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SPECIFIC CHARACTER OF ESKER-TYPE GLACIAL FORMS ON THE NE FORELAND OF THE HOLY CROSS MOUNTAINS

The NE foreland of the Holy Cross Mts is a specific area where Quarternary glacial relief overlays the old rock relief. Among glacial forms well-preserved large eskers deserve particular attention (Fig. 1). The present article concerns the question of the origin of those forms in connection with the differentiated relief of the substratum of the Quaternary. Palaeogeographic conclusions may be useful in the study of the origin and location of eskers in other Polish regions, particularly where the relief of the substratum is hard to be stated.

The NE foreland of the Holy Cross Mts is built of younger and younger series of Jurassic and Cretaceous rocks dipping towards the North. They are formed in sandstone and carbonate facies varying in resistance. The discussed area was a land in the Tertiary; erosion and denudation processes resulted then in the formation of vast surfaces of planation, diversified by zones of cuestas, denudational monadnocks and a network of valleys (C. Radłowska 1963, D. Kosmowska-Suffczyńska 1966, 1989). The eskers discussed are connected with the Riss glaciation. They were formed in the glaciphases which corresponded with the maximum reach of that glaciation. The glacial deposits of previous glaciations have been preserved in fragments only and the sub-Quaternary relief outcrops in great number on the surface directly from under the deposits of the Riss glaciation.

Among eskers situated on the NE foreland of the Holy Cross Mountains the best studied and described are: the esker from Tarłów by C. Radłowska 1963 (Fig. 2) and the system of eskers from the vicinity of Iłża by J. Drecki 1986 (Fig. 3). Other eksers of this zone have been mentioned by J. Bartosik 1972 and M. Barcicki 1988. All those forms have certain characteristic features which throw light on the question of the formation of glacial relief directly on the rock substratum.

