RALSKA-JASIEWICZOWA M., 1980: Late-Glacial and Holocene vegetation of the Bieszczady Mts. (Polish Eastern Carpathians). PWN, Warszawa. 199 p.
RALSKA-JASIEWICZOWA M. (ed.) 1989: Environmental changes recorded in lakes and mires of Poland during the last 13'000 years. Acta Palaeobot. *29(2)*, 1-120.
RALSKA-JASIEWICZOWA M. The history of vegetation in the Bieszczady Mts. (S.E. Poland) during the past 12'000 years. Veröff.Geobot.Inst.ETH,Stiftung Rübel,Zürich, *107*, 260-264.
TACIK T., ZAJACOWNA M. and ZARZYCKI K., 1957: Geobotanisches von der Beskid Niski-Kette im mittleren Teil der Karpaten. (In Polish with German summary). Acta Soc.Bot.Pol. *26(1)*, 17-43.
TOWPASZ K., 1990: Geobotanical characterization of the Strzyzow foothills. (In Polish with English summary). Rozprawy Habil., Uniw. Jagiell. *178*, 1-242.
WINNICKI T. and ZEMANEK B., 1987: *Phyllitis scolopendrium* (L.) Newm. and the *Phyllitido-Aceretum* association in the Western Bieszczady Mts. (Polish Eastern Carpathians). (In Polish with English summary). Zesz.Nauk.Uniw.Jagiell., Prace Bot. *14*, 135-140.
WOLOSZCZAK E., 1895: On the boundary of the Western and Eastern Carpathian flora. (In Polish). Spraw.Kom.Fizjogr.Akad.Umiej. *31*, 119-159.
ZAPALOWICZ H., 1909: 'Prof. Paxs Grundzüge der Pflanzenverbreitung in den Karpaten' from the point of view of our natural sciences. (In Polish). Kosmos *34*, 924-992.
ZARZYCKI K., 1963: The forests of the Western Bieszczady Mts. (Polish Eastern Carpathians). (In Polish with English summary). Acta Agr.Silvestria, Ser.Silv. *3*, 4-132.
ZEMANEK B., 1991a: The phytogeographical division of the Polish Eastern Carpathians. Zeszyty Nauk.Uniw.Jagiell., Prace Bot. *22*, 81-119.
ZEMANEK B., 1991b: Mountain taxa versus xerothermic taxa in the Polish Eastern Carpathians and their indicator value in phytogeographical investigations. Zesz. Nauk. Uniw. Jagiell., Prace Bot. *22*, 55-80.
ZEMANEK B., 1991c: The phytogeographical boundary between the Eastern and the Western Carpathians - past and present. Thaiszia (Kosice, Czecho-Slovakia) *1*, 59-67.

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The "Wołosate" peat bog reserve in the Bieszczady Mts. (S.E. Poland)

Magdalena RALSKA-JASIEWICZOWA

1. SITUATION, VEGETATION AND STRATIGRAPHY

The peat bog is situated in the upper part of the Wolosatka river valley (Fig. 1), about 3 km SSE of the village, Ustrzyki Gorne. The peat bog lies at 700 m a.s.l., and is fairly regularly elliptic in shape, measuring about 120 by 260 m. Its dome is raised about 3.20 m above the surrounding area (LIPKA and GODZIEMBA-CZYZ 1970). The surface of the peat bog was once cut with drainage ditches and was badly eroded. It is now protected as a nature reserve and there are signs that active growth is beginning to restore a natural surface. It is now a typical raised bog with a *Sphagnetum medii*-dominated surface and with *Ledum palustre, Oxycoccus quadripetalus, Oxycoccus microcarpus, Andromeda polifolia, Eriophorum vaginatum, Carex pauciflora, Drosera rotundifolia, Vaccinium uliginosum, Vaccinium myrtillus* and *Vaccinium vitis-idaea*, and the mosses, *Sphagnum medium, Sphagnum acutifolium, Sphagnum papillosum, Campylopus flexuosus, Dicranodontium denudatum*, growing in it. Sparse shrubby birches (*Betula pendula*), single non-flowering specimens of *Picea abies* and sporadic *Pinus sylvestris* seedlings occur on its surface. *Carex fusca, Carex brizoides, Potentilla erecta, Juncus effusus, Menyanthes trifoliata, Sphagnum recurvum* and *Polytrichum commune* grow in the lagg of the bog.

