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**THE PARADOXES AND TRENDS IN THE DEVELOPMENT OF THE  
THEMATIC CARTOGRAPHY**

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Dans la cartographie thématique deux situations intéressantes paradoxales ont pris naissance: premièrement, son développement a été motivé et forcé pendant longtemps sans la participation des cartographes, pour la plupart par les représentants des autres disciplines (surtout par les géographes), et deuxièmement, que la cartométrie des cartes thématiques n'a pas eu lieu en tant qu'une parallèle de la cartométrie des cartes topographiques, mais c'est la méthode de l'emploi des cartes qui a pris naissance, c'est-à-dire, une sous-discipline de la cartographie sur un niveau plus élevé. Les tendances actuelles du développement donnent un tableau clair sur le fait que la cartographie thématique enrichit sans casse la cartographie générale de faits toujours nouveaux, accélère la naissance de la cartographie théorique et étargit expressivement l'objet et la méthode de la cartographie.

**AN INTRODUCTORY DELINEATION OF THE CONCEPT**

For thematic in general is considered every other map except the topographic one. From this delineation it results that the thematic cartography is that part of the general cartography (theoretical and practical), which deals with the problems of compiling and using the thematic maps. In this sense the thematic map and the thematic cartography are defined by the basic cartographical literature and the cartographical explanatory dictionaries, for ex., also by the Multilingual Dictionary of Technical Terms in Cartography [5].

**A SHORT STORY OF ORIGIN OF THE THEMATIC CARTOGRAPHY**

It is generally known that the object of cartography at the beginning was the graphical representation of the physical earth surface and objects on it in the map plane. Gradually as the human knowledge has been enriched, to which cartography as part of geography contributed markedly by its specific form of „earth descriptions“ and also in harmony with the enlargement of the technical maturity of the human society, was enlarged also the sphere of objects, represented on maps. For whole centuries the practical exclusive object of the map was only the representation, the illustration of the earth

{topographic} surface and of its physical existing objects and also to enable orientation on this surface, or to carry out some social necessary activities (trading, travelling, discovering unknown countries, gradual precision of our knowledge on the surface of the Earth—but also for making wars). At the beginning maps were made metrically very precise, schematic, true frequently but from the logical point of view. However, their gnoseological and direct utility value of that society was in nothing less important than is the task of the present very accurate maps.

The original function of the map—was to be relatively a practical and comprehensive implement, an aid to know the spatial distribution of objects important for man's orientation on the earth surface, or near the coast, on the sea—was but seldom affected by emphasizing or by graphical-illustrative preference of some of the elements of the map content. One of the first thematic maps at the turning of the Middle Age and the modern period was the road of Germany (Etzlaub, 1942—1501), based substantially on the example of the Roman-road maps of the *Tabula Peutingerianas* type, or on the example of portolanoes. It is not excluded that singly there occurred even sooner some thematically aimed maps. Even the „hunting maps“ of the palaeolithic and mesolithic man, as well as the „navigation maps“ of the Micronesian nations can be considered for the aboriginal predecessors of the thematic maps, occurring as naturally as did the aboriginal models of topographic maps. However, for purely thematic one can consider only certain maps which were made only in the 17th century. From 1643 is known the map of magnetic changes by Kircher A. and the road itinerary map of England by Ogilby J., from 1701—1702 again the map of magnetic deviations and directions of winds by Halley E. In 1726 there took origin also one of the first thematic maps of the territory of Slovakia—the mineralogical map of the Central Slovakia by Marsigli F. The isolines in the role of isobaths had been used for the first time in 1697 (for mapping the bed of the Mass river), as isohypses in 1791 and Humboldt A. used them purely thematically on his isothermic map in 1817.

The object of interest expressed on the maps began to be therefore not only the surficial phenomena, but also those above the surface and below the surface. From 1824 is known the geological map of Smith W, however, several endeavours to express the geological conditions by map are known also from an earlier period, even from the middle of the 18th century. In 1838—1848 Berghaus H. published in Gotha the known Physical Atlas (from the actual view point a complex thematic atlas), containing 90 sheets of non topographic (therefore thematic) maps grouped in 8 chapters, containing the climatic, meteorological, zoogeographical, geological, hydrographical, magnetic, phytogeographical, anthropological, ethnographic and other similar maps. In the second half of the 19th century the theme of the maps was extended also by the pedogeographical, oceanographical ones and what is particularly important, by the socioeconomical phenomena and characteristics.

