ACTA PALAEOBOTANICA
27 (1): 27—41, 1987

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LATE-GLACIAL LACUSTRINE SEDIMENTS FROM ROZTOKI AND TARNOWIEC NEAR JASŁO (JASŁO—SANOK DEPRESSION)

Późnoglacjalne osady jeziorne z Roztok i Tarnowca koło Jasła (Doły Jasielsko-Sanockie)

ABSTRACT. Sedimentation of the lacustrine deposits consisting of silts, chalks and peats begun in the studied profiles at Roztoki and Tarnowiec from the Older Dryas. The lacustrine deposits occurring at Roztoki allowed to date evolution of the Jasiołka valley in the Late Glacial and Holocene. Deepening of the valleys in the period of early late glacial and changes of the river character from braided to meandering one were caused by disappearance of permafrost as well as by diminishing of the fubble supply to the channel. Origin of the hollows without outlet in the smaller valleys has been explained by the degradation of permafrost. At Roztoki, development of the peat bog was interrupted by clay accumulation at the beginning of the Atlantic period. At Tarnowiec, however organic accumulation terminated about 2000 years B. P. which may be linked with development of settlement in this area.

INTRODUCTION

In the Jasiołka valley between Jasło and Roztoki the lacustrine sediments occur under the cover of alluvial loams forming a terrace 4—5 m high. In the Carpathians, except for the Jasiołka valley, the lacustrine deposits have been found in the Wisłok valley near Besko (Koperowa 1970) and in the San valley near Dubiecko (Mamakowa 1962). Apart from the bottoms of the bigger valleys the lacustrine chalks occur only in the area of Jasło—Sanok Depression, filling the ancient hollows without outflow (Gerlach et al. 1972).

The profile of sediments from Roztoki first described by Szafer & Jaroń (1935) and then by Szafer (1948) and Klimaszewski (1948) was one of most important for the stratigraphy of the Carpathians valleys. Szafer & Jaroń (1935) basing on the paleobotanic studies connected the base of the sediments with the decline of last interglacial, overlying chalk with the Last Glacial and peats, clays and loams with the Holocene. In this later opinion Szafer (1948) estimated the age of sediments exclusively at the decline of the late glacial and Holocene. Phyllum *Mollusca* occuring in these deposits were described by