The lower terrace of the Wolosatka river supports *Alnus incana* scrubs. The valley floor is covered by degraded *Deschampsietum* and *Nardetum* mead-

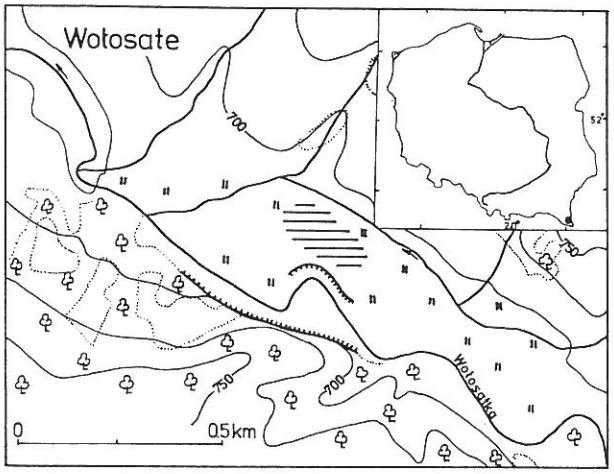

Fig. 1. The location of the "Wolosate" peat bog.

ows with *Juniperus communis*, and fallows overgrown by *Alnus incana* showing a mixture of succession stages typical of ground abandoned by man. Now fields are being cultivated again. The slopes of the valley are occupied by beech forests without fir and spruce. LIPKA and GODZIEMBA-CZYZ (1970) reconstructed the stratigraphy of the bog. Details are given in Fig. 2.

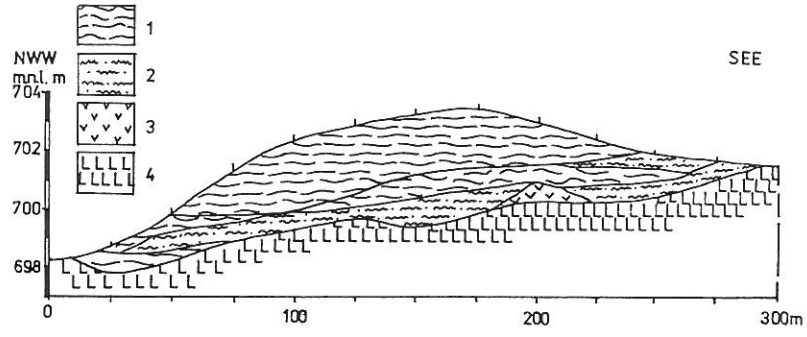

Fig. 2. Stratigraphy of the "Wolosate" peat bog shown by the NWW-SEE transect. The bore sites at 25 m intervals are indicated. (LIPKA and GODZIEMBA-CZYZ 1970, modified).
1 - *Sphagnum* peat, 2 - *Eriophorum vaginatum* peat, 3 - wood peat, 4 - clay.

