Elm, Lime and Middle Neolithic Cultivation – A Solvable Problem

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This article is a continuation of my article in CSA 1. It shows how the Alvastra pile-dwelling (4450 B.P., T1/2 = 5568) can be dated by means of pollen analysis. The redated Isberga III diagram is presented. Low values of elm, lime, and ash are said to reflect the Early Neolithic expansion, while the opposite is said to reveal the Middle Neolithic regression. It is demonstrated that there was no "regression" in western and southern Östergötland, in north-eastern Småland or in southern Scania, when these trees regenerated (the Regeneration Phase starts c. 4550 B.P. and ends c. 3750 B.P.). The expansion-regression model for the Early and Middle Neolithic is thus no longer valid. The synchronous vegetational changes during the Early and Middle Neolithic are described. Coppice woods with wandering arable fields very likely characterized the Regeneration Phase in many places in southern Sweden.

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THE ALVASTRA PILE-DWELLING, THE OMBERG GRAVE AND THE DAGSMOSSE BOG

In CSA 1:118 a pollen diagram section from the Dags Mosse bog in western Östergötland, east of Lake Vättern, was presented. The Alvastra spring-mire in which the Alvastra pile-dwelling is embedded is situated immediately to the south of and adjacent to the Dags Mosse bog. The site in the bog where cores for pollen analysis were taken is located c. 2.5 km north-north-east of the pile-dwelling (Fig. 1).

As described in CSA 1, the Alvastra pile-dwelling was a social and cult centre for a prosperous farming population with hunting and fishing as secondary occupations (Malmer, e.g. 1988:88; Browall 1986:156). About 40 years after its foundation the pile-dwelling was turned into a burial-place, into a village for the dead (Malmer, op.cit.).

The passage graves of southern Sweden (Götaland) also functioned as social and cult centres (Malmer, e.g. 1984:375). On the southern slope of the hill Omberg, only 2 km west of the pile-dwelling, at least one megalithic grave was built at the same time as the pile-dwelling (Janzon 1984 – see also Arne 1924). It is very possible that other megalithic graves existed in the surroundings of Omberg, Lake Tåkern, and the Dags Mosse bog. In any case, the Omberg grave and the Alvastra pile-dwelling together bear witness of how richly settled this part of western Östergötland was during an early part of the Middle Neolithic. This epoch – when the pile-dwelling and the Omberg grave were in use – is in the following called

"Alvastra time" (= c. 4450 B.P.).

THE POLLEN ANALYTICAL DATING OF THE ALVASTRA PILE-DWELLING

How do we know, then, that the Alvastra pile-dwelling was built at the time when the high forest of broad-leaved trees had strongly regenerated c. 700 C14-years after the elm decline, as I described in CSA 1? Of course, we have the very close and very sure C14-dates in the Dags Mosse diagram which can be compared with the dating of the pile-dwelling. In this way we are able to place the pile-dwelling at a very correct level in the Dags Mosse diagram. The Alvastra pile-dwelling is, however, as far as I know, the only Neolithic construction in Sweden which can be exactly dated by means of pollen analysis. The reason for this is that the pile-dwelling was built in a spring-mire which has been water-logged since Atlantic Time.

The deposits of the spring-mire have continuously been built up year after year, decade after decade, during centuries and millennia. Every spring and summer, pollen was brought by winds over the Alvastra spring-mire from the surrounding forests. When the "forest farmers" of the Early Middle Neolithic started their activities on the spring-mire the wind could sweep over the floor of the pile-dwelling and spread pollen from collected plants (cereals, weeds) over the nearest surroundings.

During threshing activities and cult ceremonies on the floor of the pile-dwelling billions of cereal pollen and of mugwort (*Artemisia vulgaris*) spread over the spring-mire (mugwort grew in the fields of corn, that is, on the newly cut down coppice wood

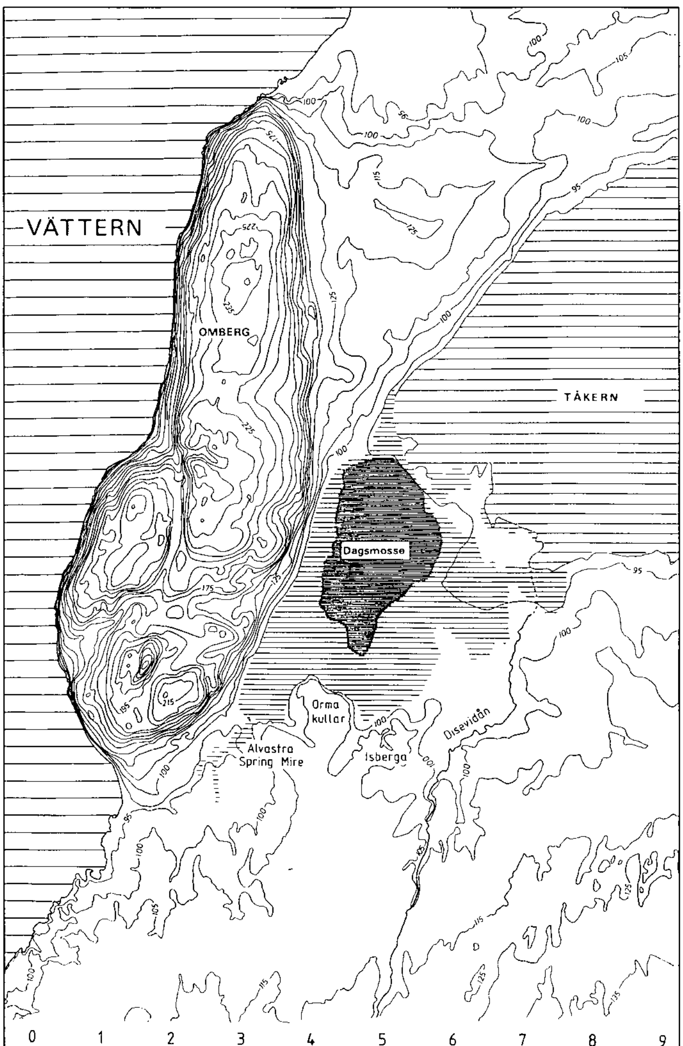

Fig. 1. Topographical and hydrological map of the area around the Alvastra spring-mire.
Drawing: R. Blidmo.

areas, and followed the harvested crop to the pile-dwelling). Year after year cereal pollen blew away from the floor, and year after year the surrounding regenerating forests spread billions of pollen over the mire, mixing it with the cereal and mugwort pollen in the continuously growing peat. Thus the activities on the floor of the pile-dwelling can be placed exactly in the pollen diagrams from the Alvastra spring-mire. This pollen analytical dating of the largest wooden construction from Neolithic time ever found in Sweden places the pile-dwelling to the first part of the Regeneration Phase (at the pollen analytical level SB1 e – see below – see also Göransson 1987:fig. 31).

