Neolithization and "Classical" Elm Decline

A Synthesis of Two Debates

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Abstract

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The debates about the "classical" elm decline and Neolithization have usually been carried on separately by palynologists and archaeologists. The purpose of this article is to bring together two contemporary debates that both deal with the same prehistoric period. The main purpose of the article is to launch ideas in general rather than to discuss the explanatory models of individual researchers. There are three prevalent explanations derived from the two debates; the elm decline has mainly been explained as due to economic transformation or ecological changes, whereas the explanation for Neolithization is based on cultural change due to, for example, social causes. In a concluding synthesis, I criticize the idea of economic transformation during the initial phase of the Neolithic, and instead point to long-term cultural changes in a non-material perspective. The cause of the elm decline was probably elm disease, and together with other ecological changes it could have affected the Neolithization process both locally and regionally.

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Introduction and basis

Two debates have dominated research about the Mesolithic–Neolithic or Atlantic–Sub-Boreal transition in Northern Europe, specifically regarding South Scandinavia. One debate has been conducted by archaeologists and has concerned "Neolithization". This discussion has mostly concentrated on when, how and why a transition occurred from an economy based on hunting, fishing and gathering to an economy based on agriculture and cattle-breeding. Archaeologists have set the border between the Mesolithic and the Neolithic as the time of the first trace of cultivation, and not when the new economy was established (see the main entry "Neolitikum" in *Arkæologi Leksikon* 1985; *Sten- och bronsålderns ABC* 1991). The Neolithization has also been set at the border between the palynologists' vegetation-historic zoning of the Atlantic-Sub-Boreal chrono-zone. The other debate has been conducted by the palynologists and has concerned the "classical" elm decline, which forms the border between the above-mentioned chrono-zones. It should be mentioned that other elm declines have also been registered in pollen diagrams, both before and after (e.g., Regnell *et al.* 1995; Lagerås 1996). Traces of climate changes, indications of changes in human activities and the great geographical spread of the *Ulmus* decline have been offered as the primary reasons for the dramatic changes to be discussed. However, the debates, although concurrent, have chiefly been conducted separately from each other. Therefore, it is of great interest to carry out a synthesis with the emphasis on the discussions of the recent decades.

Based on historic research, the concept of "Neolithization" can be defined as the farmer cultures spreading to the North European hunter-fisher-gatherer cultures, evidenced by the first traces of cereals and domesticated animals. Hence, the Neolithization can be interpreted as a deliberate economic process. It is considered to have started c. 5150 bp (4000 BC). On the basis of this definition, the research has often disregarded the quantitative value, in the sense that the earliest find of cereals or domestic animals has been taken as the start of the Neolithization. The definition has in several cases not taken into consideration the non-material cultural and mental processes of change (see the section "Economic transformation"). Recent research attempts to include concepts such as "social complexity" and "changes of mentality" (e.g., Whittle 1988; Larsson, M. in press), yet often without an explanation of these concepts.

The "classical" elm decline starts c. 5150 bp, reaches its peak c. 4750 bp and the elm starts to regenerate c. 4500 bp (Göransson 1989, p. 394). Several researchers contend that the start of the elm decline is synchronous all over North-Western Europe at the beginning of the Sub-Boreal period (see the section "Ecological changes"). It must be noted that the dating and synchrony of the elm decline are still the subject of discussion. The elm decline is considered to be one of the most important reference levels in Holocene pollen analysis. Thus, it is its synchronous course and its timing in a much debated period of vegetation-historical and archaeological transition that makes this specific elm decline "classical".

In my opinion, three different explanations for the Neolithization and the elm decline can be demonstrated: an *economic transformation* during a short transitional phase, caused by man, where by economy I refer to the material part of the concept which includes administration and the creation of resources; an *ecological change* as an explanation for the origin of the elm decline and as external elements which force man to change lifestyle and merge to a new economy; and thirdly a long-term *cultural change*, where economic change is only one part of the continuous process of change, and where the emphasis is on social and mental causes. The article does not, primarily, take up the specific researchers' general positions, but concentrates on the arguments for and against the three different explanatory models.

