

**Referaty, dotyczące problemów dyluwjum polskiego**  
wygłoszone dnia 2-go marca 1930 roku na posiedzeniu  
Polskiego Towarzystwa Geologicznego w Krakowie.

**S u m m a r y**

of the communications on the diluvial epoch of Poland at the session  
of the Polish Geological Society in Cracov on March 2. 1930.

The following communications were read:

1) E. Passendorfer: Some diluvial profiles from the West  
the Góry Świętokrzyskie (Holy Cross Mountains).

In the series of diluvial formations which cover the worn  
folds surrounding from the West the Góry Świętokrzyskie (Holy  
Cross Mountains) several profiles have been uncovered, determi-  
ning the stratigraphy of the diluvial period on this area. These  
profiles were uncovered in the shafts which were bored on pur-  
pose. The funds for this were granted by the Ministry of Educa-  
tion in 1929.

The most interesting is the profile in Olszewice, lying S. W.  
of Tomaszów Mazowiecki. There has been proved the existence  
on the sandstones of the Middle Cretaceous Period, gray moraine  
clays, on which laid a 2.5 m thick series of interglacial formations.  
These latter were built in their lower part of lake shales and in  
their upper part of peats. This series presents a rather complete  
picture of the climatic oscillations: cold climate in the lower part,  
through a temperate climate in the middle part to another cold  
one in the upper part. The shales and peats are covered by sandy  
clay, which in some places pass into sands with gravel, i. e. water  
sediment of the approaching glacier, whose moraine, formed of  
ruddy clays, encloses the profile. The series of shales and peats  
is consequently enclosed between two moraines.

The second shaft was bored in Bedlno — a place situated west of Końskie. There an untouched moraine clay was discovered; above that laid lake shales which gave place to peat, covered again by sands and river muds i. e. water sediments. Towards the top the profile is supplemented by ruddy moraine clays, appearing at a somewhat higher position than sands and river muds. Consequently here also we have two moraines, separated by an interglacial with a flora of temperate climate.

Further the interglacial series was again bored through in Mokre Barkowickie near Sulejów. Under lake shales which had been covered by the sediments of a younger glaciation, there were found sands with rare northern material, i. e. a fluvioglacial of an older glaciation.

The finding of diluvial profiles with flora enables us to interpret the profiles in those cases where the interglacial series is developed in the form of sands or silts devoid of flora. To these belong the beautiful sections uncovered in Sulejów. Here on a surface of Juraic limes, showing intensive carst processes of a period before the older glaciation, we see two moraines separated by a series of sands and silts which are the equivalent of the interglacial formations in Olszewice. Aside from these several other more or less complete diluvial sections have been found: they coincide with the respective parts of the Olszewice profile.

The gray moraine clays from Olszewice, Bedlno and Sulejów, lying under the interglacial formations, represent the sediments of the glaciation which till the present day has been regarded the oldest. Lately the conception has been brought forth that there existed a still older glaciation. In accordance with it, the gray moraine clays would be the sediment of the second glaciation, while the ruddy clays lying on interglacial formations would represent the third glaciation.

2. J. Lilpop: The flora of the interglacial profile in Olszewice.

In the central part of the Olszewice profile, enclosed both from the top and the bottom by glacial formations, there is a strata of shales which passes upwards into a stratum of peat. Both these formations contain numerous remains of plants. Their analysis confirmed fully the interpretation of the above mentioned strata as interglacial formations.

In the lower part of the shales there appear again needles

of larches (*Larix* sp.) and pines (probably *Pinus montana*). In the upper part of the shales and the lower part of the peat we find a rather rich water and forest flora which gradually passes into a high peat bog with dwarf pine (*Pinus montana*) as the dominating tree. In the topmost layer the larch appears for a second time.

Typical plants of water flora are: *Brasenia purpurea* and numerous species of the genus *Potamogeton*. The middle part of the profile is made up chiefly of firs (*Abies alba*) further of elms, oaks, birches and willows. In this layer there appears *Tsuga aff. canadensis*, a tree which probably was a relict of the tertiary period as well as two species of spruces, which it has been impossible to determine till now, and *Brasenia*. The flora of the peat bog corresponds entirely to the flora of high peat bogs which are found in Poland at the foot of the mountains in Podhale.