HOW CEREAL POLLEN, RELEASED BY HUMAN ACTIVITIES, SPREAD DURING THE REGENERATION PHASE (C. 4550 – C. 3750 B.P.)

That huge amounts or cereal pollen may be found in the occupation layer of the Alvastra pile-dwelling is evident from Magnusson's investigations (Magnusson 1964:39). In one sample – and pollen samples are small, only fractions of a cm^3 – he found no less than 2511 cereal pollen grains (with only 351 tree pollen grains). Of these cereal pollen grains 2087 were of *Hordeum*-type, 312 of *Triticum*-type, 101 of *Hordeum* or *Triticum*-type, and 10 of *Elytrigia repens*-type. (This observation corresponds astonishingly well with my ongoing investigations of carbonized seeds from the occupation layer. From the soil samples I have picked out 6827 carbonized caryopses of *Hordeum vulgare*, 1257 of *Triticum dicoccum*, and one non-carbonized caryopsis of *Elytrigia repens*; 460 carbonized mugwort seeds have been recorded.) I myself found 435 cereal pollen grains among 146 tree pollen grains in a sample from the lower part of the occupation layer (Göransson 1987:fig. 28).

Only a few metres outside the floor of the pile-dwelling the cereal pollen values are very low compared with those of the occupation layer, and tree pollen strongly dominates over cereal pollen. The percentage (or per thousand) value of cereal pollen in the spring-mire at the "Alvastra time level" is, however, much greater than we ever find during the Regeneration Phase in even the most carefully chosen "peep-hole" (Fig. 2). Thus, 32 m to the north-east of the eastern trench five cereal pollen grains were found among 874 tree pollen grains (Göransson 1987:fig. 31).

Let us make the following intellectual experiment: if the Alvastra pile-dwelling had not been found, and if pollen analysis had been performed on cores taken in the Alvastra spring-mire, then the pollen analyst might have been told the following: "You have not found cereal pollen at the beginning of the Regeneration Phase, it is impossible! This is a regression phase. There was no cultivation of cereals during that time! You have found *Glyceria* or *Elytrigia* pollen."

WHY THE EARLY MIDDLE NEOLITHIC CULTIVATION CAN NOT BE TRACED IN CONVENTIONAL POLLEN DIAGRAMS

As I described in CSA 1, no pollen of *Triticum* or *Hordeum* has been registered at the "Alvastra time level" in the Dags Mosse diagram. The explanation is that the forests of broad-leaved trees had begun to regenerate (the structure of this forest type is discussed below). Because of the filtration effect (Tauber 1965) or "curtain effect" (Göransson 1984, 1987, 1991a) of the growing forests, only very seldom are there finds of cereal pollen in cores taken in medium-sized or large basins (the Dags Mosse bog is a large basin).

Furthermore, pollen from *Hordeum vulgare (*in the main naked four-row barley) and *Triticum dicoccum* (emmer wheat) – the cereals that were cultivated during Alvastra time in the Alvastra area – spread extremely small amounts of pollen during flowering time as the pollen is "trapped" within the chaffs of the ears. Only when the ears are threshed (see previous passage) are great amounts of pollen released. It also seems as if during harvest time pollen may be released when the straws are cut off and thus "shaken" and "disturbed". This implies that it should be possible to trace the Early Middle Neolithic fields of corn which once bordered on very small basins. If we are lucky enough to find such a small basin – on all sides surrounded with light soils – in which deposits have continuously been built up during thousands of years, then the harvesting of these "Alvastra time fields" should be reflected in our pollen diagram from that basin.

With the knowledge we have gained from the above discussion, let us take a walk from the Alvastra pile-dwelling to the Isberga Nature Reserve (or "Norrö backar", that is, "the hills of Norrö") c. 2 km east of the pile-dwelling.

CULTIVATION OF CEREALS IN THE ISBERGA AREA ("NORRÖ BACKAR") DURING ALVASTRA TIME

The westernmost part of the province of Östergötland has a very low mean annual precipitation amounting to c. 450 mm, and the mean annual temperature is c. 6°C. This is thus one of the warmest parts of Sweden. The Isberga Nature Reserve ("Norrö backar") is situated within a zone of sandy-silty lime-rich dead-ice formations. These formations carry a unique dry steppe-meadow flora with its origin on the steppes of Siberia and south-eastern and central Europe (Gustafsson, e.g. 1977). Some of these species immigrated already during Late Glacial Time. None of these steppe-mea-

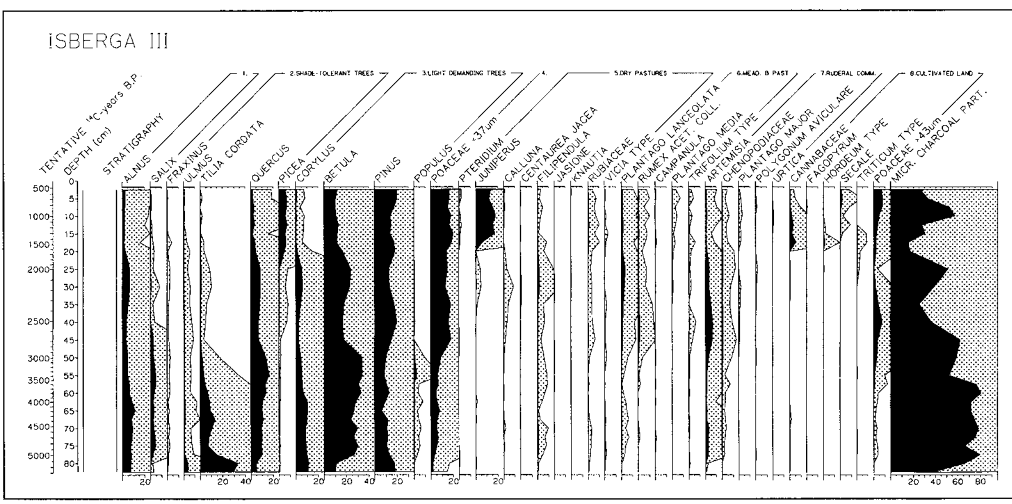

Fig. 2. The Isberga III diagram, redated in 1993. In layer 2 (see "Stratigraphy"), 97 cm below the surface, charcoal was found and dated to 6480 ± 120 B.P. (In this paper conventional C14-dates are used, T1/2 = 5568, 0-year = A.D. 1950). The distinct elm decline is found at 80 cm. Alvastra time broadly corresponds to c. 70 cm. Both cultivation of cereals and grazing took place during Alvastra time in the Isberga area, and thus in western Östergötland. In the column "Dry pastures" Rubiaceae and Filipendula are included, because Galium triandrum (fam. Rubiaceae) and Filipendula vulgaris are dominating species within the steppe-meadow society.
Analysis: H. Göransson 1978.
Computer drawing: T. Persson 1993.