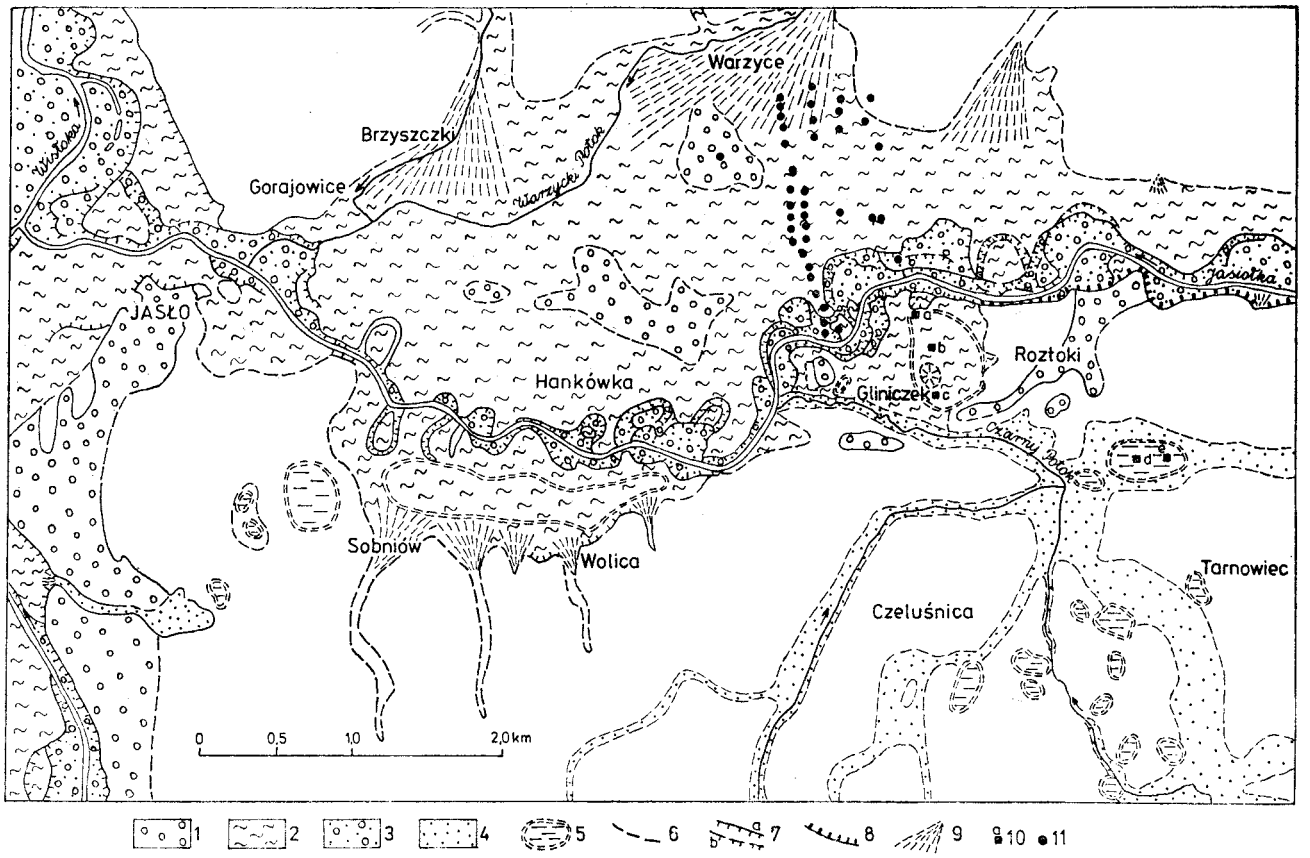

Fig. 1. Map of the Quaternary formations between Roztoki and Jasło: 1 — alluvial deposits of terraces high 7—15 m (Pleistocene), 2 — alluvial deposits of terraces high 4—5 m (Holocene), 3 — alluvial deposits of flood terraces high 1—3.5 m (Holocene), 4 — accumulation of small valleys bottom, 5 — peats and lacustrine chalks of dischargeless hollows and limits of the lacustrine chalks in Jasiołka valley, 6 — break between the valley bottom and slope, 7 — scarps of river terraces: a — intact, b — degraded, 8 — undercut slope, 9 — alluvial fans, 10 — place of pits, 11 — place of selected boring

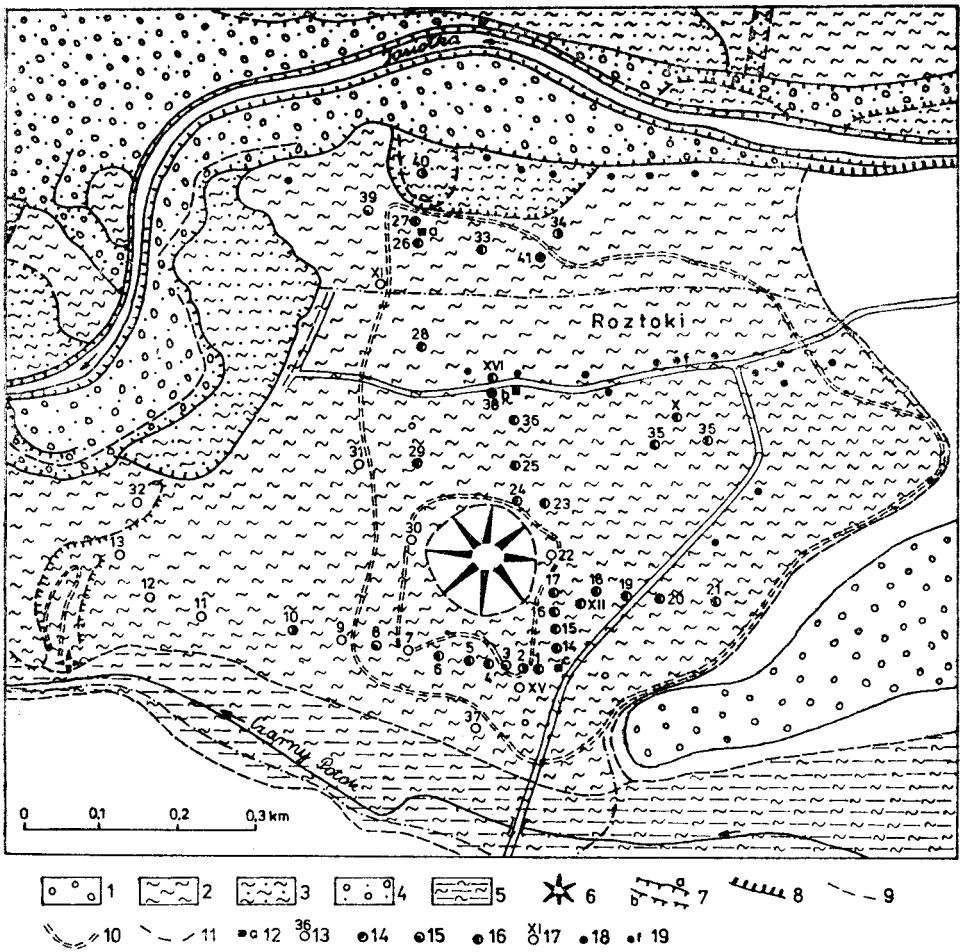

Fig. 2. Map of location of research points in the vicinity of Roztoki: 1 — alluvial deposits of terraces high 7—9 m (Pleistocene), 2 — alluvial deposits of terraces high 4—5 m, 3 — alluvial deposit of terraces high 2—3.5 m, 4 — alluvial deposits of flood terraces high 1—2 m, 5 — accumulations of small valleys bottom, 6 — cut-off meander spur, 7 — scarps of river terraces: a — intact, b — degraded, 8 — undercut slope, 9 — break between the valley bottom and slope, 10 — limits of the lacustrine chalk, 11 — limits of the Pleistocene lake after Klimaszewski (1948), 12 — place and number of pits, 13 — place and number of boring, 14 — borings in which lacustrine chalk occurred, 15 — borings in which peat occured, 16 — borings in which the flysch or river deposits occured, 17 — place of number of boring by Klimaszewski (1948), 18 — farm's well, 19 — farm's well which th samples for malacofaunistic determinations were taken

