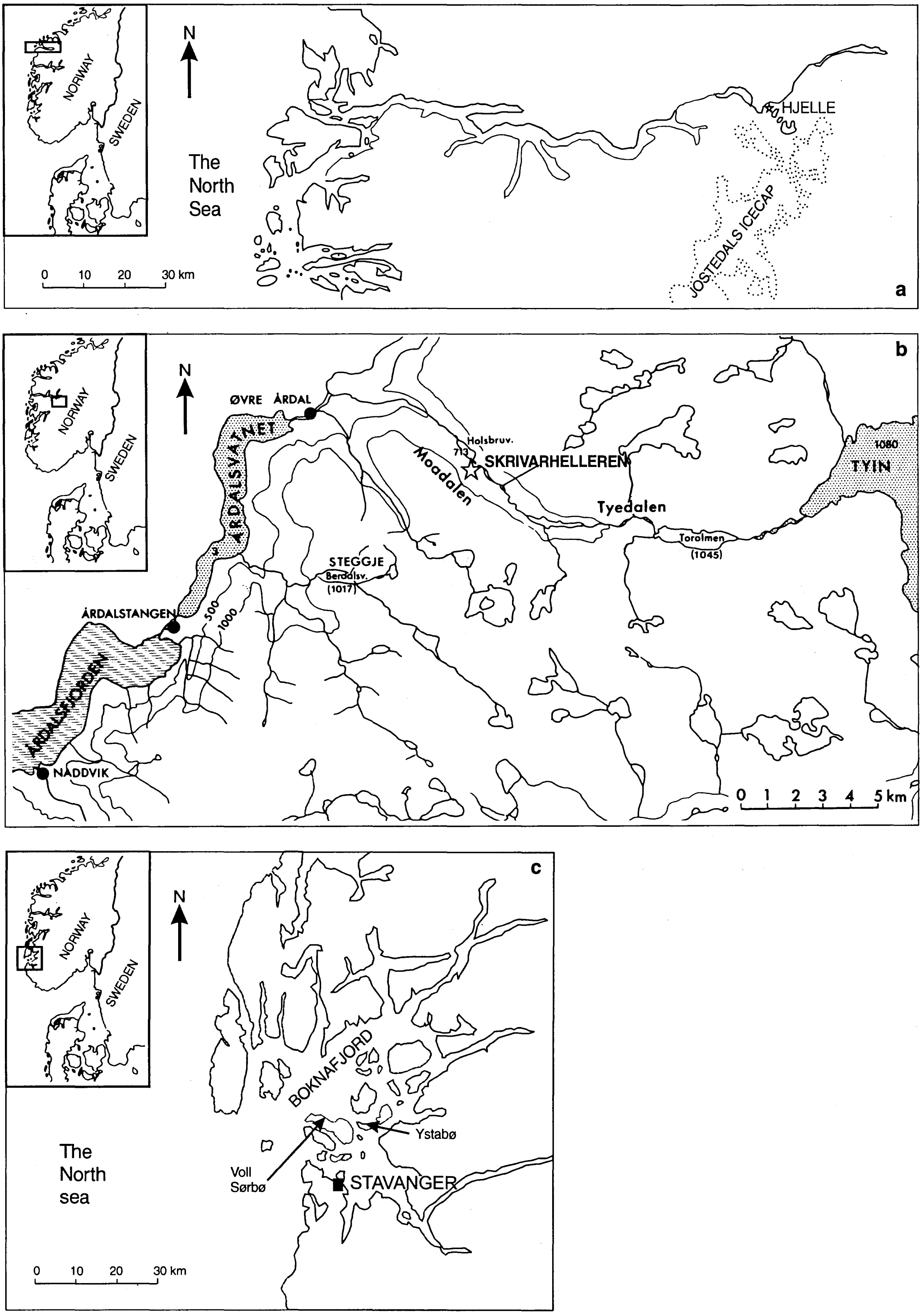

Figure 1. Maps showing the location of the sites referred to in the text, (a) the Hjelle site, (b) the Skrivarhelleren site, (c) the Voll, Sørbø and Ystabø sites.

From the Middle Neolithic onwards the finds are larger (Robinson 1994; 1998). *Triticum dicoccum* (emmer) appears to be the dominant species in the Early and Middle Neolithic (Jørgensen 1981; Robinson 1994; 1998), but *Hordeum vulgare* var. *nudum* (naked barley), *Triticum monococcum* (einkorn), *Triticum spelta* (spelt) and *Hordeum vulgare* (hulled barley) are also present. In the Late Neolithic it seems, however, *H. vulgare* var. *nudum* (naked barley) became more common (Jørgensen 1981, Robinson 1994). In Sweden, glume wheat (*Triticum monococcum / T. dicoccum / T. spelta)* and naked wheat (*T. compactum / aestivum*), naked (*Hordeum vulgare* var. *nudum*) and hulled barley (*H. vulgare*) are found in Early Neolithic contexts (Hjelmquist 1979, Gustafsson 1995, Göransson 1995, Regnell 1998). It is difficult to detect a change in dominant species. At Alvastra *H. vulgare* var. *nudum* (naked barley) and *T. dicoccum* (emmer) are dated to 4430 BP and Göransson (1995) concludes that complex agrarian systems were established at that time in southern Sweden. In Finland, however, the earliest cereal found is somewhat later, dating back to the Early Bronze Age (Vuorela and Lempiäinen 1988).

Artefacts found in western Norwegian Late Neolithic and Early Bronze Age sites, show a clear southern Scandinavian influence (Solberg 1994). Funnel Beaker pottery documented on a Middle Neolithic site in western Norway that experienced Funnel Beaker cultural contact (Olsen 1995). This proves that the hunter-gatherer population in western Norway was in contact with agricultural societies in other parts of north-western Europe at that time. This could be confirmed by pollen-analytical investigations in western and southern Norway that indicate forest clearance and an opening up of the vegetation from approximately 5200 BP (Bakka and Kaland 1971, Hjelle *et al.* 1992, Prøsch-Danielsen 1996). In addition, there are traces of cereal cultivation in Norwegian pollen data as early as the Early and Middle Neolithic. Cereal-type pollen grains are recorded from the southern part of Norway from lake sediments (identified by Ulf Hafsten). This event has a maximum age of 5685±-85 BP (TUa-665A) (Prøsch-Danielsen 1996). Further northwest Hjelle (1995) reported finds of cereal-type pollen in structures dated to the Middle Neolithic. These pollen records may be seen as an attempt to grow cereals. At the same site, it was not possible to obtain any carbonised cereal grains even though 1270 litres of soil were analysed (Soltvedt 1992).

Investigation of wear and tear on TRB flint sickles in Denmark indicates that their use increased in the Middle Neolithic (Juel Jensen 1993). In Denmark, there was a thousand year long availability phase before cultivation expanded (Zvelebil and Rowley-Conwy 1984). As in Denmark, there seems to have been a long availability phase also in Norway. The few pollen grains of cereals, recorded in the Middle Neolithic (Hjelle 1995, Kaland 1992, Prøsch-Danielsen 1996), indicate that cereal cultivation at this time was on a limited scale, so limited that carbonised grains have not been found on the excavated sites.

The investigations by Hufthammer (1995) on animal bones indicate that skeletal material from domesticated animals first occurs in Western Norway in the late Neolithic. It is assumed that agricultural production is very scant before the end of the Late Neolithic in Western Norway (Bjerck 1988).

The Excavated Sites

Four of the sites presented here were rescue excavations (Fig. 1). These sites are Hjelle, Voll, Sørbø and Ystabø. The Hjelle site was excavated by Bergen Museum, University of Bergen (Gundersen 1995). The sites Voll, Sørbø and Ystabø were excavated by the Museum of Archaeology, Stavanger (Høgestøl 1995, Hemdorff 1993). The Skrivarhelleren was excavated by C. Prescott as part of his doctoral degree (Prescott 1991; 1995).

The Hjelle site, Stryn, Søgn og Fjordane

The site was located in Mykjedalen in the inner fjord district of Sogn, 42 m asl. on a river terrace. The river terrace is bounded by steep hills on three sides and the Hjelledøla River running along the fourth (Fig. 2a). Today, local farmers consider this a marginal area with short summers and normally high precipitation but, on a more local scale and earlier in prehistory, the climate may have been favourable for farming. Fireplaces and postholes from the Bronze Age and Iron Age were documented but it was difficult to confirm any house constructions (Gundersen 1995).