dow species tolerate shade. They survived during the first part of Postglacial Time on the precipices of Omberg and on the rocks with thin soil at the shore of Lake Vättern (for instance, *Dracocephalum ruyschiana* and *Oxytropis pilosa*). From these sites most of this steppe-meadow society spread to the areas with light, lime-rich soils when man and his livestock opened the countryside. The most beautiful, still existing steppe-meadows are found within the Isberga Nature Reserve.

When we arrive at Isberga Nature Reserve we understand that it was one of the sites where the people who built the Alvastra pile-dwelling cultivated their barley and wheat. This "understanding" is based on the fact that the soils in that area (light, lime-rich soils, see above) were preferred by the Neolithic "forest farmer".

In the middle part of the Isberga area a small kettle hole is situated. Pollen analysis and stratigraphical investigations were performed (in 1977–78) on cores taken in this kettle hole. As no datings could be obtained (the analyses were accomplished before the introduction of the accelerator dating-method) my argumentation that "there are only few cereal pollen grains registered in the Early Neolithic part of the Isberga pollen diagram" (Göransson 1987:57) is to all appearances – and fortunately (!) – not correct. The pollen spectra in the lowermost clay (Isberga I and Isberga II – see Göransson 1987:58f) are very difficult to interpret. The pollen spectra in the clay (stratigraphical layer no. 1) are similar to those described by Dimbleby (1985:96f) and for that reason, and because of the 1991 dating (see below), they are omitted from the present paper. By doing so, we suddenly find that the Isberga III diagram (Fig. 2) is a most logical pollen diagram.

In the lower part of layer 2 (see "Stratigraphy" in Fig. 2) macroscopic charcoal particles were found during fieldwork in 1990 and an accelerator dating was performed in the autumn of 1991. The dating of this level gave the C14 age of 6480 ± 120 B.P. The forest fire (which very likely was initiated by Mesolithic man) from which the charcoal originated is of almost the same age as the charcoal found in the lowermost sample in the kettle hole at Nässja (6435 ± 165 B.P.). The kettle hole at Nässja is situated 20 km to the north of the Dags Mosse bog (Fig. 9).

The Isberga III diagram (Fig. 2) starts during Late Atlantic Time. At 80 cm below the surface (at pollen sample no. 2) we find the *Ulmus* decline which coincides with a steep fall of the lime (*Tilia cordata*) curve. Already at the beginning of the elm decline the unbroken *Plantago lanceolata* curve begins, disclosing continuing grazing on the steppe-meadows from the very first part of the Early Neolithic up to our days. Slightly above the elm decline (at the level where the *Salix* curve strongly rises – sample 49 in Isberga I, see Göransson 1987, pp. 59f) an irrefutable *Triticum* pollen was found and

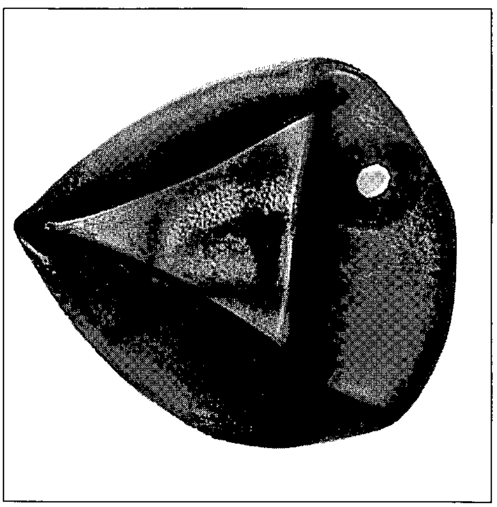

Fig. 3. Cereal pollen grain of distinct Triticum type (52 µm) from level 49, Isberga I (Göransson 1987:58), corresponding to an early part of the Early Neolithic.
Photo: T. Persson.

photographed (Fig. 3).

At 70 cm we find the level which broadly corresponds to Alvastra time. In the Isberga area the cultivation of cereals, like the grazing, has uninterruptedly gone on since the start of the Early Neolithic. In fact, the pollen curve for Cerealia-type starts well before the elm decline in Isberga III. At the lowermost level one cereal pollen was recorded (total diameter 52 µm, diameter of annulus >12 µm).

I recommend the reader to visit the Isberga Nature Reserve. The experienced observer will "feel" that the steppe-meadows there, which are still grazed, are thousands of years old. A species which is common on the steppe-meadows is dropwort (*Filipendula vulgaris*) (Fig. 4), the pollen of which cannot be separated from that of meadowsweet (*Filipendula ulmaria*). Meadowsweet grows in moist habitats. As a working hypothesis (Göransson 1987:27) I have suggested that most of the *Filipendula* pollen found in Isberga III derives from *Filipendula vulgaris* (Fig. 4).

Within the Isberga area, at Norrö (always incorrectly called "Norre" in archaeological works) a famous "curved sabre" of bronze dated to the oldest part of the Early Bronze Age, was found in 1879 (photo in Stenberger 1964:175). This find can be said to underline what the steppe-meadows tell the visitor: the dead-ice formations in the Isberga area were appreciated and utilized during thousands of years by prehistoric man.

CONCLUSION CONCERNING CULTIVATION OF CEREALS AND GRAZING DURING ALVASTRA TIME IN WESTERN ÖSTERGÖTLAND

From the above discussion we can thus state: the people, i.e. the "forest farmers", who built the Alvastra pile-dwelling and the Omberg grave did not import the cereals from distant areas. They cultivated their own corn, probably in newly cleared coppice wood areas (Göransson, e.g. 1987:72). They preferred the areas which are marked today as "steppe-meadows" ("stäppartade torrängar" or "stäppängar") on the botanical maps (Gustafsson 1977) but also other light soils (glaciofluvial deposits) where there are no steppe-meadows today.