Urbański (in Szafer 1948) and algae of the genus *Ulothrix* and *Chara* by Wołoszyńska (1938). Klimaszewski (1948) reconstructed the extent of the lake and configuration of its bottom. He related the origin of the lake to the closure of the Jasiołka valley by alluvial fan of the Wisłoka during the last glacial after deposition of the bottoms sands and clays. This caused water damming and origin of the lake between Jasło and Roztoki. Sedimentation of

the lacustrine chalk in the valley bottoms was supposed to be due to the river flow to Wisłok through Moderówka and Bajdy during the last glacial (Klimaszewski 1948). According to Klimaszewski (1948) in the Holocene the lake sediments together with overlying peats and clays were cut and new gravel sandy alluvial fill of Jasiołka was formed.

Late in the seventies new investigations started. The results indicate that the position of lacustrine sediments as well as the origin of the lake are much more complicated (Alexandrowicz 1981, Alexandrowicz et al. 1985, Wójcik 1981). Apart from the Jasiołka valley, south and east of it, many ancient hollows without outflow filled with lacustrine chalk and peat have been also found. They were best recognized in Tarnowiec.

POSITION OF FOSSIL LACUSTRINE SEDIMENTS AT ROZTOKI

The sediments with lacustrine chalk at Roztoki are situated in the Jasiołka valley at immediate prolongation of the anticlinal hummock of Roztoki. They occur in the place where the Jasiołka valley in its segment running in E-W direction widens considerable. Downstream of the gap at Brzezówka the valley is 0.5—0.75 km wide whereas at Roztoki it broadens to about 3 km, forming a small basin. Westwards near Jasło its width decreases to 0.4 km. The Quaternary valley fill is to 8 m thick. Low resistant Krosno Beds appear in the Jasiołka channel continuously up of Roztoki while down stream they are very rare. The bottom of the valley is occupied mainly by the flat terrace 4—5 m high, overlain by fans of tributaries raising gradually up to 6—7 m (Fig. 1). Fragments of the lower terraces 1—3.5 m high occur with traces of paleomeanders. Single hills and "nodosities" covered in places by thin gravel mantle ris. above surface of the main terrace. A single meander hill 4 m high occurs at Roztoki (Figs 1, 2). In the midst of the last one narrow zone with lacustrine chalk and peat as well as two longitudinal "nodosities" 2—3 m high have been found. In the area of Hańkówka above the surface of this terrace there are "nodosities" with the cover of loams and river gravels being erosion remnants of the older terrace levels. That terrace 6—10 m high probably older than the last cold stage occur over the valley bottom at Roztoki and Jasło. The river gravels overly the rock socle 5—7 m high.

CHARACTERISTICS OF SEDIMENTS OF FOSSIL LAKE BASIN AT ROZTOKI

Borings, trenches and test pits (Fig. 2) allowed to recognize the extent and thickness of the sediments as well as their facial differentiation (Fig. 2) Pit "a" was dug about 0.4 km north of the meander hill (Fig. 2). The following sediments have been found in it (from the top down: depth in metres):

0—2.50 brown-yellow clayey loams passing into yellow-grey ones

2.50—3.55 grey-green clayey-sandy loams, with fine gravels 2—5 cm in diameter
3.55—4.15 green-grey clays with numerous vivianite concretions
4.15—4.35 brown clayey loams
4.35—4.60 grey-clay, bedded with dark brown peat with single woods
4.60—5.20 brown-black compact peat: at the bottom dated by ^{14}C method at 9920±100 B. P.
5.20—5.48 white chalk with peat at the top
5.48—5.63 lacustrine chalk laminated with peat every 1—3 mm
5.63—5.68 brown peat with lacustrine chalk
5.68—5.72 grey lacustrine chalk
5.72—5.75 brown peat: dated at 11740±150 B. P.
5.75—5.77 white lacustrine chalk
5.77—5.95 grey peaty calcareous silts slightly sandy containing abundant shells of moluscs and snails

Second small shaft "b" was made about 0.2 km north of the meander hill probably in the central part of the ancient lake. It was situated near the road and school at Roztoki. The profile is as follows:

0—2.70 yellow and yellow-grey clayey loams
2.70—3.33 grey and grey-green clays with preserved in upright position remains of plants
3.33—3.55 brown peaty clays horizontally bedded gradually passing into peat
3.55—3.90 brown-black peat strongly compressed: from its bottom dating by ^{14}C method was made (Fig. 3-b)
3.90—5.30 white and white-grey lacustrine chalk: transition between overlying peat and lacustrine chalk is sharp; in this complex it was possible to distinguished: 5 cm of grey lacustrine chalk with peat; about 50 cm thick layer of white-grey lacustrine chalk next 30 cm layer of white lacustrine chalk with yellow tinge and 25 cm layer of white lacustrine chalk with pinktinge; layer of white lacustrine chalk with the great amount of organic elements occured at the bottom
5.30—5.40 grey calcareous peaty silts
5.40—5.60 grey sandy silts

Below the depth of 5.60 m grey, clayey sands have been found. In the boring drilled in the nearest location of the above described pit the substratum was reached at the depth of 7 m.

