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EIGHTH INTERNATIONAL CARTOGRAPHIC CONFERENCE
Moscow, USSR August 3—10 1976

**COMPILATION OF SMALL-SCALE THEMATIC
MAPS AND ATLASES FOR THE NEEDS OF
GEODESY AND CARTOGRAPHY**

Paper submitted
by Senior Research Associate
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PEOPLE'S REPUBLIC OF BULGARIA
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Sofia, 217, 9-ti september boul.

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In the last few decades thematic cartography has marked a particularly wide development. Thematic maps and atlases for most diverse purposes and with a most diverse content, which meet the needs of many fields of science and practical life have become a common phenomenon. But with only a few exceptions, so far no one has proceeded to the construction of specialized maps and atlases for the purpose of meeting the needs of geodesists and cartographers in the basic fields of their practical work (fundamental triangulation measurements, levelling measurements, measurements in the field of physical geodesy, satellite geodesy and observations of the Earth's artificial satellites, distance measurements with the help of such satellites, photogrammetry and cartography).

The cartographic method of research is used by a number of natural and social sciences, but however strange this may seem, cartographers have so far insufficiently made use of their own method for the needs of their own practical geodetic and cartographic work.

The development of cartographic methods, the tremendous possibilities revealed by the modern information systems in the field of geodesy and cartography, make real and useful the idea of the development of a new branch of thematic cartography, aimed at meeting the theoretical and practical needs of geodesy and cartography.

1. Character and purpose of the maps and atlases.

Every trend in thematic cartography meets the needs of certain fields

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of science and practice, of a certain circle of specialists. The thematic maps and atlases, the construction of which is proposed, must first of all satisfy the demands for a further development of both theory and practice in the field of geodesy and cartography, supplying to the specialists in these fields information which they need for their everyday work.

Usually maps and atlases depict individual natural and socio-economic phenomena or their combinations, of which they are a kind of cartographic models. In the maps and atlases intended for geodesists and cartographers, we shall have, not only and not above all, a cartographic presentation of socio-economic phenomena, but very often such presentations of the basic results of the mapping of most diverse objects and phenomena.

Depending upon their destination maps and atlases with a subject-matter of their own, a territory and scale of their own will start making their appearance. The character of the mapped object, the practical significance of these maps, and the method of using them make in most cases necessary the construction of maps of vast areas and on a small scale. We have in mind here maps and atlases embracing the whole globe of the Earth, groups of continents or countries and in less frequent cases an individual country.

If we attempt to forecast to a certain degree the ways of the further development of this branch of thematic cartography, we might say the following: small-scale thematic cartography for the needs of geodesy and cartography will clear up the categories, the classification and standardization of cartographic phenomena, of the presentation methods, and of the maps. In helping in this way mapping on a larger scale, small-scale mapping will

receive from cartography on comparatively larger scales more exact demands on the content, the characteristic features of the phenomena and the methods of their practical utilization. In this way, there is a two-way link between small and larger scale maps.

The subject-matter of the maps and atlases is determined by the basic branches of geodesy and cartography, and the fields in which the making and the use of the maps is justified and expedient. There is a need (and we shall show this further down) of series of maps to serve scientific research and the practical problems in almost all more significant branches and trends of geodesy and cartography. This presupposes that these maps and especially the atlases shall be "special" and "complex".

Future practice may perhaps impose the differentiated making of individual atlases: "for the geodesist", "for the cartographer", "for the photogrammetrist", etc. At the present stage of the development of these sciences, we think that the most topical thing is to proceed to the making of separate series of maps, which when possible could be collected into corresponding national or regional atlases, as well as into on "world" and "complex" atlas, in the sense of uniting the demands of the basic trends in geodesy and cartography.

2. Basic trends in thematic cartography for the needs of geodesy and cartography.

The practical needs and most of all the experience in using the maps intended for the needs of cartographers, will show the exact framework of their subject-matter, scope, content and design. A number of questions, however, can and must be settled on the basis of the experience gained so

far in cartography, in making the maps and atlases, and in the existing practice in the planning and carrying out of geodetic and cartographic work.

