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CARTOGRAPHIC ASPECTS OF GEOMORPHOLOGICAL MAPS
OF POLAR AREAS

Cartographic problems of detailed geomorphological maps date back in Poland to the 1950s. Works undertaken on detailed geomorphological pictures produced two legends: in Cracow (M. Klimaszewski, 1953, 1960) and in Toruń (*Instrukcja* 1962). The chronological-genetic legend of Cracow with colours presented both the age and genesis of forms. It created a comprehensive, cohesive and systematized picture of geomorphological knowledge at that time. The chief inconsistency was that it differentiated with the same methods (colours) two different groups of issues, which is contrary to the rules of semiotics and distorts the picture (J. Plit, 1973). However, the system of symbols used in it had some impact on developing an international legend ("The unified key...", 1968). The legend of Toruń was constructed for Polish lowlands. Genetic criterion was the base and the age of forms was presented by a suitable systemization of the legend. The international unified key was a summary of world achievements in the area of detailed geomorphological maps in the scales 1 : 23,000 — 1 : 50,000. The classification is based on genetics (11 colours), chronology presented by changing intensity of colours in two categories (more intensified shade — young forms and less intensified — old forms, along with abbreviations of geological terms) as well as six categories of slope steepness presented by changing brightness of used colours.

In geomorphology, similarly as in other sciences on earth, regardless of experience and international accords, there are new, less or more independent solutions. Legends of geomorphological maps, just like any other maps, primarily reflect the author's, views, regional specificity, scale of presentation and cartographic traditions as well as the publisher's economic and technological potential, which often proves to be most important. That is why contemporary maps have different forms, usually quite distant from the international model. However, they always should have the properties which are decisive for clarity of the carto-

graphic picture and presentation of information. In cartography a number of rules have been worked out which — when observed — create a base to construct systems of symbols. Quoting L. Ratajski (1971) one may refer to the main systems derived from formal logics and semiotics. For the sake of cartography, it is necessary to speak about internal relations occurring on a map treated as a formal drawing on a plane (distribution of symbols signifying objects in the map — syntactic interrelations) and about external relations (between the content of the map and the reader) which — with their semantic character — are decisive for the confrontability of map content with reality. Specifically important in this case is the possibility to identify the location of symbols with the location of objects they mark, maintenance of correct relation of their location on the map and in reality, as well as attributing respective content to the symbols (one — single meaning relation, one — multi meaning relation), taking into account pragmatic factors (e.g. isomorphism of forms), etc.

Four principles are very important when constructing a cartographic code. Firstly, a correct arrangement of the set, that is a classification to suit the graphic expression of symbols to the degree of classification. Hierarchically highest levels should correspond to simplest and most abstract symbols. The lower the level in hierarchy, the more complicated the symbol. The rule derives from the isomorphism of forms. Secondly, the postulate of subject-matter isomorphism. Various groups of objects should correspond to groups of symbols with different basic shape. Hierarchically more important objects should have clearer symbols. The third rule is the requirement of code efficiency which should make it possible to expand the code without changing the basic assumptions. The last rule is the possibility to show quantitative information with the code.

The specificity of geomorphological maps of polar areas (Spitsbergen) is due to the geographic character of the area. The landscape is morphologically active, with clear, fresh and often sharp forms, and usually it is easy for geomorphologists to interpret and classify them genetically. Excepting areas that are covered with ice or snow permanently, the open character of the area, practically without antropogenic elements and vegetation, gives a good insight into its geomorphological situation. Diversified clear-cut sculpture makes it relatively easy to locate objects and determine their ranges. The forms of sculpture are characterized by big differences in size, from "pingo" forms of over ten metres to vast multi-kilometre morain zones of glaciers, taluses, outwash fans, etc. Variety and changeability of occurring processes produce various forms. All those factors do have an impact on cartographic problems that occur

when drafting geomorphological maps of those areas. Geomorphological research conducted in West Spitsbergen by a number of expeditions from the Faculty of Geography and Regional Studies (in 1980, 1985, 1988) made it possible to draft and publish *Geomorphological map of Nordenskiöld Land* (West Spitsbergen) 1 : 75,000. The scale, which is a threefold diminution of field materials, is large enough to accurately — excepting the smallest forms — present topographically most geomorphological forms occurring in the area. They were rendered with scale symbols (within the scale of the map) with little generalization of ranges or occurrences. The map is based on a genetic classification of objects (8 groups), covering in total 98 morphological marks and a group of 6 supplementary symbols (Fig. 1). The cartographic concept was based on an assumption of monochromatic presentation of morphological content of the map in such a way that qualitative differentiation of objects can be done in a uniform way. For that purpose the signature method was used in surface, linear or point reference, depending on the character of presented objects. At the same time, wherever it was necessary, the signatures were made quantitative, thus characterizing the hierarchy among the objects.