The third pit "c" has been dug in the southern part of the ancient lake, about 0.17 km south of the top of the meander hill (Fig. 2, 3-c). The profile is as follows:

0—1.95 yellow and yellow, grey clayey loams
1.95—2.23 grey-green clays with fragments of plants
2.23—2.41 grey-black and black clays horizontally bedded passing down into black clay

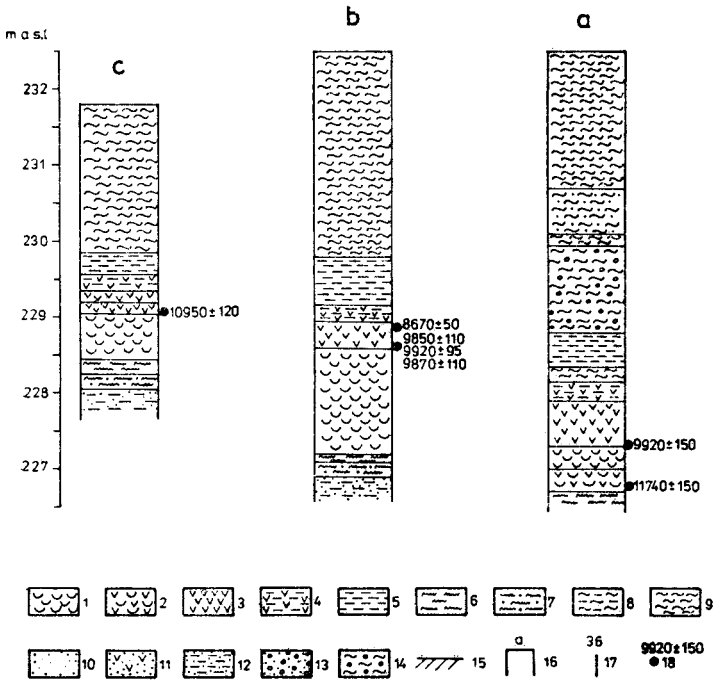

Fig. 3. Lithologic profiles of pits a—c in cross-section of valley: 1 — lacustrine chalk, 2 — peat with lacustrine chalk, 3 — peat, 4 — clayey peat or clay with peat, 5 — clay, 6 — silt (detrital calcerous gyttja) and organic silt, 7 — coarse silt, 8 — clayey loam, 9 — loams, 10 — sand, 11 — sand of organic origin, 12 — sandy clay or clayey sand, 13 — gravel with sand and loam, 14 — gravely loams, 15 — Pre-Quaternary substratum, 16 — pits, holes, 17 — borings, 18 — localities of sampling and cutcomes of ^{14}C datings

2.41—2.46 brown clays
2.46—2.53 black peats
2.53—2.57 peaty clay brown-grey in colour horizontally laminated
2.57—2.70 black peat strongly compressed; bottom of the peat is not flat and its local relief amounts to 5—10 cm; a date of 10950±120 B. P. was assigned to its bottom
2.70—3.30 lacustrine chalk; passage between overlying peat and chalk is sharp; at the top there was 5 cm thick layer of dark grey lake chalk with brown peat; below about 30 cm layer of white-grey lake chalk with lenses of plant detritus and next there was white-grey lake chalk with pink tinge; at the bottom, layer of white-grey lacustrine chalk with plenty of organic remains occured
3.30—3.50 grey sandy silts with single pieces of wood
3.50—3.70 grey and dark-grey sandy silts

Below this depth there were clayey sands. The bedrock formed of the Krosno Beds was found at the depth of 6.25 (Szafer & Jaroń 1935).

Basing on the profiles obtained from the trenches, pits and borings it was possible to determine that the occurrence of lacustrine chalk and peats is limited to the nearest surroundings of the meander hill at Roztoki (Fig. 2). Only its occurrence of the western side is problematic.

The deposits of lacustrine chalk occurring in the area of Roztoki have much smaller extent than it was previously presumed by Klimaszewski (1948). South of the pit "c" both the lacustrine chalk and peat gradually pinch out. It can be seen on the cross-section (Fig. 4) that to the west the lacustrine chalk and peats fill narrow, asymmetric, erosion channel incised in the Krosno Beds,

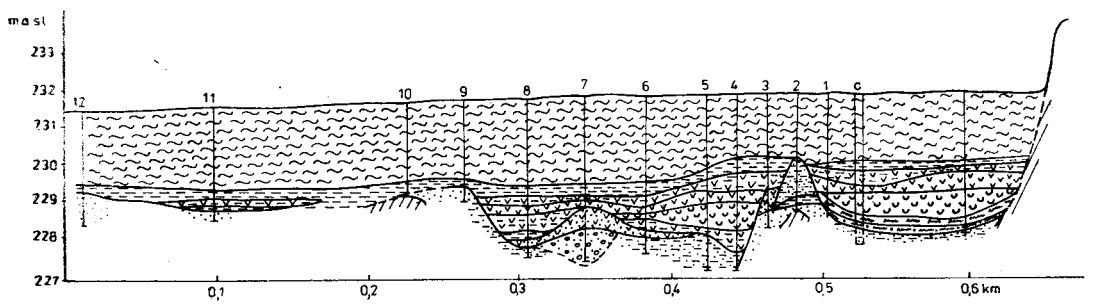

Fig. 4. Geological section through southern part of the fossil lake basin of Roztoki. Explanations as in Fig. 3

