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PREHISTORIC CEREAL RAISING AT FORSANDMOEN, SOUTH-WESTERN NORWAY: CHANGES BETWEEN THE BRONZE AGE AND THE IRON AGE.

Sverre Bakkevig

ABSTRACT

On the Forsandmoen site, Rogaland, SW-Norway, a macrofossil study of 7810 charred cereal grains from nine houses representing a time span of about 800 years (from 2990±70 BP to 2140±70 BP uncalibrated) is described. The salt water flotation used at Arkeologisk museum in Stavanger, and some improvements in the analysing process is described. The preliminary results indicate: The naked barley (*Hordeum vulgare* var. *nudum*) which is dominating the Bronze Age crop is in Iron Age exchanged with hulled barley. In general a change from naked grains to hulled grains takes place. The percentage of wheat species decreases from The Bronze Age to The Iron Age, and in the transition between these periods the emmer wheat (*Triticum dicoccum*) is replaced with spelt wheat (*T. spelta*) and common wheat (*T. aestivum*).

Introduction

In the county of Rogaland, SW-Norway, important sources for new knowledge about Norwegian farming settlements in the Bronze Age and the Iron Age have been brought to light at the Forsandmoen site, Forsand municipality. The extensive excavations which have lasted for 11 years were finished in the summer 1990. About 72,500 m² have been excavated, and traces of approx. 240 houses from the Bronze Age and the Iron Age have been found. They represent a continuous settlement through a period of about 2000 years, ending around 600 AD (Løken 1990).

The Forsand municipality is typical for the western parts of Norway by its abundance of mountains, and being surrounded by narrow fjords. The granitic bedrock is low in nutrients and agricultural activities are mainly restricted to areas with moraine deposits.

Forsandmoen is a gravel plain surrounded by mountains on three sides. The site is situated about 40 km from the western coast of Norway (fig 1), and the oceanic climate is dominated by mild winters and cool summers. This together with a high humidity, about 1500 mm/yr, makes conditions favourable for grass production. The plain is accordingly mainly used for raising cattle and little cereals are actually grown today. The only two species which occasionally are

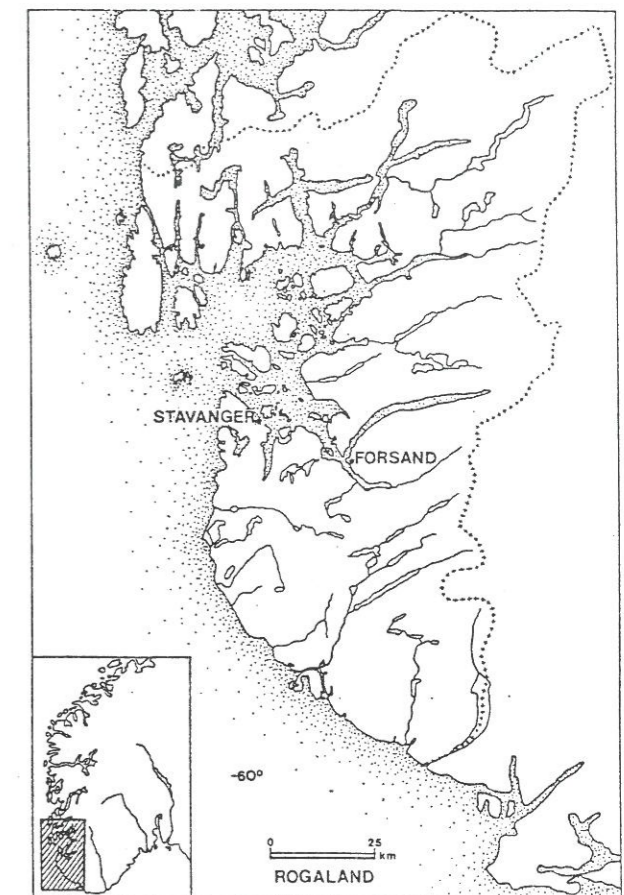


Fig 1. Location map for the Forsandmoen site, at Forsand in the county of Rogaland



Fig 2. First step in the field work flotation is washing the soil samples in water. Then the stainless kettle with sieve bottom is lowered in a bath of saturated calcium chloride, which makes the macrofossils float. Photo: Åge Pedersen.

cultivated are oat and common barley, both used as fodder. Some generations ago barley and oat commonly were sown together in this district.