Practice and scientific investigations in the field of geodesy and cartography are familiar with such basic activities as: analysis of historical experience, investigation of existing materials, assessment of the objective factors (natural, technical, socio-economic), exerting influence on these activities and their planning. Depending upon the scope and character of the work, these factors assume a significance of varying value.

In general, these basic factors and activities may also indicate the basic trends of the examined thematic cartography. Cartography in these basic trends can be realized in individual, independent maps, and in atlases of a national, regional or global scope with a narrower or wider subject-matter. We shall point out some of the possible basic trends.

2.1. Historical trend.

The making of maps and atlases on the history of geodesy and cartography will be aimed at acquainting the readers with the development of the basic stages of geodetic and cartographic work in the respective region. In mapping this trend, the basic trends in the development of geodesy, of astronomic and geodetic measurements, of topographic work, mapping on a small scale and in the field of thematic cartography, of photogrammetry and satellite measurements, etc. will have to be shown in their territorial aspect and in the aspect of time.

Historical mapping of geodetic and cartographic work may give a methodically correct picture of the development of these processes, of the basic

trends in them, which is not only of general educational significance but is also of substantial value to the scientific analysis of the historical development in these regions. Soviet cartography has given us an example in this respect with the "Atlas of the History of Geographical Discoveries". Although it does not examine specially the history of geodetic and cartographic work, the subject-matter of this atlas in many respects hints at the content and character of the maps and atlases which might examine this problem within the scope of geodesy and cartography. Many of the national atlases contain so-called sections on "the history of the map" of the respective countries, which sometimes give information on and analyse the history of cartography in these countries. Maps with a similar content are also contained in some more general atlases. Thus, for instance, in the Soviet "Atlas of Africa" (1968) is included the map "Most Important Voyages and Discoveries in Africa" (p.3) in which the picture of the cartographic studies of Africa by 1910 is also given. Furthermore, on page 50 of the same atlas is given the map "Topographical Studies of Africa, 1966". These examples are sufficient to show the real and wide possibilities which are revealed to the historical trend in the mapping of geodetic and cartographic work. They could be realized in a most diverse scope in maps or atlases for different historical periods. Of doubtless interest, for instance, would be the mapping of the tremendous, epoch-making work on the making of maps for the vast territory of the Soviet Union after 1917. These works would map out the great creative activity of geodesists and cartographers which is of world significance, and which preceded every cultural advance into the new territories, and in our times is making its first steps in mapping the other

planets of the solar system.

2.2. Astronomic and geodetic trend

The maps of this trend are intended to give the reader an idea about the present state of these measurements, as well as to show the more essential factors for their performance. Maps can be included here, which will show both the configuration and the character of the astronomic and geodetic networks.

An important place among these maps should be set aside for triangulation measurements. Indicated on the maps can be the initial points of the triangulation network, the character of their orientation (astronomical and local), the kind of networks (triangles, quadrangles, polygons, etc.); the class character of the networks, with indication of the number of their classes and their accuracies; maps with data on change of refraction with a view to the astronomic and geodetic orientation of the triangulations, etc.

Special attention should be accorded to geodetic gravimetry and cartography of the state of the fundamental gravimetric measurements. Of significance to practice is the pointing out of the kind of apparatus with which the measurements are made, the density of the gravimetric networks, with what corrections the gravimetric maps are made, etc.

In the last few years remote tellurometric and photometric methods have been widely applied in practical geodetic measurements. For the successful application of these methods it is of particular significance to take into account a number of external factors. Such factors as humidity,

temperature and atmospheric pressure are of great significance for the most exact determination of the velocity of spread of electromagnetic waves at the moment when this velocity is measured.

These factors which are distributed in space can and it is expedient for them to be cartographed for the needs of remote measurement. Of significance are also such factors as the character of the underlying surface, certain peculiarities of the soil, etc. which may influence the spread of radiowaves.

The remote photometric measurements are characterized by the fact that for the time being it is considered that a limit has been reached to a remarkable degree in the technical improvement of the instruments. The barrier that has been reached in the exactness of the measurements can be overcome precisely by taking into consideration the external factors, which should constitute the object of special thematic mapping.