The excavated fields, field I and II (Fig. 2a), are separated by a brook that may have shifted course through time and caused inwash of sediments. Profile 1 in field II revealed cultural layers from three separate occupations (Fig.2b and c) (Gundersen 1995). The youngest layer (3) is from the Migration Period. Material from layer 5 has not been ^{14}C-dated, but the age can be estimated to the Bronze Age and / or Early Iron Age. The oldest cultural layer (layer 9) with relevance to the present study was ^{14}C-dated to the Late Neolithic. This layer was separated and sealed under layers of gravel and sand washed in from the brook or transported in by an overflow of the Hjelledøla river. The layer was up to 18 cm deep. At the bottom of the layer a series

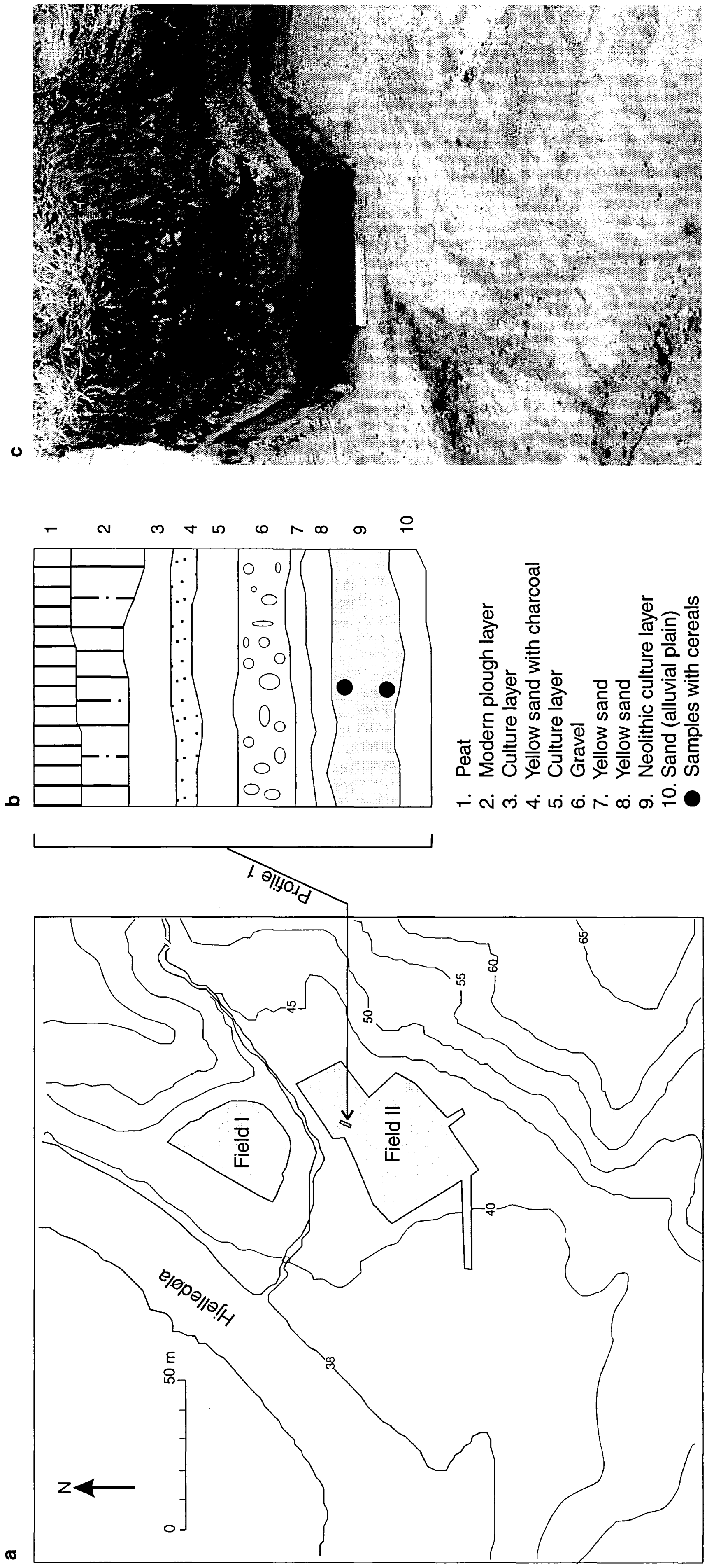

Figure 2. The Hjelle Site: (a) plan. (b) profile 1 (c) profile 1 and ardmarks.

of grooves penetrating the sandy subsoil was observed and interpreted as ard marks. The observed ard marks may cover an area of approximately 120 m². Three soil samples (1 to 3 litres each), for macrofossil analysis and radiocarbon dating, were taken from this layer and from the ard marks (fig. 2b), and sieved during the fieldwork.

Charcoal from the upper part of cultural layer 9 was dated to 3650±60 BP (Beta-74645), 2140–1950 cal. BC, and charcoal from the lower part of cultural layer 9 was dated to 3690±90 BP (Beta-74646), 2280–1950 cal. BC. One carbonised grain of naked barley from the ard mark was dated to 3760±70 BP (Beta-78028), 2320–2040 cal. BC.

The Skrivarhelleren site, Årdal, Sogn og Fjordane

Skrivarhellaren is a large rock shelter located in the Moadalen, a valley stretching from the inner Sognefjord district up to the alpine mountain areas (Fig. 1). Through this valley, a natural route of communication leads from Sogn to the eastern valley of Valdres. Skrivarhelleren lies 790 m asl. in the subalpine zone today. The shelter had stratified layers dated from the Late Neolithic, through the Bronze Age and into the Iron Age. In the rock shelter, six principal layers were excavated designated from III to VIII from top to bottom (Fig. 3) (Prescott 1991; 1995). The oldest layer (VIII) was dated to Late Neolithic period II. The conditions in the rock shelter gave excellent preservation of bone, teeth and antlers. During the fieldwork, samples from the different layers were sieved and carbonised plant material was found in six of the samples from layers V to VIII, in a Late Neolithic/Early Bronze Age context (Soltvedt 1991).

Layer V has been dated to 3520±80 BP (T-7830), 1960–1740 cal. BC, layer VI to 3550±110 BP (T-7831), 2040–1740 cal. BC and layer VIII to 3320±90 BP (T-7833), 1740–1510 cal. BC and 3420±130 BP (T-7832), 1900–1540 cal. BC (Prescott 1991; 1995).

The Voll site, Rennesøy, Rogaland

Voll is located on an island in the fjord area north of Stavanger (Fig. 1). The position of the island is central, with good access to marine resources and woods for hunting. A two-aisled house and a cultural layer were discovered close to each other at this site. These were located on a small grassy terrace sheltered by a small hill (Storhaug). The subsoil consists of well drained moraine and the terrain (around the hill) slopes slightly down to the sea where today there is a sheltered harbour. It is uncertain if the house and cultural layer were in use at the same time. Artefacts and ^{14}C-dating of charcoal indicate that the house was older than the cultural layer.

Altogether 47 postholes were registered and 23 of them formed an outline of a two-aisled house (Fig.4). The house was dated to the Late Neolithic. Soil samples from seven postholes from every part of the house and from an oblong depression outside the house were analysed (Soltvedt 1995a and b). One grain of *Hordeum vulgare* var. *nudum* (naked barley) is dated to 3560±55 BP (Ua-2601), 2030–1780 cal. BC.

The cultural layer covered 100 m² and was about 50 cm thick (Fig. 5). It was excavated in layers of five centimetres. In each layer samples were taken for macrofossil analysis. The artefacts found date the site to the Late Neolithic. A large number of small fire-affected and cracked flat stones were also found in the cultural layer (Mydland 1995a and b; Storhaug 1995). One grain of *Triticum dicoccum* (emmer) was dated to 3500±60 BP (Ua-2600), 1900–1740 cal. BC.

