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scabra, *Tilia platyphyllo*, *T. ulmifolia*, coniferous *Abies alba* and less often also *Picea excelsa*. Also other trees (*Acer campestre*, *Carpinus betulus*, *Quercus sessilis*, *Q. cerris*, even *Q. lanuginosa*, *Pinus sylvestris*) may be interspersed but they cannot be considered as typically accompanying the beech.

A peculiar mixed beech forest sociation is found on ridges in our Carpathians, especially on talus in the mountain zone. The beech retreats here sometimes to such a degree that, locally, it may even disappear, but its typical ground vegetation remains. Interesting and frequent is the fact that talus, especially under the influence of the summit climate (and even at lower altitudes), shows a certain relation to an increasingly mixed beech forest, in which often, besides the dominant deciduous trees, conifers may also come in. I described this phenomenon, for instance, in the České Středohoří Mts. but it is even more typical in various parts of Slovakia.

VII. Transitions to other types of forest.

It is necessary that we distinguish the deciduous forests mixed with beech which are usually stable sociations, from the transitional types of beech forests to other forest communities.

I have shown in my book on the Brdy Mts. (¹), that at the beginning of historic times, mixed forests of deciduous and coniferous trees predominated in Bohemia almost everywhere, and that these growths were most fit for maintaining favourable edaphic conditions. The percentage proportion of each type of individual trees fluctuated according to the habitat, or without any correlation to it, even in the natural mixed growths. This is, for instance, illustrated by the famous virgin forest of Boubín in the Šumava Mts. The chief trees forming the virgin forest are four in number, namely the fir (*Abies alba*), the beech (*Fagus silvatica*), the spruce (*Picea excelsa*), and the maple (*Acer pseudoplatanus*), which last, however, plays a far smaller role than do the first three; the elm (*Ulmus montana*) is very rare. It is extremely difficult to determine accurately the proportionate percentage of each tree, because in different parts of the forest the percentage is different and also changes in the course of time. In many parts there is forty per cent of firs

and beeches, over fifteen per cent of spruces, and a smaller proportion of maples. There are also parts, however, (for example above the Lake of Boubín) where only conifers predominate, especially the spruce, and in places form pure coniferous growths. In other places, again, as for example in the lower part of the southern corner, the forest consists almost exclusively of beeches. Some authors, as for instance Drude, maintain that the spruce is constantly gaining ground, though this does not always hold true, for it is exactly the spruce that most often is uprooted, while we never see a freshly uprooted beech or maple, but only here and there an old trunk split by lightning or broken by a storm. The loss of deciduous trees is, on the whole, insignificant in comparison with that in the case of the spruce and fir.

Also, the magnificent virgin forest above the Hoverla creek in Subcarpathian Russia (Domin⁴), in reality a mixed virgin beech forest with the beech decidedly predominating, has huge spruces and firs as well as maples (*Acer pseudoplatanus*) abundantly interspersed. Many «pure» beech forests, as far as they are natural, have arisen by selective cutting of certain species, especially conifers.

Beech forests are sometimes sharply set off against neighbouring forest communities, but in places strips of mixed forest arise in which the ground vegetation is either determined by the beech with its accompanying woody plants, or by the spruce and occasionally by the oak. Sometimes, however, not only do the leading woody plants, of the two different forest sociations intermingle, but also, in the undergrowth fragments of the two respective sociations are mixed in such a manner, that an analysis shows a peculiar promiscuity which, in reality, is not a promiscuity but a mosaic of two distinct sociations. I have shown in another paper that decaying logs and stumps can be a place of support for the invasion of foreign elements into a beech forest (see also Domin⁵). The published analyses of such intermingled sociations (as well as of cultivated forests) seemingly destroy the boundaries between the spruce and beech forests. Roads and paths, as well as forest cuttings and clearings, are also very important for the invasion of foreign elements into the beech forest region. In the virgin forest of Boubín in the Šumava Mts., I noted especially the following species growing chiefly on stumps, trunks, and roots of conifers and from them as-

sociating locally into small groups: *Homogyne alpina*, *Calamagrostis villosa*, *Listera cordata*, *Vaccinium myrtillus*, *Struthiopteris spicant*, *Lycopodium annotinum* and *L. selago*, hence only types quite foreign to typical beech forests.