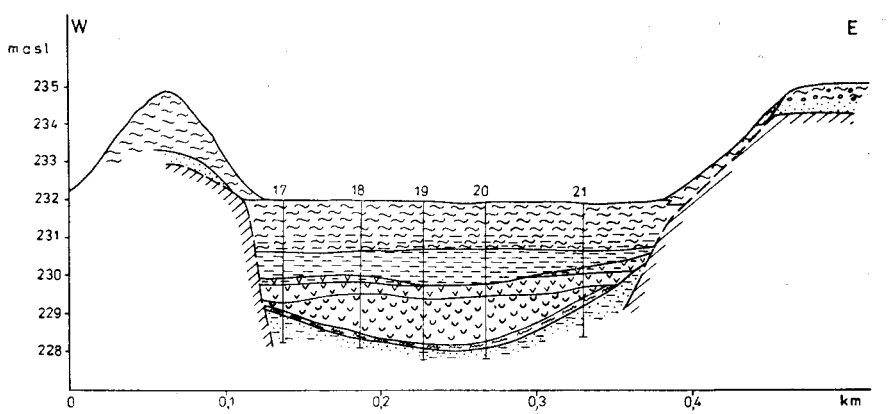

Fig. 5. Geological section through central part of the fossil lake basin of Roztoki. Explanations as in Fig. 3

clayey sands and in the gravels. The extent of the peat is bigger than of lacustrine chalk. West of the meander hill in the direction of Gliniczek in the borings drilled in a few points the flysch deposits have been found under the layer of loams, sands and clays 2—3 m thick. There was lack of chalk and peats.

East of both pit "c" and meander hill the lacustrine chalk fills wide erosion form, 120—220 m wide (Figs. 4, 5). The top of the chalk and the peat layer are

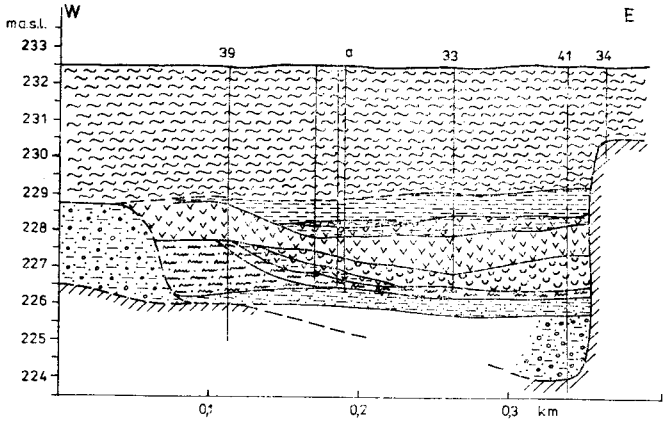

Fig. 6. Geological section through northern part of the fossil lake basin of Roztoki. Explanations as in Fig. 3

on the same level. This is an evidence to uniform filling of the erosion form followed by the peat cover.

Northwards the extent of chalk ends in the area of terrace edge. On the base of the profiles of wells made in this area it is found that quite often the bottom of the gravels occurs higher than the top of both chalk and overlying peats (Fig. 7). West of the small shaft "a" the lacustrine chalk pinches out quickly and the thickness of overlying peat layer increases to 1 m (Fig. 6).

From the cross section made on the base of borings and small shafts (Fig. 7) it is evident that top of the lake chalk and the covering peats sink northward. Simultaneously with the top sinking the bottom of chalk comes down and its

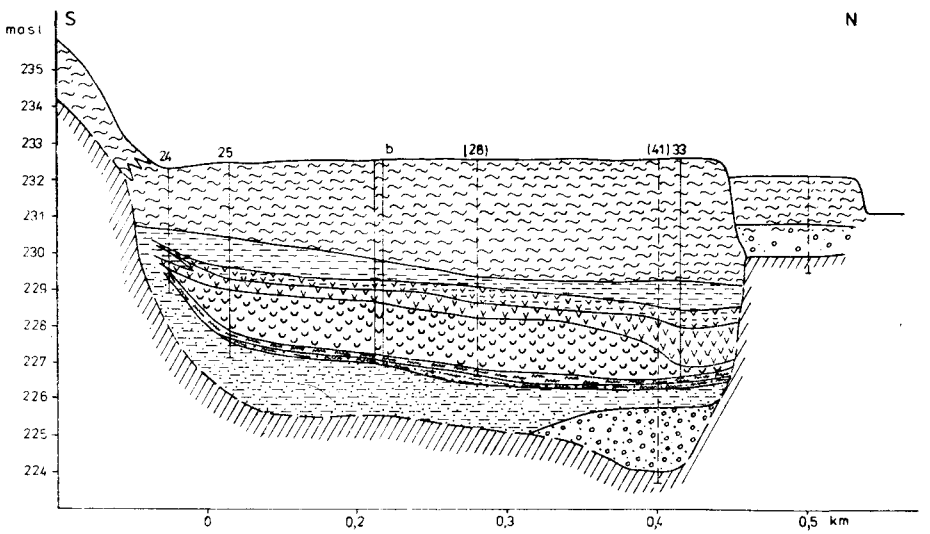

Fig. 7. Geological cross-section through lacustrine deposits of Roztoki. Explanations as in Fig. 3

