

Quo vadis classic cartosemiotics & quo vadis theoretical cartography?

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This analytical-critical article deals with developments and trends in theoretical cartography during the last twenty years. Selected activities of the Commission on Theoretical Cartography (1999-2011) of the International Cartographic Association (ICA) and the relationship between Bertin's graphic semiotics and multimedia meta-cartosemiotics are examined. Some paradoxes in modern cartography are discussed. A new theoretical conception, *meta-cartosemiotics*, is proposed. Accumulation of cartosemiotics and map-language related knowledge are presented based on selected monographic works.

Keywords: theoretical cartography, graphic semiotics, “pioneers of cartosemiotics”, paradoxes in cartography, meta-cartosemiotics

0. Preamble

The present paper is dedicated to Jacques Bertin, the famous French cartographer, geographer and cartosemiotician. In my opinion, Jacques Bertin belongs together with Michael Bocharov and Alexander Aslanykashvily to the “pioneers of cartographic semiotics”. These three scientists formed basics of graphic and cartographic semiotics in the middle of the 1960s (Wolodtschenko, 2010). They developed also diverse currents in theoretical cartography with semiotic and map-language profiles.

This paper includes my experience and selected activities as chair of the ICA Commission on Theoretical Cartography (1999-2011). The paper also presents some new conceptual-theoretical ideas and proposals based on current cartosemiotic knowledge and thinking in cartography of the 21st century.

1. Quo vadis classic cartosemiotics?

1.1 Bertin's graphic sign system and “Pioneers of Cartosemiotics”

The term “pioneers of cartosemiotics”, as well as the term “cartosemiotics” are new and exotic in the realm of cartography. In Russian cartographic publications, the term “pioneer of cartosemiotics” was used by Salischev (1982) and only related to J. Bertin. Furthermore, “pioneers of cartosemiotics” was used by myself since 1995 in my lectures related to Michael Bocharov, Jacques Bertin and Alexander Aslanykashvily (see part 1.1.1.).

In Dresden, in 2000, I got the opportunity to start a new course on cartosemiotics with seven thematic lectures; one of the themes was “pioneers of cartosemiotics”. Unfortunately, it was only an optional course on “basics of cartosemiotics” for Dresden students. This optional course on cartosemiotics has been closed in 2011 together with the unique higher education of graduate engineers (Diplom-Ingenieur) in cartography in Dresden and in Germany.

In the years 2005, 2008 (in printed form) and 2009 (electronic version available online under www.meta-carto-semiotics.org/index.php?page=wolodtschenko-5), I published an encyclopedic glossary *cartosemiotics*; it includes an essay entitled *Pioneers of Cartosemiotics and their Followers*. The monograph *Cartosemiotics in Europe* (Wolodtschenko, 2002) documented an innovative character of the pioneers of cartosemiotics and their successors. A new monograph *30 years with and for cartosemiotics* (Wolodtschenko 2011, in progress) also includes a chapter with activities of these cartosemiotics pioneers.

1.1.1. Who are the “pioneers of cartosemiotics”?

The “pioneers of cartosemiotics” are three European scientists (cf. fig.1): two East European cartographers and one cartographer from France (in alphabetic order): A. Aslanykashvily (1916-1981) Tbilisi; J. Bertin (1918-2010) and M. Bocharov (1914-1997).



Figure 1: Pioneers of cartosemiotics (in alphabetic order)

J. Bertin is a recognized and popular scientist in France, Europe and in the cartographic world. His *Sémiologie Graphique* (1967) left enormous marks in cartographic theory and has a significant impact on recent cartography and cartosemiotics. He was founder of the Cartographic Laboratory in 1954 in Paris. Unfortunately, after Bertin's retirement in 1985, this laboratory collapsed, and later disappeared (Palsky, 2011).

M. Bocharov was a cartographic “dissident” in the former Soviet Union and a victim of Soviet academic cartography in the era of K. Salischev (Wolodtschenko, 2009a). Salischev was a “Pope” of Soviet cartography in the 1970s and 1980s. In this period, he achieved a boycott of M. Bocharov and his scientific work in the Soviet Union.