Economic transformation

Several hypotheses have suggested great changes during a short period caused by man. Two often discussed hypotheses are the theory of land occupation by forest clearance and the leaf-foddering theory, where stabled cattle were fed with leaves from primarily elm. Both theories have been used, for the most part, to try to explain the elm decline (or declines) and can be seen as the main source of the debates.

The botanist Johannes Iversen was an early advocate of the Landnam theory. He saw that a general decrease in the mixed oak forest in the Danish pollen diagrams coincides with an increase in cultural flora connected with the introduction of farming. He sees especially the increase of *Plantago* (plantain) as evidence for the fact that man keeps large stocks of domesticated animals. He sees finds of cereal pollen in the charcoal layer at Ordrup Mose as indicative of a land-occupation phase with slash-and-burn cultivation at the beginning of the Early Neolithic. He still regards the phase as a local occurrence, which was not synchronous in the different diagrams (Iversen 1941, pp. 15 f.; Iversen 1949, pp. 11 ff.). Later he also mentioned that the so-called landnam phase is younger than the elm decline in South Scandinavia (Iversen 1973, p. 87).

The archaeologist and palynologist Jørgen Troels-Smith saw another explanation for the elm decline. He said that leaves from elm and ash were better suited as fodder for stabled cattle. Since the elm only flowers every 7–8 years, extensive harvesting would seriously affect the production of pollen. He based his theory primarily on finds of elm and other leaves on the floors of two buildings, one of which probably was a stable, at the Early Neolithic habitation Weier in Switzerland, and also on contemporary studies in Europe (Troels-Smith 1960, pp. 23 ff.). He claimed that one can show typical Ertebølle culture, which he considered a semi-agrarian culture, in parts of Denmark where the elm decline has been registered (Troels-Smith 1953, pp. 41 f.). Iversen was later influenced by Troels-Smith's reasoning and meant that one could easily devastate a considerable part of the elm population by girdling the trees, in order to create ideal conditions for harvesting the elms' foliage (Iversen 1960, p. 20).

Geoffrey Garbett supports Troels-Smith's theory about leaf-foddering. From pollen analysis at Ellerside Moss in North-Western England, he found a transition to a new economy, probably with stabled animals who initially were fed a diverse composition of leaf-fodder, which explains the fluctuations in the curves of *Quercus* (oak), *Tilia* (lime) and *Ulmus*. He also found a gradually more selective feeding of the cattle with elm-leaves (Garbett 1981, p. 582).

Besides Troels-Smith, Peter Rasmussen has investigated the material from Weier. The oldest phase of the habitation is dated 3106 bc (conv. ^{14}C), which is contemporary with the elm decline. Only one piece of an elm twig has been found in this phase. In the layer from Weier II (3026 bc, conv. ^{14}C), only 3% of the samples consist of fragments of twigs and leaves from elm, compared to ash and lime which comprise almost 50% of the sampled material. Hence, elm was only used to a tiny extent at the Weier habitation (Rasmussen 1989, pp. 53, 55 f., 67 f.). Unfortunately, he does not state the standard deviation of the datings from the habitations.

Hans Göransson is likewise critical of the leaf-foddering theory, and finds it hard to believe that the feeding of cattle, sheep and/or goats began almost simultaneously over several 100,000 square kilometres (Göransson 1989, p. 394). His greatest criticism is reserved for Iversen's Landnam theory, which according to Göransson must be abandoned. In Iversen's view the forest would regenerate after 100 years, but Göransson claims that it took about 700 calendar years (approx. 650 conv. ^{14}C years), according to the pollen diagrams. The forest "was taken tamed" long before the so-called Landnam, and cereal pollen has been found from the Mesolithic period (Göransson 1989, p. 396; Göransson 1994, p. 171).

