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DIFFERENT FORMS OF CIVILIZATIONS AND THE DEVELOPMENT OF WOODLANDS: SYSTEMS OF INTERACTIONS

Abstract: The development of woodland was influenced by different management since some thousands of years. During prehistoric times settlements were founded and given up after some decades. In connection with this, a secondary succession of woodland took place. The spread of beech in Central Europe was favoured and some other tree species expanded in other parts of Europe. This is documented by pollen diagrams. During historic times woodland exploitation was intensified. Some tree species became rarer by more intensive management such as beech. So human impact did not have generally the same effect on the development of woodlands. As management influenced the development of woodland more than climatic changes it is likely that this will also happen in the future. Pollen diagrams are not historic sources but can be well paralleled with historic sources. It is an advantage of pollen diagrams that they encompass a total development of vegetation and do not only reflect a single event at special points of time.

Keywords: Pollen analysis; woodland development; different kinds of management; spread of beech

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INTRODUCTION

Pollen diagrams are important documents of environmental history as they reflect the development of vegetation. Vegetation is influenced by climate, soil development and management. Pollen diagrams are unique sources of history as they do not reflect a single event and are not influenced by ideas, but encompass a development of vegetation during several millennia. It is possible to date such a diagram by C14 dates. C14 dates

do not lead to specific years but to time spans, because not years are measured but the radioactive decay of carbon 14, and on this basis, calculations lead only to time spans with a certain probability, but not to years.

THE METHOD OF POLLEN ANALYSIS

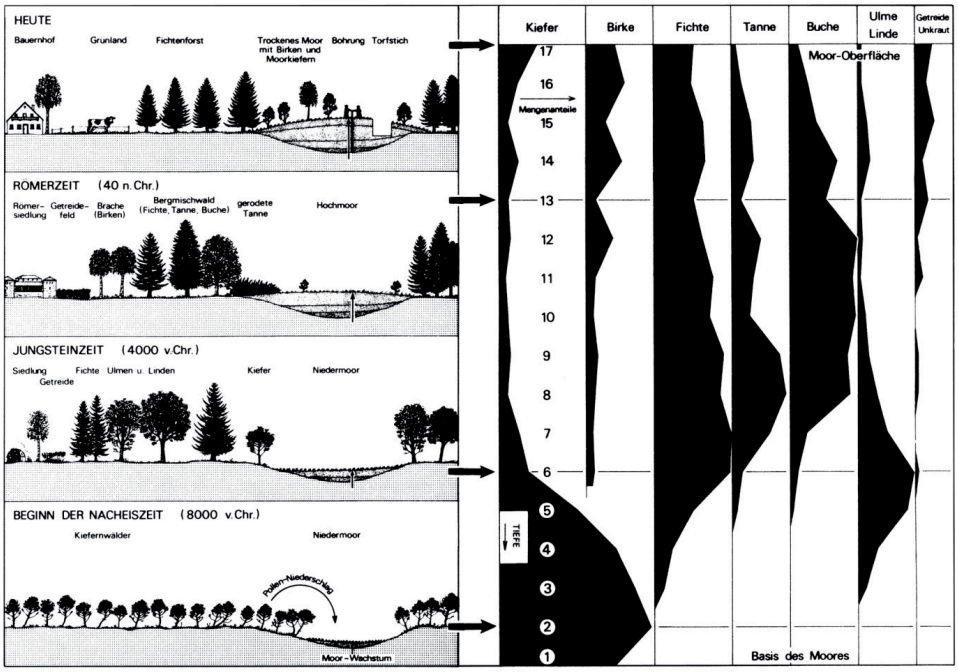
Pollen grains are the male germ cells of flowering plants. They are generated by the stamina and transported to female cells either by insects or wind. Insects normally visit several flowers of the same plant species subsequently, one after the other, so that the probability is very high, that male and female germ cells of the same plant species are brought together. Therefore insect-pollinated plants produce only relatively small amounts of pollen grains. But the probability is poor that pollen grains transported by wind reach female flower-parts of the same plant species. Therefore wind-pollinated plants generate a lot more pollen grains than insect-pollinated plants. Most of these pollen grains are never successfully transported to female parts but spoiled on surfaces elsewhere.