2. THE SHORT HISTORY OF VEGETATION AND HUMAN IMPACT

2.1. DESCRIPTION OF THE DIAGRAM

Wolosate is the youngest of the peat bogs in the Bieszczady Mts. examined by RALSKA-JASIEWICZOWA (1980). Peat accumulation started there during the declining phase of mixed deciduous forests (climatic optimum). The pollen diagram (Fig. 3) covers only the latest period of forest development and can only with difficult be divided into the following pollen assemblage zones (PAZ):

- 380-365 cm: *Corylus-Tilia-Ulmus-Picea* PAZ characterized by the falls of *Corylus*, *Ulmus* and *Tilia*, and a rapid rise of *Carpinus* and *Fagus* pollen curves. The *Picea* pollen curve is high. The indicators of man presence appear sporadically.
- 365-315 cm: *Fagus-Carpinus* PAZ. *Carpinus* and *Fagus* become the dominant pollen taxa, *Picea* still shows rather high frequencies and the indicators of human activities form the continuous pollen curves.
- 315-190 cm: *Fagus-Abies-Betula* PAZ. *Carpinus* pollen values decline and those of *Abies* become substantial. *Fagus* pollen curve shows some depression, and *Betula* and the frequencies of culture indicators increase.
- 190-0 cm: *Fagus-Abies*-NAP PAZ. Oscillations in pollen curves of dominant trees are evidently correlated with those of culture indicators, their sum in places, rising up to 25% of the total pollen sum. Therefore, it seems reasonable to describe the anthropogenic changes recorded in the pollen diagram independently from the regional forest history.

The pollen assemblage zones (PAZ) reveal the following development:

1. Since 370 cm: the beginning of continuous *Artemisia*, *Chenopodiaceae* and *Plantago lanceolata* pollen curves.
2. Since 345 cm: the slight rise of *Gramineae*, *Plantago lanceolata*, the beginning of *Rumex* pollen curve and sporadic appearances of *Plantago media* pollen are correlated with the decline of *Carpinus* and *Corylus*, and first rise of *Betula* since around 315 cm. They are followed by the declining tendencies of *Fagus*, *Picea*, a maximum of *Artemisia* and the first appearance of the *Humulus/Cannabis* pollen type. The maximum of *Betula* and of *Gramineae* pollen is correlated with the minimum of the *Fagus* curve at 270 cm. Since 280 cm the first pollen grains of cereals (*Triticum* type) appear. The decreased pollen frequencies of culture indicators between 220 and 195 cm correspond with the subsequent maximum of *Fagus* pollen.
3. At about 190 cm, the above mentioned culture indicators increase again along with the increase in cereals (including *Secale*!) and the beginning of the regular appearances of *Urtica*, *Polygonum aviculare* and *Plantago major* pollen. The *Picea* pollen values fall to a minimum followed by a transitory depression in the *Fagus* curve, and a rise in frequencies of *Abies*, *Betula*, *Corylus* and *Alnus* pollen.
   Around 135 cm the pollen values of some culture plants decrease again. The curves of *Cerealia* undiff. and *Triticum* type become discontinuous; *Secale* pollen occur only as single grains. This decline is short-lived in the cases of *Artemisia*, *Plantago lanceolata* and *Plantago major*.

4. The youngest settlement phase, covering the upper 80 cm of the profile, consists of two subphases divided by a more or less distinct depression in most pollen curves of culture indicators between 45 and 25 cm. It is characterized by double peaks of nearly all indicators mentioned so far and by the appearance of *Centaurea cyanus* and *Trifolium pratense* pollen and in the younger subphase, pollen of *Fagopyrum*. In this subphase the final decline of *Carpinus*, *Abies* and *Fagus* and a rise of *Alnus* and *Corylus* pollen curves takes place.