Torsten Madsen has calculated that if the explanation for the Danish elm decline was leaf-foddering, the unrealistic sum of one million cattle over a period of one hundred years would have been necessary. Further, he says that grass is the major source of cattle fodder, and because of this he chooses to see the Landnam as a grazing phase with felling and girdling of trees (Madsen 1990, pp. 28 f.).

A similar calculation has been made by W. Groenman-van Waateringe (1983, p. 218), who mentioned that some half a million adults would have been kept busy the entire summer if pollarding was a cause of the elm decline.

Kristian Kristiansen sees almost no signs of cultivation or domestication during the Late Mesolithic Ertebølle culture. Yet he argues that Iversen's theory about slash-and-burn agriculture should be supported. Hence, he sees the elm decline as a result of felling and pollarding and opposes the hypothesis that the elm decline occurred simultaneously. He points especially to an exploding production of thin-butted and thick-butted flint axes, which he believes were used for extensive clearance (Kristiansen 1993, pp. 248 f.), and also to plough or ard marks under megaliths as evidence of arable fields (Thrane 1989, pp. 113 f.). Kristiansen sees the introduction of farming as a revolutionary event, which was established after a very short period. He reinforces his view of a dramatic transition by characterizing the forest as "the farmers' enemy" whilst at the same time talking about "the last hunters" (Kristiansen 1988, pp. 17 f., 21; Kristiansen 1993, pp. 248 f.). Göransson opposes the axe theory and claims that it is more effective to girdle or to use fire to reach the same result (Göransson 1994, p. 169). Göransson's theories will be described later in this article.

If one speaks about abrupt and sudden changes, in this case an economic transformation that is considered to form a distinct temporal limit, then the probable causes must be equally drastic. The most usual explanations for the Neolithization have been immigration, population pressure and/or over-exploitation of resources. The latter is usually seen as the explanation for the elm decline (e.g., Garbett 1981, p. 583) and is at the same time the result of the first two explanations.

Ester Boserup's ideas have had great penetrative power since 1965, when she proposed population growth as a main factor of the development of agriculture. She reasoned that in sparsely populated areas, farming was only used as a complement to hunting. When the area became more densely populated, people were forced to switch almost totally to farming. She even claimed that if a small population does not grow, agriculture will not develop to a higher level. But she emphasized that man expends a minimum of time on food production (Boserup 1965, pp. 9, 62, 87).

Both Mats Larsson and Peter Rowley-Conwy see population growth as the probable cause of the transition to an agrarian economy. Larsson thinks that the settlement pattern of the Ertebølle culture was disrupted because of a growing population, and asserts that people tried to find more favourable ecological environments for agriculture and cattle-breeding. Rowley-Conwy sees both an internal Danish population growth and an external immigrant farming population from the south as the cause of an economic transformation (Larsson, M. 1984, pp. 164 ff., 188; Rowley-Conwy 1986, pp. 191 f.). Criticism of the theory of population pressure has been raised by Madsen, who observed that the population was regulated by internal mechanisms, and therefore could not grow on its own (Madsen 1987, p. 231).

Ecological change

Within the debate a discussion has been conducted regarding the dating of the vegetation historical change in general and the elm decline in particular. If one wants to assert that the elm decline was synchronous over North-Western Europe, then the dating must be contemporaneous at the different places. As mentioned earlier, the elm decline is one of the most important reference levels used by palynologists and its dating at different places is important for the discussion about its cause and as a comparison with other vegetation historical and cultural changes.