The thematic maps began to accomplish (and are doing so at present) their important function; therefore they help to develop those sciences whose problems they express, which as a result of feed-back means the development of the thematic, as well as of the general cartography. The thematic mapping

has taken fully the road of development of the sciences and of the society and used according to the degree of urgency of ones or the other problems. For example, an organized continuous geological (thematic) mapping was started upon in 1832. As it is known in the present period, the thematic mapping what regards its volume and exaction does not defer to the topographic mapping.

## TWO PARADOXAL SITUATIONS IN THE CARTOGRAPHY CAUSED BY THE DEVELOPMENT OF THE THEMATIC MAPPING

From conservative or other reasons many cartographers (in some countries more, in others less) continue to consider for the principal object of the cartography specific, proper only to cartography logic-metric, graphical, lessened and generalized plane representation of phenomena and objects of the earth surface (or of the surface of other airspace bodies). The representation by means of maps of subsurficial, above surfical or other „super-structural“ locally related with certain selected elements of topography, were not considered for a long time as a fact worth of attention, regarding the cartography. It was taken as an imitation, application of topographic principles in representing the non topographic phenomena, meanwhile these „simulations“ were not even considered for maps, but some schemes, cartograms... The whole thematic cartography began to develop in a quite isolated way from the „proper“ cartography (today it is called the topographic cartography).

The need of the „mapping“ principle of representation and interpretation of non topographical phenomena with the development of the society was always increasing and with the compilation of thematic maps, even with a whole systematic mapping were dealt further on by non cartographers, i.e. by the representatives of other scientific and practical disciplines. From time to time they succeeded to gain for the cooperation several cartographers (topographers-draughtsmen). There occurred the *first paradoxal situation*: the non cartographers were dealing with the complication of thematic maps, with the development of thematic cartography! This state made a marking progress at the beginning of the present century and culminated before the Second World War, or in a larger scale only after it, when the non topographical maps began to be indicated as special (in the USSR) or thematic (in the West) and the thematic (economic, special) cartography as part of the cartography. However, there persists a distrust in the mind of many cartographers, as an heritage of the past, even as a step-motherly surliness toward the thematic cartography, when such an important question as is the development of specific cartographic methods of representing thematic phenomena they consider as a marginal one for the cartography.

As the result of a considerable and always increasing expansion of the thematic cartography there began to come forward the question of the use of thematic maps. For the use of topographic maps there occurred a subdiscipline — the cartometry whose object became the various measurements on the maps (lengths, angles, surfaces). The way from these cartometric operation was not long to the various specific ways of using the topographic maps, for ex., for the demarcation of all types of constructions, for the calculations of the volume of soil or other engineering works, etc. The develop-

ment of thematic maps caused also the *second paradoxal situation*: the ways of using the thematic maps were not developing for long time, an analogous situation was not taking place as in the case of the cartometry of topographic maps and in relation with it the utilitary application of topographic maps. It caused a disharmony in the thematic cartography approximately in the sense that many thematic maps were compiled as „only for themselves“, between the individual themes regarding the map interpretation there occurred considerable intervals, gaps, certain tendencies progressed, others stagnated.

## THE SOLUTION OF THE FIRST PARADOX

At the beginning the problem of the thematic cartography was appearing in the cartographic text-books only very sporadically. It will be enough to look in the older cartographic literature and follow the track what positions were taken in various periods and in various countries in regard to such pure non topographical cartographical approaches of expression (ways, methods), as are, for ex., the cartogram, cartodiagram, non topographical applications of isolines, etc. The indication, for ex., of the cartogram (choropleth map) or of the isoline-isostratum maps (isopleth map) as something inferior, schematic, second-rate in comparison with the topographical map had come down for a very long time, it persists here and there even today.