Due to such presentation, the geomorphological content of the map is as if an isolated layer. Its signature character made it possible to stylize the symbols towards isomorphism of forms: the shapes of symbols refer to the physiognomy of objects, and the form of symbols is often identical to international proposals. On the other hand, six-colour print made it possible to distinguish areas with specifically large surface (mountain slopes, river valleys, sea terraces) or to stress additionally in colours the objects that have been marked with signatures (outwash fans, taluses, marginal zones of glaciers, glacial cirques, etc.). The purposeful redundant character of the map does not burden the content but, on the contrary, the colours help present areas that are genetically similar. The shapes of firn fields and glaciers were presented totally in blue which contrasts well with exposed morphological surfaces of the rest of the land.

Attempts were made to obtain a chronological aspect by placing a schematic exposed geological map on the margin, on a scale that is almost fourfold smaller than the main map. The back of the map was used to present scientific comments.

The graphic solution (isolated thematic layer — Fig. 2) makes it possible to use the content of the map in other scientific work. It is also easy to introduce all types of corrections, changes or supplements to geomorphological content. The separate treatment of genesis of forms

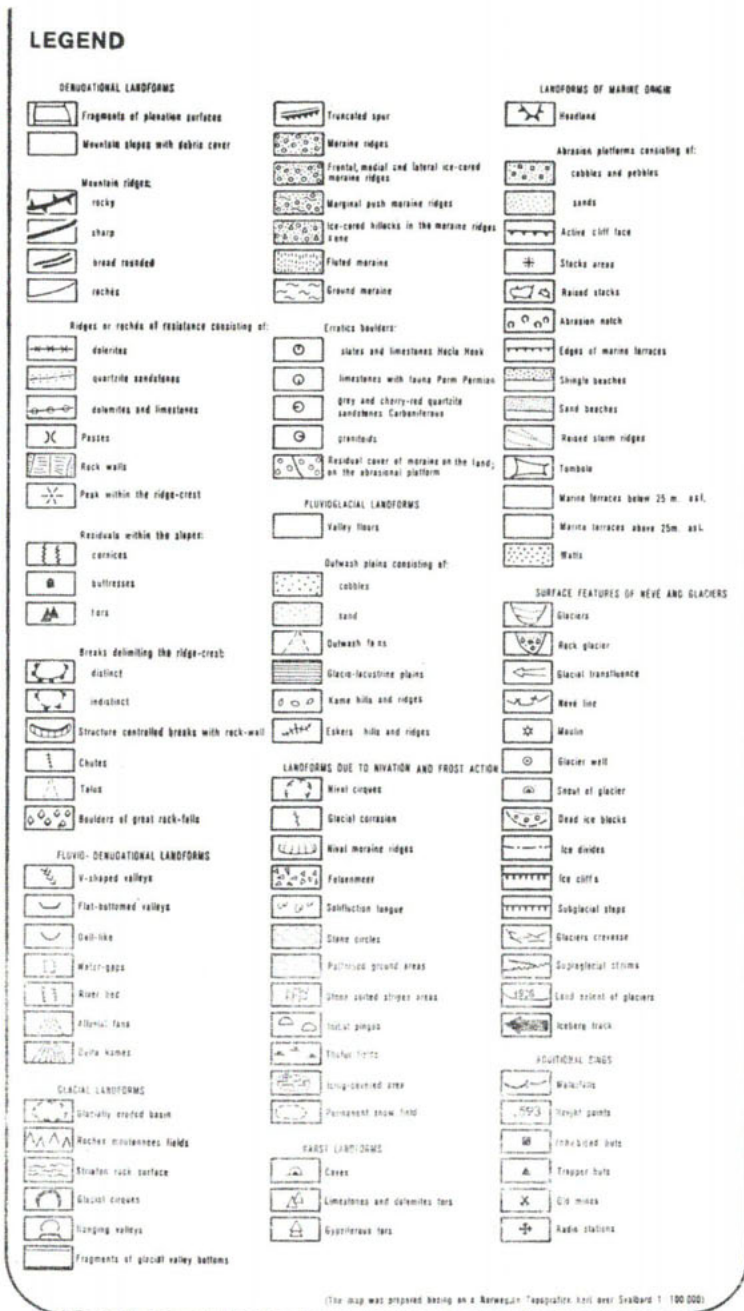


Fig. 1. Legend of the geomorphological Map of Nordenskiöld Land. Black and white version.



Fig. 2. Map's geomorphological contents. A fragment



Fig. 3. Geomorphological Map of Nordenskiöld Land. A fragment.

(main map) and chronology (margin) made it possible to avoid a frequently used solution (Cracow legend, unified key), that is presenting the two issues on one map with colours. From the cartographic viewpoint, such a solution is not right since it makes reading of the content unclear.

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