The palynologists K. Molloy and M. O'Connell (1987, p. 204) are of the opinion that the elm decline is not as synchronous as previously supposed, if one studies a small geographical area such as Northern Ireland. Göransson claims to have had datings done at two sites in north-west Ireland, which established that the dating of the elm decline is of the same age as in the Swedish peat-bogs; furthermore he maintains that datings which deviate from the mean value 5150 ^{14}C years are erroneous. He further points out that erroneous ^{14}C ages are obtained from areas with less calcareous water containing unicellular algae. The datings should instead be done on *Sphagnum*-peat which lives only on rain water, or on reed-peat (*Carex*) or sedge-peat (*Phragmites*) which acquire their carbon dioxide from the air (Göransson 1989, p. 375, p. 394). A similar dating has been done at Black Loch in Eastern Scotland

(5180±80 bp), but it seems not to concur with other datings from the British Isles (Whittington *et al.* 1991, p. 84).

Several researchers have seen a change in climate as the most likely explanation for the elm decline; among them is Iversen, who believed that just the fall in the *Ulmus* curve was mostly caused by climate and not by clearances (Iversen 1949, p. 16). In contrast to T. Nilsson, he did not explain all fluctuations in the pollen curves as a direct result of climatic variations during the period (Iversen 1949, p. 22; Nilsson 1948, p. 45). Later he partly changed his view and, inspired by Troels-Smith, saw the leaf-foddering theory as a possible cause. But he still did not abandon his own theory of climate change as a possible explanation of the elm decline. Simultaneous with the decline in the *Ulmus* curve, there is also a decline in the summer-temperature-sensitive mistletoe (*Viscum*) and the winter-temperature-sensitive ivy (*Hedera*). Since he considers that they are the best indicators of climactic conditions, the decrease in the pollen curve for *Hedera* especially implies a deterioration in the climate with colder winters between the Atlantic and Sub-Boreal zones in Denmark (Iversen 1960, pp. 21 f.). Other researchers also see climactic change as the foremost explanation for the elm decline (Göransson 1988, p. 51; Whittle 1988, p. 99).

If the climate were responsible for the elm decline, then it would have started in the north, where the elm is closer to the threshold of its extension. T. Hove (1968, p. 361) sees no such signs. A decrease in the water level will seriously affect the *Ulmus*, due to its horizontal root system. In Southern Sweden, decreases in the water level have been registered and explained as due to a drier climate, which culminated c. 4900–4600 bp as shown by the reconstruction in Lake Bysjön (Digerfeldt 1988, p. 180). Göransson sees a break in the sedimentation in Lake Bjärsjöholmssjön. The non-datable hiatus comprises the time span c. 4950–4850 bp (Göransson 1991, p. 23). This indicates that a change in climate occurred at the beginning of Sub-Boreal time, but cannot be directly connected to the elm decline which started a little earlier. Climatic/hydrological causes in combination with elm disease could explain the drastic ecological changes in the Ystad area (Berglund *et al.* 1991a, p. 428).

One theory about the cause of the elm decline is soil deterioration or sedimentological change. In Northern Ireland high frequencies of hazel, alder and birch, just before and after the elm decline, have been interpreted as a sedimentological change. The frequency of oak pollen increased in four diagrams after the elm decline, which is partly explained by reduced competition but also by soil deterioration (Hirons & Edwards 1986, pp. 142 f.). One of the causes could have been Mesolithic man's activities, which over a longer period of time could have an effect on the soil (Sturludottir & Turner 1985, p. 328). It should be noted that the elm thrives on rich soils.

