HISTORY OF LAKES ON THE YOUNG-GLACIAL AREAS OF THE NORTH-EASTERN POLAND

Jadwiga STASIAK

Warsaw University, Chair for Physic Geography, Poland

SUMMARY

Areas covered by the last glacier are rich in lakes which were established by melting of blocks of dead, buried ice. The lake age depends upon the thickness of the material covering the ice. The majority of lakes began to appear already in Alleröd as a shallow, extensive flood waters. In Holocene (Preboreal and Boreal period) there occurred the further formation and deepening of lakes under the influence of ice melting. Some lakes on sandre areas where the thickness of sandre material is considerable, appear only in climatic optimum. There is known, too, the successive appearance of great basins as Wigry lake, for example. In Holocene, there occurred considerable fluctuations of the ground water table resulting from climatic variations. The aforesaid fluctua tions caused the decay of a great number of smaller basins.

RÉSUMÉ

L'histoire des lacs de la région englobée par la dernière glaciation (Pologne du Nord-Est)

Les régions englobées par la dernière glaciation sont riches en lacs qui se sont constitués par la fonte des masses de la glace morte, fossile. L'âge des lacs dépend de l'épaisseur des couches couvrant la glace. La plupart de ces lacs datent de l'Alleröd. Ils apparaissent dans cette période en tant que crues peu profondes et étendues.

La formation et l'approfondissement des lacs se poursuivirent pendant l'Holocène (période préboréale et boréale) résultant de la fonte des glaces. Quelques-uns situés dans les régions des sandres où l'épaisseur des sandres a été considérable apparaissent seulement pendant le maximum climatique. On connaît aussi l'apparition successive de grands bassins (par ex. le lac de Wigry). La même période a vu des changements considérables du niveau de l'eau déterminés par les changements du climat qui ont causé l'extinction de beaucoup de petits bassins.

NE Poland lies within the range of the Baltic (Würm) Glaciation and these regions contain an abundance of lakes; moreover, traces of vanished lake basins are common.

These vanished lakes should be divided into two groups, the older dating back from the glacier recession and the younger are of Holocene age which, depending on size, disappeared during various stages of the Holocene, turning into peat bogs.

The oldest lake basins dating back to glacier decay, occurred fairly commonly, leaving behind deposits of clay, often of considerable thickness (12 m at Harsz). With glacier decay these basins ran dry and their deposits, mainly stratified clay beds, are found at present at different levels; with ranges from several metres above today's water level to depths often below the bottom of present-day lakes.

So far it has not been possible to establish, whether lakes dating back to the glacier recession have continued to exist until today. It is true that clayey deposits with a mollusc fauna, which are known from the village Bezławki, described by K. Swierczyński ([9]), may have originated in the Bölling; however, this basin existed for a short time only. Therefore, in the area discussed there may have existed a phase devoid of lakes, taking in the Lower Dryas, the Bölling, the Middle Dryas and the beginning of the Alleröd.

Examinations, both palynological and by the C-14 radio-carbon method (*) indicate that lakesexisting today in the area of the Baltic Glaciation came into existence in the second half of the Alleröd due to melting of big blocks of ice. Lakes that developed

(*) C-14 radio carbon examinations were made in Hannover ([6]), and in Gdańsk ([11]).

in the early Alleröd like Lake Mikołajskie [Więckowski 1966 ([11])] and Lake Wagiel [Stasiak 1963 ([6])], show in their bottom strata peat layers underlying the lacustrine deposits. It seems reasonable to assume, that initially ice melting proceeded very slowly, favouring the formation of the peats which today line the basins of some of the lakes. On top of these peats, calcareous deposits were laid down in the second half of the Alleröd.

In the light of the investigations made, the decline of the Alleröd proves to have been particularly favourable for the development of lakes. Lakes existing earlier, like Lake Kruklin ([6]) increased in size, and new lakes like Lake Mamry came into existence ([8]). While palynological examinations made so far show, that the majority of lakes appeared in the Alleröd, there are known lake basins that developed later, some even as late as during the climatic optimum. To the youngest among the lakes so far investigated belong those found in outwash areas, where the outwash sheet is thick. Observations made as to the age of lakes developed on outwashes, as well as the thickness of the outwash cover near the lakes indicate, that an interrelation exists between the age of a lake and the thickness of the outwash sheet found in its vicinity.

