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## NATURAL ENVIRONMENT

*ABSTRACT: The paper describes different aspects of natural environment in the course of the Pleistocene and underlines the necessity to distinguish between them. Then follows a categorisation of the various types of big mammals migrations in relation to their palaeoecological analyses.*

*KEY WORDS: Pleistocene – Forms of natural environment study – Types of migrations*

At present, the interest in detailed study of changes in the natural environment and, above all, in the Upper Pleistocene, grows immensely. This is not any more the matter of a single branch of science, but a summary of views of several scientific disciplines, all that can contribute to the solution of this problem. The assessments of different branches to this problem can, of course, more or less differ, and instead of an answer one can rather expect a clarification of issues only. The final result should in any case be the determination of the following findings:

1. On which all or at least a majority of branches have agreed,
2. in which they differ somewhat in some views,
3. diametrical discrepancies on which it is impossible to agree and which, at the present state of knowledge, are hard to clarify. In this case the present author would consider it advantageous to specify those different views exactly, so that to let them be gradually solved in the future.

The natural environment is a synthesis of the most varied factors, and by its comprehensive view it is superior to the climate. Among the most decisive factors are temperature and precipitation. As for temperature, it is not only the mean annual temperature, but its distribution throughout the year, above all the existence and length of duration of extreme temperatures, either low in winter or high in summer. That also holds for precipitation, decisive is not the mean annual precipitation, but its distribution into individual months.

The approaches to detailed analysis of natural environment and its changes can vary a lot and they should not be interchanged. The present article divides them into several groups.

### FIRST ORDER CHANGES, CHANGES OF GLOBAL CHARACTER

This view is at present yielded by the study of marine sediments (oxygen isotopes – OIS) which show in great detail temperature changes in marine water in the course of time. From these changes, the occurrence of warm and cold events on land can be derived. Temperature is, however, only one of the climatic factors. Ecosystems are also affected by a number of further factors (biological and geological cycles) operating only in their entirety.

Much more detailed studies of temperature changes are those of present-day glaciers in Greenland and in the Antarctica. They do not only provide a detailed picture of temperature changes, but they also yield a number of further data. At present they are temperature changes in the Upper Pleistocene expressed in maximum detail.

All temperature data obtained from both marine sediments and the Greenland glacier are objective reality and have therefore general superregional validity. In all temperature changes it is thus assumed that they must necessarily have operated globally, but their intensity must

have been geographically much different. It is a fact that so far they have not been reflected anywhere in their entirety in terrestrial sediments. An exception may be the site Königsau (Ascherslebener See), where the greatest amount of warm events have been recognised, known so far in terrestrial sediments in superposition (7 warm periods in the Young Würm only; in all earlier interstadials at this site up to the time of ca 49,000 BP there appear, besides the wood species such as *Picea*, *Alnus*, *Salix*, *Corylus* also climatically more requiring species such as *Quercus*, *Ulmus*, *Tilia*, *Carpinus*).

## SECOND ORDER CHANGES, CHANGES IN THE MERIDIAN AND PARALLEL DIRECTIONS

Due to various factors (extent of solar radiation, annual temperature and precipitation distribution and their amount, the rock substrate, absolute heights, etc.), climatically different provinces have been formed, both nowadays and in the past, irrespective of global temperature changes pointed out in the above paragraph. The borders of those provinces are not stable, in the course of time they keep changing, in both the north-south and in the west-east directions. Where these changes are of greater intensity, they cause extensive migrations of both plant and animal communities. Westward migrations are more frequent and more conspicuous than the opposite ones. This is due to the fact that while regions with arid climate could extend from the east to the west deep into western Europe, humid climate has never extended far into the east of Europe. A typical example of this is the expansion of some species (such as saiga etc.) in the Last Glacial. On the other hand, the typical west European community of the Last Interglacial, i.e. of warm and, above all, humid climate, ends roughly at that time in eastern Germany and does not continue further to the east. In essence it means that, as to possible expansion, types of arid, and in this case (in the Last Glacial) also cold climate, are always more favoured than types of warm and at the same time humid climate.

