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THE MAPPING AS A METHOD OF SCIENTIFIC RESEARCH

Geographical maps are among few intellectual achievements of human mind which evidence man's cognitive ability in the most visual manner. The examples of geographical maps created by ancient civilizations have survived until our time. They include Mesopotamian maps which were modelled upon clay tablets about 2500 B.C. (Fig. 1). Later on, original maps come from ancient Egypt and Greece. All of them are surprisingly well conceived, abundant in details and concepts of graphic presentation.

In working out contents of geographical maps at least two procedures of modification of geographical space must have been used, that is reducing and selecting of objects to be found in that space. The two conceptual operations (speculations) must be considered as the most remarkable achievements in the process of human brain development. They also marked the general trends in scientific research aimed at, at the first stage, map compilation as a "portraying of the terrain"; later on, through long evolution, they led to the rise of the theory of cartographic communication.

Despite 5000 years history of cartography and remarkable achievements in methodology of map compilation and map use, cartographers did not manage to create a general theory of map as a cartographic model of geographical reality. The reasons for this are to be sought in varied forms of cartographic notation which, using exclusively graphic and artistic means, may quite arbitrarily (diversely) formulate mapped cartographic messages on results of measurements and research regarding the space of geographical phenomena. Thus the variety of possible ways of mapping of convention of reality on geographical maps seems to be unlimited.

Fig. 1. The oldest clay-tablet map of Iraq from about 2500 years B.C. An example of cartographic model of geographical reality

As cartographers in the past did not have graphic education and they did not even know basic scientific methods of cartographic presentation, it is astonishing how they drew inspiration which allowed them during so many centuries to creatively develop methodology of the modelling of reality of the surrounding world.

In order to answer this question it was necessary to get to know specificity and characteristics of the map as the model of reality. Yet this was not analyzed until the recent two decades. However, in undertaking research on this subject accidental examples of maps were used, which precluded a precise definition of the subject and domain of basic research of cartography as a field of knowledge. And yet cartography have long made use of its own methods of cartographic notation of geographical reality in the form of messages intended by the maps to illustrate an association between two geographic distributions of the system of physico-geographical phenomena and the system of phenomena resulting from man's activity. Today, cartography provides a solid basis for theory of comprehensive research on geographical relations by way of maps, that is the theory of research via cartographic method.

Cartographic presentation usually provides unlimited possibilities of expression of the various aspects of occurrence of objects and phenomena in geographical space: starting with location and way of spatial distribution, through characteristics of quality, quantity values and dynamics of phenomena, to reveal the latent relationships of assigning, affinity and similarity between objects or territorial units.

Such an interpretation of forms and functions of cartographic relationships leads to another question: are there any objective and unequivocal methods of cartographic presentation? Objective and unequivocal, that is independent of the subjective choice of methods of presentation and the manner of its use from the viewpoint of a graphic form and visual graphic variables, including shape and size of cartographic symbols, colours and patterns, areal units, etc. To answer this question we must acknowledge that actually the objective methods of cartographic presentation remain unknown.

Thus, if we analyze contents of a large-scale geographical map, that is as a distribution of various objects, what we see is chiefly a consciously simplified representation of a certain geographical reality. By the way, it is well known that despite an evident miniaturizing of cartographic picture of the terrain on the map, it reflects most fully typical features of natural landscape and character of socioeconomic landscape.

This unique property of contents of a geographical map is obtained due to the process of cartographic generalization, which consists of the visual investigation and standardization of external features of natural landscape as is the case of the compilation of the basic map design by topographical or photogrammetrical surveying. This may also be accomplished by conceptual transformation of contents of other maps and processing of statistical data to get to know internal structure and specificity of economic and social phenomena of reality.

Due to this operation, the cartographer's consciousness absorbs stereotype models of various fragments of geographical reality: for example, of natural

landscape or spatial arrangement of socioeconomic phenomena. They take the shape of mental maps which may be materialized as drawings.