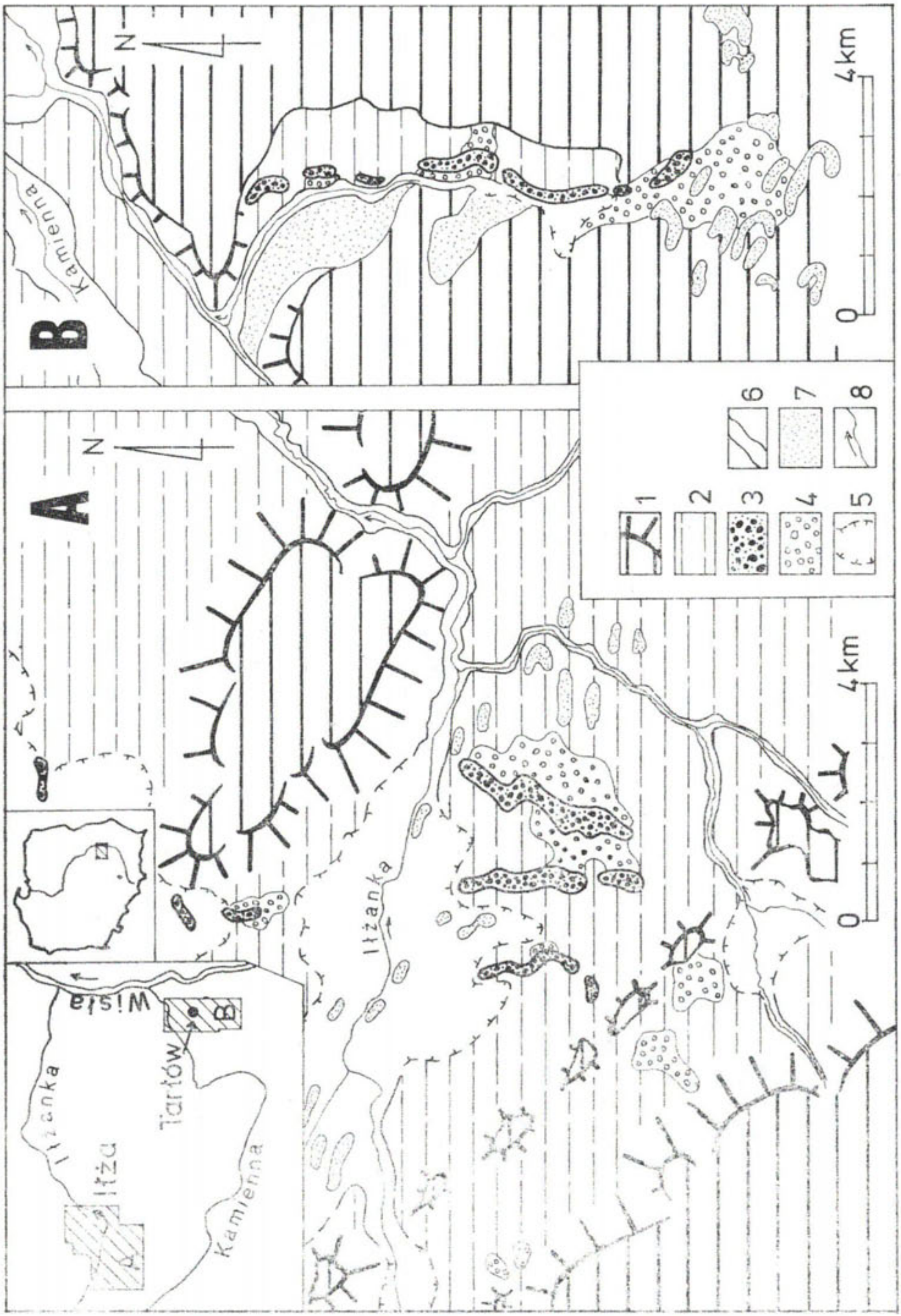
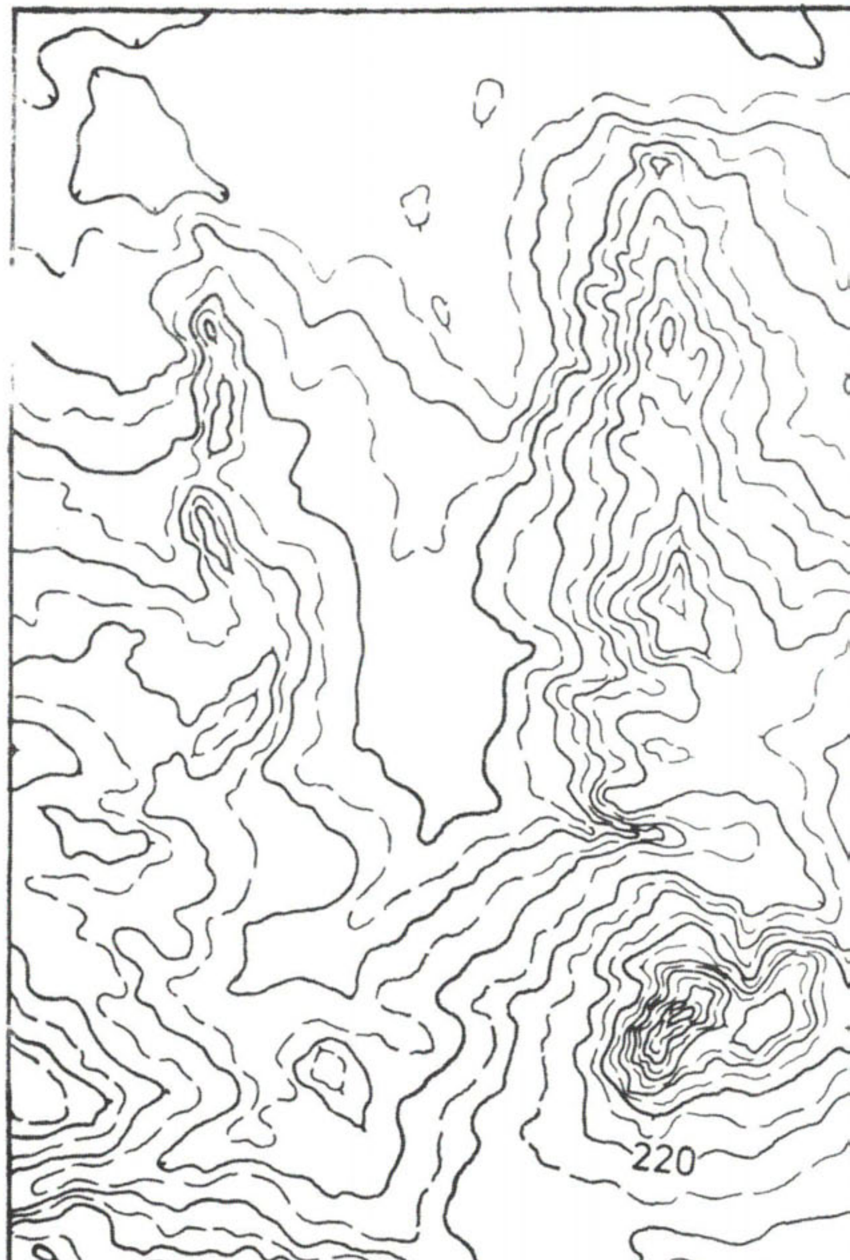