It has been suggested (Göransson 1987) that the very large fens around the low hills of glaciofluvium, dead-ice formations, and moraines constituted an extremely rich environment which was flooded annually

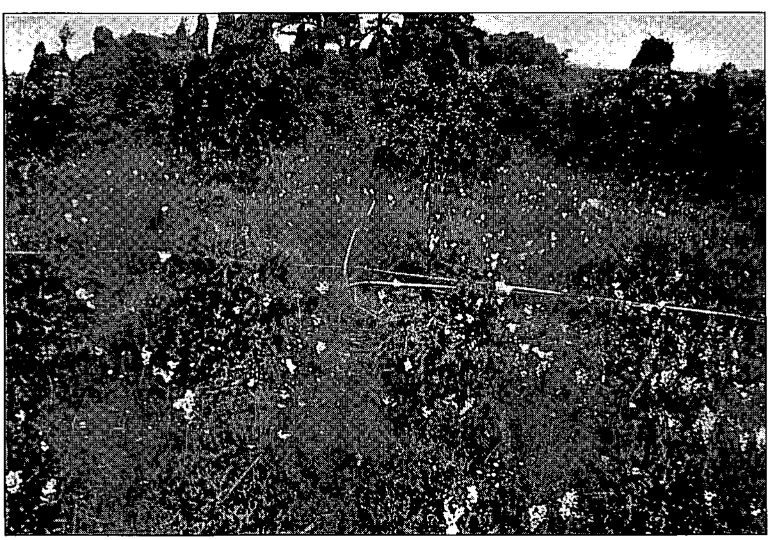

Fig. 4. Filipendula vulgaris is an important member of the steppe-meadow society in western Östergötland. Here, in the Ljungstorp area, the steppe-meadow is white with Filipendula vulgaris.
Photo: Anders Tingvall/ CALLUNA-bild.

and thus fertilized. The fens were probably grazed in early summer, after which the livestock grazed in coppice woods and very likely in the forests on the hill of Omberg. Leaves were collected for winter fodder (Rasmussen, e.g. 1989) as winter grazing was not possible in the Alvastra area. During different periods the pile-dwelling may have been used as a byre (Göransson in prep.).

It must be stressed that grazing occurred at many places and over large areas during Alvastra time. Many archaeologists believe that the Alvastra area in western Östergötland and the Falbygden area in Västergötland were a sort of Noah's arks during hard times and that no grazing or cultivation of cereals took place outside these favoured areas. As will be demonstrated in the following, this approach is antiquated.

THE DRAGON'S HEAD PHENOMENON

When the hero of the fairy-tale cut off the dragon's head, seven new heads grew up immediately from the decapitated monster. In the same way, sprouts "immediately" grew up when Stone Age man cut down trees in his forest of elm, lime, ash, hazel, oak, etc. Sprouts grew up from the stumps, and instead of one cut-down tree several trees came up. (We modern Swedes who live in cities which lie as densely populated areas within spruce forests, extending for miles and miles, are not aware of this dragon's head phenomenon. When a spruce is cut down, not a single sprout will grow up.) Within a short time span – different for different species – the grown trees flowered and spread pollen to the surroundings. For

Fig. 5. Cows grazing near Lake Vån in southern Östergötland. Ignore the spruces and you will see the Middle Neolithic forest grazing landscape!
Photo: Per Göransson 1971.

Fig. 6. Bartholin investigated no less than 200 oak logs from the pile dwelling. They were all cut down in a forest in the vicinity of the pile dwelling. All oaks had begun to grow at the same time (in my opinion this demonstrates that they had grown up from stumps). When the cutting activities started, the oaks were c. 40 years old. When these activities ended, 42 years after the start, the felled oaks were thus c. 80 years old. The c. 20 elm logs investigated by Bartholin are indicated to have grown up from stumps. The elm logs were older than the oak logs. Also the lime and aspen trunks had started their growth at the same time as the oaks. Bartholin has demonstrated that the forest of oak, lime, elm, aspen, etc. grew denser and denser during the 42 years the pile-dwelling was in use. In the picture, an oak pile four metres long, has just been taken up from the ground below the floor of the pile-dwelling by three archaeologists. Photo: H. Browall.

that reason human activities in the forests of broad-leaved trees of the Stone Age will be difficult to observe or to interpret correctly when we study our pollen diagrams.

We who have been working within the Alvastra pile-dwelling project have all seen some of the hundreds of 40-80-year-old trunks of oak, elm, lime, etc. which – thanks to the dragon's head phenomenon – grew up 5000 years ago on the gravelly hill which borders on the spring-mire (Bartholin 1978, 1983). I have "seen" the pollen rain which came from these dragon's head forests. These stump-sprout forests or coppice woods (together with high trees) produce as much pollen as an untouched "primeval" forest. That is why the old pollen analytical school talks about the "regression phase" which follows upon the Early Neolithic so-called expansion phase.

CLEARANCE MANURING ("RÖJNINGSGÖDSLING") DURING THE MIDDLE NEOLITHIC

Modern man often (or always) forgets that cultivation of cereals could not take place during the period under discussion without the utilization of "clearance manuring" (Sw. *röjningsgödsling*), which the cutting down of trees and bushes implies (Romell 1964).

When the trees are cut down, mineral nutrients are "released" in the soil and can be utilized by low-growing species such as wheat and barley. How the clearance manuring functions in detail is, to the best of my knowledge, not studied and known precisely. Long ago Romell (1938, 1964:114f) made very interesting experiments in a spruce forest. He observed that nitrogen (ammonia or saltpetre nitrogen) was released when the roots of the living trees were cut off. The grass grew high and green and the mosses disappeared. During its growth the forest had accumulated the nitrogen nutrients in the soil, according to Romell (Fig. 7).

During Alvastra time and onwards cultivation of cereals took place on "wandering arable fields" in coppice woods on light soils. We have to imagine a system of coppice wood groves of different ages. These coppice wood groves which thus "collected nutrients" (see above) were allowed to grow very dense so that the weeds were choked. Every year one coppice wood grove was cut down by axe. Branches and small trunks were burnt, and the large trunks were probably used as fences, for building (pile-dwellings!), firewood etc. The soil was hoed or ripped open between the stumps with the aid of some kind of wooden ard. Only one harvest was taken on the cleared area which was left alone for more than 20 years before the coppice wood was cut down again. It is, as earlier mentioned, impossible to trace such coppice wood cultivation in traditional pollen diagrams from medium-sized or large basins.