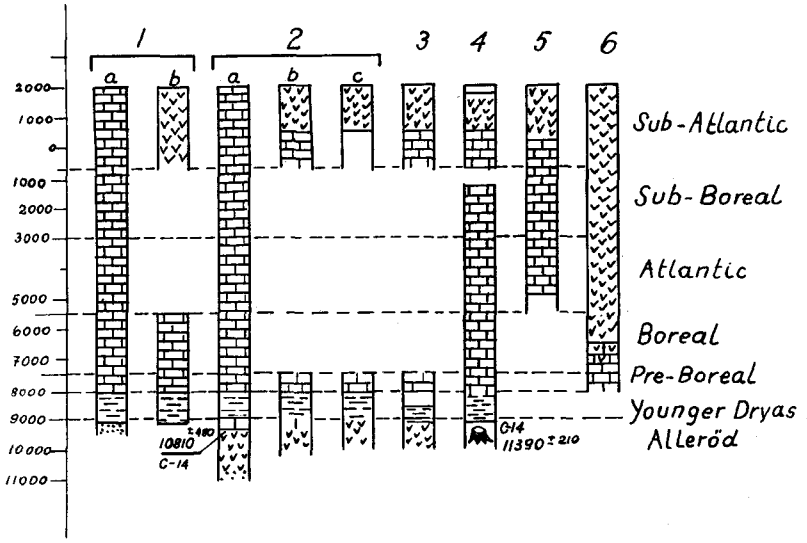
In the northern part of the Pisa outwash, where the thickness of the fluvioglacial deposits is about 30 m [Bogacki 1965 ([1])], Lakes Jegocin and Kaczarajno did not come into existence until the climatic optimum ([8]).

In the case of larger lake basins—taking as an example Lake Wigry which consists of a number of basins situated in the north-eastern part of the area discussed—it was found that they developed successively. Oldest, already existing in the Alleröd, is the north-eastern part; the southern part, adjoining an extensive outwash, came into existence much later, that is, in the middle Pre-Boreal.

Palynological examinations of lacustrine deposits, carried out during recent years [Stasiak 1966 ([7]) and ([8])], throw much light on the origin and the evolution of the lakes of NE Poland. By means of the excellent core sounding sampler equipment devised by K. Więckowski ([10]), undistrubed samples of bottom deposits can be extracted from even the deepest lake basins. It was most interesting to discover, that bottom deposits from central lake parts and bottom strata at the lake shore are of identical age. Examinations of such deposits from the central part, usually the deepest of the lake, and of shore deposits were made at Lake Mamry ([8]) and at Lake Mikołajskie, by Więckowski ([11]), for the central deposits, and by the author for the shore deposits ([8]). For Lake Mamry, the bottom deposits from both the central part of the lake and from the shore have been dated from the decline of the Alleröd. In Lake Mikołajskie, as mentioned before, the peats found on the lake bottom are from the early Alleröd. These peats occur at the bottom of the central part of the lake and in its shore part, but at the shore they are less thick. In the lakes developed in the Alleröd, late-glacial deposits line the entire lake basin, appearing very high in the shore zone, at times above today's water level. These observations reveal, that these lakes came into existence due to melting of buried ice, and that in their initial phase they constituted extensive shallow sheets of water, situated high, with surfaces much exceeding those of today's lakes. Both the formation and the deepening of these lakes must be ascribed to melting of buried ice masses, and this process brought about a decrease in the surface areas of these lakes.

The comparison of palynologically examined profiles from the central and the shore parts of the lake basins, diagrammatically shown in Figure 1 (a full documentation is given in a paper by J. Stasiak ([8]) now in print) shows in the shore profiles the absence of a number of climatic periods. Borings were made on the vanished lake shores, at short distance from the water. As illustrated in the attached diagram (Fig. 1), the shore deposits of Lake Mamry are absent of deposits of Atlantic and Sub-Boreal age. In the profiles of shore deposits of Lake Mikołajskie, are lacking the Boreal, the Atlantic and the Sub-Boreal deposits, identically as in the shore profile of Lake Tałty. On the

other hand, in borings at today's shore of Lake Kruklin, almost the full profile with all climatic periods was discovered, much like in profiles from the central part of the lake basins; however, some 100 years ago, in Lake Kruklin the water level has been deliberately lowered more than 6 m. Thus, our bore hole sunk at the shore of this lowered water surface is equivalent to a drilling far within the lake, and this is the reason why it revealed a full profile.