Fig. 1. General sketch of investigated areas

1 — rocky monadnock hills with preserved surfaces of planation, 2 — clay—and—sand ground moraine, 3 — sand, gravel and pebbles of eskers, 4 — fluvioglacial sands and gravel of kames and outwash fa ns, 5 — bottoms of dead ice and valley depressions, 6 — river aluvia, 7 — dune sands, 8 — rivers.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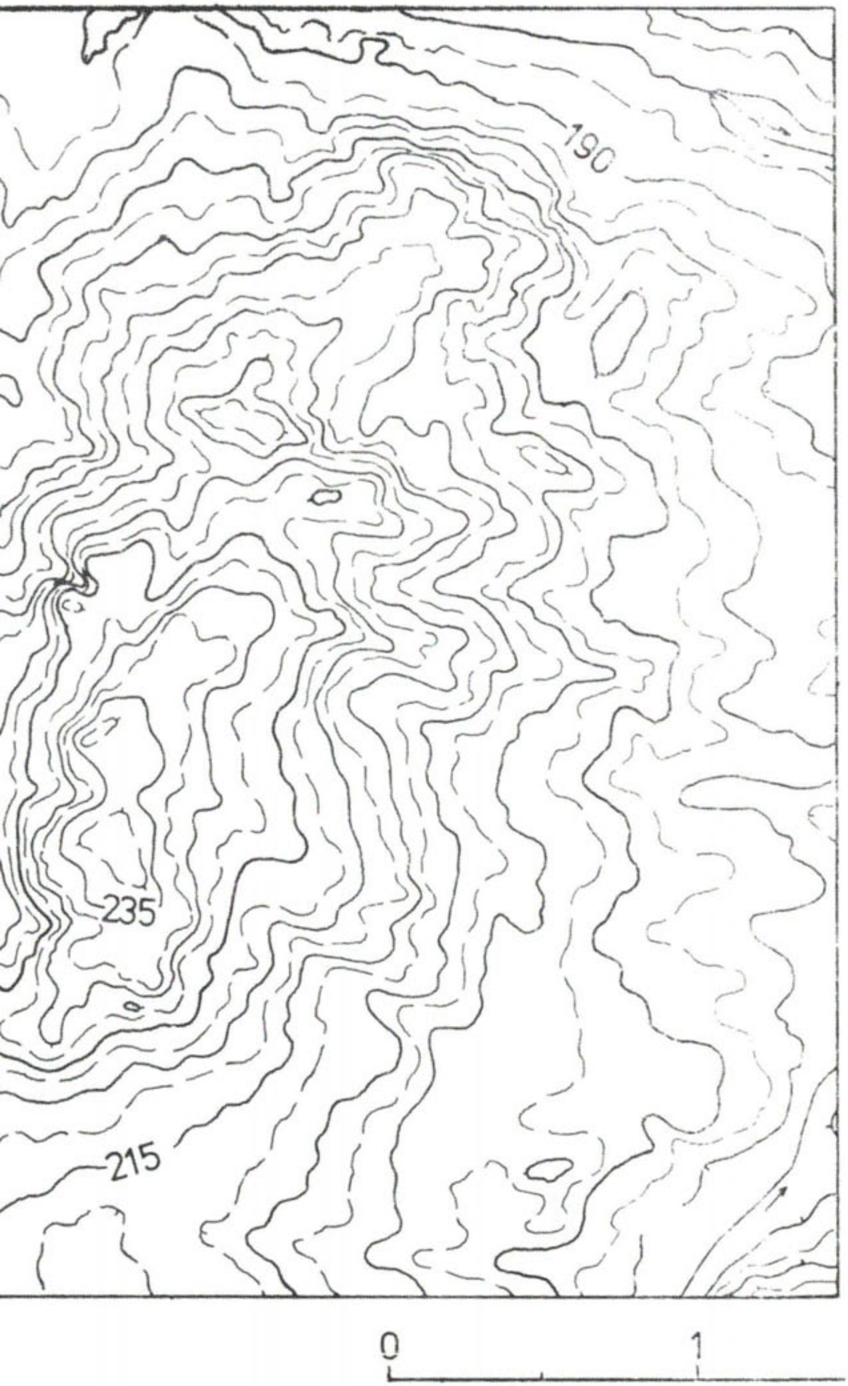
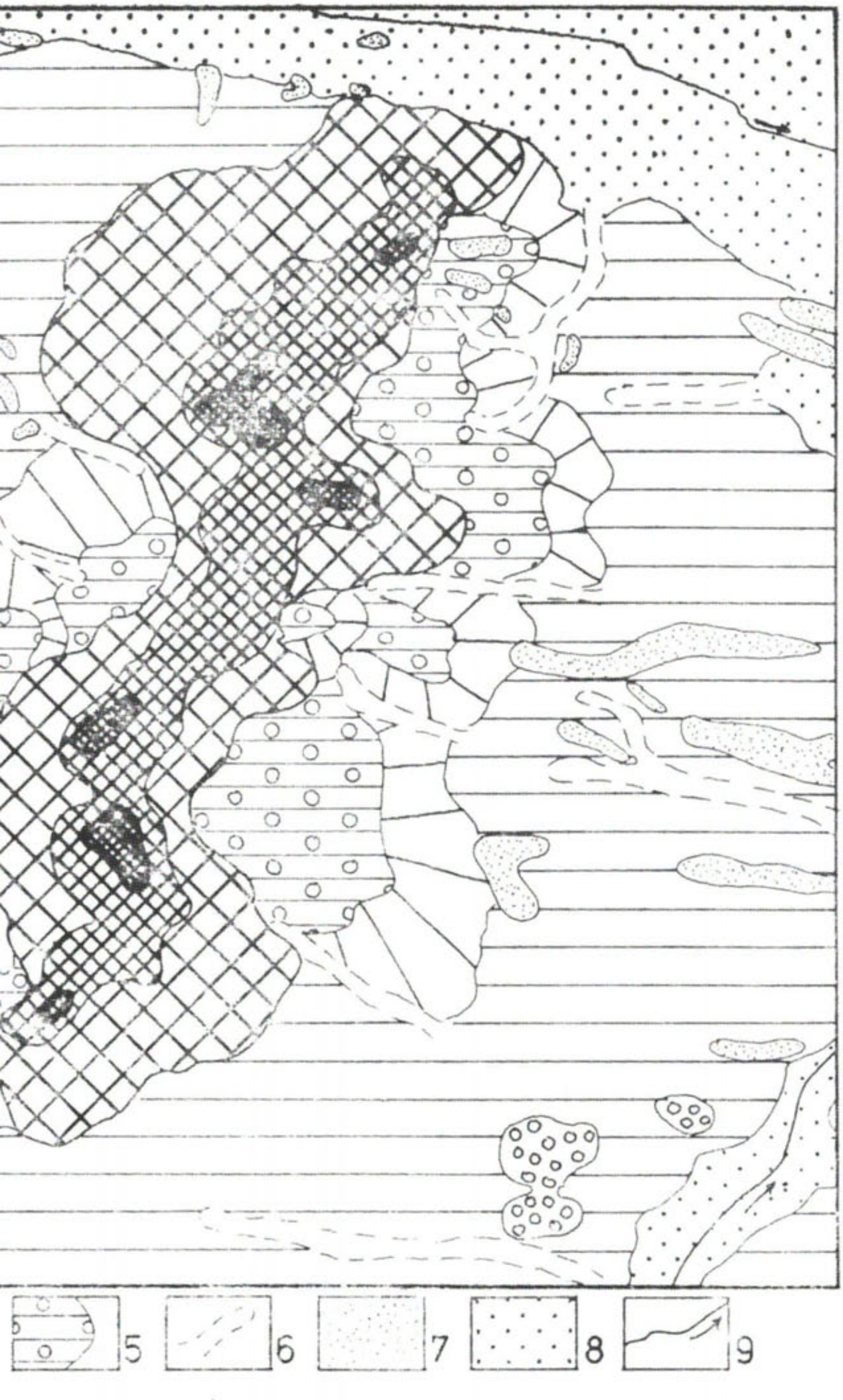


