

CONCEPTS FOR THE TEACHING OF THEORETICAL CARTOGRAPHY

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Abstract

The goals and character of academic studies in cartography demand a fairly high proportion of theoretical components in the cartography curriculum.

Since 1993 the author of this contribution has been teaching the basic theories of map design and of map use in two parts. The first part encompasses the object and role of theoretical cartography, including the history of theoretical cartography, model theory, sign theory (carto-semiotics) and communication theory. The second part deals with the theoretical principles of map use - functional theory of perception, epistemology - and concludes with an introduction to empirical cartography.

1 The term 'theoretical cartography'

Numerous natural and technical sciences contain a branch which is orientated towards theory (theoretical physics, theoretical computer science, theoretical geodesy architectural theory, etc.). This generally, while not in all cases, entails the mathematical modelling of scientific interconnections and regularities; it is ultimately a system of confirmed scientific expertise about the essential interconnections between facts in the science in question.

There have been grey areas and misunderstandings in the past on the subject matter of theoretical cartography and on what its tasks are. FREITAG (1991) is one of the authors who has made explicit reference to this. The definition of the term which appears in the "Multilingual Dictionary of Technical Terms in Cartography" (ICA / ACI, 1973) was even deemed unacceptable when the book was brought out. The main problems which brought about the misunderstandings were the unacceptable equating of science and theory and the different interpretations of the contents and categorisation of theory and methodology (OGRISSEK, 1983 and others).

To this day, theoretical cartography remains one of the branches of cartographical science which attracts a number of different interpretations. They relate, for example, to the role of empirical interests in theories, methods of developing theories (inductive-empirical and deductive), the role of semiotics and linguistics, as well as the role of mathematics. To an extent, these have given rise to their own fields of research. We should also mention that, at times, too much emphasis has been placed on cartographic communication and on gaining cartographic epistemology.

Nevertheless, theoretical cartography was developed to such an extent in the 80s that there was general consensus that it was based "on a hierarchy or a network of concepts and part theories relating to information, signs, models, communication and cognition" (FREITAG, 1991, p. 47). BERLJANT's monograph (1993) can also be included here, the principles of which were published back in the 80s.

This also relates to the system of geo-iconics, as part of the BERLJANT's overall theory. However, the conditions of digital cartography and geo-informatics have had a marked impact on development trends in the 90s.

Regardless of how theoretical cartography continues to develop, its role in the (closely intertwined) system 'cartography as a science - cartography in practice' is currently relatively clear (Fig. 1):

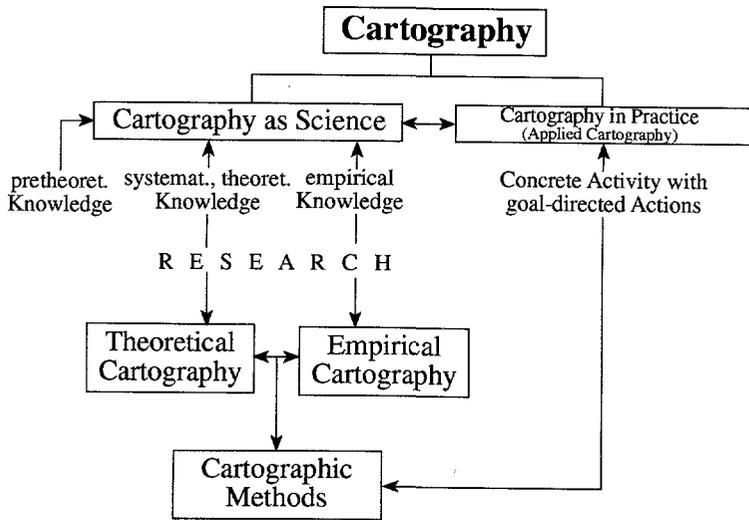


Figure 1: The position of Theoretical Cartography in the Basic Scheme of Cartography

Scientific cartography gains knowledge through research. The theoretical research side stands alongside the empirical (experimental) side, although there is also close interplay between these two areas. The aim is to derive theoretical knowledge, leading to methods (systems of rules). On the basis of the traditions and special aspects of cartography, methods are also formed from practical cartography. *Empirical confirmation attained within the scope of systematic research then leads to theory.*

2 The role of theory in modern-day cartography

The direction of cartography in the 90s has been described and analysed by many scientists (DAHLBERG, 1988, KLINGHAMMER 1988, RHIND 1993, GRELOT 1994, ORMELING 1994, TAYLOR 1994, among others). Therefore, this need not be analysed any further as we have agreed in the main with the evaluations made by these cartographers.