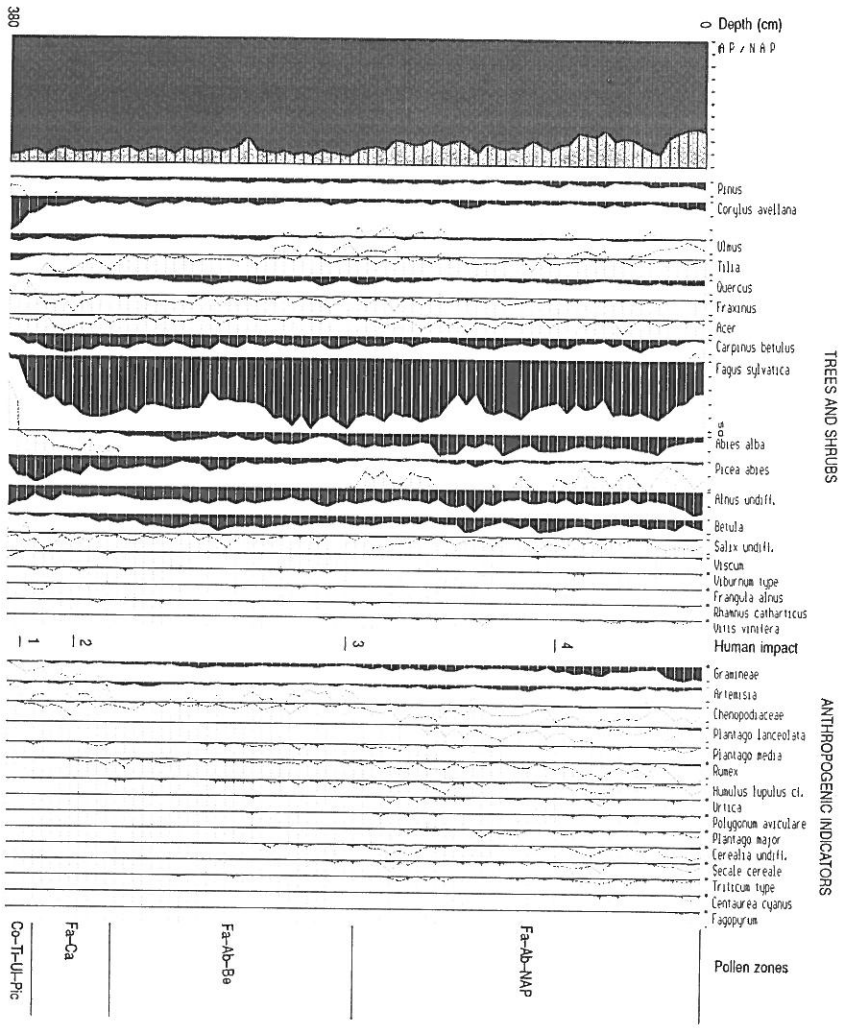

Fig. 3. Pollen diagram from the "Wolosate" peat bog.

2.2. INTERPRETATION

The profile from the Wolosate peat bog has not been radiocarbon dated and its interpretation is based on comparisons with other dated profiles. The decline of *Ulmus* and *Corylus* coinciding with the rise of *Carpinus* and *Fagus* pollen curves - the phenomenon which define the basal *Corylus-Tilia-Ulmus-Picea* pollen zone at Wolosate - have been dated in pollen diagrams from the Smerek and Tarnawa Wyzna peat bogs at c. 4'400-4'300 B.P. (RALSKA-JASIEWICZOWA 1980). These dates set the beginning of *Carpinus* and *Fagus* expansion in the whole region of the Polish East Carpathians, opening the development processes of modern forest zones in this area (*Carpinus-Fagus* PAZ). Their formation was completed by the expansion of *Abies* (*Fagus-Abies-Betula* PAZ) dated at Smerek and Tarnawa Wyzna at c. 2'800-2'700 B.P.

An interesting, individual feature of the Wolosate pollen diagram is the record of prehistoric human activities in the surroundings of the peat bog. It may be interpreted as follows:

1. The oldest traces of man, coinciding with a fall of *Ulmus* and an increase of *Fagus* pollen values, date probably from the late Neolithic. They might have been produced by the tribes of the Corded Ware Culture, which depended mostly on animal husbandry, practicing clearing by fire and axe to increase the area of pastures, but also grazing their cattle within forests. Their settlements might have been seasonal.
2. The next phase may correspond to the Late Bronze/Early Iron Age Lusatian Phase at Tarnawa Wyzna and Smerek. The subsequent changes reflect probably;
   a. the clearances in deciduous forests of the lower elevations and in spruce forests, the development of pastures (increase in grass pollen) and of secondary birch copses;
   b. the extension of forest clearances up to the beech forests, the encroachment of fir and the progressive development of post-farming communities (hazel and alder);
   c. the further increase of pasture areas at the cost of beech-fir and spruce-fir forests and the first evidence of agriculture. The settlement was presumably situated at a moderate distance from the peat bog.
3. The third cycle of changes may correspond to phase 3 at Tarnawa Wyzna, referred to the period of Roman influences. It is very clearly expressed in the Wolosate diagram by peaks of nearly all culture indicators. They point to the presence of a settlement surrounded by pastures and arable fields in the Wolosatka river area. It may have been connected with the presence of a trade route, running along the broad and easily passable valley of the Wolosatka and through the Beskid Pass towards the valley of the river Uh, although the existence of such a route has not, as yet, been confirmed archaeologically. It may have been another branch of the route detected by REYMAN (1960) running on the southern side of the Carpathians along the valley of the Latorica or Uh towards the Przelecz Uzocka pass.
   The following section of diagram represents a period of a partial reduction in human activities. The disappearance of pollen of autogamous cereals indicates the end of farming near the peat bog (there are still traces of anemophilous rye). Presumably the settlement was abandoned, but the route continued to be used and the areas adjacent to it were grazed.

4. The youngest, historical period of colonization also showed two phases. The depression of human indicators, separating the two subphases, may have been due to the economic standstill at the time preceding the Wallachian migrations and the foundation of villages in the Late Medieval Period.

REFERENCES

LIPKA K. and GODZIEMBA-CZYZ W., 1970: Peat bogs and fens of the Wolosatka stream watershed in the Western Bieszczady Mts. (In Polish). Zes.Nauk.WSR Krakow, Melioracje *59(4)*, 3-28.

RALSKA-JASIEWICZOWA M., 1980: Late-Glacial and Holocene vegetation of the Bieszczady Mts. (Polish Eastern Carpathians). PWN, Warszawa/ Krakow. 202 p.

REYMAN J., 1960: Réflexions sur le rôle du Col d'Uzok mises en lumière par les trouvailles des monnaies romaines. (In Polish with French summary). Acta Archeol.Carp. *1(1)*, 55-59.

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Lichen indication in the Przemyśl District (S.E. Poland)

Jozef KISZKA

Studies on epiphytic lichens carried out in 1986 in the Przemysl District aimed at elaborating a lichen indication map. A map of the Przemysl District on the scale of 1:100'000 was divided into plots of 2 km^2 for wood, and 4 km^2 for woodless areas (arable fields, meadows, etc.). In each plot the number of epiphytic lichens in stands, the morphological appearance of their thalli (healthy, degenerating, decaying), and also their abundance on the trunks of various tree species was established. The data collected in each square were compiled in files. Information on epiphytic lichens was correlated with indicator species (Table 1) of the zone scale by HAWKSWORTH and ROSE (1970) adapted for the Polish flora (KISZKA 1977, 1990). Squares of identical scale degrees were connected by means of isolines and thus six lichen indicator zones were distinguished in the Przemysl District (Fig. 1).

Mean SO_2 levels in the winter months corresponding to the zone scale degrees are given in Table 2. Differences in values of SO_2 in respective degrees of the scale are stimulated, inter alia, by climatic differences between England and Wales (Atlantic climate) and Southern Poland (a more continental climate). It should be noted that the data are only an estimate, since in the natural environment the air is likely to contain various phytotoxic compounds such as HF, H_2S, NO, NO_2 and some others, which synergetically affect the lichen thalli.

In the Przemysl District where zone I and II have a very high SO_2 level in the air, the epiphytic lichen flora no longer occurs or it is confined to a few, strongly resistant taxa of the zone scale 2 and 3 (Table 1). Even in zone VI,