Fig. 3. Hypsometry and geomorpholog
1 — rocky monadnock hills with preserved
moraine, 3 — (a) esker culminations, (b) pr
kame hills, 5 — kame terraces, 6 — dry v
valley bottoms, 9 — rivers.

y of Iłża region eskers
surfaces of planation, 2 — plains of ground
·oper esker ramparts, (c) esker slopes, 4 —
·alleys, 7 — dunes, 8 — river terraces and



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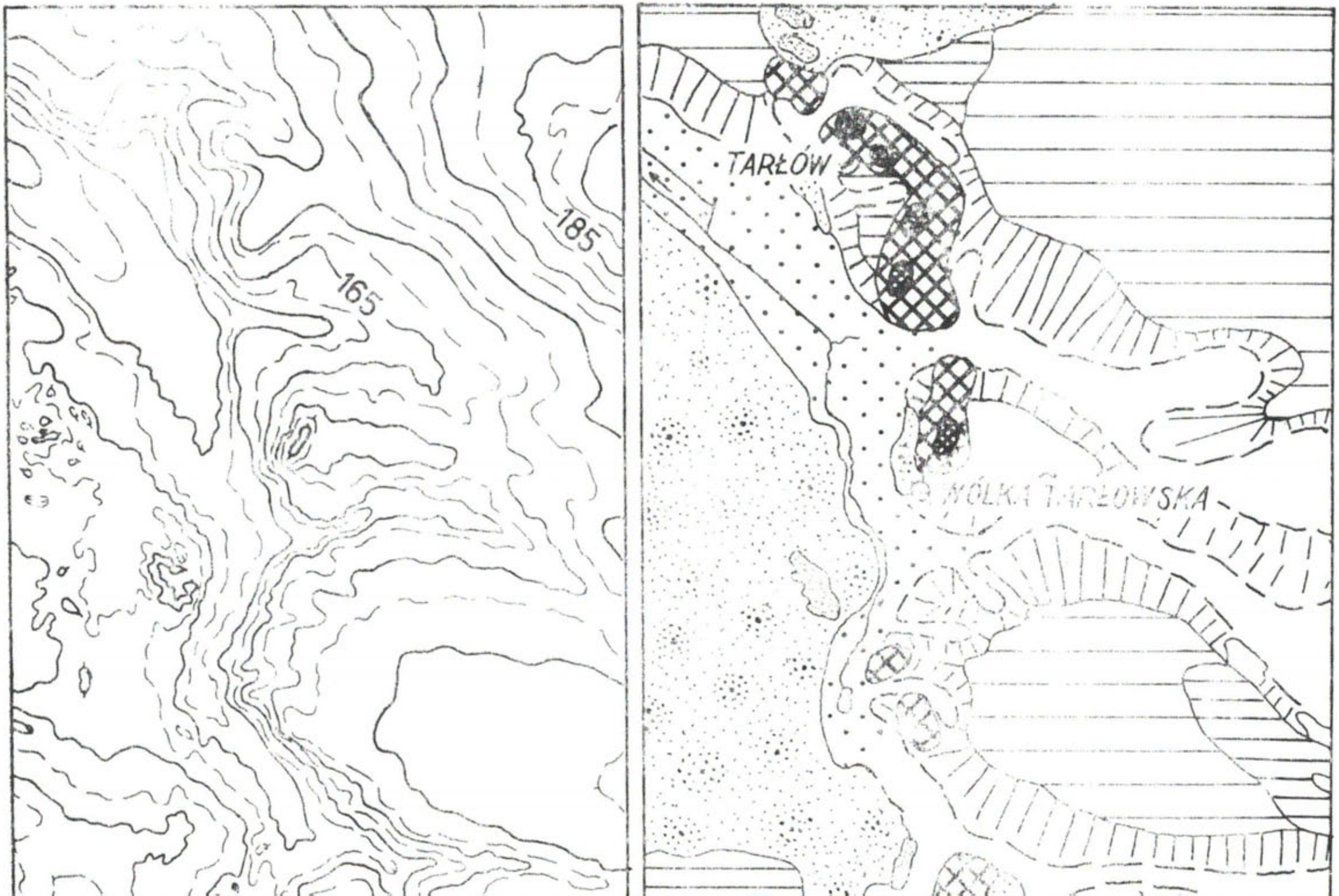

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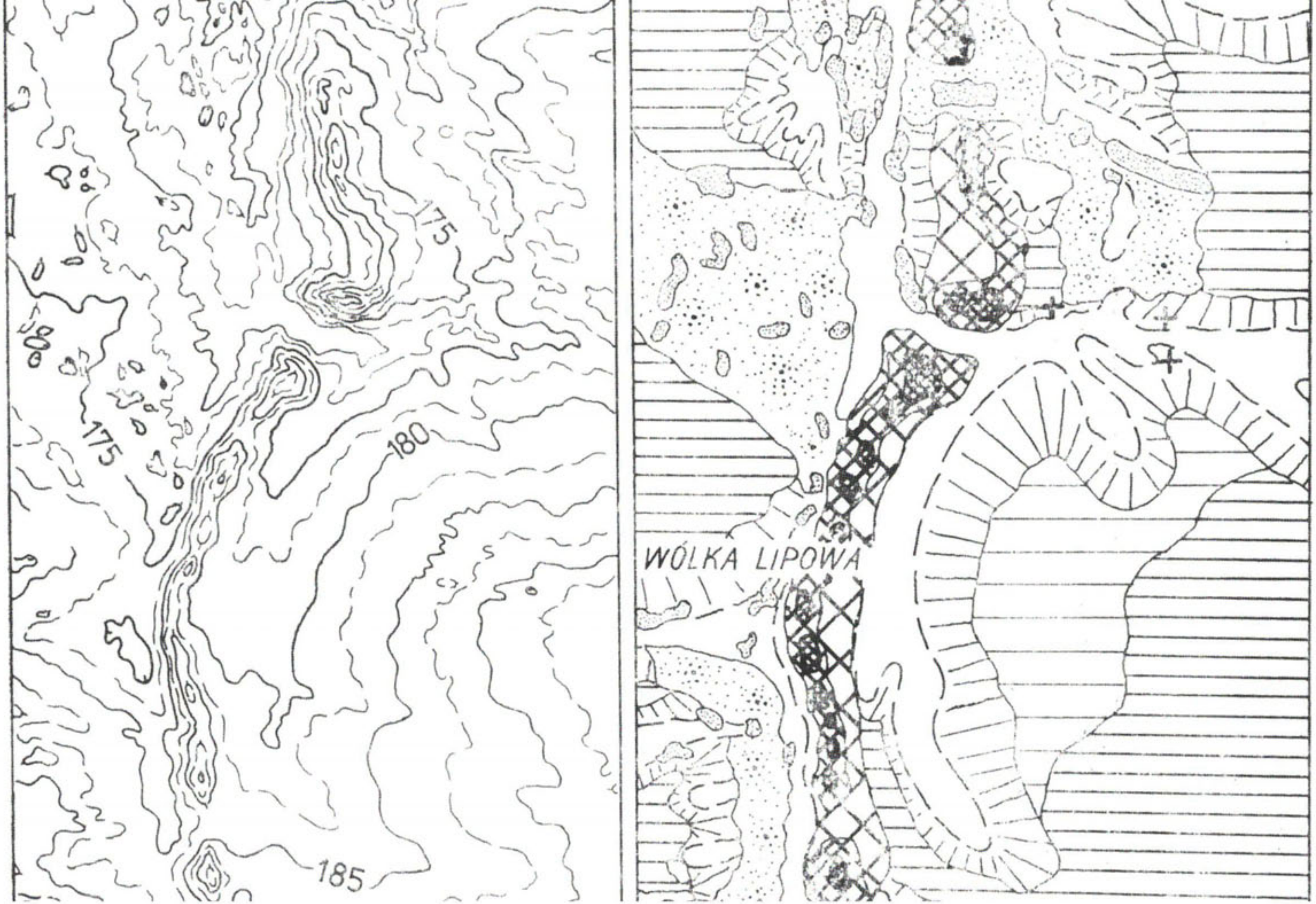