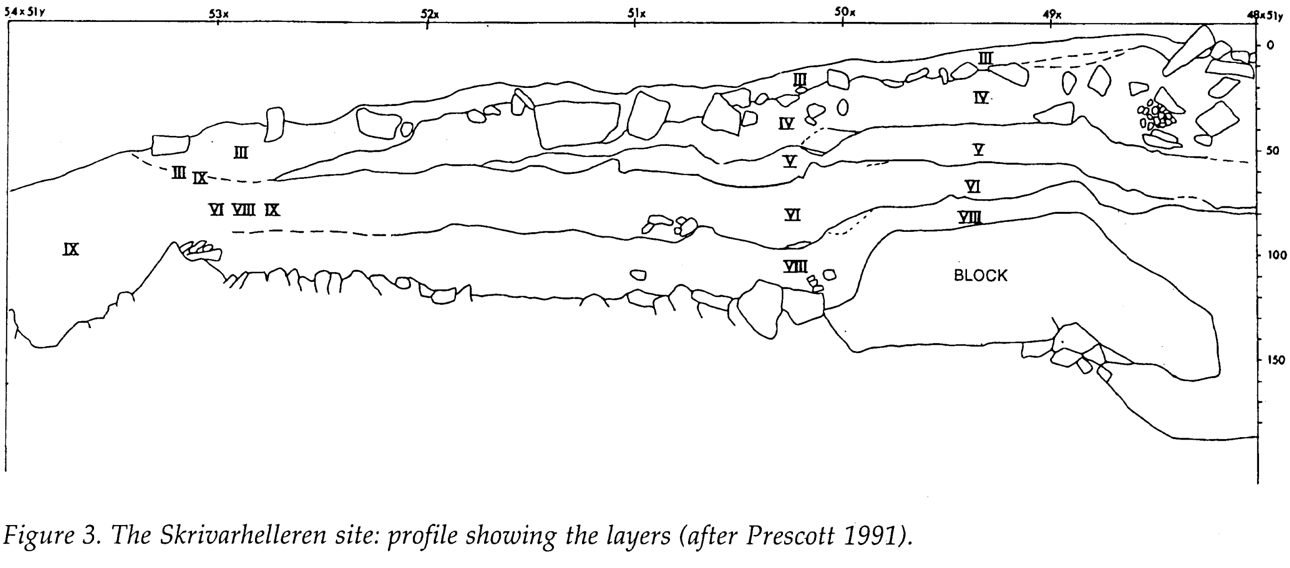

Figure 3. The Skrivarhelleren site: profile showing the layers (after Prescott 1991).

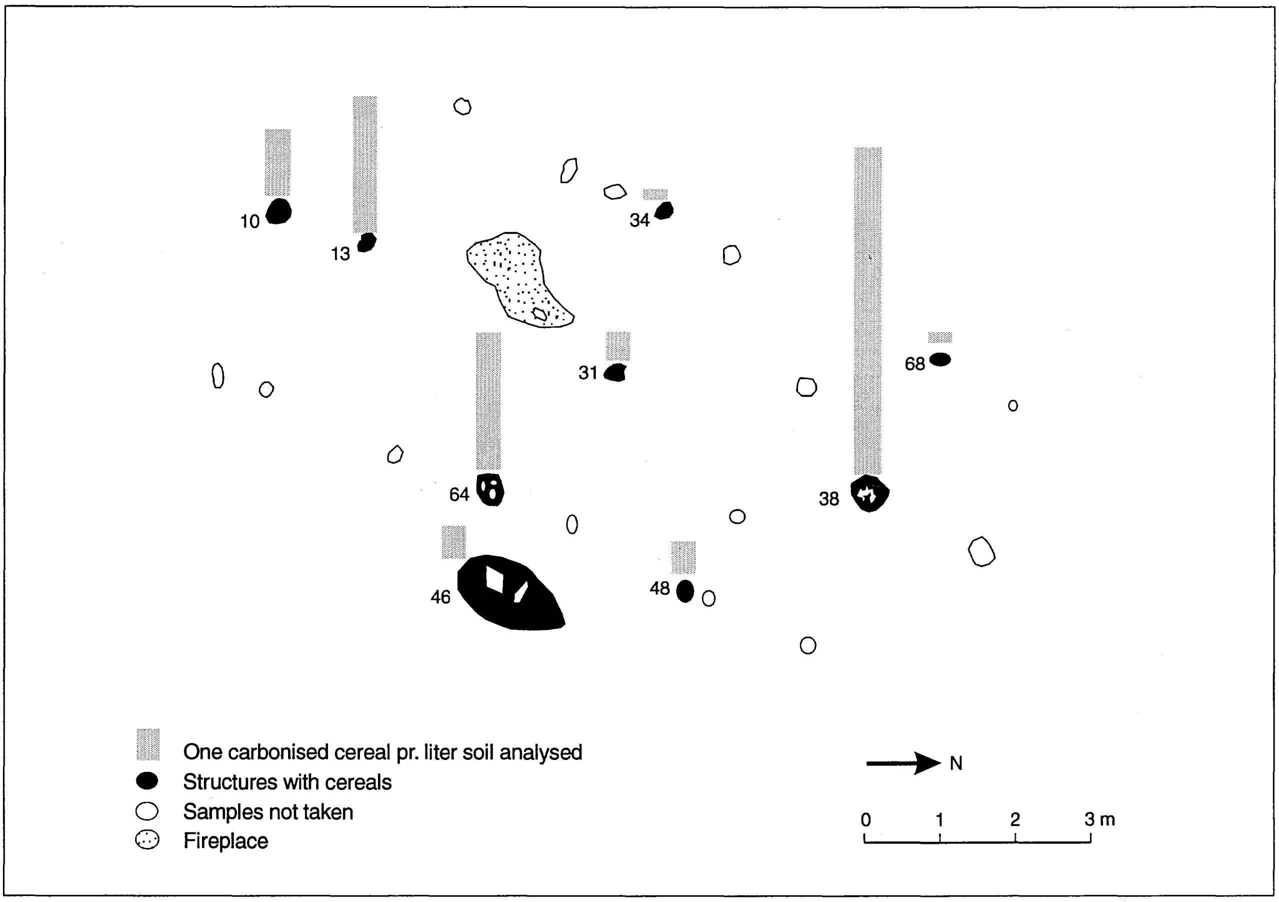

Figure 4. The Voll site, two-aisled house: the height of the columns is given by the total number of cereal grains per litre of soil analysed from each structure. The number of grains was calculated as the sum of the whole grains, plus the number of grain fragments divided by three.

The Sørbø site, Rennesøy

Sørbø is located on the same island as Voll but 10 km. east (Fig. 1). At Sørbø, both historic and prehistoric remains are seen in the landscape. A Middle Age stone church, an old (Scandinavian) stone monument, a rune stone, a field balk, an Iron Age boat house and a number of grave mounds are present (Høgestøl 1995). Phosphate mapping indicated that there were also remains of occupation in the subsoil (Forsberg 1991), and postholes from a two-aisled house was found in a meadow (Hemdorff 1995). The subsoil consisted of well drained moraine. In the two-aisled house, only the postholes of roof bearing posts could be recovered (Fig. 6). A cultural layer, probably deposited inside the house when it was inhabited, was also found.

Soil samples were taken from five postholes of roof bearing posts. From the cultural layer, two samples were taken close to each other. The volume of the samples was between 0.2 and 2.0 litres. A fragment of *Corylus avellana* (hazelnut shell) from the cultural layer was dated to 3395±70 BP (T-10320), 1880–1610 cal. BC and a grain of *Hordeum vulgare* var. *nudum* (naked barley) from a posthole was dated to 3385±60 BP (Ua-3537), 1870–1610 cal. BC. The dates show that the fill in the posthole and the cultural layer are contemporary.

The Ystabø site, Talgje, Finnøy, Rogaland

Ystabø is located on a small island, Talgje, southeast of Rennesøy in the Boknafjord area. A prehistoric house foundation was excavated on the highest plain on the island. The excavation revealed a two-aisled house foundation (Fig. 7) with clear parallels to Early Bronze Age houses found in Denmark (Hemdorff 1993). The subsoil consisted of an yellow sandy moraine allowing the house structure to appear distinctly. Samples were taken from 44 of the house structures. Usually soil samples of 0.3–3.0 litres were sampled from the different house structures. From house structure no. 46, thought to be a cooking pit or a fireplace, the volume sampled was 14 litres.