In the examined field of cartography for geodetic purposes, the mapping of those factors that are of significance for the levelling measurements must also be included. Besides the task of mapping the basic characteristics of the levelling networks which are to be similar to those of the triangulation networks (configuration of the networks, accuracies, classes, etc.), of interest in this connection is the mapping also of such natural conditions which are of significance for levelling, such as characteristics of earthquake regions, the depth at which the soil freezes, etc.

Considerable stress along this line should be laid on the mapping of the conditions which are of significance for cosmic geodesy and the observation of the artificial satellites of the Earth. The themes and the content of the maps in this case will be determined by such factors as, for instance:

the number and location of the stations for the observation of the artificial satellites of the Earth, the character of the instruments used, the altitude above sea level of the stations, the number of clear nights in the different regions, the time of the rising of the sun in the different regions (and stations), with a view to achieving synchronous observations of the artificial satellites of the Earth, the misty days and nights, etc.

2.3. Photogrammetric and long-distance investigations trends

The taking of aerial and photogrammetric pictures of the Earth's surface from cosmic space depends in large measure upon the natural and socio-economic factors which can be mapped and can then successfully be taken into consideration in planning and carrying out these measurements. The high value of the measurements, the complex character of the instruments used and several other factors convincingly hint at the expediency of a cartography made in for the benefit of aerial photography.

The altitude of the terrain with a view to determining the altitude at which the aircraft taking the aerial photographs are flying, the number of sunny days, the velocity and direction of the wind, the cloudiness with a view to determining the best-suited time for flying, etc. are factors which are most directly related to photogrammetry. The range of themes can be completed with a number of more specific problems, such as the inclines of the terrain, the character of the cast shadows, the reflecting properties of the soil, the character of the vegetation, the periods and the degree of its fallen leaves, etc. Of significance are also some "social and technical

factors", such as the height to which rise the buildings in the inhabited places in connection with their aerial photographing, etc.

It should be noted that all natural and socio-economic phenomena which we have pointed out so far as suitable themes for cartography should be duly classified and characterized for the needs of geodesy and cartography.

2.4. Cartographic trend

The cartographic trend offers the most and most diverse themes to cartography. This is determined by the great variety, the wide scope of cartographic practice and the diverse themes of the cartographic works. The use of the maps destined to serve the editorial and construction processes in cartography may be essential. We all know of the practice widely to search for and make of initial materials, and the latest information, and of the borrowing methods of portrayal in cartography. These important but scattered pieces of information can be compactly systematized on maps reflecting the state and character of the mapping of vast territories. The structure and concrete themes of the maps along this line could be determined by the basic stages in cartographic work, namely; editorial- investigative work and study of the cartographic sources, selection of the mathematical foundation of the maps; construction of a hydrographic network and one of the relief, communicating roads, inhabited places, boundaries, soil and vegetation cover, inscriptions of names. These are the most general trends in cartography, which are of significance both for general geographic and for thematic cartography. In many cases even until now cartographic practice necessitates the construction of maps and schemes which help

the editorial and their drawing. This is very often practiced in the construction of large cartographic works. Such investigations have been carried out and special maps and schemes have been made, for instance, of the population and the inhabited places in the world in connection with the construction of the "World Map - M.1:2 500 000". Sometimes such investigations and the corresponding drawing of maps is also made for smaller regions. Such maps were made in studying the character of the hydrographic network of Bulgaria for the purposes of small-scale cartography.

There are many examples, in which mapping the relief, the communication network, boundaries, etc. maps and schemes are made, classifying and distributing the phenomena with a view to their cartographic presentation. It is only to be regretted that most of these investigations and special maps made in connection with them are accessible to only a limited circle of cartographers. In a number of cases they are performed for a second time for one and the same territory, and time and money are necessarily spent again for this purpose. On the other hand, in cases when these investigations are omitted for the sake of economy, the quality of mapping is not up to the mark.

Many elements of the natural and socio-economic environment assume a specific characteristic, which helps cartographic work. Thus, for instance a number of quantitative and qualitative characteristics of the river network such as density, average length of rivers, average bend of the river beds, the character of their feeding with water and the water regime of the rivers are of direct significance for their cartographic presentation and can

be expressed cartographically. In the same way a number of quantitative and qualitative characteristics of the relief are of essential significance for its presentation on the maps.