Normally pollen grains, especially their genetic contents, are only preserved for some hours. But if they are deposited in water or in wet soil, e.g. peat or lake marl, their outer walls can be preserved for millennia. It is possible to determine the plant species by examining pollen grains with a microscope. Walls of fossil pollen grains have the same characteristics as recent ones, so that these grains can be determined.

One can examine an entire peat profile and analyse samples, e.g. in distances of 5 cm. After plotting percentages of all pollen types in the samples one can develop a pollen diagram showing the development of vegetation in the course of time. In fig. 1, a simplified pollen diagram (right) is combined with four sketches of landscapes which are represented by the pollen diagram. These four landscapes or landscape images present the same site at different points of time.

The diagram is labelled in German. It shows the changing quantities of pine (Kiefer, Pinus sylvestris), birch (Birke, Betula), spruce (Fichte, Picea abies), fir (Tanne, Abies alba), beech (Buche, Fagus sylvatica), elm (Ulme, Ulmus), lime (Linde, Tilia), oak (Eiche, Quercus), cereals (Getreide) and weeds (Unkraut). The quantities of the pollen types are presented from the basis of a bog (bottom) to the actual surface (top). The landscapes in which the vegetation occurred are a pine wood which was formed just after the end of the last Ice Age, a deciduous woodland with some spruce

Figure 1: A schematic pollen diagram. For explanations see text



Source: Own research.

trees, in which first farming took place, a mixed beech-spruce-fir-woodland of Roman Age and the modern landscape with grassland, a farm and afforested spruce. It is also indicated that peat was accumulated so that the bog grew in height. In the modern landscape the peat was mined, and a profile for pollen analysis was taken from the bog.

The character of vegetation depends on the climate. Therefore, pollen diagrams were often interpreted predominantly as reflections of climate history. But if this would be correct, the same developments of vegetation should be evident in a vast area. This is indicated only for the older parts of vegetation history, as it is normally evident that a pine or birch woodland is replaced by some deciduous tree genera such as oak, elm and lime later on. Before the first cereal pollen grains were deposited no human influence on the vegetation is evident. Woodlands were not cleared. Only very few tree species could expand, because there was no space for them in the woodlands. After the formation of dense oak woodland, it was nearly impossible that additional tree species expanded as no clearings existed which could be overgrown.

The later developments cannot generally be paralleled. Spruce was only present in some areas before afforestation took place. Fir was not generally present, too. And beech expanded at very different points of time (Küster, 1996; 1997). Beech expansion was therefore not triggered by climatic developments.

CHARACTER OF LAND-USE AND THE EXPANSION OF BEECH

But there is another evidence: In many Central European pollen diagrams first pollen grains of cereals were detected in the same layers in which first beech (Fagus sylvatica) pollen grains are present, indicating that the expansion of beech started at the same point of time when cereals were grown for the first time. Therefore, it is obvious that a special human influence may have favoured beech expansion. This is in contrast to the opinion that beech was generally pushed back by human interaction. But this does not seem to be generally the case. It depends on the character of civilisation which is reflected by the pollen curves whether beech was favoured or pushed back.

The few cereal pollen grains which were deposited in the bog before the Birth of Christ reflect prehistoric crop husbandry. During prehistoric times, a kind of management can be detected which was totally different from that of later historic periods. Woodlands were cleared to get timber and firewood and to obtain fields to cultivate crops. Crops only can grow outside the woods and shadow reduces the yields. Prehistoric settlements and their fields only existed for some decades and shifted afterwards (an instructive example Hvass, 1982). We do not know why this happened. Perhaps the crop yields decreased after some decades, or it became too difficult to get enough timber to mend houses in the vicinity of the settlement. Mending of houses was certainly frequently necessary as open fires were used in timbered houses, which were always endangered to be lit. The population might have been forced to abandon the settlement and decided to build new houses in other environs. There timber and firewood might have been still present. And it was possible to design new crop fields where the yields were better.

The old settlements and fields were abandoned, so that a secondary succession of woodland could start on the fallow. A secondary succession includes an expansion of shrubs first, including birch, willow and poplar. After some decades also oak is expanding again, but in this situation also a "new" tree species can expand such as beech. In the course of time, beech is more successful than oak as beech can grow under an oak canopy, but oak cannot grow under a beech canopy.