By the use of phosphate analysis the traces of prehistoric agricultural activity were limited to about 12 hectares of the totally 190 hectares large plain (Løken 1985). Now 7.5 hectares have been excavated by the use of excavators and subsequent manual cleaning. The soil consists of gravel and pebbles, and when the topsoil is removed, post holes, fireplaces and other structures appear. They are usually considerably darker than the surrounding and underlying gravel, due to higher content of humus and varying influence of charcoal and charcoal dust.

Totally slightly more than 240 houses of different size and function have been detected. Some are very small, and possibly storage huts, just 10 m², other houses are 50 m long and ab. 350 m². Together the houses

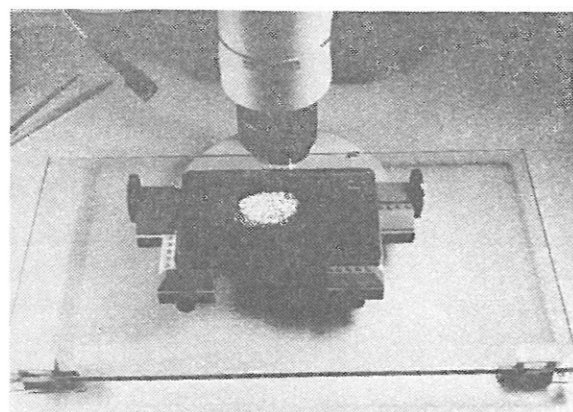


Fig 3. Carriage for systematic movement of macrofossil material under microscope, built from toy bricks, and rolling on a glass plate to ensure constant distance to the objective. Photo: Sverre Bakkevig.



Fig 4. The macrofossils can be collected by a tip of sticky modelling clay, fixed to the lower end of a fine brush. This combined tool is very efficient for both sorting and selection, and gentle to fragile macrofossils. Photo: Sverre Bakkevig.

illuminate building practice and changes in the size and structure of the settlement through a time span of ab. 2000 years, from 1400 BC to 600 AD (Løken 1991 and 1992).

Macrofossil fieldwork and laboratory methods

The dominating element in the podsollic soil on Forsandmoen is a gravel with a high stone content. As the soil, with the exception of the top soil, contains little humus, and repeatedly changes between wet and dry condition during the year, and also might freeze and thaw to a varying extent in the winter, the conditions are unfavourable for the conservation of uncharred material. In few years such material will be mineralized, and in addition earthworm activity can transport fresh seeds deep into the soil. This is commonly