Other agricultural systems may have existed during the first part of the Middle Neolithic – the coppice wood model must not be the only usable one for that epoch. Experiments in annual cropping of wheat and barley with and without manuring have been performed at Rothamsted and Woburn Experimental Stations (Russel and Voelcker 1936). These experiments demonstrate that harvests can be taken in the same area – on better soils in England – without manuring for more than one hundred years. Cultivation of cereals without manuring on permanent fields on the light, calcareous soils in western Östergötland during the Early and Middle Neolithic cannot be *totally* excluded.

Permanent, manured fields may have existed already during the Early Neolithic

Fig. 7. Romell's root-cutting experiment in an old spruce forest. All roots of the spruces have been cut off. Metal plates have been pressed down in the soil to prevent roots from growing into the experiment field (in the middle of the photo). The experiment area which was thus screened off from the living trees reacted as after a strong nitrogen manuring. The grass grew green and thick; the effect of the "clearance manuring" ("röjnings-gödsling") is demonstrated in an elegant way. Photo: L.-G. Romell 1940. Published with the permission of Romell's grandson D. Romell 1993.

in Switzerland according to Troels-Smith (1984). Rowley-Conwy's (1981) model for cultivation during the Early Neolithic is that the livestock, so to speak, "took care" of the labour: sheep, pigs, and cattle kept the weeds away and manured the soil, which was ploughed by the pigs – thus a sort of permanent fields. In my model for the Middle Neolithic the trees function as ploughs and manure-spreaders. Why on earth should the Neolithic forest farmer try to get rid of elm, ash, lime, and oak – trees which "collected" nutrients in the forest farmer's soil? The "expansion" theory means that the trees mentioned above grow up during epochs of "regression". I wonder if it is not the opposite!

When the coppice woods were established and maintained during the Middle Neolithic, the supply of mineral nutrients and nitrogen was secured. The roots of the trees absorbed nutrients from the depth; and the cutting down of a coppice wood grove caused Romell's "clearance manuring" effect (see above). The yearly leaf-fall was of great importance as a never-ending source of nutrients to the humus layer. So, why believe that Stone Age man was so unintelligent that he tried to get rid of these valuable trees?

NO REGRESSION IN GRAZING ACTIVITIES – AND PROBABLY NO REGRESSION IN CULTIVATION OF CEREALS – DURING THE MIDDLE NEOLITHIC (THE REGENERATION PHASE) IN SOUTHERN ÖSTERGÖTLAND AND NORTH-EASTERN SMÅLAND

Many archaeologists believe that the climatically and pedologically very favoured Alvastra area and the Falbygden area in Västergötland were exceptions from the General Rule of Regression during an early part of the Middle Neolithic. My pollen diagrams from southern Östergötland and north-eastern Småland demonstrate that this is not so. Grazing took place during the whole of the Regeneration Phase (rather high values of *Juniperus*, scattered *Plantago lanceolata*) according to the pollen diagrams from Lake Vån and Lake Ämmern (Göransson 1987:74–76). Furthermore, pollen of Cerealia-type is recorded from the Regeneration Phase (Fig. 8). We now understand that if a very small kettle hole, surrounded by light soils, had been found in southern Östergötland, then pollen analysis on material from that kettle hole very likely should have shown us an unbroken Cerealia-type curve for the whole of the Regeneration Phase.

My new investigations in the Mabo Mosse bog in north-easternmost Småland reveal an almost unbroken *Plantago lanceolata* curve throughout the Regeneration Phase, and Cerealia-type occurs at the beginning of the Regeneration Phase.

From my pollen analytical point of view, may I say the following odd things? It was not necessary – and it was not possible – for the sparse population of southern Östergötland and northern Småland to build passage graves or pile-dwellings in order to get social and cult centres. Probably certain very high or big trees, strange rocks (huge erratics), etc. could have sufficed as "meeting places" for the forest farmers of that area (if "meetings" were at all necessary).

The archaeologist who wants to find traces of the Middle Neolithic forest-farming culture in southern Östergötland, northern Småland, and other areas which today are covered with spruce forests, must think and work in a new way. The archaeologist working in such areas must not look for monuments; he or she must, so to speak, search directly in the soil. It is a pity that modern forestry destroys all the traces of this suggested former forest-farming culture.

THE FOREST REGENERATION IN THE YSTAD AREA DOES NOT REFLECT ANY "REGRESSION" IN CULTIVATION OF CEREALS OR IN GRAZING

The simple model which implies that high values of elm, lime, oak, and ash in our pollen diagrams indicate a "regression" in cultivation is, as revealed above, no longer valid. This rigid model has been cherished by the older, very dogmatic pollen analytical school. As archaeologists often believe that pollen analysts and other specialists in natural sciences are magicians of a sort, the archaeologists cite these magicians in their archaeological papers and write about the "Middle Neolithic regression". Then our pollen analytical magicians, in turn, cite these archaeological papers (!) in an attempt to strengthen the "regression" model. Indeed, the medieval scholastic would not have swallowed such an arguing-in-a-circle bait!

As repeatedly said in this paper, it is impossible to trace the Middle Neolithic cultivation and grazing in conventional pollen diagrams. Within the Ystad area, in southernmost Scania, not a single pollen diagram from a suitable place – a very small basin on all sides surrounded by light soils – has been published. All diagrams are said to reveal that a "regression" followed upon an Early Neolithic expansion. In spite of the