thickness increases (Fig. 7). Regular and slight lowering of the chalk top takes place up to the line pit "b" — boring No. 28 (Fig. 7). Similar observation bears on overlying peat layer. In the northern part of the ancient lake basin the top of the lacustrine deposits lowers considerable with simultaneous decreasing of their thickness (Fig. 7).

Comparing the profiles of small shafts on the cross section (Fig. 3) one can notice that in the pits "c" and "b" the top of lacustrine chalk occurs almost on the same level while its thickness in the "b" one increases more than twice. Overlying peats and clays have similar thickness in both diggings. In the pit "a" the chalk top lies 0.7 m below its bottom in the "c" one and 1.3 m further down than its top in the pit "b" (Fig. 3). One can wonder why the lacustrine chalk has such low position in both the pit "a" and profiles of the borings drilled in this part of the ancient lake basin. If the lake underwent gradual filling up, shallowing and overgrowing then in its deepest parts the thickness of lake chalk should have been the greatest and the chalk top should have occurred higher in the small shaft "a". Presumably considerable shallowing or even flowing out of the lake took place and probably some parts of the lacustrine deposits were eroded.

Assuming that the sedimentation of lacustrine chalk started at the same time about 11800 years B. P. and knowing the date of its termination, the rate of accumulation has been calculated. For the "b" and "c" pits similar values have been obtained 0.7 mm/year while in the "a" one it is twice as smaller 0.3 mm/year. It could indicate possible erosion of the chalk top.

ORIGIN OF THE LAKE AT ROZTOKI

Present studies have given a lot of new data comparing with Klimaszewski (1948). The occurrence of lacustrine chalk at Roztoki is restricted to the nearest surroundings of the meander hill. Also at Gliniczek similar hill is enclosed with separate buried lake basin filled with lacustrine chalk (Fig. 2). Next ancient reservior with lacustrine chalk occupying large area occurs in the Jasiołka valley between Wolica and Sobniów (Fig. 1). It can be assumed that in the Late Glacial of the last ice age between Roztoki and Jasło there were formed few water basins, being incised within river covers and flysch sediments. In these lake basins lacustrine chalks were deposited. In the longitudinal profile of the river they do not form the same accumulation level. At Roztoki the top of lacustrine chalk lies at the height of 226.6—227.3 m over sea level, at Sobniów at 226—226.4 m while present-day outlet of Jasiołka to Wisłok is situated at the height of 220.5 m i.e. about 8 m lower than the chalk top at Roztoki.

To accept Klimaszewski hypothesis (1948) for an origin of the lake at Roztoki blocked at Jasło by alluvial fan of Wisłoka it would be necessary to assume that the Jasiołka valley in the late glacial period would have been

covered up to the height of 229 m a.s.l. However there is no evidence for such high accumulation in the last glaciation.

Results of the present author investigations contradict also possibility of the Jasiołka flow to Wisłok in the period of last glaciation. Such flow might take place but much earlier because the gravels at Moderówka form the terrace 15 m high above the present-day Jasiołka channel. The only place where such flow would have been possible is the depression in the area of Potok between Jedlicze and Ustrobna but it could exist in the early period of last glaciation. The river gravels occuring on the watershed of Jasiołka and Wisłok are covered by 10—12 m thick series of loams. Therefore, in can be assumed that at the time of the lake existence Jasiołka flew to Wisłoka in the area of Jasło.

The lake deposits occurring at Roztoki fill up an erosion form incised in the flysch sediments and alluvia. Its origin can not be unequivocally stated at the present stage of investigations.

Occurrence in the surroundings of the meander hill of both the channel with chalk and peat and of distinct erosion forms of the river beds west of mentioned hill incised in the flysch, river sands and gravels (Fig. 4) could be connected with Jasiołka lateral shift of channel. In similar situation in the San valley near Dubiecko the lacustrine chalks and peats fill quite wide of paleomeander surrounding meander mountain (Starkel 1960, Mamakowa 1962). At that time the river changed its character from braided to meandering beginning with cutting wide meanders and undercutting the slopes. After forming the erosional plain with meander hill the river had to throw its bed northwards of present one. It could not be excluded that disappearance of permafrost in the late glacial period and thawing of ground ice might also help in extension of depression in which the lake originated.

HISTORY OF LAKE AND DEVELOPMENT OF THE JASIOŁKA VALLEY IN ROZTOKI AREA

Designation of age of the deposits from Roztoki has a great importance for the recognation of progress of erosion and accumulation processes in the valley bottoms on the area of the Jasło—Sanok Depression during Late Glacial and the Holocene. A picture of different age cuttings and covers put into them in the cross-section of the valley can be seen on the section constructed on the base of the boreholes. During pleniglacial period the accumulation plain was formed. Between Roztoki and Warzyce its surface was at 231—232 m a.s.l. On its surface there are wide and shallow depressions filled up with sands, silts, clays and peats indicating the existance of the channels of braided type.