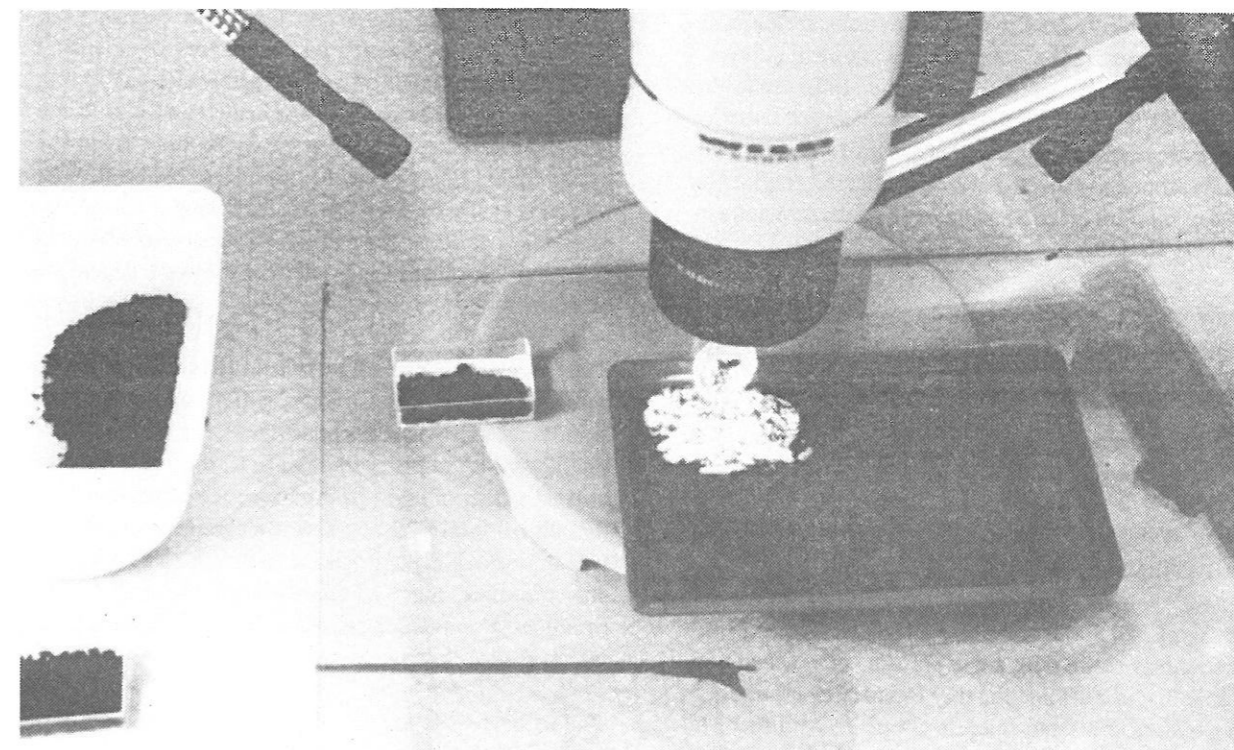


Fig 5. A small spoonlike container is mounted on a flexible suspension to the right of the microscope, just above the tray with the macrofossils and in the edge of the visible field of the microscope. Thus the whole process of sorting and collecting selected macrofossils can be done while looking through the microscope. Photo: Sverre Bakkevig.

Species\House	XXXII 2990±70	LIX 2780±100	XCI 2370±120	LX 2340±150	SUM	CXXIV 2140±80	XIX 2140±70	XXI 2140±70	SUM	XCIX 2440±40	XC 2400±50	SUM
Hulled barley (<i>Hordeum vulgare</i>)	43	32	4	13	17		2	45	47	24	7200	7224
Naked barley (<i>H. v. var. nudum</i>)	1451	205			0				0	3	100	103
<i>Hordeum</i>		9			0	2		6	8	3	400	403
<i>Hordeum</i> total	1494	246	4	13	17	2	2	51	55	30	7700	7730
Emmer wheat (<i>Triticum dicoccum</i>)	127	64			0				0		40	40
Spelt wheat (<i>T. spelta</i>)	8				0	5	4	7	16	42	50	92
Common wheat (<i>T. aestivum s.l.</i>)	4	7			0		1	9	10	2		2
<i>Triticum</i>	42	14			0			5	5	4	20	24
<i>Triticum</i> total	181	85	0	0	0	5	5	21	31	48	110	158
Oat (<i>Avena</i> sp.)	3				0	12	1	2	15			0
Determined grains	1678	331	4	13	17	19	8	74	101	78	7810	7888
% <i>Triticum</i>	10.8	25.7	0.0	0.0	0.0	26.3	62.5	28.4	30.7	61.5	1.4	2.0
% Naked grains	97.3	87.6	0.0	0.0	0.0	26.3	62.5	28.4	30.7	65.4	2.7	3.3

Fig 6. The number of cereal seeds from 9 houses at Forsandmoen. Houses with similar or nearly similar ages are grouped together. All ages refer to uncalibrated ¹⁴C datings from Laboriet for radiologisk datering, Trondheim, Norway.

indicated by the observation of earthworm capsules and viable seeds even in the layer of archaeological interest. Charred material is therefore the only reliable macrofossil. Even if scattered finds of insect remains occur, little attention is paid to this group of macrofossils. By the reasons mentioned above uncharred fragments can be of modern origin, and charred insect remains are not likely to occur.

Fireplaces have extensively been used for ^{14}C dating, the ages of most of the houses are actually being determined in this way, but fireplaces contain normally little macrofossil material except charcoal. The post holes have been the most important structures for collecting charred macrofossils. During the excavations totally 8 m^3 of soil samples have been selected from in average 10 post holes in each of slightly more than 100 houses.