The currently most prevalent explanation for the elm decline is disease. Research in England and Ireland has to a great extent resulted in this theory. The most usual argument for elm disease is the striking and synchronous decrease of the elm over a short period and throughout a large geographical area (Watts 1961, p. 35; Molloy & O'Connell 1987, p. 216; Huntley & Birks 1983; p. 415; Peglar & Birks 1993, pp. 65 f.). One interesting observation has been made by Sylvia Peglar, who was able to analyse the year-by-year progress of the elm from annually laminated sediments at Diss Mere, Norfolk, England. The frequency of *Ulmus* pollen fell by 73% in 6 years, and she can only explain the rapid course of events by elm disease, probably in conjunction with earlier human activities in the area (Peglar 1993, pp. 2, 10 f.). D. Moe and O. Rackham also see man as a possible carrier of disease. They think that present-day elms, which grow faster after pollarding or have other disturbances, are more easily infected, and that the spread of the disease may have been through the pollarding tools. (Rackham 1980, p. 266; Moe & Rackham 1992, p. 67). Other arguments for disease are the selective fall of the elm in pollen diagrams, the lack of cereal pollen (O'Connell *et al.* 1987, pp. 160 ff.) and occasional finds of the bark beetles *Scolytos scolytos* and *Scolytos multistratus*, who are carriers of the disease from the fungus *Ceratocysti ulmi* (today called "Dutch elm disease"). The bark beetle is the only carrier of the disease that moves from sick to healthy trees and thus gives rise to the disease's epidemic proportions (see Aaby 1986, p. 82; Peglar & Birks 1993, p. 66). The problem with this theory is the difficulty of proving it, because there are no fossil finds of *Ceratocysti ulmi*, only the carrier (Peglar & Birks 1993, p. 66; Rasmussen 1989, p. 67).

Tage Nilsson believes that several species of trees show a decline in the pollen curves more or less at the same time, and that one cannot discern a specific pathogen attack (Nilsson 1961, p. 20). In the Ystad area the decline also affected ash and lime (Berglund *et al.* 1991b, p. 419). Garbett has criticized the theory of elm disease and thinks that the frequency of ivy, which flourishes on dead elm trees, is unchanged when the elm decreases in the pollen diagrams from the English site Ellerside Moss (Garbett 1981, pp. 547 f., 581). Mats Larsson maintained that the theory should be abandoned, because oak and lime, which decrease simultaneously with the elm, are not susceptible to elm disease (Larsson, M. 1984, p. 191). Nor do Sturludottir & Turner believe in elm disease, after having studied the pollen diagrams from Pawlaw Mire in Northern England, because the ash did not replace the elm, which they think should be the case when they grow on the same type of nutritious soils (Sturludottir & Turner 1985, p. 327).

The result of a climactic change and an accompanying decrease in the sea-water level has been discussed from a more archaeological point of view by, for instance, Mark Zvelebil and Peter Rowley-Conwy, who declared that the deterioration in the basic resources brought about by the disappearance of the oysters in Limfjorden placed the Ertebølle economy under pressure. They also believed that a drier climate made cultivation of cereals more attractive. Accordingly, these causes would expedite an economic transformation (Zvelebil & Rowley-Conwy 1984, pp. 110 ff.; 1986, p. 194). Contrarily, Lars Larsson thought that it was the rise in sea-levels that induced changes in the habitation structure along the coast (Larsson, L. 1988, pp. 184 f.). Likewise Kristiansen has suggested that a climactic deterioration could have started a change in economic and habitation patterns (Kristiansen 1988, p. 27). Madsen does not believe that the oysters are the cause, and observed that half of the coastal population during the Ertebølle period lacked oysters as a seasonal resource. Various techniques for storing fish would in any case easily solve the problem of decreasing resources (Madsen 1987, p. 235). Julian Thomas extends the criticism and wonders how the loss of the Danish oysters could have caused the expansion of the agrarian lifestyle to Britain and South Scandinavia (Thomas 1988, p. 62). Critical voices have also been raised against evidence that a change in climate could have had such a dramatic effect on available human resources and habitations at all (Jennbert 1984, p. 81; Midgley 1992, p. 6). Several researchers still claim that early agriculture was favoured by the opening of the landscape (Berglund *et al.* 1991a, p. 428).