A. Aslanykashvily was not a cartographic dissident, but Salischev inhibited a translation from Russian into English of his monograph *Metacartography* (Aslanikaschwili, 1968, 1974). Nevertheless, thirty years later, in 1998 the Japanese cartographer Tositomo Kanakubo translated this book into Japanese. Figure 2 shows selected monographs on cartosemiotic investigations.

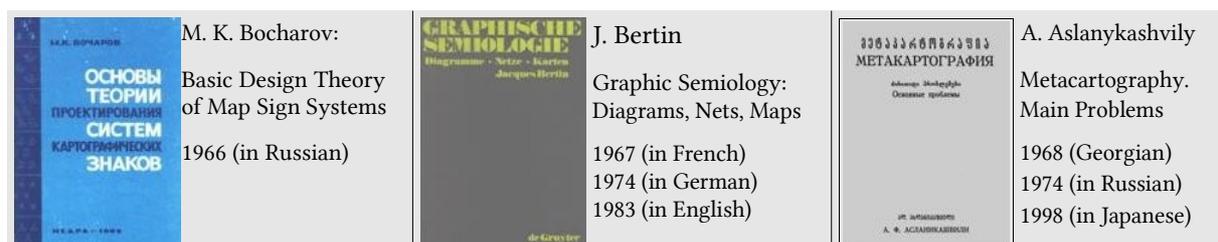


Figure 2: Selected monographs of the pioneers of cartosemiotics

The monographs of Bocharov (1966) and Aslanykashvily (1968, 1974) were published in the Soviet Union or beyond the “Iron Curtain” respectively and therefore had no or just little impact on western cartographers. However, these three books by Bocharov (1966), Bertin (1967) and Aslanykashvily (1968) were the first semiotically related ones in 1960s cartography. Table 1 includes main content parts of these three monographs. Since the end of 1970s, the library of the Dresden University of Technology (SLUB) has all three books and offers it to readers and researchers.

Table 1: Contents of three monographs by Bocharov/ Bertin/ Aslanykashvily (cf. fig. 2)

Bocharov (1966)	Bertin (1967/1974)	Aslanykashvily (1968/1974)
§1 General questions of the theory of sign system, 5-41pp. (28%)	Part 1: Semiology of Graphic System, 7-199 pp. (46%)	§1 Introduction, 3-19pp. (13%)
§2 Criteria for estimation of information content, 42-52pp. (8%)	Part 2: Using of Graphic System, 200-421, pp.(52%)	§2 Map language, 20-51pp. (29%)
§3 Criteria for estimation of cartographic information content, 53-79pp. (20%)		§3 Cartographic method, 52-121pp. (58%)
§4 Project of sign system for vegetation of topographic maps, 80-131pp. (35%)		

1.1.2. Bertin’s graphic semiotics: some restrictions

This part of the article focuses on classic graphic semiotics and its components, and deals with Bertin’s graphic system or graphic semiotics as it was presented in his book (Bertin, 1967) as one of the classical works on graphical visualization.

The graphic system or “graphic language” after Bertin (1967) includes six graphic variables (shape, size, brightness, grain, colour, direction) with accordant application rules. It is oriented on pragmatic goals of an optimal creation and transfer of any visual information. It was related to three graphic models: nets/networks, diagrams and maps. The chapter “Using of Graphic System” (200-421 pp.) of Bertin’s monograph has the following page proportions: 16 pp. or (8%) for nets, 76 pp. or (34%) for diagrams and 128 pp. or (58%) for maps.

The graphic system of Bertin (1967) is a system with semiotic “limits”. That is, this graphic system develops an “autonomic modus” and has several restrictions:

- graphic system is a part of map design
- graphic system focuses on paper printed cartosemiotic models;
- three cartosemiotic models are considered (maps, diagrams and nets/grids);
- maps are the main spatial models in Bertin's system. Atlases, globes, anamorphoses, panoramas, aerial/satellite images etc. are not taken into consideration;
- domination of statistical, analytical maps;
- domination of static maps.