Consequently we see a characteristic progression of floras, proving the climatic series from a cold climate through a climate similar to our present one (or perhaps a little warmer, as the presence of the pollen of broad-leaved lindens (*Tilia polyphyllus*) would indicate) to a return of the colder climate.

For stratigraphic reasons special attention should be paid to the following species:

*Brasenia purpurea*, a predominating species of interglacial periods.

*Pinus montana*, which represents the alpine element, and which could have come to the Olszewice peat bogs only at the time of the return of the cooler climate connected with the lower moraine of the profile under discussion.

The migration of *Pinus montana* on the plain started most probably in the Sudethians as they were the nearest mountain chain.

Next to the Olszewice profile there are two more interglacial outposts of *Pinus montana*.

In Unter-Glinde near Hamburg *Pinus montana* appears in the lower part of a group of strata containing a flora of a strikingly temperate climate. Consequently the outpost is undoubtedly a relict one.

In Lüneburg on the river Elbe we find *Pinus montana* in the profile whose lower parts have not been explored as yet. Since however it is difficult to suppose that it might have come here in a preglacial time — we must accept that both in Lüne-

burg and in Olszewice it was a relict of the foregoing glacial period. Consequently the profile in Lüneburg is an interglacial one.

The supposition based on the analogical situation of the two profiles in relation to the respective chain of moraines that it belongs to the same interglacial period as the profile in Olszewice is confirmed by the presence of tertiary species in Lüneburg, to which also belongs the now non-existent spruce (*Picea omoricoides*) and also the non-existent cranberry (*Vaccinium priscum*).

The third geographical element is represented in Olszewice by *Ledum palustre*, a shrub of Siberian origin, which to-day does not grow in the arctic tundra.

The same three geographical elements i. e. alpine, Siberian and Tertiary are represented, although in part through the medium of different species, also in the known diluvial flora of Ludwinów near Cracow.

In this way the comparison of geographical elements served as basis for comparing three distant profiles, although they are represented only in part by various species. The lack of eastern element in Lüneburg is a natural result of the distinctly western location of this place.

These three elements characterize, therefore, in Poland the vegetation of the interglacial period which followed the Cracovien glaciation (to use the nomenclature of prof. Szafer).

3. J. Premik: On the preglacial, glacial and interglacial formations in the area of Middle Warta, Widawka and Prosna.

The research conducted during the last few years on the diluvial formations in the Voivodship of Łódź have allowed us to differentiate the following:

Preglacial sediments. These are shaped into multicolored silts or jurassic débris, strongly cemented. The first are of lake origin, the second a disintegration sediment, which has undergone some slight shifting (Bieniec, Juljampol). The sands from the banks of Widawka belong also to preglacial sediments. Their top-parts are probably of fluvio-glacial formation, because we find in them northern material.

Glacial and interglacial formations. Here belong: the oldest moraine, preserved only in bits on the area of the district of Wieluń and Częstochowa. It is formed of local material with an admixture of northern material. This latter under-

went great disintegration. The interglacial and fluvio-glacial periods developed in the shape of silts, river muds and gravel sands (Wierzbie). The younger moraine is perfectly preserved in the basin of the river Warta. It is composed of several metres of gray argillaceous clays with crystalline boulders of northern origin. The younger interglacial and the fluvio-glacial sediments as regards its facies are of varied shapes, i. e. sands, river muds, silts striped with fauna and plant detritus and peats with very rich flora <sup>1)</sup> (Szczerców—Osjaków). The youngest moraine and the front moraines, excellently preserved or partially washed off, are found near Warta and Widawka. They are often divided and show the oscillations of the glacier. The fluvio-glacial and lake formations with fauna are connected with the youngest glaciation.

Similar or identical formations have been found by numerous Polish scientists on wide areas of Poland.

It follows from the above that the conditions of the formation of diluvial and preglacial sediments were similar on wide areas of Poland or differed very slightly from one another. From this the important conclusion may be drawn that the age of these formations can be determined more accurately. Consequently the stratigraphy of these sediments gains better foundations.