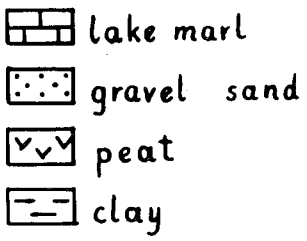


Fig. 1 — Schematic profiles of the examined lakes.
1. Lake Mamry: *a*) central part; *b*) marginal zone.
2. Lake Mikołajskie: *a*) central part; *b*) and *c*) marginal zone.
3. Lake Tałty — marginal zone.
4. Lake Kruklin.
5. Lake Jegocin.
6. Peat Karaska.

The absence of certain climatic periods in the deposits of the littoral zone must be ascribed to changes suffered by the lake surface during various periods, caused by either processes of ice melting, or by climatic oscillations.

Figure 2 illustrates the evolution of the oldest lakes of the Masurian Lake District, based on palynological examinations of profiles of their shore deposits. In the Alleröd, the Upper Dryas and the beginning of the Pre-Boreal, these lakes were of wide extent and shallow; their surfaces reached farther than today. In the Boreal these lake surfaces grew smaller. During the climatic optimum, the lakes were again larger than during the Boreal, but smaller in area than they are today. A similar decrease in size is observed in the Sub-Boreal. In the Sub-Atlantic period the lake surface grew distinctly larger; still, considering the area occupied by the lake basins, this area was smaller than at the decline of the Alleröd.

In the littoral zone, usually Sub-Atlantic deposits are found overlying the late-glacial and early-Holocene deposits. The rise of the water level in the lakes during the Sub-Atlantic is most probably due to the climate turning more humid, and to the fact, that during their life the lake basins were filling up with deposits. A comparison of the water volume of the lakes during the Atlantic and Sub-Atlantic period might show but minor differences because, during Atlantic period the lakes had smaller surfaces than today but were much deeper.

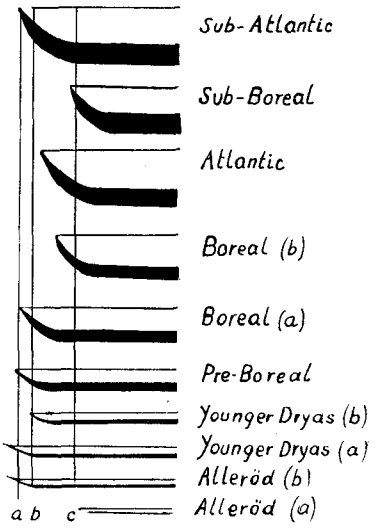


Fig. 2 — Formation and evolution of lakes in the Masurian Lake District.
a, *b*, *c* - Supposed positions of lake examined profiles: *a*) Lake Mikołajskie and Tałty; *b*) Lake Mamry; *c*) Lake Kruklin.

It seems, that particularly suitable for studies of oscillations in the water level are examinations of the littoral zones of the lakes. They are usually of moderate thickness and very accurately recording all oscillations of the water level which, in turn, picture the successive changes suffered by the water surface of a given lake.

The lakes, found in the young-glacial area under discussion, developed in a similar way as described above, that is, due to melting of large blocks of buried ice; these lakes also resemble each other in the type of their deposits. During the Alleröd, a calcareous gyttia layer, rather sandy in the littoral zone, was laid down in the lake basins on top of peat or gravel sheets. From the Upper Dryas one finds deposits of mainly eolian character, consisting of quartz with an admixture of illite (7). With the Holocene setting in, there developed calcareous deposits, usually more calciferous in the littoral zone, in the lakes of the area under discussion.

The disappearance of the Holocene lakes in this region began with the Boreal. Deciding factors in this disappearance of lakes and their conversion into peats were, in the first place, their size and depth. Minor and shallower lake basins changed during the Holocene into peat bogs, while larger and deeper basins remained lakes until today. Field observations indicate, that some 50% of the lakes of NE Poland have turned into peat since the beginning of the Holocene .

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