The pioneer of the theoretical generalization of the existing state and by it of the solution of the first paradox was Baranskij N. N. [2], who within the frame of the subdiscipline—the economic cartography—created by him, took a correct standpoint to such particularities which became later the most characteristic distinctive features of the thematic cartography, as are the special graphical approaches and representation methods: the dot method, area map method, qualitative map method, cartogram, cartodiagram, single line map method, etc. But already in the 1960-s, therefore approximately 10—15 years ago were published the remarkable monographies from the sphere of the thematic cartography of Arnberger E. [1], Witt W. [10], Imhof E. [4], and others, which generalized and systemized the potential of facts from this sphere accumulated by the development—which in the end is a normal phenomenon—the consequence of the development of each discipline. Even if these monographies and the methodic publications published after them differ considerably from each other (they crystallized the difference in the conception of certain serious theoretical questions in various cartographic schools), yet it is clear that the first paradox was solved by them, i. e. the routine cartographers took in charge the further development of the thematic cartography and the thematic cartography became a remarkable and even a motive power of the development of the present cartography. The question of the topographic cartography, i. e. the topographic compilation of maps, thanks to the technical progress, became a matter of mechanization and automation, use of air and aerocosmic photographs, i. e. a great part of its former problems became only a skillful craft. And the contrary, the thematic cartography caused that the cartography and geography come again close together, because there arose before them a whole series, and even spheres of common interests and problems. The origin and activity of the

International Cartographic Association (I.C.A., 1961) follows and supports fully this trend in the orientation of the present cartography.

## THE SOLUTION OF THE SECOND PARADOX

The solution of the second paradox, i. e. whether a certain „cartometry of the thematic maps“ should take place or not, was much slower and appeared only recently. It was considered for a long time and it is still considered even today, whether the problem of map use should form part of the object of cartography or not. The answer to this dilemma is not simple at the first sight. In the life we will find many examples, visibly analogous, but giving the opposite answers. Thus, for instance, it is not usual for the producer of cars (or of a whole series of other products) who would seize wrongfully the right to make a decision on problems, spheres and conditions of their use. Their use is still competently a much larger problem. Another analogy can be looked for in some one of the sciences, for ex., in mathematics. The development of mathematical approaches (deriving of formulae, mathematical formulation of laws) appears to be purely a mathematical matter, but the problem of applicability of their use touches the mathematics only marginally, or obviously it does not belong to it. From the „thematic“ mathematic occurred independent disciplines, as are the statistics, economics, meteorology... but even the mathematical cartography, the mathematical geography, etc. A certain, but not quite similar analogy between the mathematics and the cartography there is here. The thematic offsprings belong to the mathematics (even to the cartography) by their form-method, but they belong to other disciplines by their object theme.

The impulse to the solution of the map use question was given by Prof. Saltichtchev [7] in 1955, however a real proof that the *method* of this use belongs fully to the cartography given under an active contribution by Prof. Salichtchev, A. M. Berliant [3], who teaches this problem at the Moscow University as an independent subject-matter since 1970 under the name of the „Cartographic Method of Research (in Russian „isledovanija“) The name of the subject-matter need not be identical to the name of the cartography subdiscipline, but substantial is that its viability is confirmed by the time test. According to this solution the theoretical potential of the cartography is enriched by such methodical approaches to the analysis and to the use of the cartographic representation, as are descriptions, various graphic approaches (profiles, cross-sections, graphs, diagrams, blockdiagrams, graphic addition and subtraction of isoline surfaces, etc.) graphical-analytical processes (cartometric and morphometric methods, including in the determination of averages, densities, frequencies, delineations, etc.), mathematical-statistical processes (determination of various statistical coefficients and criteria of correlation), as well as the morphometric processes (determination of criteria of the homogeneity, differentiation and of other similar properties).

## THE TRENDS IN THE DEVELOPMENT OF THE PRESENT CARTOGRAPHY

If in the recent years have been solved two, it can be said centuries old problems of relationship between the cartography and the thematic carto-

graphy, it does not mean at all that calm and equilibrium set in this double-relationship. It is generally known that the development of facts in the world is considerably inconsistent, even when many of the recent achievements are moderating it constantly. In spite of the rapid flow of informations, some of the scientific successes are not becoming automatically and at once the property of all those interested in, because there exist various causes which make doubtful their relevancy. It takes frequently several years, even whole decades, before the theoretical progress in on or the other discipline can be defined and considered as objective, general and irreversible.