We stress that the area under discussion underwent three glaciations as testified by three moraines separated by two interglacials. The oldest moraine is preserved only in bits. This glaciation reached far to the south beyond our area — probably up to the Carpathians — as testified by facts proved by Szafer, near Jarosław in Małopolska. The second glaciation left numerous well preserved moraines which are identical with the lower moraines of Piotrków, Olszewice and Warsaw. It included also the areas lying far down to the South. The interglacial formations lying between the moraines of the second and the youngest glaciations are represented on the great area of Central Poland by various sediments, e. g. sands, peats and lake formations. These last formed several times on the area under discussion and beyond it. During the regression of the glacier of the second (the youngest) glaciation on the area of Widawka—Warta—Prosna—Pilica many lakes

<sup>1)</sup> Vide: page 405, Piech: The flora of the interglacial strata in the environs of Szczerców, Dzbanki Kościuszkowskie and some other places in the basin of the river Warta.

were formed, interconnected by narrow straits or separated from one another by low water divides. Consequently these lakes stood in close connection with the oscillations of the glacier and depended to a large degree from the morphological and tectonical depression existing here.

The last glaciation reached to the north areas of the Częstochowa district, where it left a few badly preserved front moraines. The division of these moraines proves the oscillations of the glacier of this period. This glaciation left numerous well preserved stadial moraines in the districts of Wieluń, Noworadomsko, Sieradz and Łask. On the area of the river Widawka there existed then a large glacial protuberance which at the time of the regression and the shrinking of the glacier remained here in the shape of a broken off block of dead ice.

On the edge of the regressing glacier, on the external side of the front moraines, there formed out of thawed waters and towering river waters lakes or channels of regressing waters. There existed also periglacial valleys on the line Warta (Załęcze Wielkie)—Prosna (Kowale—Praszka), further Olewin—Złoczew—Wieruszów.

Our observations made on the area under discussion certify that the contemporary geological shaping corresponds in a general way to the subglacial ones.

4. K. Piech: The flora of the interglacial strata in the environs of Szczerców, Dzbanki Kościuszkowskie and some other places in the basin of the river Warta.

Interglacial strata of the localities mentioned in the title showed in macroscopic and pollen analyses (v. Post method) the following picture of the changes in the flora of the interglacial period Masovien I. (= Elster-Saale Intergl. = Mindel-Riss Intergl.).

The silt and sand strata underlying the lake mud settled at a time when the surrounding hills were covered by pine — birch forests with an admixture of willows. (*Pinus-Betula-Salix*). This forest retreated before pine — oak forest with an admixture of *Ulmus* and *Acer*. At that time there lived in the waters of the lake *Ceratophyllum demersum* L., *Najas marina* L., *Nymphaeaceae*, *Typha*, and there began to appear *Brasenia Schröteri* Szaf. The pine-oak forest retreated before oak-linden forests in which *Quercus*, *Tilia platyphyllos* Scop. and *Tilia cordata* Mill. dominated and

*Acer tataricum* L., *Acer campestre* L., and *Ulmus* formed a rather considerable admixture. *Pinus* appears sporadically and the spruce (*Picea*) also began to appear. In the undergrowth of the forests there dominated *Corylus avellana* L. with an admixture of *Viburnum* and *Sorbus*. The lake flora shows an abundance of *Brasenia Schröteri* Szaf. *Ceratophyllum demersum* L., *Ceratophyllum submersum* L., *Najas marina* L., *Stratiotes aloides* L., *Trapa natans* L. var. *muzzanensis* Jäggi, *Nuphar luteum* L., *Aldrovanda vesiculosa* L., and others. Under this phase comes also the thermic optimum Masovien I.

In the following period *Carpinus betulus* L. and *Picea* dominate the forests. Intermixed with them are: *Tilia*, *Quercus*, *Acer campestre* L., *Ulmus*, *Betula* and *Pinus*. In the undergrowth there is a small number of *Corylus avellana* L. and *Sambucus nigra* L. In damp places the *Alnus* grows in great amount. At the end of this phase *Picea* predominates and *Abies* begins to appear.

During the following phase the foremost is *Abies* of which forests are created. *Picea* is considerably intermixed and *Carpinus*, *Tilia cordata* Mill., and *Quercus* appear singly. In this period a high peat bog with peat (*Sphagnum*) and *Ericaceae* is developed on the formerly lake. *Betula nana* L. appears on the peat bog and remains there until the peat bog is flooded by rising waters of the glacial transgression Varsovien I. (= Saale-Eiszeit = Riss). The *Abies* forests disappear to make way for pine forests. *Pinus* becomes the dominating tree for a long period. In these forests *Picea* is the intermixture and toward the end *Betula* also. In view of the fact that in the upper layers of laminated clay covering peat bog and underneath the Varsovien I. moraine, there is no tree pollen, it may be considered that the climate at the front of the glacier created a forestless area over a great region.