1.2. Focuses of selected publications related to the image

Within the two last decades of the 20th century, several monographic works on the topic of cartographic semiotics were published (cf. Schlichtmann 1999). Exceptional contributions on issues of map language in the 1960s and 1970s were made by A. F. Aslanykashvily and L. Ratajski. H. Schlichtmann, A. Liouty and J. Pravda continued this research in the 1980s, each in his own way searching for a map language theory. The cartonomic conception by A. Liouty (1988) was a theoretical and conceptual engine, which broke the stagnation in Soviet Cartography in the 1980s. In the 1990s, A. Wolodtschenko continued cartosemiotic research and began to study atlases as semiotic models.

What is typically for cartosemiotic research in the 20th century? Cartographers and cartosemioticians were in “captivity” of topographic, thematic and special maps as cartographic sign systems. Graphic semiotics of the 20th century was also classic graphic sign-system focussing mainly on paper print maps.

From a technological point of view, the “internet paradigm” has changed the priority of traditional maps in the first decade of the 21st century (e.g. Google-Earth maps, air/satellites images and terrains). In addition, the monopoly of analogical maps was dramatically changed due to digital cartography's developments.

Two selected examples of monographic publications of the 20th century by Liouty (1988) and MacEachren (1995) will be briefly considered by way of example. Table 2 shows main contents in pages and % of both monographs.

Table 2: Contents of monographs by Liouty and MacEachren

Liouty (1988)	MacEachren (1995)
Part 1: Map language: essence and system, 14-123pp. (34%)	Part 1: How meaning is derived from maps, 21-212pp. (41%)
Part 2: Main functions of map language, 124-282pp. (49%)	Part 2: How maps are imbued with meaning, 213-354 pp. (31%)
Part 3: Theory of map language and cartographic science, 283-310pp. (8%)	Part 3: How maps are used, 355-462 pp. (26%)

Today one can confirm that A. Liouty (1988) continued developing the map language theory of A. Aslanikashvili, while A. MacEachren (1995) improved Bertin's graphic system through new map functions and structures of representation, visualization and design of maps.

The main “image”-focus (illustration-focus) of Bertin (1967, 1974) were six graphic (visual) variables located in a two-dimensional coordinate system; the main “image”-focus of MacEachren (1995) was a cubic map-use space for cartographic visualization and communication; the main “image”-focus by Liouty was a twofold structure of a map language with two-sublanguages system (language of mathematic graphics and language of graphic communication). Later, I proposed (Wolodtschenko, 1999) a four-sublanguage system, which extended Liouty's structure of map language with aspects of verbal and pictorial language (*Bildsprache*, in German). All four publications put their focus on maps (Fig. 3).