Analogous examples are abundant. I described an especially interesting case (4, pp. 30—31) from Subcarpathian Russia. In a ravine on Mt. Kečirka in the Velký Trostinec valley there is a mixed virgin beech forest with a small strip dominated by spruce, which phenomenon alone suffices to cause a quite different type of ground vegetation. We find here *Calamagrostis arundinacea* ab. and *Vaccinium myrtillus*, abundantly gregariously first taking root on mossy stumps or fallen trunks and persisting even after the latter have decomposed and finally seemingly disappeared. *Lycopodium annotinum* grows very greg. in this community, *Dryopteris spinulosa* is abundantly scattered while *Gentiana asclepiadea*, which species is almost entirely lacking in the beech forest region, is only scattered. The ground here is mossy. This community does not belong, of course, to the beech but is a fragment of an entirely different (spruce) sociation, here fairly well developed but in many other places difficult to distinguish and seemingly mixed with the beech forest undergrowth. There where the fir forms a small growth in the beech forests (with or without interspersed spruce) as for instance at the foot of the rocky shaded ridge on Mt. Kečirka, a mossy *Oxalis* type is developed with *Dryopteris pulchella* (v. scat.), *Valeriana tripteris* (only scat.), *Vaccinium myrtillus* and *Lonicera nigra* (v. sc.).

If the spruces here grow in a more humid ravine, a mossy type arises in which are also present growths of *Luzula silvatica*, *Carex silvatica*, a little of *Vaccinium myrtillus*, establishing itself chiefly on mossy trunks with gregarious *Lycopodium annotinum*. Other herbaceous plants may also appear, such as *Doronicum austriacum*, *Crepis paludosa* and shrubs, such as *Lonicera nigra*, in abundance, etc.

In such a manner foreign elements and fragments of spruce associations penetrate into beech forests (even into virgin growths); in normal beech forests not even *Vaccinium myrtillus* can be found anywhere. Even in virgin beech forests without any human influ-

ence, small places arise by soil degradation where, for instance, *Struthiopteris spicant* and colonies of other spruce elements can establish themselves.

Transitional types of beech and spruce forests are quite frequent and in reality of two types:

a) in the mixed forest of deciduous and coniferous trees, one sociation dominates in the undergrowth, whereas the other is represented at least fragmentarily;

b) in the mixed forest, the undergrowth is determined either only by the beech or only by the spruce.

To the transitional beech-oak forests also belongs the *Poa nemoralis* type (with two subtypes, namely *Poa nemoralis* and *Poa nemoralis-Melica uniflora*), as was described by R. Mikyška (1) in the *Quercetum* and *Fagetum* in the Štiavnické Stredohorí (Slovakia). In the tree stratum, in most cases, *Quercus robur* predominates, whereas the beech retreats. The forest is somewhat open as the growth is rather irregular due to the steep slopes. The rocks are eruptive rocks (andesites predominating) and the ground vegetation has the character of a community in a rather dry and sunny habitat with often shallow and stony ground. Some species as *Arabis arenosa*, *Cytisus nigricans*, *Genista tinctoria*, *Sedum maximum*, *Laserpitium latifolium* and others indicate a rather xerophytic character of this sociation. Mikyška characterises this type, first, by a great dominance of *Poa nemoralis* which is constant in all modifications of this type, further by the combination of *Fragaria elatior*, *Galium Schultesii*, *Quercus robur* as constant species, and the following differential species: *Arabis arenosa*, *Digitalis ambigua*, *Chrysanthemum corymbosum*, *Calamintha clinopodium*, *Laserpitium latifolium*, *Lapsana communis*, *Sedum maximum*, *Silene vulgaris*, *Vicia sepium*. Already from these remarks we see the relation of this forest to the oak forests.

Most remarkable are the transitions between beech forests and *Quercetum lanuginosae*, two sociations physiognomically, floristically and ecologically entirely contrasting. In the southwestern spurs of the Carpathians, these transitional types are fairly frequent. I became acquainted with them in the Tematín hills (dolomite) from where they were first described by Sillinger (1) and in the Mt. Rokoš group (also dolomite).