The Cartographic representation not only of the natural but also of a number of socio-economic factors, as we have already pointed out, is of direct significance for raising the quality of cartographic work. Specially constructed maps for the inhabited places with their characteristic as regards density, size, character of settlement, etc., would be of great use in cartography. The same is the case also in mapping a number of other phenomena.

As we have already pointed out, in the field of thematic mapping, the themes and the diversity of the problems are far wider. Even the mere presentation of certain basic trends in thematic mapping, the indicators, the detailed character and methods in which it has been performed, would be of essential importance for future cartography.

Today, when cooperation, standardization and interaction in the field of cartography assume particular importance, thematic cartography in our own cartographic field may play a very positive role. May be one of the most accessible and easily achievable experiments in this respect would be the mapping of the condition and peculiarities of the realized complex national atlases in the world. The initiative taken by Dr. Stams (GDR) along this line must be unreservedly supported.

The maps and atlases of geodesists and cartographers ought not to contain mainly reference data which can be found in textbooks and manuals. Naturally, as in every atlas so also in these atlases it would be useful to include a number of statistical, bibliographic, technical and reference data.

But it is not this that will determine the character of the maps and atlases. The basic content should consist of maps which will reflect the natural, socio-economic and technical conditions (including the apparatus and cartographic works) in their spatial distribution, classified and systematized for the purposes of geodetic and cartographic practice and research.

3. On certain forthcoming tasks

The construction of thematic maps for the needs of geodesy and cartography maps out a new trend in thematic cartography. The new subject-matter of cartography sets for solution a number of problems connected with the classification, destination, content, form, methods of use of this type of atlases and maps. Practical needs will without any doubt necessitate a new terminology, connected with this mapping.

All these problems could be most correctly resolved with the active participation of the International Cartographic Association (ICA), with the international cooperation of cartographers. A number of problems connected with determining the use, character and content of the maps and atlases, as well as that of a unified terminology should be solved with the active cooperation of such organizations as the International Federation of Geometers (FIG), the international Society of Photogrammetrists, etc.

The new trend offers wide possibilities for research and mapping which can be implemented on the basis of both national and many-sided cooperation. As has already been indicated, maps and atlases may be made, which serve the different trends in geodesy and cartography or on a wider, complex basis. In most cases there exists a general tendency in geodetic and

cartographic practice, to solve all problems by proceeding from the general to the particular. On this basis, as well as from the concrete analysis of the practical needs, we may conclude that it would be useful to start working on the construction of a world atlas of the geodesist and cartographer. It should be noted that a considerable amount of information, data and even maps, schemes and tables exist or have even been published in a number of official publications all over the world. The collection, systematizing and visual presentation of these data in a "World Atlas of the Geodesist and Cartographer" would be welcomed with interest by thousands of specialists, not only in the field of geodesy, cartography, photogrammetry, etc., but also by many specialists in sciences close to these fields of science. It may with great probability be said that the work on the making of an atlas will achieve besides its concrete results (the making of the atlas), also a number of generalizations, affecting the most general problems of the examined trend in cartography for the purposes of geodesy and cartography.

A number of problems on the construction of maps and atlases would be solved most successfully and easily with the close cooperation of the permanent commissions and working groups at the ICA. We consider it as expedient that it should be proceeded to the solution of the following major problems:

1. Thorough elucidation of the theoretical and practical foundations of the emerging trend of thematic cartography for the needs of practice and research in the field of geodesy and cartography.

2. Elaboration of a thematic plan and basic principles for the

construction of a "World Atlas of the Geodesist and Cartographer." This task includes the complete elucidation of the themes, cartographic means, and methods of using the maps in practice.

3. The character of geodetic and cartographic work, its global scope and the uncontested advantage of international cooperation in these fields call for these tasks to be resolved with closest coordination and mutual assistance. The working-out of the theoretical, research and construction tasks along these new lines and on the proposed atlas would most effectively be solved within the framework of a work group of the ICA.

4. The financing of these activities could be effected both within a national framework, within a framework of the ICA and with the support of some of the organizations of the UN, insofar as this activity is aimed at the technical progress of all mankind.