Soil samples of about one litre each are first transferred to a stainless kettle with sieve bottom and washed in a water bath (fig 2). Then the tray is partially submerged into a bath of saturated calcium chloride, with specific gravity of about 1.4. This brings the charred material to float, even if totally wet, while minerogenic material and most of the organic but uncharred material sinks to the bottom.

The float consisting of charred material is removed by a skimmer of fine meshed metal net and placed in boxes in water, and brought to the laboratory. A more detailed description of the flotation process is described in Bakkevig 1982 and 1991. In the laboratory the charred material is rinsed in water, the uncharred and recent roots are removed carefully, and the rest let to dry slowly.

When the sorting and determination of the macrofossils started it was obvious that both the quality and the quantity of the material called for routines which could assure that no important finds were missed. On the contrary the great amounts of macrofossils should be examined as efficiently as possible. According to my experience from different institutions, the binocular examination of macrofossils is often carried out in an astonishing primitive manner, often just a random examination of totally black material against a shiny white and light reflecting plate of china or plastic, and without a system making sure that all material will be examined. The result is an inconvenient large contrast, loss of details and even if most of the material is examined several times, some part may not be examined at all. The continuous changes between staring into the microscope and then for some seconds focusing on the boxes outside the microscope to drop a find is also inconvenient.

In order to avoid these problems and improve the efficiency I recommend some small improvements. I distribute a thin layer of charred material on $17 \times 11\text{ cm}$ plastic trays which one by one is loaded on a 4-wheeled miniature carriage. This can easily be built from toy bricks like "Lego" (fig 3), or other material. The wagon is easily rolled forth and back under the microscope on a plate of glass which ensures a level movement and constant distance between the material and the objectives.

The track of the macrofossil carriage is determined by parallel guidelines and arrows, which can be observed simultaneously with the charred material on the plastic lid. The width of the guidelines is slightly less than the normal width of sight in the binocular, thus ensuring that all material will be observed against the deep-red tray in just one zigzag ride for each tray. The deep-red colour reduces much of the reflection of light and still produces a convenient contrast to black macrofossils which makes them easily distinguishable.

The macrofossils are picked up by a fine sticky tip of modelling clay attached close to the tip of a fine brush, the brush being used for sorting the material (fig 4). Both small and larger finds can very gently be lifted by the model clay tip, and redeposited either in an adjoining box or even better in a small spoonlike container held as close above the level of focus as possible by mechanical support. When just the rim of the container can be seen through the microscope, it is possible to select and deposit macrofossils continuously without taking the eyes away from the microscope (fig 5).

These simple and cheap adaptations have greatly improved both the efficiency, the ergonomics and the quality of the sorting and determination process connected with the large macrofossil material from Forsandmoen, a material consisting of about 20,000 charred cereal grains. At present only a part of the cereal finds are examined, and the number of other seeds and interesting macrofossils waiting for determination, like traces of food, coprolites, seeds of wild food plants, weeds etc. probably exceeds the number of charred cereal grains.

Results

The systematic collection and examination of macrofossils from more than 100 selected houses representing a 2000 year settlement period, have resulted in a rich and unique material which can be treated to answer many different questions. Only a part of the material is yet examined, and mainly from the oldest periods of settlement.

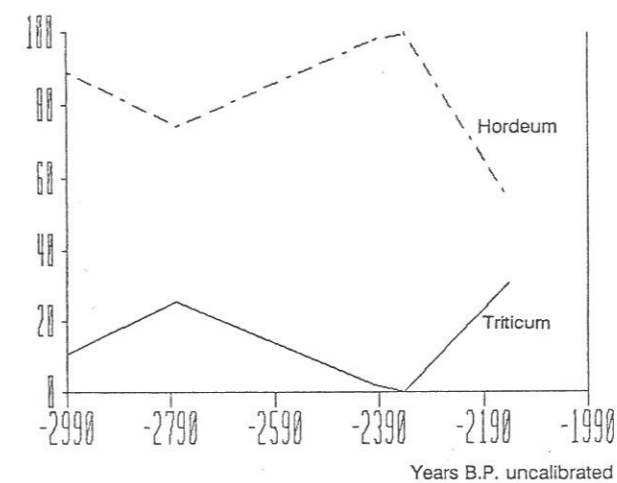


Fig 7. The relation between wheat species (*Triticum*) and barley species (*Hordeum*). Wheat species is common in Bronze Age but decreases in the transition to Iron Age.