In the last 10 to 15 years the cartography found itself under a strong influence of the theory of informations. On the exaggerations and wanders of this application in cartography has already been written [6], based partially on an identical contrary standpoint of Prof. Salichtchev from 1973 and 1975 [8, 9]. Finally the already mentioned Berliant A. M. had pointed very realistically to the so far most efficient place of this theory in the cartography [3], i.e. it is in the sphere of the analysis of certain quantitative characteristics on maps. In the present period the application of the theory of informations in the cartography has grown into the problem-theory of the cartographic communication, within which again many searches ended in the problem-theory of map perception. To this last problem was devoted also one of the principal themes of the International Cartographic Conference in Washington in 1978. The attention of a considerable number of cartographers in many scientific and production institutions was directed to the-analysis of the process of perception, grasping and functioning of the graphic method of expression in the cartography. The use of a considerable quantity of symbols and various graphic approaches to indicate various significances has rectified in itself the cartographic researches towards the semiology, psychology, to the theory of knowledge (gnoseology), to the logics. From a similar interdisciplinary perceived approach it is not far to the language theory of the cartographic interpretation (to the map language, to the cartographic language) if to the interdisciplinary approach we add still the theory of systems and the linguistics. On the other hand, if we give in this approach a larger space to cybernetics, we will find ourselves on the position of the theory of the cartographic modeling as a methodic approach to the description of a certain spatial reality or hypothesis. Within this theory the greatest attention so far is paid to the mathematical-cartographic modeling, though its traditional manual-graphic forms have not yet exhausted all their potential possibilities.

A question for the sceptics: would it be possible that this trend had affected so strongly the cartography if it had remained solely classical (topographic)?

## CHANGES IN THE STRUCTURE OF THE CARTOGRAPHY

We mentioned that in relation with various disciplines the cartography plays a similar role as the mathematics: formally-methodic. The problem of the cartography is sometimes considerably stigmatized by its theme, even there appear in it methods-ways-approaches, which are quite narrowly spe-

cialized. It is not to be wondered at in the mathematics that certain mathematical methods (laws, formulæ) are meant for a limited sphere of roles, for ex., the theorem of Pythagoras is solely for the determination of sides and only in a right-angled triangle, and it does not serve for the calculation of, for ex., the surface of an arbitrary triangle, n-angled, etc. We know for what the differential, integral calculus, the spheric trigonometry can or cannot be used. In the cartography there occurs (even if in a far lesser measure) an analogous situation: some means of expression and methods of graphic representation are sufficiently universal as to be able to use them to indicate and interpret cartographically a very wide sphere of phenomena, others on the contrary, have a relatively narrow sphere of use. The first expressive change, which the thematic cartography brought with it into the general cartography, was the system of various expressing methods of a varied degree of universality.

The second significant change in the cartography was the enlargement of its object, i. e. an important change in its extent. We have already mentioned that the object of interest of the cartography for whole centuries was the representation of the earth, topographic surface. The extension of the cartography object also to other space bodies and the relationships between them would have probably brought a general progress into the cartography even if it had remained only a topographic cartography. Certainly the extension of the cartography object also to the space quality and quantity, or to spaces of various qualities and quantities — is the merit of the thematic cartography. Meanwhile in this new object figure not only the traditional and physically real existing objects, but there are in it also the abstract phenomena, concepts and characteristics, the existence of which is frequently controversial, debateable, hypothetical.

It has been affirmed till now (and frequently affirmed inconsiderately further on) that the map „represents“, i. e. it does something visually illustrative. Such an affirmation has already lost its general character, because it holds only for a narrow sphere of some objects (constructions, residential areas, mountains, etc.) certainly even this usually on the maps of large scales, because how can it be possible „to represent“ the air pressure, the temperature of the surface or subsurface underlier, the coefficient of evapotranspiration, the modulus of outflow, the character of differentiation, the diagnosis, the correlation, etc., i. e. things which have no real expression, physioenomy, form, or other indication imaginable by man?! In spite of it similar phenomena are expressed on the maps, but it is not a representation, because the replacement of these phenomena for the cartographically expressing (and in their substance conventional) means is a new, higher form of representation — a cartographic interpretation! It is only one of the several substantial proofs of various changes which were brought into the cartography by the thematic cartography.