Probably as early as before the phase of Oldest Dryas or by the beginning of the Bølling interphase dissection of the valley took place and the river most likely together with deepening of its channel change the character from braided to meandering one. In the Warta valley such change happened at the boundary

of the Oldest Dryas and Bølling (Kozarski 1983). Dissection of alluvia is probably connected with the decline of permafrost as well as with diminishing of both the hill-side processes and supply of debris to the channel (Starkel 1977). The river incised than up ca 3—4 m to the depth of 226—225 m a.s.l., and formed erosional plain by the lateral shifting of meandering channel. The gravels pierced in the boring 41 at Roztoki and occurring down to the depth of 224 m a.s.l. may be connected with valley deepening in the Eemian interglacial (Klimaszewski 1948) as well as with the Bølling interphase.

After incision of the channel at Roztoki area the Jasiołka river had to throw its bed northwards in the direction of Warzyce where the alluvial cover 8 m thick has been found in the borings. Their channel has been probably separated by levee from the Roztoki depression, where the lake could be formed. It happened probably at the time of deposition of the clayey sands and silts in the area of Roztoki. Accumulation of the lacustrine deposits have begun from the Older Dryas, commencing at Roztoki with sedimentation of silts with the great amount of organic elements (gyttja). A date of 11740 $\pm$150 years B. P. is assigned to the beginning of this accumulation in the pit "a" (Fig. 3).

Since that time until the Holocene in the lake basin lacustrine chalks were deposited. The peats encroached on lacustrine chalk at the marginal parts of reservoir as a result of its filling. In the southern margin an organic accumulation started already at the beginning of the Younger Dryas about 10950 $\pm$120 years B. P. (Fig. 3) and probably the reservoir got filled by lacustrine chalk upon which plants gradually developed from the margin to the centre of the lake. At the beginning of Holocene the lake was the subject of flowing down — water level lowered and probably in the northern section some part of the lacustrine chalk deposits was eroded. In the both pits "a" and "b" an organic accumulation begun at the same time as it results from the dating of the peat bottom (Fig. 3).

Since the beginning of the Holocene in the region of Roztoki occurred accumulation of the peats from several cm up to 1 m. In the area of Roztoki during deposition of chalk and peat it was closed reservoir without discharging into it flood waters of both Jasiołka and Czarny Potok its left side tributary, for there is no traces of the flood accumulation in the profiles of the lacustrine chalks and peat.

Development of the peat bog was disrupted by the accumulation of clays and next of alluvial loams. The age assignement of the peat, about 10 cm down from its top in the small shaft "b" where the first significant traces of mineral parts have been found, gave date of 8650 $\pm$50 years B. P. It locates the beginning of swellings in the Boreal. The peat bog was buried already in the Atlantic period which could be connected with the increased flood frequency (Starkel 1977, 1981). It has been also noticed in several worked up profiles on the area of the Carpathians and foredeep (Starkel 1977, Starkel et al. 1981). In some places accumulation of the gravels and loams encroached on the clays (Fig. 3 pit "a"). Since the Atlantic period, filling up of deep channels from late glacial occurred

as well the formation of the mudy cover, superstructure on the gravels from the last cold period. The biggest accumulation took place probably in the period of deforestation of the area of drainage basin caused by the human activity.

LACUSTRINE DEPOSITS FROM TARNOWIEC

Apart from the Jasiołka valley the lacustrine deposits occur also in the other few places. They fill up the hollows without outlet of the ovate or circular shape to several hundred meters in diameter and 3—4 m deep. Such forms have been found near Jasło—Tarnowiec and Czeluśnica (Fig. 1). The biggest and well visible also on the aerial photographs occur at Jasło—Sobniów. It is filled with relatively thin deposits of lacustrine chalk, peats and clays. In Czeluśnica and Tarnowiec there are smaller but much deeper forms. At Tarnowiec sediments fill the wide depression drained by small watercourse (Fig. 1). Two pits and research trench have been made situated in the central and marginal parts of the basin (Fig. 8).

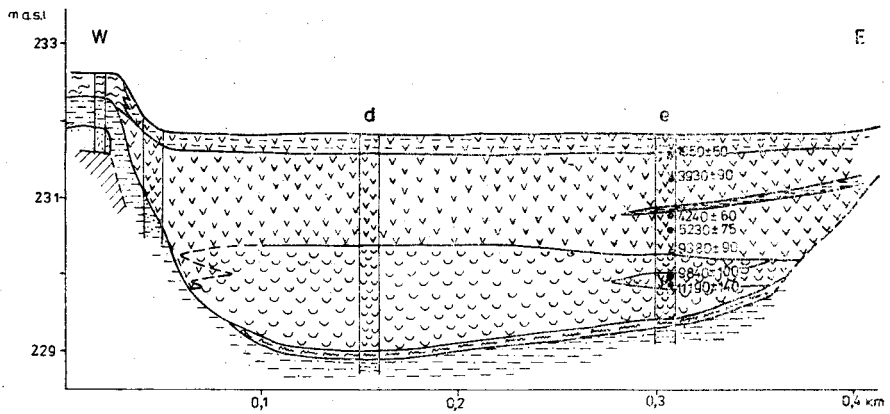

Fig. 8. Geological section of lacustrine deposits in Tarnowiec. Explanations as in Fig. 3