In this regard, the analyses and evaluations serve at all times to emphasise the importance of theory and theory's increased stature in cartography. At the same time, they also point out the risks which may develop if theory is neglected. GRELOT (1994) emphasises the importance of the theoretical basis both for engineering-type cartography work, which is characterised to a large degree nowadays by digital information and digital tools, as well as for the tasks of map design and communication. It was in a similar vein that TAYLOR (1994) in his closing address to the 16th ICA-Conference in Cologne stated that "cartography must, in addition to the applied production basis, include an explicit consideration of the theoretical basis of the discipline and must also consider the socio-political context of cartographic production, including the decisions on what is to be mapped and who makes these decisions" (p. 53).

TAYLOR puts forward a triangular scheme for the conceptual basis of cartography. This has been adopted and changed slightly by GRELOT. The inside of the triangle symbolises visualisation. The three outer sides are cognition / analysis, communication (visual and non-visual) and formalisation (new computer technologies, new multimedia techniques). The concept 'modelling' can be linked to any of these concepts.

This term is indispensable to theoretical cartography, and it has gained in importance (cf. BOLL-MANN 1985, TÖRÖK 1991, among others). TÖRÖK (1991) sees the model concept as the basis for a newly conceived ontological interpretation of cartography ("Cartographic modelling is a suitable conceptual framework for the creation of a theory of New Cartography", p. 465).

Irrespective of TÖRÖK, albeit with due regard for the importance of the model theory, which is associated as a central theme with the development of theoretical cartography (from BOARD in 1967 through to STEURER in 1989, and on further ...), we have also brought the model theory very much to the fore in devising the curriculum for Theoretical Cartography at the Technical University of Dresden.

Observations, comments and interpretations made by cartographers of repute since the end of the 70s (FREITAG 1979, GRYGORENKO 1986, OGRISSEK 1987, KANAKUBO 1991 and SHEHU 1994, among others) serve to re-affirm the fact that the role of theory in modern-day cartography is evidently accepted by all sides.

3 Theoretical cartography as part of the course at university

The goals and character of academic studies in cartography demand a fairly high proportion of theoretical components in the cartography curriculum.

This is generally the case, although it is achieved in universities in Germany and abroad in different ways. It comes down to the different local conditions, which, naturally enough, are not the same in Dresden as they are in Berlin, Vienna, Utrecht, Moscow or Madison, etc.

In the following I do not intend to report on the courses in cartographical theory at the various universities because there is insufficient information available on this world-wide. Even in the case of German universities we are only familiar with the framework of the courses at the Free University of Berlin and at Trier (Cartography as a Field of Geography), as well as at Bonn and Hanover (Cartography as a Field of Geodetic Surveying). As for universities abroad, we know most about the State University of Moscow (BERLJANT 1993).

The Technical University of Dresden has run a separate full-time course in Cartography since 1957. The degree in Cartography has included a separate module in Theoretical Cartography since 1973. This is referred to in the following:

The 1991 curriculum was unveiled at the Ladenburg Symposium which was organised by MEINE (FRIEDLEIN 1990, KOCH 1990). Details were published three years later (KOCH 1993).

This curriculum has been revised since then and was approved by the Free State of Saxony on 16th Jan. 1995. The following course curriculum is outlined in the relevant course regulations. This curriculum describes the general objective of the course, as well as forming the context for the theory studies: "The objective of cartography as a science is the digital and analog modelling of phenomena and facts relating to space ... using graphics-related and graphical methods of expression. Cartography examines the essence and application of cartographical forms of expression in terms of space, facts and time in the course of human communication. It essentially sets out to perfect theories and to devise and steadily enhance suitable methods of designing, and the technical production and use of maps ... Geo-informatics is currently opening up new cartographical horizons ... Geo-informatics is concerned in particular with the development and application of theories and methods of recording, structuring, storing, managing and processing geo-data" (p. 2).

In line with these premises, the scope of the foundation studies in mathematics and science, including studies in computer science, is already relative wide-based. However, this problem will not be examined in the following.

In principle, there are two different ways of teaching cartographical theory:

Firstly: The course modules can be designed in such a way that theories, methods, rules, procedural instructions, standards and other aspects of the course are only taught in the individual subjects (lectures and seminars).