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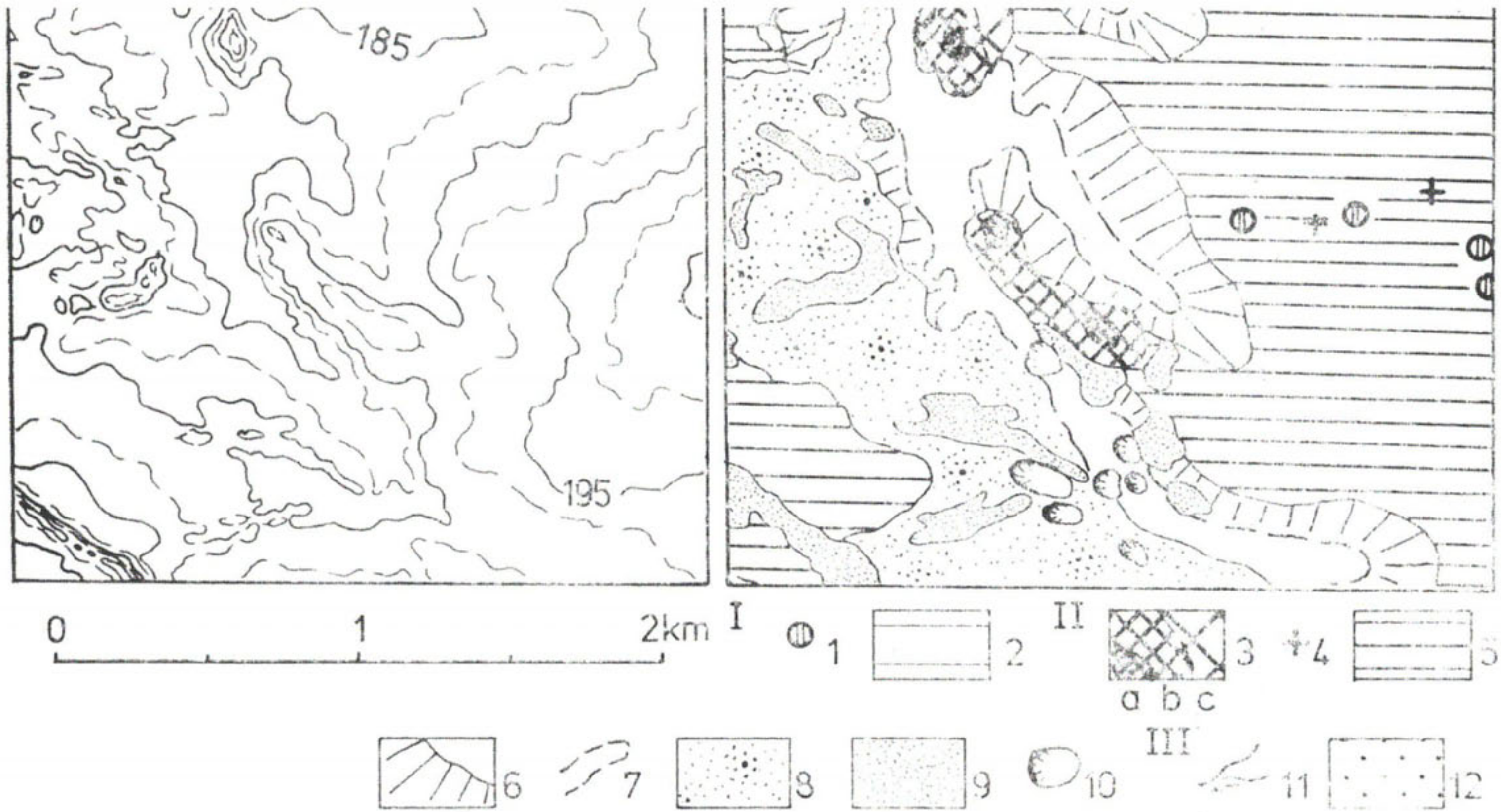