If scattered prehistoric settlements existed in an area which all persisted for a restricted time span, also secondary successions of woodlands could take place at a lot of sites. Therefore, it became possible that beech expanded during a long time-span, i.e. between around 5000 B.C. and the beginning of the Middle Ages. In the mountainous and hilly areas of Southern Germany and adjacent territories beech expanded between 5000 B.C. and 1000 B.C., in the plains of Northern Germany between 1000 B.C. and the Birth of Christ, in Southern Jutland between the Birth of Christ and 1000 A.D., at the Southern Baltic Sea coast (including N Poland) between the Birth of Christ and 500 A.D. and in Southern Sweden between 500 and 1000 A.D. (Küster, 1996; 1997). More exact data for beech expansion should not be given as all data are developed from C14-measurements which only give a time span but not "exact" years.

There is no pollen diagram indicating a spread of beech after 1000 A.D. The expansion of the tree species came to an end at about the same point of time in different parts of Europe. At about 1000 A.D. the outer limits of beech distribution were reached and not changed during the last 1000 years, in Southern England, in Southern Scandinavia and in the area just East of the mouth of river Wisła in Poland.

The reason for this may be a remarkable change of the land-use strategy. In historic times, it was not common to abandon and shift settlements and fields. Settlements generally became stable, and, in general, secondary successions of woodland did not take place any more. So, beech expansion was no more possible. The stabilization of settlements happened in connection with the foundation and construction of churches and the integration of settlements to infrastructures. As settlements and fields were not moved any more, goods which became short had to be delivered inside an infrastructure which included markets and trading routes.

In historic times, land use was intensified a lot, and trees were cut more often, because the demand of timber and fire wood grew enormously. Some tree species can withstand intensive utilization and form secondary stems, but the ability of beech to stand intensive utilization is restricted, so that beech became rarer during historic times.

OTHER TREE SPECIES WITH SIMILAR EXPANSION MECHANISMS

Beech does not seem to be the only tree species which was favoured by prehistoric settlements and secondary successions of woodland. In some parts of Poland, the same phenomenon became evident with the spread of hornbeam (Carpinus betulus; Ralska-Jasiewicz, 1964), in Finland and Northern Scandinavia (Moe, 1970) and also in the Swiss Alps (Markgraf, 1970, 1972) spruce (Picea abies) became more frequent during prehistoric times. The reason for this may be similar to the reason for beech expansion: Clearings and secondary successions of woodland allowed the expansion of newly invading tree species.

CONCLUSIONS

Pollen diagrams are not really historic documents, but they are important as sources of the past which were generated independently from written documents. It is not the correct way to interpret a pollen diagram as a historic source. But it is remarkable if it is possible to detect developments in history and in a pollen diagram which can be paralleled independently.

In spite of many assumptions the influence of climate developments on the vegetation history was only important just after the end of the Ice Age, when first woodlands developed in a former grassland area. This was certainly influenced by climatic change. In later periods the change of the land use strategy was obviously more important, as it allowed either secondary successions of woodland (with the allowance of the expansion of lately arriving tree species), or intensive land-use prevented this.

It can be demonstrated that human influence did not always have the same effect on vegetation development. It did not start with an initial "landnam" which was proposed by the Danish botanist Johannes Iversen (1941). His theory was often discussed. But the "landnam" did not result in permanent land-use. Rather, in prehistoric times, land was not reclaimed as a single event, but obviously several times. This is clearly demonstrated by archaeological research: At several points of time settlements were founded, woodlands were cleared and given up again. Only in historic times settlements and their fields were mostly stable and were not given up again. This fact obviously had an important influence on the formation of woodlands.

There are historic sources that settlements were abandoned in historic times, too, especially in the middle of the 14th century and during the Thirty Years' War (1618–1648; Jäger,1994). But these processes obviously were not comparable to the situation in prehistoric times, as possibly only the settlements were abandoned and not the fields, so that the fallows were not overgrown by woodland formed during a secondary succession.

Since millennia, different kinds of management influence the development of woodlands more than climate change. This becomes clear by the fact, that similar developments of vegetation took place at very different points of time. It is therefore likely that also in the future different management will influence woodland development more than climate change.

Hansjörg Küster was Professor for Geobotany at Leibniz University Hannover. He published extensively about the history of landscape, history of the forest, the history of farming etc. He was born in 1956 and passed away on February 26, 2024.

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