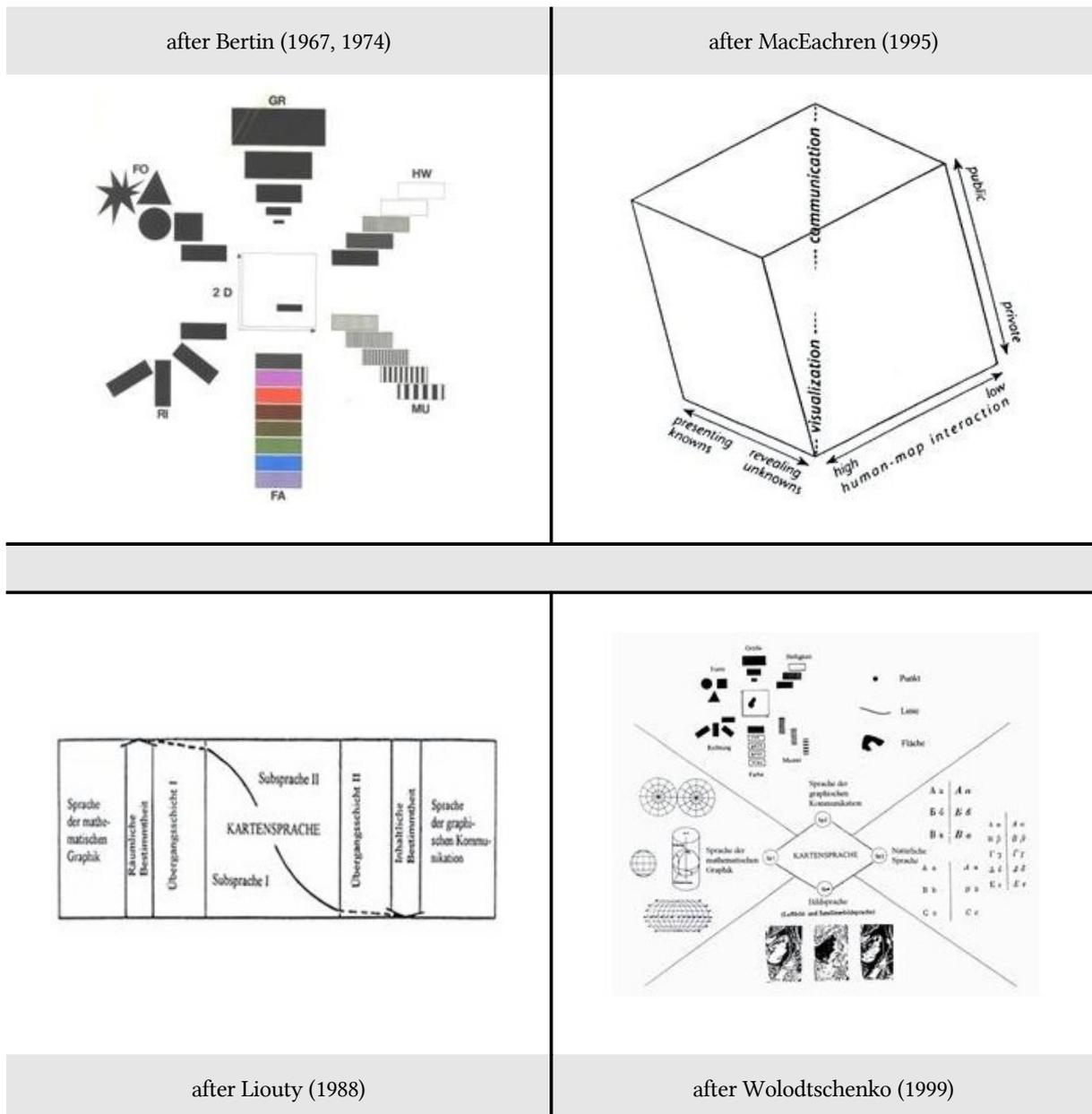


Figure 3: Focuses of selected publications related to the image

1.3. From graphic semiotics to multimedia meta-cartosemiotics

Classic cartosemiotics (semiotics of maps) as graphic semiotics of Bertin, Bocharov and Aslanykashvily dominated in the 20th century. Their influence will be still significant in the beginning 21st century, but they may become a part of the multimedia meta-cartosemiotics.

The map-related method of research was also a main method for classic cartosemiotics; maps as sign-element models and knowledge models were a main focus of cartosemiotic research. Table 3 illustrates methods, languages, variables and perception-related characteristics of map semiotics and semiotics of multimedia spatial models.

The multimedia meta-cartosemiotics will be a cartosemiotics of the 21st century with various time-spatial knowledge models (multimedia electronic maps, atlases, geoportals, mash-up models etc.).

Table 3: Selected characteristics of map semiotics and multimedia semiotics

Semiotics of map signs (graphic semiotics)	Semiotics of multimedia spatial models
Methods	
cartographic (map-related) method of research	cartosemiotic method of research
Languages	
map languages (topographic, thematic and special maps)	languages of cartosemiotic models (electronic atlases, geoportals etc.)
Variables	
visual graphic variables (shape, size, brightness, grain, colour, direction)	semiotic meta-variables (map, text, image/illustration)
Perceptions	
visual perception	visual, acoustic and haptic perceptions

2. Some paradoxes in cartography

The theme of paradoxes has been considered and discussed already several times in the web-journal “meta-carto-semiotics” (Wolodtschenko, 2008, 2009b). These paradoxes can leave deep marks - whether for better or for worse. Only three paradox-related themes will be briefly considered: the problems of generations; a “one-sided” or “one-track” cartography and “contradictions” of cartography.