Fig. 2. Hypsometry and geomorphology of the Tarłów esker (after C. Radłowska 1969),

I — Forms dating from the Tertiary: 1 — karst depressions, exhumed rock relief; II — **Pleistocene forms: 3** — esker: (a) crest parts, (b) proper esker ridge, (c) esker material at ridge base, 4 — arratics, 5 — denudational plain, 6 — denudational slopes, 7 — dry trough-shaped valleys, 8 — sheets of wind-blown sands, 9 — dunes, 10 — deflation basins; III — Holocene forms: 11 — erosive rock incisions, 12 — flood terrace plain.

All the eskers discussed are situated in regions of a differentiated and not deeply occurring rock basement inclined opposite to the movement of the ice sheet. This is the first important common feature of the studied forms — their situation connected with depressions of the older basement: they lie on the descent of those depressions. In the case of the Tarłów esker it is a valley oriented N—S, while in the case of the Iłża eskers——the slope of a Middle Jurassic cuesta oriented from NW to SE (Fig. 4). A similar situation of eskers in relation to the sub-Quaternary basement was stated in Estonia by A. Raukas, E. Rähni, A. Miidel (1971). They most frequently accompany there the proximal slopes of old uplands and marginal valleys.

The investigated eskers are relatively short; the longest Tarłów esker is eight kilometers long. The reciprocal position of eskers described by Drecki (1986) and M. Barcicki (1988) suggests that esker crevasses (tunnels) were much longer than the eskers and crossed various morphologic zones of the basement. However, the accumulation of esker series was connected only with the zones of rock depressions slopes. It may be then assumed that the esker system near Iłża was founded on a common system of crevasses but as for accumulation it was a group of completely different esker units. It is confirmed by their inner structure where we cannot observe, along this system of crevasses, any resistance selection and no gradual decrease of the deposit fraction towards the distal parts of the whole group of forms. The formation of eskers proceeded in stages, not at the same time. First the distal parts were formed, then the middle ones and finally the proximal parts of eskers. This can be proved by the fact that proceeding northwards, the successive younger and younger culminations of the ekser have a decreasing absolute altitude and at the same time the directions of the lamine dip clearly indicate the southward run-off water which is in discordance with the inclination of the rock basement. Eskers are mainly built of sand, gravel and pebbles. Among the latter local rocks prevail and their content generally exceeds 50%. The frequent occurrence of a very soft rock not resistant to destruction deserves special attention. This fact means that the deposit was taken directly from the basement and its transportation was short.

Comparing the forms discussed here with classical eskers of lowland areas we can observe the lack of the neighbouring so-called esker-adjoining channels. Instead, there is the characteristic occurrence of kame terraces on esker slopes (Fig. 5). Both these facts prove unquestionably that the ice sheet vanished areally in its marginal zone and that the