This variability relating to greater distances is not typical of the Upper Pleistocene only, but it occurs at present too. As mentioned by Larsen (1980), the boreal forests of Canada, despite their certain uniformity, show relatively high differences between their eastern and western parts, or between their northern and southern parts, where these differences are even greater and more marked.

It should be stated that the above changes in the individual provinces take place not only in longer time periods, but they can also be observed in a single period. To some extent they depend of global temperature changes discussed earlier, but also of a number of other factors as well. Unlike the earlier ones, they do not, in any case, have a global character.

## THIRD ORDER CHANGES, LOCAL CHANGES IN THE ENVIRONMENT

Relatively significant climatic differences and those in the natural environment are found, in the Upper Pleistocene, between the individual provinces, but also in smaller territories inside them. They are not only changes following from the vertical zonation, but rather territories of different sizes which, compared to their surroundings, exhibit more favourable, or, on the other hand, worse environment. They are regions extremely swinging out of the generally prevailing climate in the surroundings, and they can be denoted as refuges. These climatically favourable refuges were of great importance, particularly in colder events, for both vegetation and for animals bound to it and, of course, for the then people, whose economic basis was, above all, hunting. A typical example, as far as Moravia is concerned, was the region of Dolní Věstonice and Pavlov in the Last Glacial. In the river valleys, rich vegetation was preserved consisting, besides a number of herbs, also of wood species, not only coniferous trees, but also deciduous ones, such as oak, beech, elm, etc. Due to the fact that it was a very cold period of the Last Glacial (the period dating to ca 26,000 BP), it can hardly be assumed that the deciduous trees could have migrated there at that time only. They must have got there much earlier, either in the Last Interglacial or in the first Würm interstadials which were climatically much similar to the Last Interglacial and persisted there since that time. It was evidently the southern border of the taiga which, according to Larsen (1980) can sometimes be defined only with difficulties. It passes gradually over deciduous trees (*Ulmus*, *Fraxinus*, *Acer* in North America, *Quercus*, *Tilia*, *Fraxinus* in Europe and Asia) into a landscape of park character and that again into pure steppes, of course depending on regional climate. In North America even coniferous, mixed and deciduous forests existed relatively close before the head of the glaciers (Larsen 1980). This kind of development would much correspond to that known from south Moravia.

Such refuges are nothing unknown, even at present. They are described from a boreal forest of Canada as a response to different kinds of soils, topography of the place and the microclimate. It is a region of the north of Canada which has not been covered with ice. It is even stated that in those refuges plant communities must have survived Pleistocene glaciation.

It is evident that it was those very favourable places, which must have been numerous, that permitted a quick spread of plants in more favourable periods. From the above viewpoint it follows that a substantial role for plants, animals and man in the Last Glacial is not so much that of macroclimate, but rather of mesoclimate and microclimate, changes between the individual provinces and above all local changes. The latter were evidently also decisive for long lasting stays of the then people.

Changes in the above three groups are thus not fully dependent on each other, they need not always correspond

to each other and they must not be arbitrarily mixed up in any study.

The above facts have of course immediate effect on organic life. As for the vegetation, the present author is not a specialist and cannot express himself to it. However, brief mention will be made here of mammals of that time. Their finds come today mainly from the cultural layers, and unlike gastropods, they are not the whole communities of the given ecosystem. Despite that, it is possible to excerpt some important conclusions even from this incomplete community.

In publications, prevailing the species diversity and the MNI of the individual species are stated. From that basis further conclusions are then drawn. The requirements of the individual animals on the food base in the course of the year are, however, little stressed. The bigger the herbivores, the more energy they need for their life, the bigger and the richer must their vegetable food be, not only in summer, but above all in the winter months. Usually no distinction is made between the species that inhabited the studied region permanently and those which got there by migration and lived in the region only seasonally, for a certain part of the year. By not distinguishing between the two groups of animals, erroneous conclusions can of course be arrived at, mainly as far as their environment is concerned.