2.1. Paradox of generations

This subtopic illuminates an interesting generation problem or generation paradox in recent cartography (and in society on the whole). At the moment, one can distinguish three main generation groups in cartography (Tab. 4): a classic, a half-digital/half-classic (HD/HC) and a digital generation (DG). The half-digital/half-classic generation holds important positions in government and private institutions (universities, mapping agencies, commercial cartographic publishers etc.). A particular conflict exists between HD/HC and the digital generations at universities and academic institutes. In about 10 years, this digital generation will dominate relatively and in ca. 20 years even absolutely. Where and how cartography will go on under the DG's leadership in 10-15 years? It remains today a large and open question.

Table 4: Modern generations (after Wolodtschenko 2010)

Time	Generation group I (>65 years)	Generation group II (35-65 years)	Generation group III (<35 years)
2010	Classic (Pensioners) 15-20%	Half-digital/Half-classic 50-60%	Digital Generation 30-35%
2020	-	Half-digital/Half-classic 30-40%	Digital Generation 60-70%
2030	-	-	Digital Generation 95-100%

2.2. Paradox of a “one-sided” cartography

This paradox is characterized by modern cartography with its dominance of geospatial technologies. After Gartner & Schmidt (2010), technological cartography (with five “geospatial techniques”: internet-cartography, neogeography, ubiquitous cartography, LBS and augmented reality) forms the structure of modern cartography. It is easy to see that the term GIS is not illuminated.

Table 5 shows a possible structure of modern cartography, which includes theoretical and methodological fundamentals in declaration form only. Gartner & Schmidt (2010) propose to define theoretical and methodological fundamentals and to integrate the recent technological development of modern cartography. Such appeal is very needful for modern cartography in times of a dominance of a “one-sided” technological cartography.

What are the theoretical and methodological fundamentals of modern cartography? Which discipline deals with theoretical questions? One of these disciplines can be cartographic semiotics. This discipline is subdivided into general and applied cartosemiotics and deals with diverse cartosemiotic models as spatial knowledge models with cartographic and non-cartographic traditions.

Table 5: Structure of modern cartography (after Gartner, Schmidt 2010)

Modern cartography		
Technological cartography		Theoretical cartography
geospatial techniques:	geospatial data	theoretical and methodological fundamentals
internet-cartography, neogeography, ubiquitous cartography, LBS and augmented reality		

2.3. Paradox of “cross-roads” of cartography

Current cartography's situation characterizes the subject's changes and contradictions. Table 6 demonstrates selected “contradictions” of cartography for two centuries, the 20th and 21st one. These contradictions reflect cartography in a situation of radical change and they also reflect a binarisation process (cartography and geographic information/GI science).

The “cross-road” of contradictions and changes can be considered as a time metaphor and a “barometer” of stagnation or development of cartography. Cartography of the 21st century seems to loose identity. From technological side, cartography merges with GI science.

In theoretical cartography, a cartographic-semiotical tendency can be observed. Cartosemiotics can be a powerful methodological and theoretical basis, especially for time-spatial models with cartographic and none-cartographic traditions.

Table 6: Selected “contradictions“ of cartography (Wolodtschenko 2010)

20th Century	21st Century
„Contradictions“ of cartography	
Cartography	Geoinformatics /Geomatics
Science	Management
Authorship	Anonymity
Personality	Top-Manager
Cartographer	Geomatician
„Aspirations for independence“ (of geodesy und geography)	„Aspirations for dependance“ (of geoinformatics or geomatics)

3. From 20th century to 21st century: Quo vadis theoretical cartography?

This chapter will illuminate some of the new and old problems in cartography of the 20th and 21st century. Several themes related to the development of theoretical cartography were considered and discussed in Wolodtschenko (2008). Therefore, only selected themes and questions will be briefly and exemplarily presented and explain below.

3.1. Technology vs. theory

The question “Quo vadis theoretical cartography?” illuminates also the new and old problems between technological and theoretical cartography in the 20th and 21st centuries. In the 20th century, cartography pleaded for its “independence” from geodesy and geography. Quite the contrary, 21st century's pleads for its “dependence” from GIScience, geomatics and informatics.