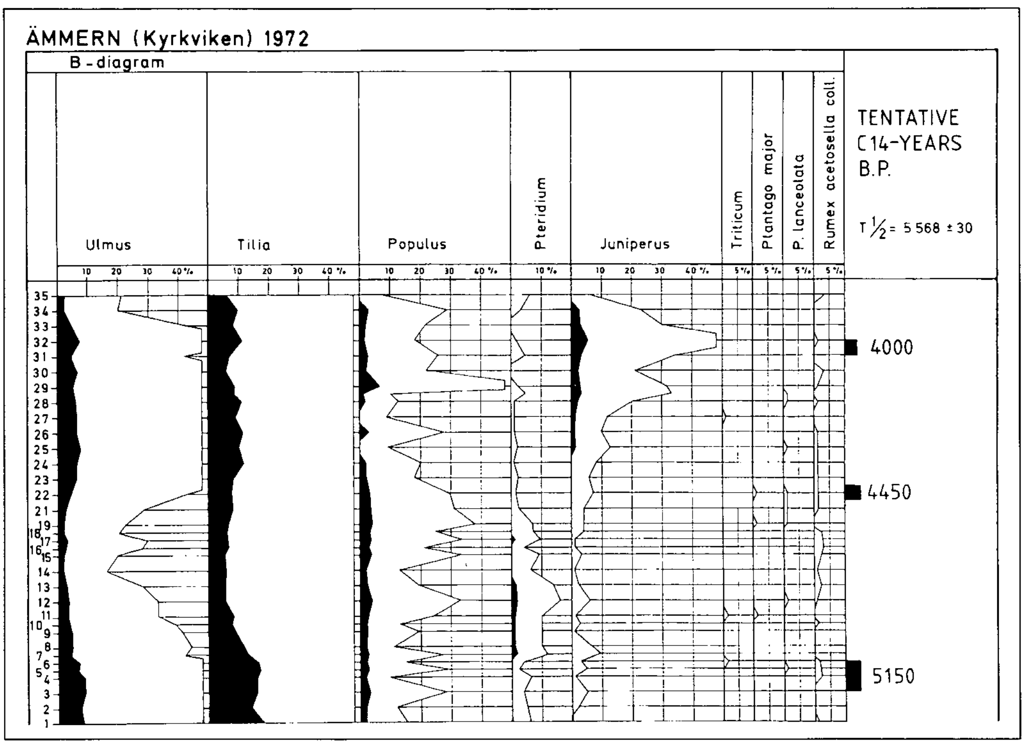

Fig. 8. The pollen diagram from the Kyrkviken Bay, Lake Ämmern, in southern Östergötland. The elm, lime and juniper curves rise at the same time – from the beginning of the Regeneration Phase – and scattered Plantago lanceolata are registered. Probably forest grazing occurred during the whole of the Regeneration Phase (during the whole of the Middle Neolithic). Also in the Ystad area, in southernmost Sweden, juniper increases during the Regeneration Phase according to the Fårarps Mosse diagram (see text). Analysis: H. Göransson 1972.

fact that very small basins have not been investigated within the Ystad area, my own pollen diagram from Lake Bjärsjöholmssjön (which is "less than medium-sized"), 4 km north-west of the town of Ystad, is rather unmasking: the *Plantago lanceolata* curve is unbroken throughout the Regeneration Phase (Göransson 1991). This discloses that the forests surrounding Lake Bjärsjöholmssjön were grazed regularly throughout the Middle Neolithic. Already long ago this Middle Neolithic forest grazing was exposed (Nilsson 1961) – even then a warning against the "regression" model was sent out. At a level which corresponds to Alvastra time – that is, an early part of the Regeneration Phase – pollen of *Triticum* and *Hordeum* are recorded in the Lake Bjärsjöholmssjön diagram. Thus there is no "regression" during Alvastra time in that area.

There is only one basin within the Ystad area, hitherto investigated, which is so small – however, not small enough! – that the diagram from it at least partly demonstrates what really occurred during the Regeneration Phase. The site, which is situated 10 km north-east of the town of Ystad, is named the Fårarps Mosse bog. The first diagram from that site was published a decade ago (Hjelmroos 1983:47). (In that diagram the Early/Middle Neolithic border is drawn 25 cm too high up.)

In the Fårarps Mosse diagram we find a simultaneous rise of the elm, lime, ash, *and* juniper curves – exactly as in my pollen diagrams from southern Östergötland (see above). Furthermore, the *Plantago lanceolata* curve is intact throughout the Regeneration Phase. These phenomena show that the regeneration forests were grazed bush or coppice woods. The Cerealia curve is continuous from a bit up in the Regeneration Phase. As mentioned, cereal pollen is found in Lake Bjärsjöholmssjön in the first part of this phase. The Cerealia curves from these two sites *together* disclose that cultivation of cereals, to all appearances, took place during the whole of the Middle Neolithic, during the whole of the Regeneration Phase – which thus was no "regression" phase.

With the knowledge gained from the Alvastra area in western Östergötland, we can make comparisons with the Ystad area in southern Scania and conclude: cultivation of cereals took place in the Ystad area throughout the Middle Neolithic, probably in a system of coppice woods. Forest grazing occurred over large areas during the whole of the Regeneration Phase – in the inner parts of the area the *Plantago lanceolata* curve may reflect seasonal grazing (a sort of "transhumance"). The fens were grazed in early summer.

High values of elm, lime, ash, oak, and hazel during the Regeneration Phase do not reflect any regression but rather cultivation in a broad sense. Cultivation of cereals is above all reflected by high values of *Tilia*, as *Tilia* coppice woods grew on light, calcareous soils.

THE EARLY AND MIDDLE NEOLITHIC SYNCHRONOUS LEVELS IN POLLEN DIAGRAMS FROM GÖTALAND, SOUTHERN SWEDEN

Already in 1935 Nilsson, in a series of pollen diagrams covering the whole province of Scania, demonstrated that a row of Subboreal (Early and Middle Neolithic) pollen analytical levels ("Leitniveaus", "index horizons") were easy to identify from site to site. These levels reflected changes in the vegetation and they were assumed to be synchronous over the whole of Scania and also outside Scania (in eastern Denmark, etc.). In 1964 Nilsson presented a C14-dated pollen diagram from the Ageröds Mosse bog in central Scania and many of these Subboreal index horizons were thus dated.

Nilsson's publications are among the most important pollen analytical works ever produced in Sweden. As they are written in German they cannot be read by the English-speaking world (cf. Malmer 1991:

286). If Nilsson's works had been better known, a lot of needless talk and writing could have been avoided.

During my investigations in north-easternmost Småland (the Mabo Mosse bog) and western Östergötland (the Dags Mosse bog) it was shown that Nilsson's Subboreal index horizons were fairly easy to identify also in these northern parts of Götaland. I present here a diagram section from Lake Bjärsjöholmssjön in southernmost Scania and one from the Dags Mosse bog in western Östergötland (Fig. 10). In these diagram sections some of the Early Subboreal index horizons have been dated and comparisons can be made between the two sites.

The pollen diagram from the Mabo Mosse bog is currently being computer-drawn at the University of Lund and it cannot be presented here. It will, however, be referred to in the text. Note that the C14-values of the index horizons in Lake Bjärsjöholmssjön are transferred from the Ageröds Mosse bog, which is situated c. 50 km north-north-west of Lake Bjärsjöholmssjön. (The C14-dates in brackets refer to the datings of the gyttja in the lake. These dates are, on average, 220 years too old because of the so called "hard-water effect".)

