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present phenological spectra of every sociation and every type, not to mention the fact that the spectrum varies according to the exposure, altitude, as well as to climatic regions, etc.

#### IX. Shrub vegetation below canopy.

There are not, always, many strata in beech forests. The moss covering is nearly always lacking, the herbaceous undergrowth (in one or two layers) is more or less well developed but can also be suppressed (see *Fagetum nudum*), and the shrubby growth (young trees and true shrubs) is very unequally developed. As the most characteristic shrubs accompanying the beech, the following can be mentioned:

*Cornus sanguinea*

*Corylus avellana*

*Daphne mezereum*

*Lonicera nigra*

*Lonicera xylosteum*

*Ribes alpinum*

*Ribes grossularia*

*Rosa pendulina*

*Rubus idaeus*

*Sambucus racemosa*

*Sorbus aria* (chiefly on limestone)

*Sorbus torminalis*

*Spiraea media* (only in Subcarpathian Russia)

Rather characteristic for some beech forests are also *Evonymus verrucosa*, *Ligustrum vulgare* (ab.), *Stachylea pinnata* and *Viburnum opulus*. Besides, a good many other shrubs (for instance *Cornus mas*, *Crataegus*, *Cotoneaster tomentosa* (Carpathians only), *Berberis vulgaris*, *Rhamnus cathartica*, *Viburnum lantana* and some *Rosa* and *Rubus* species are sometimes present in some beech forest sociations.

#### X. Ground vegetation.

The ground vegetation is the most reliable basis for a sociological classification of beech forests, because the general tree stratum is uniform and the small number of accompanying trees cannot be depended upon for establishing definite sociations. Since a sociological classification of beech forests is exceedingly difficult, many authors avoid a definite evaluation and distinguish simply «types», often characterised also ecologically. These types, however, are not identical with the well-known C a j a n d e r's forest types, because these authors interpret the beech forest, including its tree

stratum, as one unit. This interpretation is without any doubt a correct one, because the influence of the tree layer on the ground vegetation is much more evident than in other forests. This is evident already from the fact that a normal beech forest has an influence upon the microclimate, upon the cyclic light intensity, as well as upon the formation of humus by leaf-decay, and upon the microbe vegetation. As I have already described above, a small spruce enclosure, measuring only a few square meters, causes, in a virgin beech forest, a radical change in the ground vegetation which points out quite clearly the dependance of the undergrowth upon the tree stratum.

On the basis of the ground vegetation, it is possible to distinguish beech forest sociations and their numerous variants. This classification, however, has many difficulties, as:

1. First of all, there are the antropical influences (forest culture, selective or clear cutting, grazing, etc.) which render it difficult to recognise the original beech forest sociations.

2. The evaluation of forest communities is and always will remain subjective and therefore one author can regard, as distinct sociations, such communities which in the opinion of another would be considered only as less important variants of one and the same sociation. According to the new terminology, introduced by G. Einar Du Riez (1929), *sociation* becomes a fundamental sociological unit, corresponding to association in the former sense of the Upsala ecological school. On the basis of this new conception, our beech forests consist of numerous sociations (small associations) and these sociations in turn form a single *consociation* (a group of association in the old sense) which consociation at the same time is an association of a single consociation.

3. For a correct evaluation of sociations, it is necessary that we know and compare growths of mature beech forests where the canopy has not been opened by selective felling. Besides that, it would be important to know every type of a beech forest in all stages of its development, that is, of virgin forests with natural openings and of cultivated forests with clearings. A change in light intensity, caused sometimes in virgin forests by the uprooting of old trees often brings about a complete change in the undergrowth.

4. The classification is further complicated by the fact that different types of beech forests are often made up of combinations of identical species so that we are compelled to accept the dominance of species as the determining character.

5. Some beech forest communities which appear to be distinct sociations are connected by various transitions.

6. Debatable is the question in what manner we ought to evaluate the floristic composition of the undergrowth and the dominance of the individual species. Sociation, in the narrower sense, should have constant dominants so that, for instance, analogous types of beech forests with *Asperula odorata* or *Mercurialis perennis* as dominants should be regarded as distinct sociations. Further, it is a question whether we can regard, as a single sociation, beech forests with abundant *Asperula odorata* and more or less abundant *Mercurialis perennis*, and whether we can add to this sociation as variants (resp. facies), communities, otherwise identical but differing by the presence or absence of mountain, calcareous, or geographically characteristic species. In reality only the correct recognition of these types is of importance, whereas their specification as sociations or variants and facies is a matter of subjective opinion in a similar manner as is the evaluation of species in taxonomy. From this point of view I do not emphasise, for the time being, the solving of the question, which phytocoenosis ought to be designated as a sociation and which as a variant of another sociation. These problems shall have to be solved by comparative studies in the future, after the studies of the European beech forests have been completed at least in rough outlines. How little our Czechoslovakian beech forests are known in world literature is best shown by L ä m m e r m a y r ' s book (1).

7. Of especial difficulty is the classification of those communities which I have called *Fagetum herbosum* and *altiterbosum*, because both types intermingle rather often, and the typical *F. herbosum*, when the canopy is loosened, takes on the character of the second group. Also *F. nudum* is, in reality, only a stage of this or that sociation with a latent herbaceous undergrowth.

8. Beech forests in optimal conditions and development appear frequently like mosaics of communities each of which, in other instances, has the character of distinct sociations.

9. It is sometimes very difficult to distinguish stable and transitional (resp. initial) stages as well as it is difficult to decide which types belong to the same sociation as the result of a chance or antropic change of the habitat. Thus I have described (<sup>4</sup>, p. 23—24) from Subcarpathian Russia beech forest types of an essentially different physiognomy but in reality brought about by the increase in light intensity. In the shade of an old, tall-trunk beech forest on a stony ground, we find the *Mercurialis-Phyllitis* type with very abundant *Urtica dioica*; in the lighter shade of more open forest places, the *Athyrium filix femina* type dominates; and on the still lighter places on coarse talus, a shrubby growth of *Rubus idaeus*, *Ribes grossularia* and *Lonicera nigra*, is to be found.

Besides, the same type (for instance *Carex pilosa*, *C. alba*, *Melica uniflora*) may be, in some instances, only a stage of another stable sociation or else a final stable community.

As a distinct sociation one cannot accept a growth which is characterised only by the fact that a single species of this or that sociation determines locally the aspect by its high dominance. A sociation must have its own sociological structure, a certain stability, and a certain geographical distribution. As I have already mentioned, it is a matter of personal opinion whether the geographical and edaphic variants ought to be evaluated as distinct sociations.

Sociations and variants of beech forests we characterise by the floristic composition and by the physiognomy of their tree, shrub and ground vegetation strata (also of the mossy layer, if present). In a broader sense, these principal sociations are complicated by other accompanying sociations, namely the epiphytic growths of bryophytes, lichens, algae, the mycoflora, and, of course, also the microbe vegetation of the soil.

## **XI. Sociations, variants and facies of Czechoslovakian beech forests.**

As far as the beech forests of our state are concerned, it seems advisable to distinguish two sociologically and ecologically essentially different groups, namely the true beech forests (*F a g e t u m v e r u m*) and the spurious beech forests (*F. s p u r i u m*) to which latter may also be joined the degraded beech forests. The bare-floor beech