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Half a century of the scientific activity of Professor Leszek Starkel – an Honorary Member of the Association of Polish Geomorphologists

In November 1953, a young graduate student Leszek Starkel became the first research assistant in the Department of Geomorphology and Hydrology, established in Cracow as a branch of the Institute of Geography, of the Polish Academy of Sciences. He received his M.Sc. diploma in physical geography at the Jagiellonian University in Cracow half a year later, in February 1954. He got his doctoral degree in geomorphology in the Institute of Geography, Polish Academy of Sciences in 1959 and his post-doctoral (habilitation) degree in 1964. The title of professor he received in 1971. Professor Starkel was elected Corresponding Member of the Polish Academy of Sciences in 1983 and Full Member 15 years later.

Leszek Starkel was born in Starachowice, Poland on 8 September 1931. The fall of 1953 was for him the start of a dynamic and fruitful research activity and a real international scientific career. Working at and developing the Department, he passed all levels of scientific degrees and honours. He served as Head of the Department from May 1968 till November 2001. Professor Starkel retired in 2002 but he is still active and works part-time in the Department of Mountains and Upland Areas, Institute of Geography and Spatial Organization, Polish Academy of Sciences.

The first and main research discipline of Leszek Starkel has been geomorphology. Detailed geomorphological mapping was a part of his master's thesis, under the supervision of Professor Mieczysław Klimaszewski (the author of the mapping concept). Subsequent detailed map sheets (Dębica, Trzciana and Lesko) compiled by Leszek Starkel provided essential information on contemporary relief in the Piedmont area and of the Flysch Carpathians. This mapping method has remained a useful tool applied in his numerous studies in Poland, India (the Darjeeling Himalayas) and Mongolia. An important achievement of his was the publication (as Chief Editor) of the General Geomorphological Map of Poland, 1:500 000 (in 1980). A widening scope of research interests and the stimulation of interdisciplinary studies are readily visible in Professor Starkel's publications and involvement in major national and international scientific programmes and projects. It has also been reflected in his most significant publications, including his contribution to the famous *Encyclopedia of Geomorphology* (Ed. R. Fairbridge).

The results of studies in the Carpathians gave him evidence on the importance of the Holocene for the shaping and significant changes of terrain morphology, not only in mountainous areas. It was reflected in a series of significant publications, such as the monograph on *The Evolution of Land Relief in the Polish Flysch Carpathians During the Holocene* (1960), a synthetic study entitled *Postglacial Climate and Moulding of European Relief*. His monograph on the palaeogeography of the Holocene (in Polish *Paleogeografia holocenu*, 1977) is still a comprehensive and useful textbook for researchers and students.

Professor Starkel's field studies in India enabled him to observe geomorphic effects of catastrophic rainfalls and stimulated his interest in extreme phenomena. Worth noting (beside a number of important papers) is the book: *Rains, Landslides and Floods in the Darjeeling Himalayas*, edited by L. Starkel and S. Basu and published in India (2000).

An interdisciplinary programme on changes of the natural environment of Poland in the late Pleistocene and Holocene was launched and developed by Professor Leszek Starkel in the 1970s. It was affiliated to the INQUA framework. He brought together geomorphologists, palaeobotanists, Quaternary geologists, archaeologists, and others. The programme stimulated a number of interdisciplinary studies reported in a series of volumes on *Evolution of the Vistula River Valley During the Last 15,000 Years*, edited by the Professor.

One of the most spectacular and useful achievements of Leszek Starkel has been developing the concept, coordinating the preparation, and publishing an important monograph on *Geography of Poland. The Natural Environment* (in Polish), was published in 1991 (second edition in 1999). He also contributed several chapters to it. The book is still the most comprehensive presentation of knowledge on the natural environment of Poland.

In this short text it is impossible to list all or even the most important projects and publications written, initiated, created and edited by Professor Starkel. His major scientific interests and achievements have taken several directions. Besides those mentioned above, his research activity could be grouped in the following fields: Relief evolution of the Polish Carpathians. Palaeogeography of the Polish Carpathians, Poland, and Europe as a whole in the Holocene. Palaeohydrology of the late Quaternary, including the evolution of the river valleys during the last 15,000 years at different scales: Poland, the temperate zone, and the globe. Present-day geomorphic processes (especially the role of extreme events in the evolution of landscape in temperate and monsoonal zones, in the Darjeeling Himalayan and the Cherrapunji regions as examples). Latitudinal and vertical zonality of the geographical environment in the continental climate of Asia (with the Khangai Mts in Mongolia as an example).