Thanks to it the cartography changed imperceptibly from the ordinary service discipline into a scientific discipline in which formed a wide component of a theoretical potential — the theoretical cartography, the cartology. Within it, apart from certain common and integrating areas (axiomatics, terminology, etc.), formed already 4 markedly independent theoretical-methodological spheres — subdisciplines of the theoretical cartography: methods

of the mathematical-cartographic projections (incidentally formed several centuries ago and still recently considered as the unique theoretical subdiscipline of the cartography), methods of generalization, methods of cartographic interpretation and methods of map use.

## THE RELEVANCE OF DEVELOPMENT OF THE METHODS OF CARTOGRAPHIC INTERPRETATION

We are of the opinion that the development of cartographic interpretation is one of the most underestimated subdisciplines of the cartography. On the thematic maps we can often witness examples of a primitive approach to the graphical-informative side of the problem, theme. Frequent are the cases that a map or a map set of excellent content are of an under average level from the cartographical-interpretation stand point. The causes are various. One of them is also the fact that the graphic side of the map was always considered as a routine affair, acquired by practice (similarly as the generalization on the map), meanwhile decisive as a rule were always only the personal conditions (talent) of the individual. For a relatively low and specific need of maps of the society (in comparison with the industrial products or with the works of the culture) map production remained for long centuries in general the affair of a narrow circle of specialists. To a wider extension of map compilation in the civil life stood in the way also the fact that the compilation of topographic maps (from which are usually derived documents for the thematic maps) was strategically and tactically important from the military stand point. It is why the organization of teaching the cartography was first started at the military schools (and naturally for military needs) and the education of civil cartographers was organized but singly. Even today the cartography is not a current discipline at the high schools, but rather a Cinderella.

The needs of the thematic cartography in this sense caught the cartography unprepared. The reorientation of the „topographic“ cartographers into special, thematic ones was taking place slowly, sporadically and in substance even these were drawing only from the heritage of the past. Therefore it is no wonder that the graphical side of information they were solving simultaneously with the theme mostly the representatives of other disciplines (geographers, hydrometeorologists, botanists, pedologists, statisticians, etc.). The greatest „hunger“ for expressing methods had those disciplines which required an interpretation of the socioeconomic characteristics. For lack of other possibilities a forced conventionalization was started on such maps, there began to occur complicated, illegible and even illogical maps. Let us cite at least one example: the portion cartogram of individual professions (of the economically active population, students, etc.) from the total number of the population *according to administrative units!* Of a quite frequent case is the illustration of characteristics of the population (but also of the economy, of the non production sphere, etc.) in any of the thematic atlas, so it is not necessary to give a concrete source. It is known nowhere in the world the administrative units have their extent exactly proportional to the number of inhabitants (in the gross production value, etc.). It is why even the expres-



sion of portions of such spaceless phenomena is not desirable to give in the spatial (administrative) units. Thanks to the metric properties of the map there occur distorted illustrations—interpretations of phenomena and of their characteristics, such maps-cartograms express something quite different as is ascribed to them. There occur a forced convention—something similar as is the affirmation that the shorter sides of the rectangle are longer, that blue is red, etc. In the given case the method of the cartogram is wrongly applied and for the logical interpretation of the phenomenon it is necessary to use the method of the cartodiagram cartogram, some of the anamorphous methods, or it is necessary to search for new graphic expressing methods. But the interpretation possibilities of the map are still far from being exhausted.

When we recall to ourselves the development of the thematic cartography and mainly the persons who contributed in a major part to its successes, we must state with recognition that they were mostly geographers who developed it in its width and depth. It is an irreversible fact. Even in the present time the cartography, in its wide conception, compared with the other disciplines, needs the most of a cooperation with the cartographers, for which it presents always new and new problems. They are the problems which they are not in a state to be solved by individuals, particularly by the geographers or independently from them by the cartographers. On the contrary, the most suitable appears the way of mutual coaction and cooperation, meanwhile it is not a matter of a mechanical division of work, but of a deep integration.