An example from the ICA Research Agenda (2003-2011) (<http://icaci.org/research-agenda/introduction>) illustrates the “forefront” of recent cartography and geoinformation (GI) science (see also: Moellering, 2011). Table 7 (left side) shows the keywords of the ICA Research Agenda: technological issues have dominant positions (seven positions from ten). The right side of the same table presents seven salient ICA themes of cartographic research in the last ten years (based on almost 3000 proceedings contributions of the ICC 1999-2009); the themes were selected for the novel network spatialization method, including semantic and cartographic generalization (Fabrikant & Salvini, 2011). Cartographic theory does not belong to these themes. Table 7 illustrates two thematic areas with priorities in recent cartography and geoinformation science.

Modern cartography or neo-cartography (after Gartner & Schmidt, 2010) including technological development (internet-cartography, neogeography, ubiquitous cartography, LBS and augmented reality) and implications (see Tab. 5) gives another example. However, the question “What are the theoretical and methodological fundaments of neo-cartography?” remains unanswered in the article by Gartner & Schmidt (2010).

Table 7: Keywords of the ICA Research Agenda and ICA themes (after Fabrikant & Salvini, 2011)

Keywords of the ICA research agenda 2003-2011	ICA themes (1999-2009)
1. Geographic Information (GI)	1. spatial/data/information
2. Metadata and SDIs	2. data/generalization
3. Geospatial analysis and modelling	3. satellite/images
4. Usability of maps and GI	4. GIS
5. Geovisualisation and visual analytics	5. national/mapping
6. Map production	6. cartography/mapping
7. Cartographic theory	7. atlas
8. History of cartography and GI science	
9. Education	
10. Society	

3.2. Cartographic management vs. cartographic science

The changeover from cartographic science to cartographic management does not mean stopping the development of theoretical cartography. The management “philosophy” dominated cartographic science in the first decade of the 21st century and will continue to dominate. Indeed, it is a new style of science in the globalisation era - not only for cartography.

Currently, cartography advances new leaders as rule managers of cartography. Unfortunately this style of leadership brings also an element of cartographic dilettantism about. Cartographic leaders-managers are there in many countries – as the saying goes: you reap what you saw.

After nearly 100 years of developing cartography as an institutionalized science, one can state that the time of outstanding or strong (in the negative as well as the positive sense) personalities as Arnberger, Imhof, Salischev etc. has passed. It was a time of classic and “polarized” cartography. It was the time of the 20th century. Future cartography (after Konecny, 2007) will be ubiquitous mapping, e.g. adaptable cartography, mobile cartography and sensor cartography. This is not feasible without cartographic management.

3.3. *Twenty years without the ICA-Yearbook*

From 1961 to 1990, the International Cartographic Yearbook (ICY) was edited in 30 volumes (I-XXX) publishing a variety of theoretical and methodological articles in three languages (German, English and French). Today, one can only regret that the ICA does not publish the ICY since almost 20 years. In the first decade of the 21st century, one can notice that the methodological and conceptual deficits of modern technological cartography will not disappear. Technological asymmetry is also reflected in the ICA commissions (Wolodtschenko, 2009c).

3.4. *ICA and universities*

The universities are a main source for the ICA's executive committee and the ICA's commissions. 10 of 12 ICA presidents (1961-2011) were/are professors at universities. In my opinion, the popularization of cartography takes place in a “palace of cartography”. This means that almost all International Cartographic Conferences (ICC) were held in exclusive congress palaces or convention centers. Also the conference fees have been rising rapidly (e.g. about U.S. \$ 70 for the ICC 1968 and approximately U.S. \$ 700 for ICC 2009 and ICC2011). Despite a few travel awards, today's ICA congresses are affordable only for cartographic officials and wealthy entrepreneurs.

Is a new social strategy “university cartography” vs. “palace cartography” reality? I think, the answer is “yes!”. A change in the relevant ICA strategy from “Palace Cartography” to “University Cartography” is conceivable. Thus, “University Cartography” will be an important cultural element for the young generation in the modern society.

3.5. *Twelve years of the ICA Commission on Theoretical Cartography (1999-2011)*

The ICA Commission on Theoretical Cartography was established in the course of the 19th International Cartographic Conference in Ottawa, Canada, in 1999. It was a difficult time for compromises, inspiring search for new theoretical ideas and conceptual solutions. From 1987 to 1999, the ICA's theoretical movement was headed by the Japanese cartographer Tositomo Kanakubo. In accordance with a proposal of the vice-president of the ICA T. Kanakubo and the Japanese Cartographic Association, the 11th general assembly approved a new ICA commission on Theoretical Cartography (TC-commission) in August 1999.