Three carbonised grains from three different

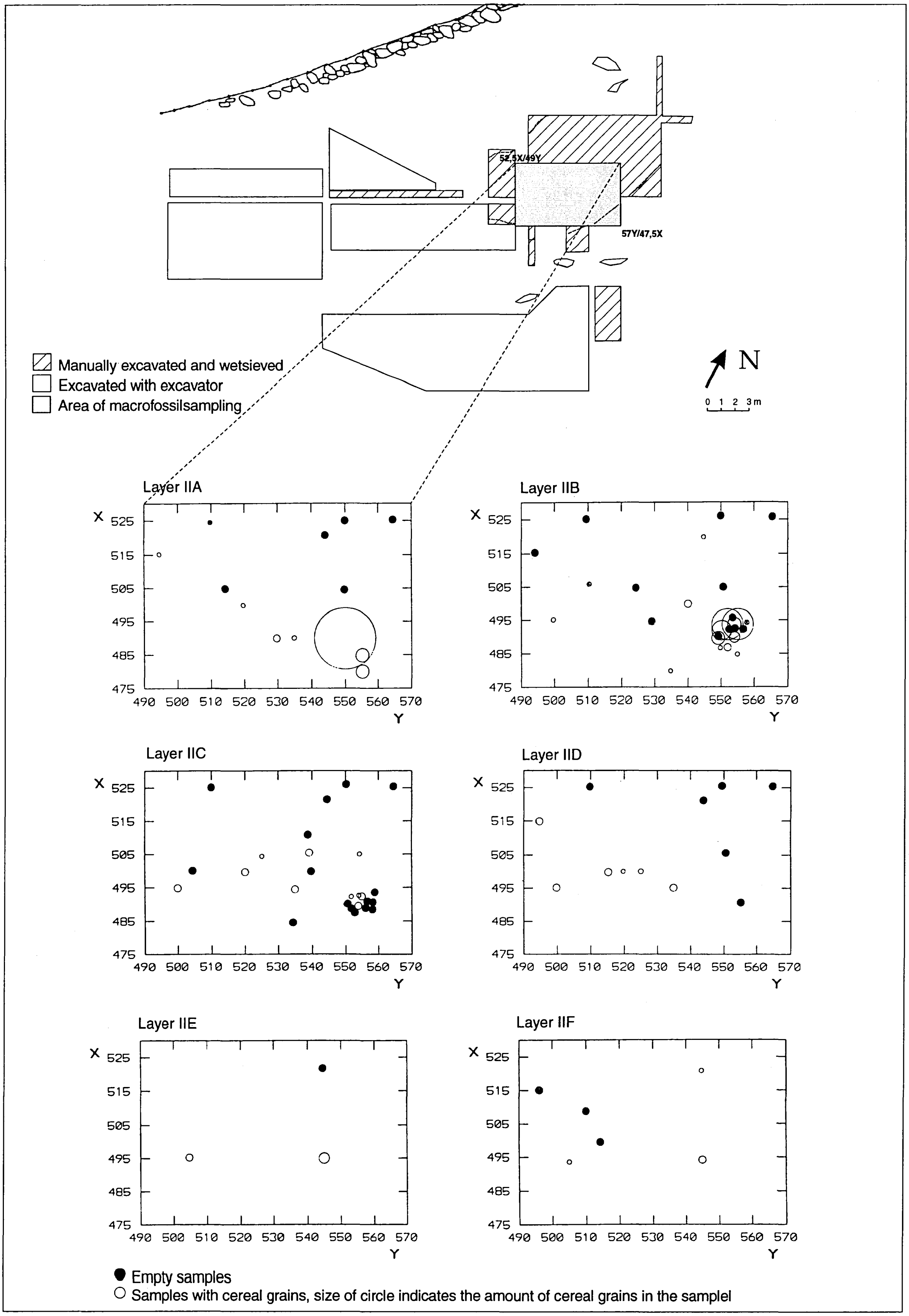

Figure 5. The Voll site, cultural layer: (a) excavated area, (b) distribution of cereals in the sampled area.

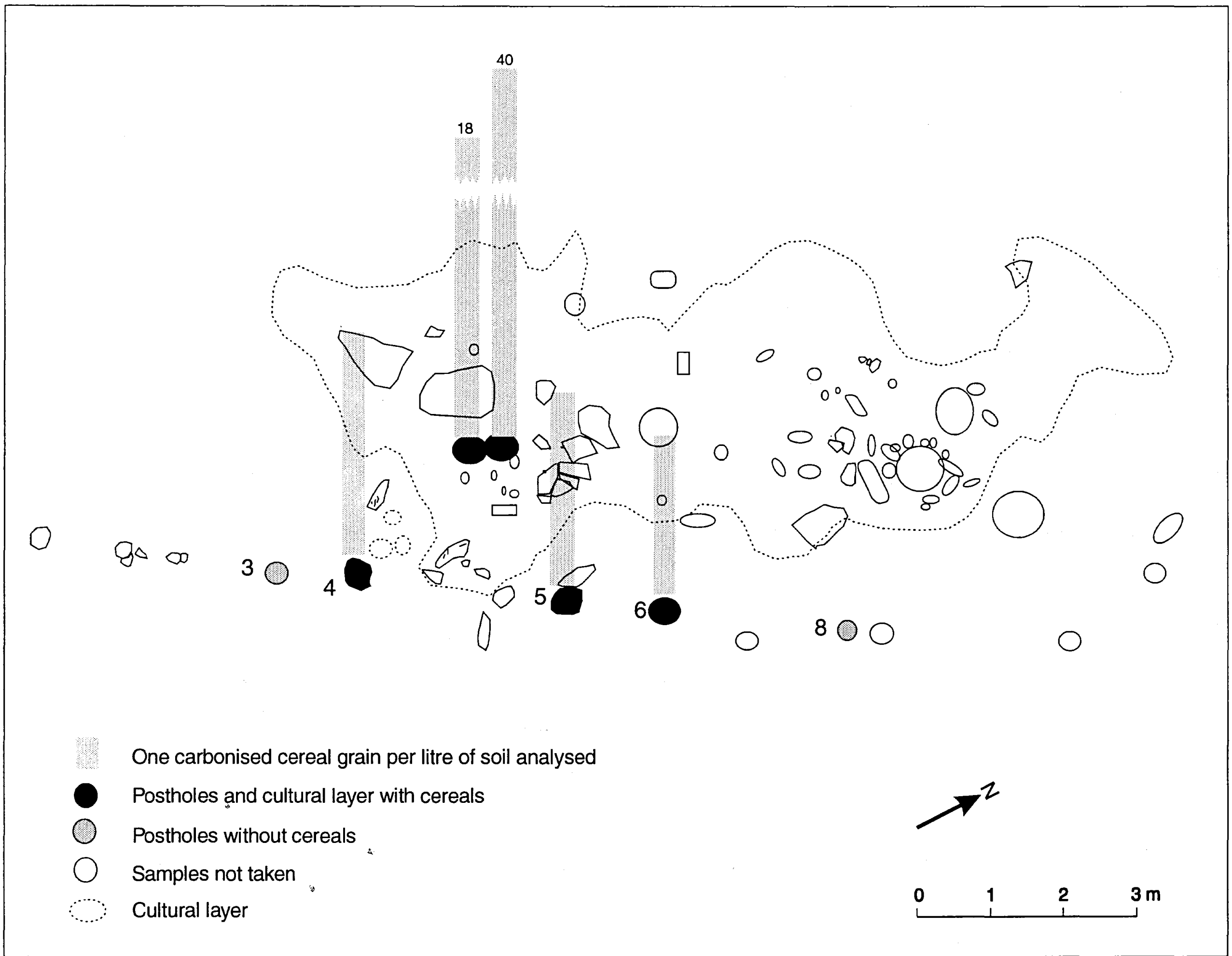

Figure 6. The Sørbø site, two-aisled house. (For the height of the columns see Fig. 4.)

structures were dated: from structure 2: 3280±65 (Ua-3313), 1680–1510 cal. BC, from structure 41: 3380±60 (Ua-3316), 1760–1530 cal. BC and from structure 46: 3205±65 (Ua-3318), 1410–1410 cal. BC. The house was probably in use during a period around 1700 BC. The dates confirm the suggestion that this must have been an established farm in the Early Bronze Age.

Laboratory Methods

The volume of each sample was measured before processing in the laboratory. The samples were washed through a sieve with a mesh size of 0.5 mm. The material was then floated in saturated saltwater, washed in water and dried (Bakkevig 1982). This method separates organic and minerogenic material. The plant remains were sorted and identified under a binocular microscope with x6 – x40 magnification. Only carbonised plant remains were investigated. Reference literature and the reference collection at the Museum of Archaeology, Stavanger, were used in the identification work. If not commented on, the BP dating is calibrated according to Stuiver and Kra (1986).