#### REFERENCES

1. ARNBERGER, E.: Handbuch der thematischen Kartographie. Wien 1966, 554 p. —
2. BARANSKI, N. N.: Ekonomičeskaja kartografija I—III. Moskva 1939—1940. —
3. BERLIANT, A. M.: Kartografičeskij metod issledovanija. Moskva 1978, 256 p. —
4. IMHOF, E.: Thematische Kartographie. Berlin—New York 1972, 384 p. —
5. Multilingual Dictionary of Technical Terms in Cartography. Wiesbaden 1973. —
6. PRAVDA, J.: Gnozeologicko-semiologické aspekty kartografického vyjadrovania. Geodetický a kartografický obzor, Nr. 1, 1979, pp. 2—7. —
7. SALICHTCHEV, K. A.: O kartografičeskom metode issledovanija. Vestnik Moskovskogo universiteta, seria fyz. mat. nauk, Nr. 10, 1955, pp. 161—170. —
8. SALICHTCHEV, K. A.: Nekotoryje čerty sovremennogo razvitija kartografii i ich teoretičeskij smysl. Vestnik Moskovskogo universiteta, seria Geografija, Nr. 2, 1973, pp. 3—13. —
9. SALICHTCHEV, K. A.: O kartografičeskom metode poznania (analiz nekotorych predstavlenij o kartografii). Vestnik Moskovskogo universiteta, seria Geografija, Nr. 1, 1975, pp. 3—10. —
10. WITT, W.: Thematische Kartographie. 2. Auflage. Hannover 1970, 1248 p.

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#### PARADOXY A TRENDY V ROZVOJI TEMATICKEJ KARTOGRAFIE

Tematická kartografija je kartografiou netopografických máp. Jej pôvod pramení hlboko v histórii, pretože mnohé z najstarších kartografických pamiatok (lovecké, cestné, plavebné a iné staré mapy) boli vlastne účelové, mali zvýraznenú netopogra-

fickú tému. Avšak o tematických mapách z dnešného hľadiska možno hovoriť až začiatkom 17. storočia [1643 — magnetická mapa A. Kirchera, cestná itinerárová mapa Anglicka J. Ogilbyho, 1701—1702 — mapy magnetických odchýlok a smerov vetrov E. Halleyho a pod.]. Teší nás, že medzi pionierske počiny môžeme zaradiť aj mineralogickú mapu stredného Slovenska F. Marsigliho z r. 1726. Prvé geologické mapy vznikli v polovici 18. stor., známa izotermická mapa A. Humboldta pochádza z r. 1817, organizovanie súvislého geologického mapovania sa datuje rokom 1832, prvý komplexný tematický atlas (pod názvom *Fyzický atlas* H. Berghausa) bol vydaný v Gothe v rokoch 1838—1948 atď. Rozvoj tematickej kartografie nezadržateľne progresoval, ale jej prvý rozvoj nastal až po II. svetovej vojne.

V rozvoji tematickej kartografie vznikli dve paradoxné situácie: po prvé to bol fakt, že sa forsírovala dlho bez účasti kartografov, odborníkmi iných disciplín, a po druhé, že kartometria tematických máp nevznikla ako obdoba kartometrie topografických máp, ale vznikla disciplína vyššej úrovne — metodika využívania máp. Riešenie týchto paradoxov sa začalo nedávno, prakticky pred 10—20 rokmi, kedy boli vydané kapitálne monografie z tematickej kartografie [Arnberger, Witt, Imhof a ďalší]. Tieto jednoznačne vymedzujú miesto tematickej kartografie v rámci všeobecnej kartografie. K riešeniu druhého problému prispeli najmä sovietski vedci [Sališčev, Berljant], ktorí konštituovali nový predmet „Kartografická metóda výskumu“ na Moskovskej univerzite.

Súčasný trendy rozvoja dávajú jasný obraz o tom, že tematická kartografia obohatila a obohacuje kartografiu o množstvo teoretických poznatkov, prístupov a metód, že podnecuje kumuláciu teoretických poznatkov a napomáha rozvoj kartografie ako vedeckej i praktickej disciplíny.