Cultural change

It is principally within archaeology that non-material cultural changes are regarded as a background to Neolithization. Archaeologists also view the period as a long continuous change, where the economic ambitions are subordinate. Exceptions to this general trend are the ideas within archaeology that describe the Neolithization as caused by cultural changes during the Mesolithic, but where the acceptance of domestication resulted in an economic transformation at the beginning of the Early Neolithic. In other words, social and mental changes within hunter-gatherer groups made them open to a new economy. Zvelebil & Rowley-Conwy (1984, p. 110) talk of an availability phase stretching over a period of a thousand years, when people had contact with farmers in the south, but did not adopt their mode of subsistence. Madsen (1987, p. 236) thinks he sees its cause in a desire to consolidate the power structure with a narrowed resource base, by counteracting the introduction of new resources. The resulting effect is a shortage of resources at the coast, resulting in a rapid economic change. Mats Larsson complements and adds social and ideological causes, followed by a rapid transformation when the Neolithization as an idea becomes accepted in Scania (Larsson, M. in press).

However, Jennbert prefers to see continuity and argues that between the Ertebølle culture and the TRB culture, especially in the Scanian Löddesborg material, one can register an intermediate phase of c. 500–600 years, consisting of "mixed" finds from deposits and uncontaminated layers belonging to both "cultures". This indicates a gradual and long transition (Jennbert 1984, pp. 38, 128 f.). She is supported by Midgley (1992, p. 405), who also sees a period of transition in the North German material. Madsen is still critical of the "stratigraphic sequence" at the Löddesborg site and points to the possibility of undetected post-depositions, which caused movements of materials between the levels. Since the explanation invoking an intermediate phase containing mixed finds does not fit into his explanatory model, he regards Scania as peripherally located (Madsen 1987, pp. 235 ff.). Nor does Mats Larsson (in press) see any convincing evidence for synchrony between Ertebølle culture and TRB culture; however, he sees a continuity in the flint material.

The argument for a slow transition is also built upon agrarian traces during the Late Mesolithic, when Jennbert thinks that cultivation and cattle-breeding already occur. She points, for instance, to imprints of cereal grains in the Ertebølle ceramics from the Scanian sites of Löddesborg and Vikbo (Jennbert 1984, p. 93, p. 128). W. Groenman van-Waateringe (1983, p. 228) emphasizes that agricultural activities prior to the elm decline occurred in both Britain and Ireland. At the English site Diss Mere evidence has been found of local cereal cultivation 120–160 years before the elm decline in the pollen analysis. Due to the greater acceptance of finds of cereal pollen in pre–elm-decline contexts, the reporting of these by palynologists has become more frequent (Peglar 1993, pp. 8 f.; Peglar & Birks 1993, p. 64). Göransson states that pollen grains of cereal type (i.e., unspecified cereals) from before the elm decline have been found at five sites in Scania and emphatically maintains that not all the pollen grains found in Scania, Denmark and Britain are descended from wild grass (Göransson 1991, p. 22; Göransson 1994, p. 171).

Göransson has a theory that the Neolithic way of life may have started long before the elm decline and accordingly sees no break in continuity. He claims that high values of microscopic charcoal particles during the Mesolithic indicate both spontaneous fires and also clearance fires. By girdling trees or by setting fire to wood piled around the base of the trees, favourable conditions were created for garden cultivation as well as grazing and browsing game. Cutting down trees for timber caused sprouts from the root system to grow and several trees to grow in place of the tree cut down. An increased pollen production from broad-leaved Late Atlantic trees reflects the presence of coppice wood. By studying small kettle holes on light and lime-rich soils (i.e., where cultivation occurred), he believed it possible to find evidence for girdling and cultivation. Pollen from low-growing plants, for instance cereals, does not spread for such large distances as pollen form high-growing forest. Coppice woods and climax forests from large or medium-sized basins show the same results in pollen diagrams (Göransson 1988, pp. 47 f.;

Göransson 1991, pp. 28 f.; Göransson 1994, p. 169).