Secondly: Restricting teaching in the individual subjects to specific theoretical components (such as Graphics Theory in Map Design, the Theory of Colour Reproduction in Reproduction Techniques, etc.).

The general basic know-how which is required in virtually all subjects, as well as for research, (including what could be possibly be termed Metatheory, such as Scientific Theory, Terminology, etc.) is taught in a separate subject called Theoretical Cartography. We have chosen the second option at Dresden.

The curriculum includes various courses which cover extensive theoretical ground, such as Map Design (the BERTIN theory), Digital Cartography, the Theory of Map Projections, Mathematical (Analytical) Cartography, Generalization/Fundamental Principles and Digital Methods of Generalization.

Additionally, there is a separate subject called Theoretical Cartography. This subject was introduced in 1973 by Professor OGRISSEK. Originally it was taught in two parts:

Part 1 - Cartographical Communication, Part 2 - Psychological Engineering Principles of Cartography. The course was later altered, in line with his 1987 textbook (OGRISSEK 1987). OGRISSEK distinguishes consistently between the General Theory of Map Design and the General Theory of Map Use. Both parts of the general theory, which each comprise their own special theories, also contain methodical components. The sub-modules of the system of Theoretical Cartography include the History of Cartography, Cartographical Terminology, Cartographical Training and the Theory of the Objective of Cartography.

This system was explained in detail not only in the 1987 textbook but also in the International Yearbook of Cartography (OGRISSEK 1981). Therefore, there is no need to examine the system in any greater detail here.

In 1993, I was faced with the problem of having to teach Theoretical Cartography in keeping with the new demands placed on cartography.

The new concept had to be geared towards modern-day cartography (cf. new curriculum), have no methodical constituent parts if at all possible, include aspects of the historical development, be pluralistic and be a suitable base on which to build. Numerous publications provided stimuli for the new idea, most notably journals published in the German-speaking world. I wish to mention FREITAG (1992), HAKE (1988), PRAVDA (1984) and STEURER (1989), to name but a few. Notable theoretical applications also provided food for thought, such as PRELL (1983), among others.

We were able to provide students with a reading list in 1994 (KOCH and HEIDIG 1994), containing 155 titles and replacing the old 1983 reading list. Another reading list is currently being compiled for the module on Perception Theory and Empirical Cartography.

Once again the course material for the present concept is divided into two parts because it is impossible to cover all of the material on Theoretical Cartography in the 30 classes during a single semester. The first part encompasses the object and role of Theoretical Cartography, including the History of Theoretical Cartography, as well as Model Theory, Sign Theory (Carto-Semiotics) and Communication Theory. The second part deals with the Theoretical Principles of Map Use - Functional Theory, the Theory of Perception, Epistemology - and concludes with an Introduction to Empirical Cartography.

All in all, this amounts to a complete system, which can however be developed both as a whole and in its constituent parts. Importance is attached to moving from the general to the particular (in cartographical terms). For example, Cartographical Sign Theory is derived from General Sign Theory. It is important to get the students thinking as well.

The students' exercises generally involve works of literature. The individual pieces of literature are then discussed in a group (for example in 1993 discussion focussed on the extensive work of KANA-KUBO and his ICA working group).

Exercises have been carried out in the past in the form of an empirical study (written questionnaire) in part 2 of the course, where aspects of theoretical cartography are combined with problems of empirical cartography as ways of optimising map use and map design.

4 Final comments

We realise that we need to constantly re-examine our current concept, which takes model theory as its starting base (because maps are essentially and primarily models of geo-spatial reality, being modelled using a special sign language, and tie in everything in a process of communication ...), and which treats theoretical questions of map use separately, in keeping with established Dresden traditions. This concept has most certainly not been fully perfected yet. If necessary, the concept must be made more specific, corrected or expanded. Recent publications which have provided ideas in this regard include the special supplement in "Geographica Slovaca" (PRAVDA, SCHLICHTMANN, WOLODSCHENKO 1994) and issue 5 of "Kartosemiotik" (Dresden-Bratislava 1994). In the main, ideas in theoretical aspects of geo-computer science are currently originating in the Anglo-American world, for example at the International Symposia on Computer-Assisted Cartography (AUTO CARTO). We refer here to CHRISMAN (1993) and many others. To round off, I would just like to mention that students of Cartography at the Technical University of Dresden have excellent opportunities for following optional university courses in philosophy, psychology, sociology and communication studies at neighbouring institutes, enabling them to consolidate and enhance their general theoretical basis.

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