Results and Discussion

The Hjelle site

The two samples from the upper and lower boundary of layer 9 and one sample from the ard mark (Fig. 2b and c) contain charred plant remains. The macrofossils are relatively well preserved. Some cereals and the cereal kernel fragments are however poorly preserved, which prevents determination to genus. The carbonised cereals found are mainly *Hordeum vulgare* var. *nudum* (naked barley) (Table 1). The kernels of *H. vulgare* var. *nudum* vary in size from 3.5 to 6.0 mm in length with an average length

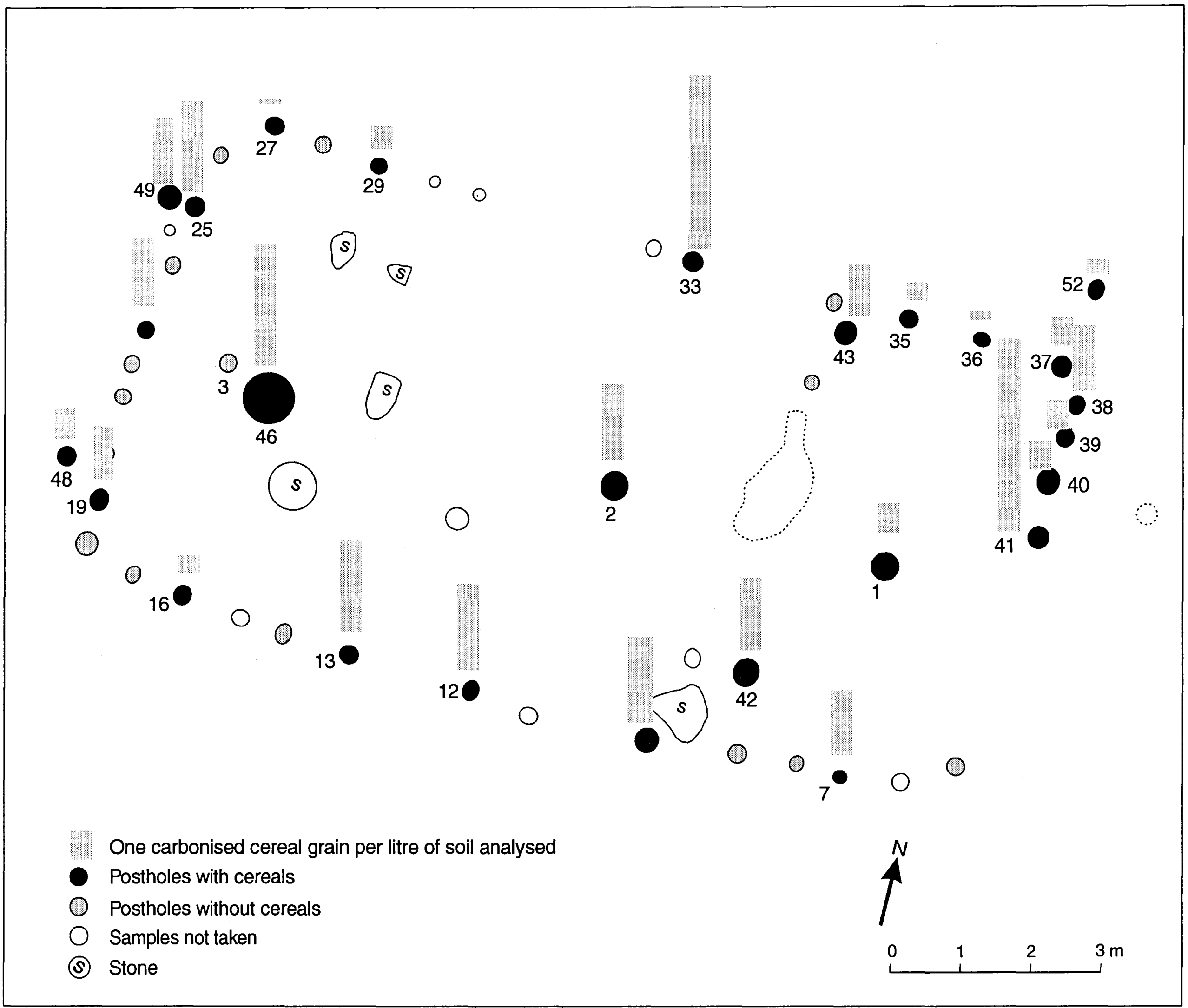

Figure 7. The Ystebø site, two-aisled house. (For the height of the columns see Fig. 4.)

of 4.9 mm. Some of the grains are swollen by burning and are therefore shorter, wider and thicker than the original form. 23 grains per litre of soil analysed were found in the sample from the ard mark and ca. 27 grains per litre of soil analysed were in the upper and lower samples from layer 9. Four internodes were also found, two of them are determined to *H. vulgare* var. *nudum* (naked barley) and one to *Triticum* sp. (wheat). The length of the internodes of naked barley are not more than 2.5 mm, which indicates that there is six row-barley in the material. Weeds are nearly absent.

These are the earliest dated cereals in Norway at present. The overlapping radiocarbon dates indicate a time-limited and intensive cereal cultivation at the Hjelle site. The theory of intensive cereal cultivation is supported by the thickness of layer 9.

Several factors may have caused the deposition of carbonised cereal grains in the soil and the ard marks. If the presence of carbonised cereal grains were a result of slash and burn activity a higher percentage of weed seeds would be expected. Another possibility is fertilisation of the fields by ash from fireplaces etc.. This is indicated for fields in the Iron Age (Sølvberg 1976). A lot of charcoal is found in field soil from the Iron Age and is interpreted as a method of fertilisation by Hagen (1953).

The presence of an arrowhead made of slate, which is a Middle Neolithic hunting tool, indicates that the site was occupied also before the cultivation of cereals took place in the Late Neolithic. This also indicates that the area was attractive for hunting, which was probably the case also in the Late Neolithic. The location of the site and the recorded cultivation therefore suggest a mixed economy during the Late Neolithic settlement period. The radiocarbon dating of the naked barley is the earliest cereal dated in Norway.

The Skrivarhelleren site

Three carbonised grains, two grains of *Triticum* sp. (wheat) were found in layer V and VI and one grain of naked *Hordeum vulgare* var. *nudum* (barley) in layer VIII.

Because of the altitude and climate, it is not likely that cereals were grown here. Probably they were transported to Skrivarhelleren as travelling provisions or as food supplies for a longer stay in the rock shelter. Together with archaeological artefacts (Prescott 1995), carbonised cereals give an indication of seasonal land use in the sub-alpine zone in the Late Neolithic/Early Bronze Age. The finds of wheat and barley suggest farming activities in the fjord area of Sogn. There is also a possibility that the grains came from farms in the valleys east of the mountains.

The Voll site

Grains, mainly of *Hordeum vulgare* var. *nudum* (naked barley) with some *Triticum* sp. (wheat), and seeds of weeds are found in the samples from the two-aisled house (Table 1). Grains were present in all the analysed structures from the house, but the density of cereals differs between the structures (Fig. 4). The density is highest in structure 38 with ten cereal grains per litre of soil analysed.

It was observed that grains from some structures (38, 64, and 31) seem to have been burned under equal conditions. They are all swollen and strongly vesicular whereas the grains from structure 10 and 13 were not strongly vesicular. Most of the grains from structure 38, 64, and 31 may originate from the same processed crop suggesting that the grains were scattered over this part of the house at the same time.

Few weed seeds and few weed species were found, which indicates nearly weed-free fields or that the cereal grains were processed before being deposited in the house. Carbonised cereals present in postholes are probably the result of an activity inside the house. In that case, this could have been cooking, processing or storing of grains and the activity was not restricted to special areas of the house. Since few seeds of grassland plants were found, it is reason to believe that animals were not kept inside the house.