Over more than the last four decades Professor Starkel has served on several geomorphological commissions of the International Geographical Union: the ones on Geomorphological Mapping, Periglacial Processes, Slope Evolution, Present-day Geomorphic Processes, and GERTEC. However, outside Poland he has chiefly been engaged in the work of the International Union for Quaternary Research (INQUA). In the years 1973–1981 he chaired the Euro-Siberian Subcommission of its Holocene Commission, after which he headed the Working Group on Human Impact on Soil Erosion from 1981 to 1988. In 1991 he founded the INQUA Commission on Global Continental Palaeohydrology, which he also chaired until 1995. He has also been engaged in the work of the Commissions on Palaeoclimate and Carbon Cycle.

To sum up the half-century of Professor Starkel's scholarly activities, he has attended more than a hundred international events in 37 countries, including seven IGU, nine INQUA and two geological congresses, and all five congresses of the International Association of Geomorphologists. At two of them he gave a plenary lecture. His field studies have brought him not only to such European countries as Romania, Bulgaria, Georgia and the Ukraine, but also to India, Mongolia and China in Asia.

Back at home, Professor Leszek Starkel has participated in developing the concept of the Integrated Monitoring of the Natural Environment; he has worked out the conception of monitoring catastrophic processes. A founding member of the Association of Polish Geomorphologists, he has always taken active part in its work.

His stimulating role in the formulation of new, original research topics at the national and international scales is well known and appreciated. As a co-ordinator of studies carried out under national geomorphological programmes, Professor Starkel has contributed to the development of the methodology of geomorphological research.

Professor Starkel still engages in the scientific life of Polish geographers and geomorphologists. On their behalf we would like to wish him further achievements enriching Polish geomorphology, and all the best in his private life.

Andrzej Kostrzewski
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The problem of the identification of relict rock glaciers on sedimentological evidence

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Abstract: In order to establish sedimentological criteria for the identification of relict rock glaciers, a study of published information about the internal structure of both active and relict rock glaciers has been carried out. The literature survey revealed that there is no single lithological feature which could independently serve as a proof of the decisive role of ground ice for the transport of rock debris. However, a sequence of a bouldery mantle and a core composed of diamict, together with a layering which dips steeply up-slope are the strongest premises for the elimination of any process other than that associated with a cold environment. Certainly, in attempting to distinguish between a moraine and relict rock glacier, the geomorphological setting must be taken into account and, notwithstanding this, an effective differentiation is often virtually impossible. Sedimentological parameters such as grain size distribution, sorting and grain morphology are largely controlled by the properties of the source rock and, as such, they are of no value in attempts to identify relict rock glaciers.

Key words: sediments, ground ice, relict rock glaciers

Introduction

The imprint of the Pleistocene periglacial environment in the Central Europe has been recognised since the beginning of the previous century. Usually, sedimentary structures were supposedly evidence of permafrost, whereas landforms typical of the periglacial environment are very scarce. Indeed, only two types of such landforms are known, i.e. remnants of pingo mounds and relict rock glaciers. There are very few examples of both and, in any case, inferences often have to be preceded by various restrictions.

Basically, there are two approaches to the definition of a rock glacier. The first, best represented perhaps by Martin and Whalley (1987) or Hamilton and Whalley (1995), assumes the morphology as the sufficient premise. Such an opinion, shared also by Humlum (1996), results from a conviction that there is a genetic continuum between a true glacier and a rock glacier and hence, no unambiguous limit between these two phenomena can be established.

The second approach is the genetic definition advocated by Haeberli (1985) and Barsch (1996), who both assume that a rock glacier is a landform which has resulted exclusively from creep in a permafrost environment.

The accepting of either the former or the later causes far-reaching divergences in interpretations. Complications arise from the fact that creeping permafrost does not always produce a landform which shows the relief typical of a rock glacier, whereas, by contrast, processes not necessarily connected with permafrost can be expressed as forms morphologically similar to rock glaciers (Fig. 1). The so-called "kurumogletchers", described from Siberia by Romanovskii *et al.* (1989), serve as an example of the former and the earthflows or "Bergsturzes" (Barsch, 1983, 1996; Whalley and Martin, 1992) may be regarded as a good example of the latter.

Having adopted such a morphological option, one is thereby released from the task trying to explain origin of a landform. However, in such a case, rock glaciers then lose any importance in