The TC Commission celebrated its 10th anniversary in 2009. Therefore, volume 12/2009 of the “Diskussionsbeiträge zur Kartosemiotik und zur Theorie der Kartographie” (Discussion papers on Cartosemiotics and on the Theory of Cartography) was published as a collection of papers of interdisciplinary nature, dedicated to the 10th anniversary of the ICA Commission on Theoretical Cartography. It includes articles on cartography, cartosemiotics, general semiotics, geography, and a number of other related disciplines. Main dates and selected events of the TC Commission are presented in Table 8,9,10,11.

3.5.1. ICA Seminars/Workshops

Publications and seminars/workshops are essential aspects of each ICA commission or working group. The following tables 8, 8a and 8b illustrate the TC Commission's activities and their distribution in three periods and four continents and by countries. Table 8 is the base for the tables 8a and 8b. The theoretical interests are clearly connected with European traditions (10 activities) and show increased activities particularly in the third period of the TC-commission (16 activities). From a geographical point of view, countries such as Ukraine, Lithuania and Russia have a strong theoretical and methodological interest focus.

Table 8a: Continents-related activities (1999-2011)

period	number of activities	continents			
		Europe	Asia	America	Africa
1999-2003	4	3	1		
2003-2007	8	6	1		1
2007-2011	16	10	5	1	
<i>Sum</i>	28	19	7	1	1
%	100%	67%	26%	3.5%	3.5%

Table 8b: States-related activities (1999-2011)

States	%	States	%	States	%			
Ukraine	7	26	Spain	1	3,5	Germany	1	3,5
Lithuania	6	22	South Africa	1	3,5	France	1	3,5
Russia	4	15	Poland	1	3,5	Canada	1	3,5
China	3	12.5	Japan	1	3,5			

Table 8: Selected activities (1999-2011)

Periods	Activities	Co-organizers/country/year
1 1999-2003	Seminar	TU Dresden/Germany (2000)
	Meeting	20. ICC Beijin/China (2001)
	Workshop	NVP Cartography Kyiv,Ukraine(2002)
	Seminar	Gdansk University/Poland (2002)

2	2003-2007	Seminar	Vilnius University/Lithuania (2003)
		Meeting	21. ICC Durban/South Afrika(2003)
		Seminar	NVP Cartography Kyiv,Ukraine(2004)
		Meeting	22.ICC A Coruna/Spain (2005)
		Seminar	Vilnius University/Lithuania (2005)
		Symposium	Wuhan University/China(2006)
		Workshop	NA University Kyiv/Ukraine(2007)
		Pre-ICC Seminar	23.ICC Moscow/Russia (2007)
3	2007-2011	Seminar	Vilnius University/Lithuania (2007)
		Workshop	NA University Kyiv/Ukraine(2008)
		Workshop	Toronto UniversityCanada (2008)
		Workshop	Vilnius University/Lithuania (2008)
		Seminar	IWEP Barnaul/Russia (2008)
		Workshop	NA University Kyiv/Ukraine(2009)
		Seminar	IWEP Barnaul/Russia (2009)
		Seminar	Vilnius University/Lithuania (2009)
		Seminar	NVP Cartography Kyiv,Ukraine(2009)
		Seminar	St.Petersburg University (2010)
		Seminar	NA University Kyiv/Ukraine(2010)
		Workshop	Polytecnic University Hong Kong(2010)
		Seminar	Hosei University Tokyo (2010)
		Workshop	NA University Kyiv/Ukraine(2011)
Workshop	Vilnius University/Lithuania (2011)		
		Pre-ICC Seminar	IGN, Paris (2011)

3.5.2. Selected monographs (1988-2011)

Numerous monographic texts on cartosemiotics and map language aspects were published in the last 20 years. Table 9 shows selected monographs in chronological order with information on author, year, title and (L)anguages, and with publication's by TC-commission members in the period 1999-2011. In addition, table 10 shows lexical publications. The list of publications reflects a theory-oriented accumulation of cartographic and cartosemiotic knowledge in the last decade of the 20th and in first decade of the 21st century. A short statistics: 35% of the monographs are written in Slavic languages; 30% in German and 25% in English; 22 from 25 authors are from Europe. The roots of theoretical cartography have also European origin.