Most of the cereals from the cultural layer were found in layer IIa and IIb in square 49x/55y but cereals are also found in other parts of the layer (Fig. 5). In layer IIb the number of cereals per litre of soil analysed was as high as 67. This is the highest concentration of cereals found so far in Late Neolithic contexts in Norway. Activity was obviously going on in or near the spot 49x/55y (Fig. 5). The identification of carbonised grains was difficult because they were strongly burned and deformed, and the epidermis was destroyed. Grains are mainly *Hordeum* var. *nudum* (naked barley), but a few grains of *Triticum monococcum/dicoccum* (einkorn/emmer) were also found. Nutshells of *Corylus avellana* (hazel), fruit stones of *Rubus idaeus* (raspberry) and seeds of weeds were also found (Table 1 and Soltvedt 1995a and b). Remains of hazel and raspberry are usually found in all archaeobotanical material from sites in Norway, and indicate settlement activities.

A total of 64 weed seeds are identified, of which 2/3 are identified to *Persicaria maculosa* and *Galium* sp.. Both are relatively high-growing weeds. The number of seeds of low-growing weeds are few. A flint sickle was found in the layer. The cereals were probably harvested by sickle. There were few internodes and few small grains in the samples. The cereals were therefore probably partly processed before they were deposited at the sampling point. The carbonised cereal and the large number flat and fire-affected stones (Mydland 1995; Storhaug 1995) indicate that the area around 49x/55y might have been a drying place for grains.

The Sørbø site

Three of the five postholes contain a few carbonised cereal grains (Fig. 6). The main cereal is *Hordeum vulgare* var. *nudum* (naked barley). The two samples from the cultural layer contain a high number of grains (18 and 40 cereals per litre of soil analysed) in addition to many internodes (Soltvedt 1995c). This may indicate that the grains were charred before they had been completely processed. If the grains were burnt while in storage, the presence of internodes shows that they could have been stored as ears.

The Ystabø site, Talgje

Carbonised grains were found in 25 of the 44 investigated house structures (Fig. 7). The majority of the grains that could be identified are *Hordeum vulgare* var. *nudum* (naked barley). Three grains are determined to *Hordeum vulgare* (hulled barley) and five grains to *Triticum* sp. (wheat). Few weed seeds were found. The sampled structures are randomly distributed in all parts of the house whereas the density of cereals is highest in the north-east corner of the house (Fig. 7). This area might have been used as a storeroom.

A structure in the northern part of the house (46) initially appeared to be like a common fireplace but it contained big stones and quite a number of carbonised grains. This could have been a drying pit for grains or a pit for food preparation. Because cereals are found throughout the house it is not likely that it housed animals. Carbonised cereals are also found in postholes outside the walls of the house.

The results show that *Hordeum vulgare* var. *nudum* (naked barley) was the main cereal cultivated. It is difficult to conclude how extensive the cultivation of *Triticum* (wheat) and *Hordeum vulgare* (hulled barley) was or if they were grown at all. The few grains of *Triticum* sp. and *Hordeum vulgare* may have been contamination (like weeds) in the naked barley fields.

Establishment of Agriculture on the West Coast of Norway in the Late Neolithic

The number of analysed samples is low, especially from Hjelle, Skrivarhelleren and Sørbø. This is mainly due to a tight margin of expenditure. The volume of samples may also seem small, but all the material accessible in the structures was usually collected (Table 1). Because of the low amount of cereals in each structure, it is difficult to state the correct composition of cereals grown at the sites (van der Veen and Fieller 1982). However, it permits an indication of the main tendencies of the material.

The cereals found at all four sites were mainly *Hordeum vulgare* var. *nudum* (naked barley) (Table 1), although some *Triticum dicoccum* (emmer), *T. monococcum* (einkorn) and *Hordeum vulgare* (hulled barley) were also found. A great number of the grains are difficult to identify and it is questionable whether they are all naked barley. As seen in Fairweather and Ralston (1993) different species can dominate in different structures or contexts at a site. Probably this is not the case here because *H. vulgare* var. *nudum* (naked barley) is dominant in cultural layers, postholes and the cooking pit/ fireplace.

The assemblages of plant remains from postholes and cultural layers obviously reflect different activities. The number of cereal grains is low in the postholes. Probably the cereals in the postholes can be interpreted as waste products of food preparation. Since cultivated plants clearly dominate in the samples, it must be suggested that crop growing was important in the economy. The density of cereals in samples from the cultural layers at Voll (Fig. 5) and Sørbø (Fig. 6) is higher than in samples from the postholes. The presence of cereals and fire-affected stones in the cultural layer at Voll may reflect a drying place for cereals. At Sørbø, the finds of cereals in the cultural layer may be remnants of a cereal store that was burned, though the size and density is not as great as for the assemblages that Rowley-Conwy (in press) discusses in his paper.

Few weed seeds were found together with the cereals on the sites. An exception is the samples from the cultural layer at Voll. Here the number of grains for each weed seed is lower. This may indicate that these cereals had been deposited when they were at an earlier stage of processing than those from the other sites. This again leads to the suggestion that drying of the cereals is an early stage in the process as described by Hillman (1984). The dominance of high-growing weeds indicates that the ears were separated from the straw before drying.

So far the interpretation of the biological material in W Norway has shown that it is possible to date established cereal growing in this part of Norway to the Late Neolithic. There is a possibility however that future excavations within this area will record cereal cultivation before 3700 BP.

The reasons why neither carbonised grains nor traces of an agrarian economy have been found from earlier contexts in Norway may be numerous. To establish agriculture, an appropriate ecological setting has to be developed in the natural landscape (Rindos 1984). Landscapes that were created by the regression of the sea, like the Litsa area, were suitable for husbandry and cornfields (Prøsch-Danielsen 1996). Here human beings did not need to create an agricultural landscape.

Another aspect that can explain the late establishment of cereal cultivation is that cereals had to be genetically adapted to a new climate. The genetic adaptation of wheat and barley to new areas perhaps took time and delayed the agrarian process. Wheat and barley are predominantly self-pollinated (Zohary 1969), which means that the population is split into independent pure genetic lines. When a population is taken from one area to another, with a different environment, it is possible that only some of the genetic lines survive in the new area. When harvesting the lines that ripened in the new area, they were selectively chosen and, if the largest cereals were chosen for sowing next year, there is an ongoing process that will adapt the cereal to a new set of ecological conditions. It was probably necessary to make repeated attempts before there were genetic lines in the sown material that could survive and give reliable production in a new area. It may also have been necessary to obtain seed grain from an area other than one with which cultural contact was already established. The process takes time and can be one of the reasons for the long interval which elapsed between the introduction of agriculture and the establishment of cereal cultivation in some parts of Scandinavia.

	Hjelle	**Skrivar-helleren.**	**Voll**		**Sørbø**	**Ystabø**
	Ard mark and cultural layer LN	Cultural layers V–VIII LN/EB	Two-aisled house LN	Cultural layer LN	Two- aisled house EBA	Two- aisled house EBA
	Soltvedt 1994	Soltvedt 1991	Soltvedt 1995	Soltvedt 1995	Soltvedt 1995	Soltvedt 1993
No. Samples	3		18	99	7	44
Cultivated						
Hordeum vulgare L. var. *nudum* (naked barley)	54		72	333	44	81
Hordeum vulgare L. (hulled barley)				2		3
Hordeum L. sp. (barley)		1		29	9	
Triticum monococcum L. (einkorn)				1		
Triticum dicoccum L. (emmer)				6	3	
cf. *Triticum* L. (wheat)	1	2	5		1	5
Cerealia grain, undiff	58		68	123	118	66
Cerealia rachis segments	4				37	2
Collected						
Corylus avellana L. (hazel) shell fragments			4	80	31	2
Vicia L./*Lathyrus* L. ("wild pea")		1	2	4		1
Rubus idaeus L. (raspberry)	4		4	10		
Weeds						
Persicaria maculosa S.F.Gray (redshank)			6	34		2
Persicaria Miller. sp. (hensgras)				6	1	12
Fallopia convolvulus (L.) À. Löve (clinging buckwheat)	1			4		4
Stellaria media (L.) Vill. (chickweed)				3		2
Spergula arvensis L. (corn spurrey)			2	1		1
Chenopodium album L. (fat hen)	1			4		2
Rumex L. sp. (sorrel)				1		
Potentilla erecta (L.) Räuschel (common tormentil)						
Galium L. sp. (bedstraw)				10	2	1
Galeopsis L. sp. (galeopsis)		1		1	1	
Plantago lanceolata L. (ribworth-gras)				3		1
Ranunculus L. sp. (buttercup)						1
Urtica urens L. (nettle)				1		
Rumex acetocella L. (sheep's sorrel)						1
Carex L. group Distigmaticaea (sedge)			1		2	
Poaceae (grass)		1	1			
Other						
Varia	6		10	54	37	25

Table 1. Total number of carbonised seeds and fruits found at the investigated sites. The authorities follow Lid and Lid 1994.