Kristiansen is critical of Jennbert's theory of Mesolithic cultivation, and declares that the evidence is ambiguous and lacks support from finds at other sites in South Scandinavia. He is also critical of Göransson's above-mentioned theory which does not constitute evidence, but is only a working hypothesis. He states that no traces of domesticated animals or cereal grains have been found from the Mesolithic (Kristiansen 1993, p. 248).

From an economic perspective, several archaeologists want to depreciate the importance of domesticated flora and fauna during the initial phase. Jennbert emphasizes that cereals and domestic cattle did not occur naturally in South Scandinavia, and claims that imprints of cereal grains and remnants from domestic cattle are few in number in comparison with later parts of the Early Neolithic and Middle Neolithic. Because of favourable environments for the habitations, the agrarian production should not have had any great importance for the diet; instead one would expect to find social factors behind the changes (Jennbert 1984, pp. 132, 147). Madsen (1990, p. 32) also believes that cereal cultivation was of minor importance, but that the domestication of animals was of importance as an economic element, with the pig being well suited to forests and cattle to natural grazing environments. Rowley-Conwy (1985, pp. 189 f.) and others have pointed to the problem of explaining the significance of domestication. Neolithic domestic bulls and female aurochs were in fact of similar size, and they suggest that the cattle could have consisted of female aurochs. Price and Gebauer (1992, p. 104) go further when they claim that the first agrarian expansion did not start until 2600 bc (uncal.), i.e. in the border between Early and Middle Neolithic. Kerstin Lidén (1995, pp. 30 f.) even questions the importance of cereals in the Stone Age diet, and maintains that no definite differences in diet were noticeable between the Mesolithic and Neolithic. Cereals may initially have been used for brewing beer or for other beverages (Jennbert 1984, p. 147; Price & Gebauer 1992, p. 109).

At the same time as several archaeologists would depreciate the importance of cultivation in the Early Neolithic, several others want to advance a continuing hunting tradition. P.-O. Nielsen (1985, p. 115) pointed out that on 17 occasions TRB A ceramics had been found at Ertebølle sites both on the coast and in the interior, which indicates an ongoing exploitation of hunting resources. The importance of hunting, fishing and gathering is emphasized for the first 500–600 years of the Neolithic (Price & Gebauer 1992, p. 101), and Midgley (1992, p. 403) sees this as an argument against a rapid change to farming.

Instead of an economic change, the introduction of cereals and cattle may indicate exchanges of luxury products with the purpose of creating networks such as marriage links with neighbouring groups (Jennbert 1984, pp. 147 f.; Thomas 1988, p. 65). Domesticated foods were initially exotic and could have been prestige items in a society with social inequality (Price & Gebauer 1992, p. 109). "The domestic scene was the important social context among the early farmers" (Midgley 1992, p. 477). A symbolic significance of domestication can explain the concentration of cereals located at causewayed enclosures (Thomas 1991, p. 21).

Julian Thomas (1991, pp. 13, 182) does not see the Neolithic as a specific economy. "It is the recognition of the symbolic potential of these elements to express a fundamental division of the universe into the wild and tame which creates the Neolithic world". The conclusion of Thomas's view of the Neolithization is that the Neolithic way of life and technical knowledge were adopted, instead of only the technology, such as cows, axes and grave constructions. Emphasis is thus laid on basic changes and not on the initial phase. A. Whittle (1988, p. 100) argues that these changes are discernible at the beginning of the Middle Neolithic in larger and more permanent habitations and the construction of causewayed enclosures and megaliths. Thomas (1991, p. 182) is of the same opinion and holds the construction of monuments to be the first act of Neolithization.