Even if a basic map design is made by a topographic-table survey or photogrammetric survey, it is well known that this is not the picture of the terrain faithful in all details but that it only resembles reality. This resemblance is the more close, the more specificity of the terrain mapped is known to the cartographer due to his study of the literature on the subject and measuring space and ground observations. This mainly applies to natural phenomena and physical objects which can be directly measured and observed. All other maps are compiled as a result of a complex process of transformation of the content of general maps as well as pull-up and synthesization of economic and social information coming from other source materials.

General (topographical) maps represent the space of real objects and phenomena, while thematic maps present not only real objects but also results and aspects of nature and human activity tested by prepared scientific investigation. Thematic maps may also comprise purely abstract concepts, such as ideas, views and scientific hypotheses, as well as conclusions drawn from the analysis or synthesis of some real spatial conditions, state of development of social, economic and other phenomena under investigation. The above-mentioned scientific investigation and selection of the most appropriate methods of cartographic presentation of results of this research make up the essential generalization of map contents. Generalization activity at the particular stages of editing of maps is reflected in various research methods and forms of graphic expression (Fig. 2).

The process of map editing begins upon the rise of demand for the given map and undertaking of discussion on map contents and function. This determines to a large extent the choice of appropriate generalization activity.

Generalization activity changes according to the scale of the map, character of the phenomena, way of arrangement of objects and phenomena in the space, kind of source material etc. However, they usually stay unchanged at the successive stages of map compilation. This is illustrated by a general pattern of the process of editing and compilation of geographical maps.

STAGE 1. Expression of general conception of the map.

Programme of map editing which qualifies its assignment, subject-matter and title is prepared.

The main generalization activity at this stage will include synthesization of notions and terms, as well as categorization of elements of the map content.

STAGE 2. Elaboration of editorial instruction of the map.

Editorial assumptions qualify parameters of the map foreseen in the plan, including projection, map assemblage, method of graphical representation, division of the mapland into homogenous territorial units etc.

Generalization at this stage of map designing is realised by transformation of geographical space, classifying and clustering according to the similarity of their

Procedures of Generalization

Fig. 2. Schematic diagram of cartographic generalization — Essential methodology of investigation and modelling of reality

attributes as well as of structural units of a mapped territory. In this help will be given by standard specifications of details and features.

STAGE 3. Elaboration of cartographic code, i.e. system of cartographic symbolization.

Primary generalization activities in this case are symbolization and nomenclature of the phenomena presented, as well as grouping.

STAGE 4. Elaboration of a trial specimen of the map and compilation of specifications.

The merits complement of the compilation specification will be directions concerning sequence of insertion of the elements of map contents and examples of employment of such procedures of generalization as simplifying of the shape and filtering of details, as well as relocation of elements of the map contents.

STAGE 5. Editing of map content according to the compilation specifications using previously settled graphic means and cartographic methods of representation.

Map editing is realised by selection of complexity phenomena and portraying of selected phenomena on the compilation sheet. One important concept of map editing involves the presentation of map content as a series of visual planes, so as the most important information has to be shown on the first plan, while less important details may be shown on the second or even third plan.

It is well known that any generalization activities permit considerable freedom of selection of the manner of analysis of phenomena and objects represented, and handling of graphic means of expression. That is why the content of each map is marked by a considerable amount of subjectivity. To limit the role of subjective approach in map editing it is necessary to have a thorough knowledge of properties of methods of cartographic presentation.

If this knowledge might take the form of general rules defining the usefulness of the particular methods of cartographic presentation for the sake of representation of selected phenomena, the content of any map would have the value of a precise and objective (that is the clearest) description of results of scientific investigation of phenomena in geographical space.

Unfortunately, even such a domain as symbolization of cartographic information on maps does not have a universal character. However, graphic variables in the drawing of the map content express complex functional relationships between objects in a more many-sided and legible way than calculated statistical figures. Moreover, they do it with the highest possible (according to the map scale) location accuracy and saving most place on the map.

Therefore, until today, the elaboration of a universal and unequivocal way of presenting cartographic information on maps has remained the most responsible and open research task of modern cartography.