The migration of the individual animals can be divided into several groups:

### Roaming

These are minor movements of animals in the region in which they exist, and they are connected with the amount of food in the course of the year. The animals look for places which yield them most food. This concerns above all big herbivores and possibly predators bound to them, mainly those hunting in packs, not small mammals. From among big mammals those roaming activities are conspicuous not so much in animals bound to regions covered with grass, bushes and trees, but rather in animals living in arid and semiarid regions, whose radius of action can be relatively large. For instance in saiga, if due to lack of precipitation a situation occurs that the vegetation is insufficient for nutrition, they travel hundreds of kilometres to other more favourable regions.

### Seasonal migrations

This is a cyclically repeated regular movement of some animals between the winter and the summer months. It is evoked mainly by the amount of food, competition in the given region and the onset of reproduction. A whole number of species move for the summer to other regions than those they lived in winter. The shift of animals always occurs along the same routes and even the passages across rivers and mountains are usually the same. As it could be demonstrated in analysing e.g. the fauna of Pavlov, however, this does not mean in any case that there is a complete disappearance of the species in its winter habitat.

A certain, although small number of animals always remain there.

Seasonal migrations of mainly those species which do not exist any longer, are still little known. That migrations did not involve small distances only, is evident for instance from the following example: before the colonisation of North America by white people bison were moving twice a year from Canada as far as to Mexico and back (Cloudsey-Thompson 1988).

### Migrations in the meridian direction

They are due to conspicuous climatic changes of interglacial and glacial character. This type of migration concerns mainly species that are fairly stenoeous. Although they have already been treated in several partial publications, a monographic analysis and an overall detailed evaluation of migrations of Pleistocene animals of the individual European provinces is still missing.

### Migrations in the direction of parallels

They are connected with changes in arid and humid climates, not directly by changes in mean temperatures, which can be secondary. The aridisation of climate leads to the extension of steppes of eastern Europe in the direction of western Europe and thus also to the migration of east European and Asian elements to central and western Europe. On the other hand, the increase in humidity does not proceed as far as the eastern part of central Europe and to eastern Europe, at least not for longer periods of time. That is why in those regions communities so typical of the Last Interglacial of western Europe and the western part of central Europe are not found. As far as the treatment of those migrations is concerned, the same holds for them as for the preceding paragraph.

## SUMMARY

1. In any evaluation of the natural environment of a given region, a given ecosystem, it must be first realised on which view the evaluation will be based (global, provincial and local). Their mutual mixing is not possible.
2. Information of global character yield only a global picture of changes, mostly only annual mean temperatures, irrespective of whether it concerns hilly lands, mountains or lowlands or the northern and the southern regions of Europe.
3. Like today, also in the past the individual European provinces had a somewhat different development of the environment in the given cold or warm event. That is why it is impossible to include in one group, from the point of view of the detailed study of the vegetable or animal community, e.g. England, France, Spain, Germany, Poland, the Ukraine, Russia, i.e. generally speaking, the whole regions of western, central, southern and eastern Europe.

4. The most important role in minor geographic units, which are in fact all present studies of the individual localities, is that of local peculiarities. They can be quite substantially climatically different from their surroundings. They can either have extremely harsh climatic conditions or, on the contrary, very favourable ones. The two cases are, of course, reflected in both the vegetation and the animal communities and their importance for a long lasting presence of man is as clear as daylight. These were evidently a sort of refuges.
5. The particularly varied relief of Europe is especially suitable for such changes. There are different sizes of both hilly lands and mountains and lowlands, which makes it possible to give rise to local peculiarities. The situation is, of course, different in eastern Europe with large open and extensive plains, where local changes will only hardly be looked for.
6. A detailed comprehensive study of the natural environment of the territory of Europe must thus utilise not only the knowledge of global character, but be also oriented on the study of possible local climatic particulars. This concerns above all the palaeoecological evaluation of the individual localities.

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