Synthesis

A central organization or a deterioration in the basic resources would be necessary to bring about a rapid economic change throughout a large geographical area such as North-Western Europe simultaneously. There are no signs of this in the transition between the Late Mesolithic and the Early Neolithic. The advocates of a rapid change build their theories upon local studies, as an explanation for general conclusions. On a pan-European scale, I believe that we often see different results, depending on where the investigations are made. For example, in South Scandinavia regional differences are noticeable. At the same time as the oysters disappeared around the east coast of Jutland, which was shown by a striking and rapid change in the material culture in the transition period, for example, in Norsminde (Andersen 1990, p. 38), an intermediate phase has been registered belonging to both periods at the Löddesborg site in Scania, which was never dependent on oysters. This shows both regional differences with regard to the rate of change of the material culture, and also that local environmental changes can influence man's attitude to adopting a new technology. South Scandinavia should be seen as a heterogeneously composed region with different environments and ethnic groupings.

The number of cereal finds in South Scandinavia is very small during the Early Neolithic, which would have been economically precarious for the Neolithic population. Finds of cereal grains, or grains from cereal pollen, are in several cases characterized as "of cereal-type", i.e. one is not always sure if they were descended from wild or domesticated grass (cereals) (see Molloy & O'Connell 1987, p. 214). The number of bone finds from domesticated animals is also marginal. Several Late Mesolithic sites show a continued tradition of hunting, fishing and gathering in the Early Neolithic. To describe the Early Neolithic people as "the last hunters" is consequently wrong.

The leaf-fodder theory as an explanation for the elm decline is most unlikely. Contemporaneousness at several European sites is the greatest argument against this theory. Whether the elm decline is entirely synchronous is not clear. However, it must be mentioned that the "classical" elm decline did not occur everywhere (e.g., Lagerås 1996, p. 12). One cannot dismiss datings that deviate from 5150 bp, but it is the environment where the datings are made that decides their reliability. If the elm decline is really synchronous it could not have been caused by man. There is no possibility that the same idea could have been adopted at the same time in England, Ireland, Denmark, Sweden, Germany and Poland – especially not if the frequency of *Ulmus* pollen fell 73% in 6 years as at Diss Mere. At several sites with a registered elm decline, no human activities have been documented at the same time as, for instance, in central Germany (Frenzel 1966, p. 104), central Poland (Ralska-Jasiewiczowa & van Geel 1992, pp. 38 f.), Eastern England (Peglar 1993, p. 8) and Scania (Regnell *et al.* 1995, p. 85). The most likely explanation is elm disease, which could have been aided by different local climactic changes and perhaps also by human activities. More open areas in the forests may have facilitated the introduction of agriculture, but hunting could also have been favoured for the same reasons.

The exchange of cereals and domesticated animals had a more social than economic function in the initial part of the Neolithic, and due to the small quantities involved consisted of prestige items. Use of the products points to a ritualistic importance, especially deposit concentrations of cereals at causewayed enclosures, dated to the end of the Early and the Middle Neolithic. At this time, one can see the result of the mentality change that occurred after the Middle Mesolithic in the form of a new technology, such as T-shaped stag-antler axes, ceramics and shaft-hole axes. In the transition period one sees the first traces of adoption of the technique of farming, and not just a copied technology. Besides domestication, more individualistic ceramics are also noticeable, both in shape and in ornamentation. At the same time as the establishment of a new economy late in the Early Neolithic and in the Middle Neolithic, a change in religion as well as basic social and ideological changes are also noticeable, with, for example, the construction of causewayed enclosures and megalithic monuments. In a teleological perspective one can at this time argue that a "process of civilization" has started, and that man will purposefully "Neolithize".

An *economic transformation* did not occur at the transition between the Mesolithic and Neolithic periods, but the traces of economic change are more manifest at the end of the Early Neolithic. *Ecological changes* locally/regionally favoured the introduction of the Neolithic way of life, at the same time as the Mesolithic way of life was favoured or disfavoured. In particular, it is the non-material *cultural changes* that caused the Neolithization, and it is the gradualness of the change of mentality that caused the process to be deliberate and slow. Local/regional differences as regards the timing of change and specific characteristics are the result of varying ethnic groupings.

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