The lack of beech (*Fagus*) in described strata is worthy of consideration. The considerations in the matter of appearance of the beech in the interglacial Masovien I. lead to the conclusion that the low areas of Central Europe in contrast to the areas of France and Southern England on one side and the elevations of Southern Poland, as well as Central Russia on the other side, did not possess beech (*Fagus*) in the mentioned interglacial period.

### Discussion.

1. Professor Szafer discussed the matter of the names of Polish glaciations. According to his opinion it is proper to use Polish names for Polish glaciations, until such a time when it shall have been determined accurately to which glaciations described in other European countries correspond the Polish glaciations, both the northern ones on the plain and the mountain ones in the Polish Carpathians. The author refers to the fact that e. g. the German geologists do likewise, and that in the recent diluvial literature we find local names for the determination of glacial periods (Elster-Eiszeit, Saale-Eiszeit, Weichsel-Eiszeit). The same refers also to interglacial periods; for them too it is best to use Polish local names. Therefore the author proposed in his paper on „The outline of stratigraphy of the Polish Diluvium as based on floristic data“ (in German, V. Yearbook of the Polish Geological Society, Cracow, 1928) a series of names and he expects the geologists to take a positive stand as regards his positions (and not a negative one like J. Lewiński). He does not maintain that the names proposed by him should be accepted; on the contrary they may and even should be changed, if need arises. He quotes several names which might prove more suitable than the ones proposed by him in 1928.

In the second part of his paper he announces that in Hamernia near the river Lubaczówka (north of Jarosław) he has found in 1929, under the moraine of the greatest glaciation (Cracovian) fossil peat, of considerable thickness, lying on Cracovian silt of the Tertiary period. Macroscopic and microscopic analysis of the flora (pollen analysis) has shown, contrary to expectations, that in the slab-like peat in Hamernia and in the silt sand lying underneath on the silts of Krakowiec there is an excellently preserved series of the development of the flora, which at the bottom bears the character of a cold coniferous forest with larches as a dominating tree (the author compares this forest with the Siberian tajga) towards the top, it passes gradually into warmer forest flora with beeches, hornbeam and other deciduous trees. The author draws from this fact the conclusion that the diluvial peats in Hamernia point distinctly to the existence in the Polish plain of one more glaciation older than Cracovian, because they possess a series of flora of a distinctly interglacial character.

This glaciation whose existence had been already suspected



by some observations of J. Lewiński, J. Czarnocki, Kuhl, and others, has become now an actual problem of the Polish diluvial study. The author expresses the hope that in 1930, this problem will be solved by the common effort of Polish geologists, geographers and botanists.

The author has no doubts as to accepting the existence of one more glaciation (the fourth) on the Polish plain, older than Cracovian and consequently he proposes that temporarily this glaciation be called Jaroslavien, and the interglacial period between Jaroslavien and Cracovien be called Sandomirien.

2. Professor Jan Nowak. For several years I have been reaching the conclusion, that the problem of the parallization of the Polish diluvium with the diluvia of the neighbouring countries should be treated separately from the detailed stratigraphy of the diluvial period in Poland. Otherwise we arrive at the fact that simultaneously the greatest Polish glaciation is classified by Lewiński under „Mindel“, and by Polański under „Riss“ although there is no doubt that in both cases the same glaciation is discussed. For these reasons Danish geologists determine their diluvium with letters of the alphabet, the German geologists give local names, etc. Stratigraphy should be built up on the basis of local conditions and parallization made when the data of the various countries shall have been gathered in sufficient numbers. Consequently the division of Prof. Szafer (1928) who took into consideration only positive data and included the whole area of Poland ought to be followed more widely. Also, as the data grows larger this division should be extended. This will facilitate parallization in the future, since at present both in Poland and abroad the necessary materials are still missing.

Polish geologists working on the diluvium must needs take up the problem of purely glacial formations (moraines) and work out a statistical method which together with the method of isorhythmic lines shall enable us to understand the mechanism and the phases of the movements of the glacier on the area of Poland. After this work will have been accomplished it will be possible to adjust certain hazy details in the interpretation of interglacial periods. I am certain that the government will not refuse financial support for a speedy fulfillment of this pressing scientific research.