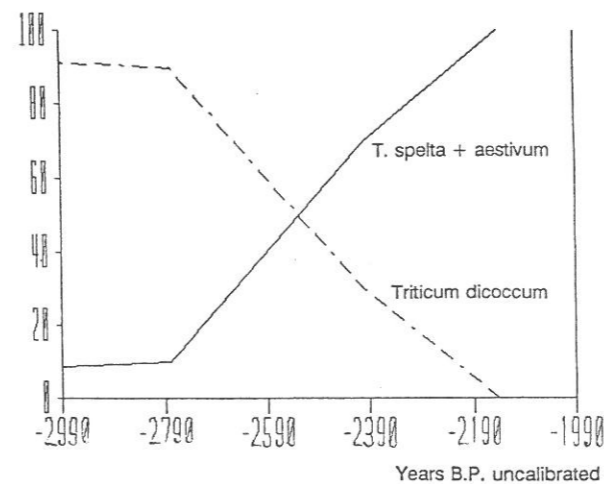


Fig 9. When regarding the wheat species the emmer wheat (*T. dicoccum*) is dominating in the Late Bronze Age but gradually decreases in frequency and is replaced by spelt wheat and bread wheat (*T. spelta* and *T. aestivum* s.l.).

For this study of the transition between Bronze Age and Iron Age I have selected nine houses which by ^{14}C are dated to Bronze Age and the first part of Iron Age. The yield of charred grains varies greatly from house to house, with the richest finds from Bronze Age (fig 6).

The most important cereal in both Bronze Age and Iron Age has been barley, *Hordeum vulgare* (fig 7), but through the transition to the Iron Age the relation between naked barley, *Hordeum vulgare* v. *nudum*, and hulled barley, *H. vulgare*, has been reversed (fig 8). In the Bronze Age naked barley was dominating the crop. As an example 97% of the barley in house XXXII

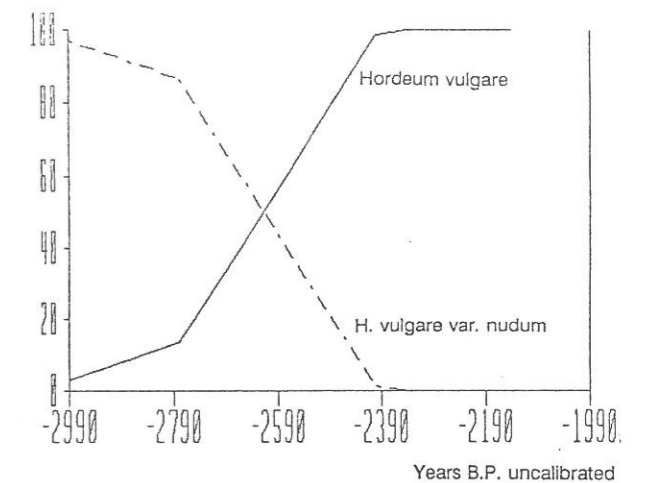


Fig 8. The naked barley (*H. vulgare* v. *nudum*) decreases from nearly 100% to ab. 0% in 600 years, and is at ab. 2390 BP fully replaced by hulled barley (*H. vulgare*).

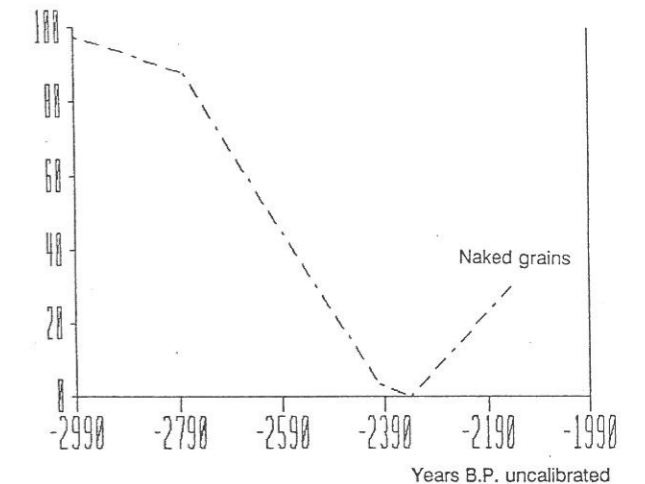


Fig 10. Of the different cereal species found the species with naked grains (*Hordeum vulgare* v. *nudum*, *Triticum dicoccum*, *T. spelta* and *T. aestivum*) has very little importance in a period around 2300 BP.