Barley has a wide genetic variation (Zohary and Hopf 1993) and is therefore also adapted to cultivation in a cool and oceanic climate and this may be one reason why *Hordeum vulgare* var. *nudum* (naked barley) is dominant in the assemblages covered in this article.

Jennbert (1984) suggested that agricultural products were used as gifts and in religious spheres in Denmark before 3300 BC when agriculture was established south of Scandinavia. Norwegian (Olsen 1995; Prescott 1996) and English authors (Moffett *et al.* 1989) suggested the same for other areas around the North Sea. If people attempted to grow cereals and it was difficult to obtain reliable harvest, it is reasonable that cereals became even more important as gifts.

In those excavations of settlements from the Late Neolithic/Early Bronze Age in Western Norway where sampling and flotation has been executed, carbonised cereals have been found. The earliest indication of cornfield preparation in Norway is documented on the Hjelle site. Ploughing with an ard is here dated to the end of the Middle Neolithic/ Late Neolithic and it is worth pointing out that this is an area that is geographically distant from earlier accepted agro-pastoral centres such as Rogaland and Sunnmøre. The finds of Late Neolithic carbonised cereals at Skrivarhelleren far away from a farm also demonstrate the consolidation of crop cultivation in this time period in western Norway.

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References

Bakels, C. C. 1991. Western continental Europe, pp. 279–99 in van Zeist, W., Wasylikowa, K. and Behre, K.-E. *Progress in Old World Palaeoethnobotany*. Rotterdam: A. A. Balkema.

Bakka, E. and Kaland, P.-E. 1971. Early farming in Hordaland, Western Norway: problems and approaches in archaeology and pollen analysis. *Norwegian Archaeological Review* **4**, 1–35.

Bakkevig, S. 1982. Makrofossilanalyse. Saltvannsflotasjon av materiale fra Rugland på Jæren (Macrofossil analysis – salt water flotation of material from Rugland in Jæren). *AmS-Skrifter* **9**, 33–41.

Bakkevig, S. 1995. Neue makrofossile Beiträge zur Kenntnis des vorhistorischen Getreideanbaus in Südwestnorwegen, pp. 5–15 in Kroll, H. and Pasternak, R. (eds.), *Res Archaeobotanicae – IWGP. Proceedings of the Ninth Symposium Kiel 1992.* Kiel: Oetker-Voges-Verlag.

Bjerck, L. G. B. 1988. Remodelling the Neolithic in Southern Norway. *Norwegian Archaeological Review* **21**, 21–33.

Fairweather, A. D. and Ralston B. M. 1993. The Neolithic timber hall at Balbridie, Grampian Region, Scotland: the building, the date, the plant macrofossils. *Antiquity* **67**, 313–23.

Forsberg, A. 1991. RennFast, fosfatkartlegging (RennFast – phosphate mapping). Unpublished report, Archaeological Museum of Stavanger.

Glørstad, H. 1996. Noen boplasser fra Komperød i Skjeberg, Sarpsborg kommune, Østfold (Some settlements from Komperød in Skjeberg, Sarpsborg municipality, Østfold). *Nicolay* **67**, 42–63.

Greig, J. R. A. 1991. The British Isles, pp. 299–334 in van Zeist, W., Wasylikowa, K. and Behre, K.-E. (eds.), *Progress in Old World Palaeoethnobotany*. Rotterdam: A. A. Balkema.

Gundersen, H. 1995. Arkeologiske undersøkelser på Hjelle, Stryn, 1994 (Archaeological investigation at Hjelle, Stryn, 1994). Unpublished report, Bergen Museum, University of Bergen.

Gustafsson, S. 1995. *Fosie IV. Jordbruks Förändring och Utveckling från Senneolittikum till Yngre Järnålder.* (Part IV. Change and Development of Agriculture from the Late Neolithic to the Early Iron Age) (Malmö Museer Rapport 5). Malmö: Stadsantikvariska Avdelingen.

Göransson, H. 1995. *Alvastra Pile Dwelling. Palaeoethnobotanical Studies* (Theses and Papers in Archaeology New Series A6). Lund: Lund University Press.

Hagen, A. 1953. *Studier i Jernalderens Gårdsamfunn* (Studies of Iron Age Farm Society) (Universitetets Oldsaksamling Skrifter b4). Oslo: University of Oslo.

Hemdorff, O. 1993. Hus fra eldste bronsealder funnet på Talgje (House from the early Bronze Age found at Talgje). *Fra Haug ok Heidni* **1993/4**, 24–6.

Hemdorff, O. 1995. A. Lok. 13B Sørbø. De arkeologiske undersøkelsene (A. Locality 13B Sørbø. Archaeological investigation), pp. 146–51 in Høgestøl, M. (ed.), *Arkeologiske Undersøkelser i Forbindelse med Rennfastprosjektet, Rennesøy k* (Archaeological Studies in the Municipality of Rennesøy, Rogaland, South-West Norway) (AmS-Varia 23). Stavanger: Archaeological Museum of Stavanger.

Hillman, G. 1984. Interpretation of archaeological plant remains: the application of ethnographic models from Turkey, pp. 4–41 in van Zeist, W. and Casparie, W. A. (eds.), *Plants and Ancient Man.* Rotterdam: A. A. Balkema.

Hjelle, K. L. 1995. Boplassavsetninger og pollenanalyse, et eksempel fra Kotedalen i Hordaland (Settlement deposits and pollen analysis, an example from the Kotedalen site, Hordaland), pp. 187–202 in Bergsvik, K. A., Nygård, S. and Nærøy, A. J. (eds.), *Steinalderkonferansen 1993* (Arkeologiske Skrifter 8). Bergen: Historical Museum, University of Bergen.

Hjelle, K. L., Hufthammer A. K., Kaland P. E, Olsen A. B. and Soltvedt E. C. 1992. *Kotedalen – en Boplass Gjennom 5000 år* (Kotedalen – a Settlement through 5000 years) (Volume 2, Naturvitenskaplige Undersøkelser). Bergen: Historical Museum, University of Bergen.

Hjelmquist, H. 1979. Beiträge zur Kenntniss der prähistorichen Nutzpflanzen in Sweden. *Opera Botanica* **47**, 1–58.

Hufthammer, A. K. 1995. Tidlig husdyrhold i Vest-Norge. (Early husbandry in Western Norway), pp. 203–20 in Bergsvik, K. A., Nygård, S. and Nærøy, A. J. (eds.), *Steinalderkonferansen 1993* (Arkeologiske Skrifter 8). Bergen: Historical Museum, University of Bergen.

Høgestøl, M. 1995. *Arkeologiske Undersøkelser i Forbindelse med Rennfastprosjektet, Rennesøy k* (Archaeological Studies in the Municipality of Rennesøy, Rogaland, South-West Norway) (AmS-Varia 23). Stavanger: Archaeological Museum of Stavanger.

Jennbert, K. 1984. *Den Produktiva Gåvan. Tradition och Innovation i Sydskandinavien för Omkring 5300 år Sedan* (The Productive Gift. Tradition and Innovation in South Scandinavia 5300 years ago) (Acta Archaeologica Lundensia series 4, 16). Lund: University of Lund.

Juel Jensen, H. 1993. *Flint Tools and Plant Working. Hidden Traces of Stone Age Technology.* Aarhus: Aarhus University Press.

Jørgensen, G. 1981. Korn fra Sarup, med nogle bemærkninger om agerbruget i yngre stenalder i Danmark (Cereals from Sarup, with comments about farming in the Late Neolithic in Denmark). *KUML* **1981**, 221–31.

Kaland, P.-E. 1992. Pollenanalytiske undersøkelser utenfor boplassen i Kotedalen (Pollen analysis of sediments outside the settlement in Kotedalen), pp. 65–90 in Hjelle, K. L., Hufthammer A. K., Kaland P.-E, Olsen A. B. and Soltvedt E. C., *Kotedalen – en Boplass Gjennom 5000 år* (Kotedalen – a Settlement through 5000 years) (Volume 2, Naturvitenskaplige Undersøkelser). Bergen: Historical Museum, University of Bergen.