Let us now compare the two diagrams. The elm decline (= the initial fall of the elm curve) was dated to 5180 ± 60 B.P. in the Dags Mosse bog. A C14-sample with its focal point 2.5 cm above the elm decline was dated to 5100 ± 50 B.P., after reduction by 220 years (see above), in Lake Bjärsjöholmssjön (the corresponding level was not dated in the Ageröds Mosse bog). In the Mabo Mosse bog this level was dated to 5130 ± 60 B.P. Thus, the initial fall of the elm curve is reasonably synchronous from southernmost Scania to westernmost Östergötland.

AT/SB was dated to 5020 ± 60 B.P. in the Dags Mosse bog. A sample immediately *below* AT/SB was dated to 5060 ± 90 B.P. in the Ageröds Mosse bog. Thus this level is synchronous from Scania to Östergötland.

Nilsson's index horizon SB1 g corresponds to the very *Ulmus* minimum after the elm decline. At the same level *Betula* has a pronounced maximum. SB 1 g was not dated in the Ageröds Mosse bog; the dating collapsed in the Dags Mosse bog; while in the Mabo Mosse bog it was dated to 4740 ± 60 B.P. A thick layer of charcoal at a level broadly corresponding to SB1 g in the kettle hole at Nässja (20 km to the north of the Dags Mosse bog) was dated to 4750 ± 60 B.P.

SB1 f is of the greatest interest as it marks the beginning of the forest regeneration after the elm decline, that is, the start of the "Regeneration Phase". SB1 f was dated to 4510+ 80 B.P. in Ageröds Mosse, to 4520 ± 60 B.P. in Mabo Mosse, and to 4590 ± 60 B.P. in Dags Mosse – indeed a beautiful synchronism. (Note that this forest regeneration starts about 500 years after AT/SB! AT/SB in the main corresponds to the start of Iversen's "Landnam". According to Iversen, the forest ought to regenerate 50–100 years after the "Landnam". The Landnam model is demolished by the C14-datings – see Nilsson 1964:39.)

SB1 e is easy to observe from southernmost Scania to westernmost Östergötland. It is slightly, but distinctly, younger than SB1 f and is thus situated a bit up in the Regeneration Phase, with higher values for *Fraxinus*, *Ulmus*, *Tilia*, and above all *Quercus* than at SB1 f. SB1 e corresponds exactly to the time when the Alvastra pile-dwelling and the Omberg grave were built and used. The mean value of the C14-datings of the pile-dwelling is slightly younger than 4450 B.P. The same level was dated to 4450 ± 60 B.P. in the Dags Mosse bog. A level which is situated slightly below, or at, SB1 e was dated to 4490 ± 60 B.P. (after reduction by 220 years) in Lake Bjärsjöholmssjön. The only C14-dating from the Omberg grave hitherto presented has given the age 4490 ± 95 B.P. (Janzon 1984:362).

CONCLUDING WORDS CONCERNING THE EARLY AND MIDDLE NEOLITHIC SYNCHRONOUS LEVELS

Thus there seem to be some unknown factors lying beyond man's control, beyond man's activities, beyond the effect of grazing on a large scale which cause the vegetational changes that were synchronous over large areas, from the elm decline level (c. 5150 B.P.) up to index horizon SB1 f (c. 4550 B.P.) and further upwards in time.

If the causes are *not* found in factors lying beyond man's control, then we have to imagine huge herds of cows and enormous flocks of sheep simultaneously grazing (and browsing stump-sprouts) over hundreds of thousands of square kilometres in north-west Europe from AT/SB up to SB1 f. After c. 500 years the majority of these animals are attacked by some epizootics and begin to die and, strangely enough, at the same time the cereals are affected by some sort of plant pathology. The Early Neolithic Expansion Phase ends – in a tragedy!

The poor, surviving, former forest farmers began to fish and hunt again, to collect hazel-nuts and – in some sort of a strange despair – to build their largest megalithic graves. Into these graves the starving former farmers crept, heartbroken, abandoned by the divinities – and dying. The First Regression Phase had begun in a gruesome way.

In my opinion, the vegetational changes during the epoch described above may reflect something different. In this paper I have tried to describe how it might have been during

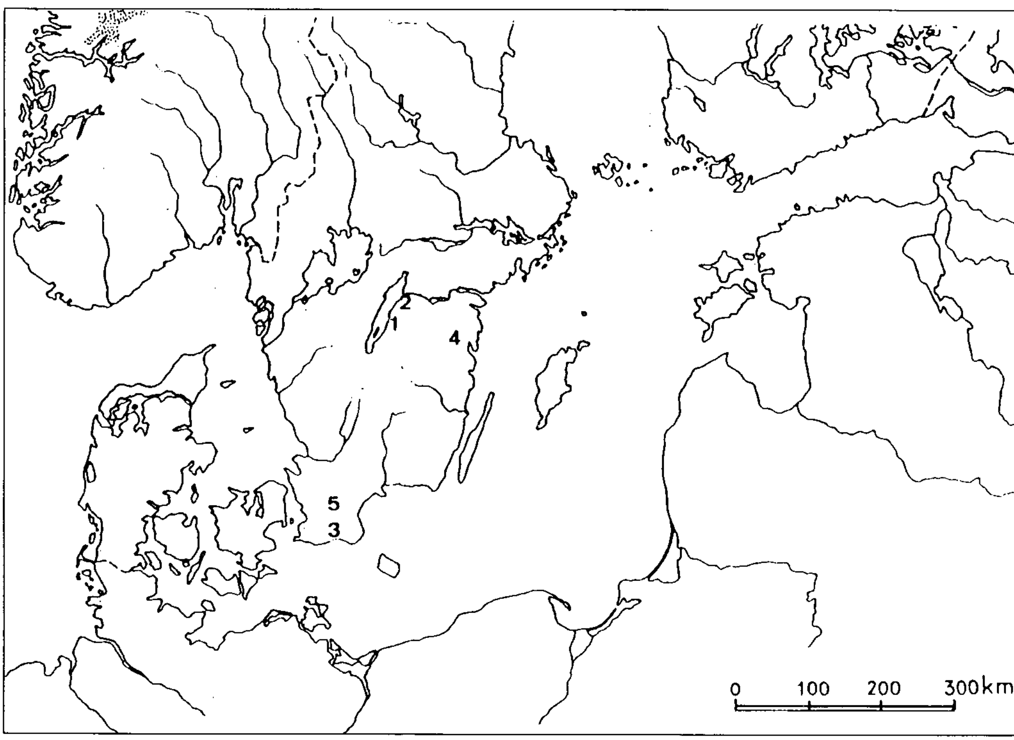

Fig. 9. The position of the different localities mentioned in the text. 1. The Alvastra spring-mire and the Dags Mosse bog. 2. The kettle hole at Nässja. 3. Lake Bjärsjöholmssjön. 4. The Mabo Mosse bog. 5. The Ageröds Mosse bog. "Götaland" broadly corresponds to the area which is found to the south of an imaginary line going from the Norwegian border through the middle of Lake Vänern, passing to the north of Lake Vättern and eastwards to the north of the island of Gotland.