(2990 ± 70 BP, uncalibrated) is naked. In the approx. 200 years younger house LIX (2780 ± 100 BP, uncalibrated) 87% of the barley is naked. In the beginning of Iron Age nearly all the barley is hulled. Often the grains are swollen, indicating wet condition when being burned. The barley grains also often have lentil shaped depressions which indicate that the crop has been harvested unripe.

In the Bronze Age the emmer wheat, *Triticum dicoccum*, was the dominating wheat species (fig 9). As early as around 3000 BP scattered grains of oat are found. The grains are often small, and with a variable size. Most

probably the oat was at this stage more like weed in the fields of barley and wheat species.

In general the transition between Bronze Age and Iron Age is also a change between naked and hulled cereals (fig 10). The naked grains were more easy to grind to flour, but are normally regarded as less able to withstand diseases like fungal infections.

Macrofossils from archaeological excavations in other countries, especially in Central Europe, often contain complete ears, parts of ears, spikelet forks, and also chaff from the threshing and winnowing of the crop. This is seldom the case at Forsandmoen, where the finds of spikelet forks are few. This must indicate that threshing has taken place outside, and just the threshed and rinsed grain have been subject to conservation by fire. Another possible explanation is that the conditions are unfavourable for the preservation of small and fragile parts of the ear. Most of the relatively stronger grains and seeds are in very bad condition (Bakkevig 1991).

In addition to cereals, other plant remains are found in varying degree. The analysis of this material is not yet started but there seems to be a marked increase in the frequency of weed seeds in Iron Age compared with Bronze Age. This is especially the case for weeds which live in wet and acidic soil.

Discussion

The result presented above is an indication of a marked change in the practice of cereal raising at Forsandmoen in the transition between BA and IA. Can these changes be correlated to climatic changes in the same period? Can pests and diseases be a part of the explanation, for example attack on the crop by beetles or fungal diseases? Have the changes in cereal raising been caused by an exhaustion of the soil and formation of an iron pan causing higher watertable? Which social and economic structures have been in action in the period between Late Bronze Age and Early Iron Age, and which influence do these factors have on the cereal cultivation? Pollen analysis around and on the Forsandmoen site has shown that the same cereals as represented by macrofossils really have been cultivated in the area (Prøsch-Danielsen & Simonsen 1988, Hæg 1991), but have all the cereals we detect traces of really been cultivated on the site, or might the macrofossils in part be an indication of import and trade? And as other macrofossil finds of cereals in Norway are not abundant, how representative are the results from Forsandmoen for other parts of Norway?

The macrofossils from Forsandmoen can contribute to the solution of these questions, and a series of similar problems arising when we are trying to explore the prehistoric agriculture, but at this stage in the Forsandmoen project we shall preferably talk about indications and wait for further examination and systematic data treatment before the conclusions can be drawn. The results presented here are based on finds from nine houses which by ^{14}C are dated to the Late Bronze Age and Early Iron Age. When more houses from the Iron Age is analyzed the distribution of cereal species might change. Even if the age of the house is determined on charcoal from fireplaces inside the house, each fitting the plan of the house, the charcoal might be from an older or younger period than the house itself, thus resulting in incorrect ^{14}C age. This could also be the case with the charred grains from pits and post holes inside the houses. To overcome this uncertainty we have set up a plan for ^{14}C dating by accelerator on many single grains from selected structures. Other macrofossil finds like seeds of weeds are not yet analyzed in detail, but this material will surely also contribute to the understanding of the agricultural practice, and problems concerned with the cultivation of cereals.

The considerable changes in cereal cultivation at Forsandmoen, which is indicated at this stage of the investigation will probably be generally confirmed through further work, even if some corrections can come up. No single factor is likely to be responsible alone for the rise and fall of the different cereal species mentioned above, or for the changes from naked to hulled grains, but both the climatic factor itself, and the secondary effects of the climatic changes in the transition between Bronze Age and Iron Age should be paid special attention.

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