Lid, J. and Lid, D. T. 1994. *Norsk Flora* (Norwegian Flora). Oslo: Det Norske Samlaget.

Mofett, L., Robinson, M. A. and Straker V. 1989. Cereals, fruit and nuts: charred plant remains from Neolithic sites in England and Wales, and the Neolithic economy, pp. 243–61 in Milles, A., Williams, D. and Gardner, N. (eds.), *The Beginnings of Agriculture* (BAR International Series 496). Oxford: British Archaeological Reports.

Mydland, L. 1995a. Storhaug I – et sen-neolittisk hus på Rennesøy (Storhaug I – a Late Neolithic house at Rennesøy), pp. 125–131 in Høgestøl, M. (ed.), *Arkeologiske Undersøkelser i Forbindelse med Rennfastprosjektet, Rennesøy k* (Archaeological studies in the municipality of Rennesøy, Rogaland, South-West Norway) (AmS-Varia 23). Stavanger: Archaeological Museum of Stavanger.

Mydland, L. 1995b. A. Lok. 59 Voll. De arkeologiske undersøkelsene (Locality 59 Voll. The archaeological investigations), pp. 132–7 in Høgestøl, M. (ed.), *Arkeologiske Undersøkelser i Forbindelse med Rennfastprosjektet, Rennesøy k* (Archaeological studies in the municipality of Rennesøy, Rogaland, South-West Norway) (AmS-Varia 23). Stavanger: Archaeological Museum of Stavanger.

Nærøy, A. J. 1993. Cronological and technological changes in western Norway 6000–3800 BP. *Acta Archaeologica* **63**, 77–95.

Olsen, A. B. 1995. Fangstsedentisme og tidlig jordbrukspraksis i vestnorsk yngre steinalder belyst ved undersøkelsene i Kotedalen, Radøy, Hordaland (Sedentism and agriculture in the late Stone Age hunter-fisher society of Western Norway), pp. 131–50 in Bergsvik, K. A., Nygård, S. and Nærøy, A. J. (eds.), *Steinalderkonferansen 1993* (Arkeologiske Skrifter 8). Bergen: Historical Museum, University of Bergen.

Prescott, C 1991. *Kulturhistoriske Undersøkelser i Skrivarhelleren* (Cultural-historical Investigations in Skrivarhelleren) (*Arkeologiske-Rapporter* 14). Bergen: Historical Museum, University of Bergen.

Prescott, C. 1995. *From Stone Age to Iron Age: a Study from Sogn, Western Norway* (BAR International Series 603). Oxford: British Archaeological Reports.

Prescott, C. 1996. Was there really a Neolithic in Norway? *Antiquity* **70**, 77–87.

Prøsch-Danielsen, L. 1996. Vegetation history and human impact during the last 11,500 years at Lista, the southernmost part of Norway. *Norsk Geografisk Tidsskrift* **50**, 85–99.

Regnell, M. 1998. Archaeobotanical finds from the Stone Age of the Nordic countries. A catalogue of plant remains from archaeological contexts. *Lundqua Report* **36**, 1–14.

Rindos, D. 1984. *The Origins of Agriculture*. London: Academic Press.

Robinson, D. E. 1994. *A Catalogue of Crop Plant Remains from Danish Prehistoric Sites* (NNU report 13). Copenhagen: Nationalmuseets Naturvitenskablige Undersøkelser.

Robinson, D. E. 1998. Plantemakrofossiler fra Spodsbjergbopladsen (Plant macrofossils from the Spodbjerg settlement site), pp. 175–89 in Sørensen, I. H. (ed.), *Spodsbjergbopladsen*. Rudkøbing: Langeland Museum.

Rowley-Conwy, P. in press. Through a taphonomic glass darkly: the importance of cereal cultivation in prehistoric Britain, in Huntley, J. and Stallibrass, S. (eds.), *Taphonomy and Interpretation in Environmental Archaeology*. Oxford: Oxbow Books.

Solberg, B. 1994. Exchange and the role of import to Western Norway in the Late Neolithic and Early Bronze Age. *Norwegian Archaeological Review* **2**, 111–26.

Soltvedt, E.-C. 1991. Makrofossiler fra Skrivarhelleren (Macrofossils from Skrivarhelleren), pp. 130–2 in Prescott, C., *Kulturhistoriske Undersøkelser i Skrivarhelleren* (Arkeologiske rapporter 14). Bergen: Historical Museum, University of Bergen.

Soltvedt, E.-C. 1992. Makrofossilanalyse fra Kotedalen (Analysis of macrofossils from Kotedalen), pp. 123–37 in Hjelle, K. L., Hufthammer A. K., Kaland P. E, Olsen A. B., and Soltvedt E.C. 1992. *Kotedalen – en Boplass Gjennom 5000 år* (Kotedalen – a Settlement through 5000 years) (Volume 2, Naturvitenskaplige Undersøkelser). Bergen: Historical Museum, University of Bergen.

Soltvedt, E.-C. 1993. Makrofossilanalyse, Østabø gnr. 43, Talgje, Finnøy k. (Analysis of macrofossils, Østabø gnr. 43, Talgje, Finnøy k). Unpublished report, Archaeological Museum of Stavanger.

Soltvedt, E.-C. 1994. Makrofossilanalyse av planterester i prøver fra Hjelle, Stryn, Sogn og Fjordane (Macrofossils analyse of plant remains in samples from Hjelle, Stryn, Sogn og Fjordane). Unpublished report, Archaeological Museum of Stavanger.

Soltvedt, E.-C. 1995a. Makrofossiler (forkullete frø og frukter) (Macrofossils (carbonised seeds and fruits)) (Lok. 27, Voll), pp. 131–2 in Høgestøl, M. (ed.), *Arkeologiske Undersøkelser i Forbindelse med Rennfastprosjektet, Rennesøy k* (Archaeological Studies in the Municipality of Rennesøy, Rogaland, South-West Norway) (AmS-Varia 23). Stavanger: Archaeological Museum of Stavanger.

Soltvedt, E.-C. 1995b. Makrofossiler (forkullete frø og frukter) (Macrofossils (carbonised seeds and fruits)) (Lok. 59, Voll), pp. 137–40 in Høgestøl, M. (ed.), *Arkeologiske Undersøkelser i Forbindelse med Rennfastprosjektet, Rennesøy k* (Archaeological Studies in the Municipality of Rennesøy, Rogaland, South-West Norway) (AmS-Varia 23). Stavanger: Archaeological Museum of Stavanger.

Soltvedt, E.-C. 1995c. Makrofossiler (forkullete frø og frukter) (Macrofossils (carbonised seeds and fruits)) (Lok. 13b, Sørbø), pp. 150–1 in Høgestøl, M. (ed.), *Arkeologiske Undersøkelser i Forbindelse med Rennfastprosjektet, Rennesøy k* (Archaeological Studies in the Municipality of Rennesøy, Rogaland, South-West Norway) (AmS-Varia 23). Stavanger: Archaeological Museum of Stavanger.

Stuiver M. and Kra R.S. 1986. A computer program for radiocarbon age calculation. *Radiocarbon* **28**, 1022–30.

Sølvberg, I. Ø. 1976. *Driftsmåter i Vestnorsk Jordbruk ca: 600 – 1350* (Farming Techniques in Western Norway ca. 600–1350). Oslo: Oslo University Press.

van der Veen, M. and Fieller, N. 1982. Sampling seeds. *Journal of Archaeological Science* **9**, 287–98.

Vuorela, I. and Lempiäinen, T. 1988. Archaeobotany of the site of the oldest cereal grain find in Finland. *Annales Botanici Fennici* **25**, 33–45.

Zohary, D. 1969. The progenitors of wheat and barley in relation to domestication and agricultural dispersal in the Old World, pp. 47–66 in Ucko, P. J. and Dimbleby, G. W. (eds.), *The Domestication and Exploitation of Plants and Animals*. London: Duckworth.

Zohary, D. and Hopf, M. 1994. *Domestication of Plants in the Old World* (2nd edition). Oxford: Oxford Science Publications.

Zvelebil, M. and Rowley-Conwy, P. 1984. Transition to farming in northern Europe: a hunter-gatherer perspective. *Norwegian Archaeological Review* **17**, 104–28.