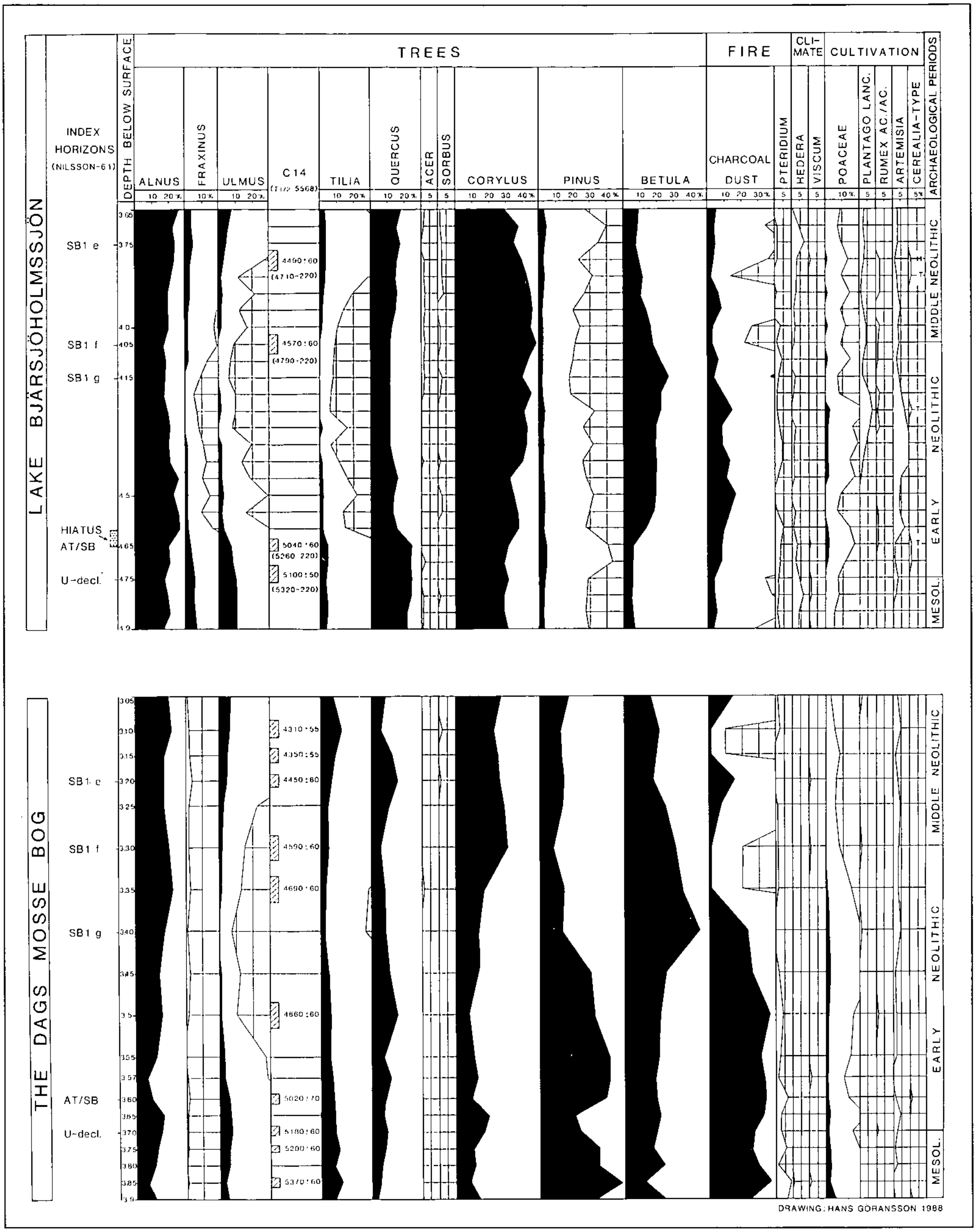

Fig. 10. The pollen diagrams from Lake Bjärsjöholmssjön, southern Scania, and the Dags Mosse bog, western Östergötland. Analysis and drawing: H. Göransson 1988.

the Regeneration Phase, with the aid of carefully chosen sites for pollen analysis.

SUMMARY
The present paper shows that the pollen analytical expansion-regression model for the Early and Middle Neolithic is nothing else than pure armchair speculations. (The expansion model was highly favoured by the bankers' profit optimism of the 1980s). Pollen diagrams from the western and southern parts of the province of Östergötland, from north-eastern Småland and southern Scania disclose that forest grazing and wandering arable fields in coppice woods characterized the Middle Neolithic. The forest functioned both as plough and manure-spreader. High values of elm, ash, lime, and oak thus reflect long fallows. Sprouts "immediately" grew up when the forest farmer cut down the trees (the dragon's head phenomenon). Thus there was no regression in cultivation during the Middle Neolithic; instead a rather ingenious form of agriculture existed.

ADDENDUM
Since finishing this manuscript I have met Leif Gren, a human geographer. He has demonstrated that the innumerable clearance cairns in Götaland (not least on the southern Swedish Uplands) are a reflection of an extensive, rotating cropping system, in which large areas of land lay in long-term fallow (coppice woods) during the Late Bronze Age and Early Iron Age (Gren 1989:91). The human geographer Catharina Mascher draws attention to the parallel strips in the meadow which border on the megalithic graves in Karleby in the Falbygden area in central Västergötland (Mascher 1993:30). The human geographers have, indeed, "searched directly in the soil", as I have suggested in the present paper. Is it to be the human geographers who will help me to put to death the myth of "the Middle Neolithic regression"?

English revised by Laura Wrang.

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