In the central part in shaft "d" the following sediments occur (from the top down: depth in metres):

0—0.25 grey-black clayey loam (soil)
0.25—1.45 brown peat with some wooden pieces
1.45—2.38 white lacustrine chalk (white lime)
2.38—2.45 white lacustrine chalk with pink tinge
2.45—2.80 white-grey lacustrine chalk with plant remnants
2.80—2.90 dark grey sandy silts with fauna and plant remnants
below 2.90 fine grained silty sands with single shingles of hornstones

Second pit "e" was situated east of "d" one. The profile is as follows:

0—0.25 brown-black peaty clay (peaty soil)

0.25—0.60 brown clayey peat
0.60—0.95 brown peat
0.95—1.00 grey-black clay
1.00—1.55 black peat with wooden pieces and trees roots
1.55—1.58 white-brown lacustrine chalk with peat
1.58—1.80 white-grey lacustrine chalk laminated with peat at the bottom
1.80—2.00 brown peat with grey lacustrine chalk
2.00—2.40 grey lacustrine chalk with irregular laminations of peat
2.40—2.50 limy silts with peat
below 2.50 clayey sands with single hornstones containing plant remnants down to the depth of 3 m

On the transection it can be seen that outwards the thickness of chalk is diminishing while of peat is increasing. From west, this hollow is bounded by the hummock 0.5—1.0 m high faintly marked in the present relief of the hollow's floor. This hummock is formed by loams and the Krosno sandstones reaching the same level as the peat top (Fig. 8).

From pit "e" a few samples have been dated. The oldest date of 11119±115 years B. P. was obtained from the peat interbeddings. The datings made from the peat interbeddings in chalk as well as from the bottom of the peat may indicate younger age comparing with palinologic determination. Lacustrine chalks and peats occurring in this profile represent continuous organic sedimentation since the Older Dryas until Sub-Atlantic period within the closed water basin without outlet. In the marginal parts of the lake, peat interbeddings are marked at the top of chalk giving an evidence of the lake overgrowing as early as Allröd. From the beginning of the Holocene the whole basin was overgrown by the peat. About 4240 years B. P. discontinuity in the peat accumulation took place caused by interbedding of grey-brown clay due to the increased floods and bigger supply of clayey elements from the slopes connected with the human activity in the Neolithic period. At that time one can pressume the occurrence of already formed system of outlets on this area. Upwards in the peat the amount of mineral elements increases. It may be connected with frequent encroaching of flood waters into the reservoir containing clayey elements due to the bigger supply of the slope material. About 2000 years B. P. development of the bog was interrupted and the clay layer 0.25 m thick with organic elements was deposited. It was probably caused by the deforestation and soil cultivation.

The hollows without outlet filled by lacustrine chalks and peat are found frequently on the area of the Jasło—Sanok Depression (Gerlach & Koszarski 1968). These authors recorded the occurrence of older than the Holocene hollows without outlet filled mostly with lacustrine chalk and peat that were interpreted as the deflation pan. The clayey sands with single shingles of hornstones occurring below the lacustrine chalk and silts and existence of the forest and bushy community in the late glacial raise doubts for such an origin of these hollows as presented in the last mentioned paper. Therefore different reasons of their origin should be searched for. These hollows are probably connected

with process of thermokarst in the terms of an existence of permafrost in the last ice age. Different types of melting forms might originate as a result of permafrost's disappearance particularly in the places of the pingo occurrence. During decline of permafrost, thawing of ground ice caused the formation of the pans and sinks which were occupied by lakes. Explanation of genesis of these hollows will be discussed separately.

SUMMARY

The deposits occurring at Roztoki allowed to date and investigate development of the valley in the Late Glacial and Holocene. Deepening of the valley floor going down below present-day channels took place before the Alleröd. It was connected with disappearance of permafrost and with reduction of solifluction processes with simultaneous development of dense vegetation with trees.

During the Alleröd and Younger Dryas in all depressions of various origine lacustrine chalk was deposited. In the Holocene due to the water table lowering as well as to the change of climate organic accumulation followed. In the Jasiołka valley at the boundary of the Boreal and Atlantic periods organic accumulation was interrupted by encroaching of clays and burying of the peat bog with the Holocene muds, while in the hollows without outlet the accumulation of peats still lasted. More significant interruption was marked about 4240 years B. P. when in the marginal part the clays encroached on the peat bog. These clays were probably connected with erosion caused by increasing of the precipitation on the turn of the initial and middle Sub-Boreal phases. Organic accumulation terminated about 2000 years B. P. in Tarnowiec.

The fossil deposits from Tarnowiec represent the continuous sedimentation since the Older Dryas until Sub-Atlantic period in the small water basin without outlet what will be shown on the palynological diagrams, by K. Harmata (page 43).

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