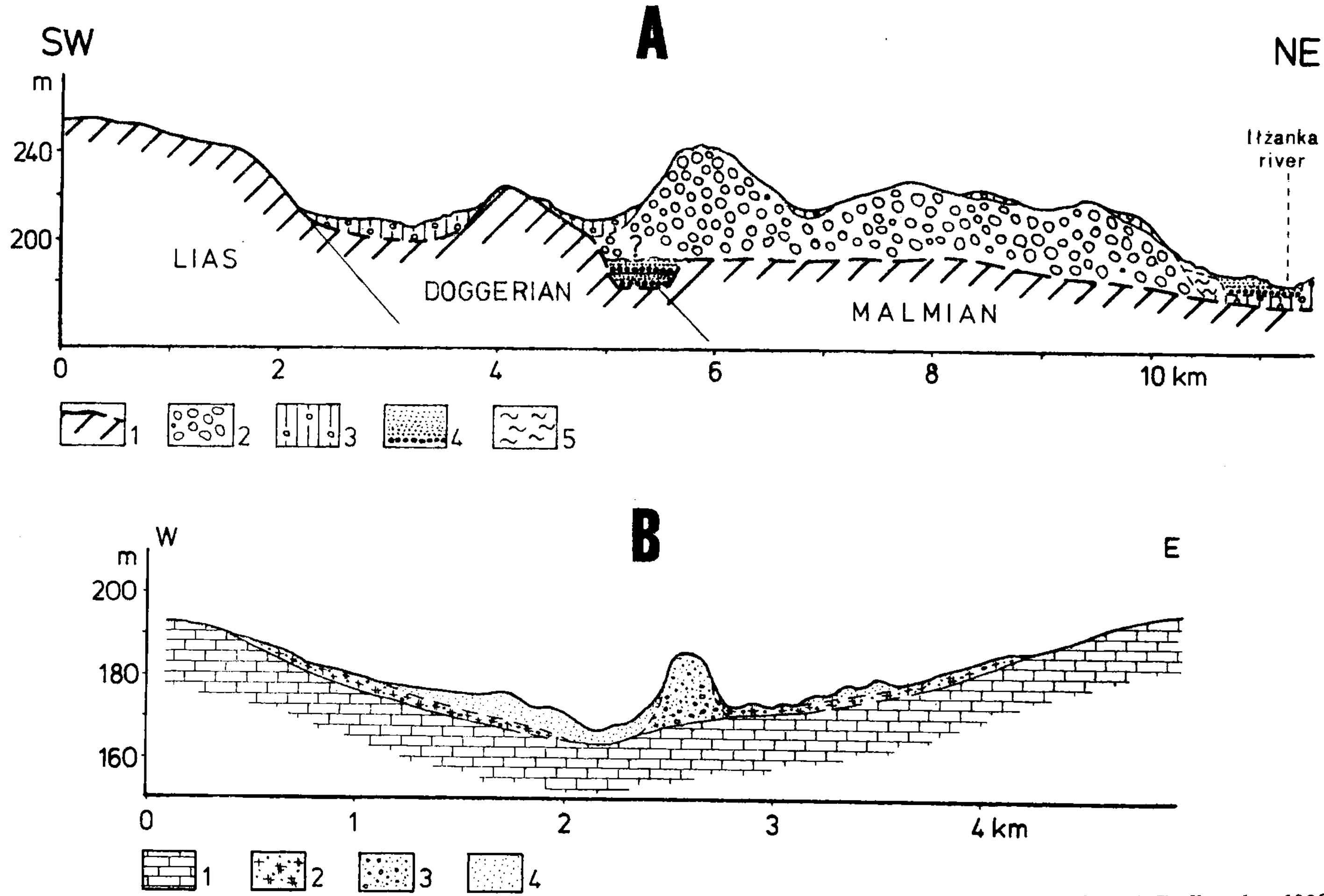

Fig. 4. Schematic sections of esker near Iłża — A (after J. Drecki 1986) and Tarłów esker — B (after C. Radłowska 1969, A: 1 — rock basement, 2 — fluvioglacial esker series, 3 — boulder clay, 4 — river gravels and sands, 5 — silt, B: 1 — upper Cretaceon rocks, 2 — boulder clay, 3 — fluvioglacial esker series, 4 — sands.

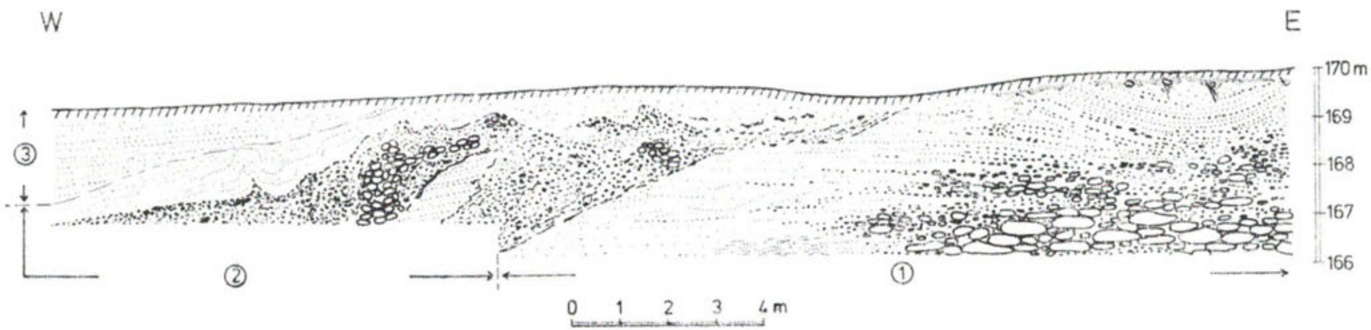

Fig. 5. Outcrop in the Tarłów esker — transverse section (after C. Radłowska 1969)
1 — esker material, 2 — two series of slope deposits containing patches of strongly disturbed ablation material, 3 — kame terrace sands and gravels.

accumulative activity of glacier waters prevailed over their erosive activity.

An important palaeogeographic conclusion which may be drawn from the study of the northern slope of the Holy Cross Mountains is the statement of the visible dependence of the esker formation and the differentiated relief of their direct basement. Another statement that may be also essential to esker investigations in other Polish regions, and particularly where the reconstruction of the basement relief is difficult, is the fact that the direction of flow of fluvioglacial waters forming esker ramparts and concordant with the general direction of the ice movement may be discordant with the inclination of the basement on which the accumulation of deposits led to the formation of esker ramparts.

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