Table 9: List of selected cartographic-semiotical monographs (1988-1999, 1999-2011)

Author, year	Title	L
Liouty, A.A.(1988)	Map language: essence, system and function. Moscow. (in Russian)	R
Pravda, J.(1990)	Zaklady koncepcie mapoveho jazyka. Bratislava. (in Slovak)	S
Wolodtschenko A.(1993)	Map language problems and cartosemiotics. Dresden. (in Russian)	R
Kekelia D.I.(1995)	Cartosemiotics. Tbilisi. (in Georgian)	G
MacEachren, A.(1995)	How Maps Work. New York and London.	E
Neytchev, P.(1997)	Jezyk czy kod kartograficzny? Warsaw (in Polish)	P
Wolodtschenko A.(1997)	Cartosemiotics and prehistoric maps. Barnaul-Dresden. (in Russian)	R
Hussy, C.(1998)	La Carte, un Modele, un Langage. Geneve.	F
Schlichtmann, H.(Ed. 1999)	Map Semiotics Around the World.). Regina.	E
ICA Commission on Theoretical Cartography (1999-2011)		
Wolodtschenko, A.(1999)	Kartosemiotische und konzeptionelle Aspekte der 90er Jahre. Dresden .	G
Casti, E.(2000)	Reality as representation. The semiotics of cartography and the generation of meaning. Bergamo.	E
Brodersen, L.(2001)	Map as Communication. Allerod 2001.	E
Wolodtschenko, A.(2002)	Kartosemiotik in Europa. Dresden 2002.	G
Wolodtschenko, A.(2003)	Ausgewählte Beiträge zur Kartosemiotik und zur Theorie der Kartographie 1993-2003. Dresden.	G
Hruby, F.(2006)	Semiotische Begründbarkeit kartographischer Signaturen. München.	G
Wolodtschenko, A.(2006)	Atlas cartosemiotics. Dresden. (in Russian)	R
Wolodtschenko, A.(2007)	Nationalatlas Deutschland: ein kartosemiotisches Porträt. Dresden.	G
Brodersen, L.(2008)	Geo-communication and information design. Allerod.	E
Jobst, M.(2008)	Ein semiotisches Modell für die kartographische Kommunikation mit 3D. Wien.	G
Wolodtschenko,A. (2010)	Prähistorische Karten und Zeichensysteme. Mini-Atlas. Dresden.	R

Tabelle 10: Lexical publication of the TC Commission

Lexical publications		
Berliant, A.(2005)	Kartograficheski slovar. Moskva. (in Russian)	R
Wolodtschenko, A.(2005)	Mini-Glossary. Cartosemiotics. Dresden. (in Russian)	R
Wolodtschenko,A., Shevchenko,V., Poliakova,N. (2009)	Kartosemiotichny slovnyk. Dresden (in Ukrainian)	U
Wolodtschenko, A.(2005)	Mini-Glossary. Cartosemiotics. Dresden, 2 nd ed. (in Russian)	R
Wolodtschenko, A. (2009)	Kartosemiotika. Mini-glossary. Dresden, 3 rd ed. (in Russian)	R
Schlichtmann H. (2011)	Cartosemiotics. A short dictionary. ICA, Regina.	E

3.5.3. “Cartosemiotic triangle”: research and education project 2007-2011

In its third period (2007-2011), the TC-commission has initiated and carried out in the context of the ICA activities the project “Cartosemiotic triangle” at three universities. The initiators of this project (cf. Fig. 4) were G. Beconyte and A. Cesnulevicius (Vilnius University, Lithuania), I. Rotanova (Altai University, Barnaul, Russia), A. Zaporozhets (Kyiv Aviation University Ukraine) and A. Wolodtschenko (Chair, ICA Commission on Theoretical Cartography). The TC-commission members V. Shevchenko (Kyiv) and A. Koshkarev (Moscow) also participated in this project. The project included various seminars/workshops (four seminars in Kyiv, three in Vilnius and two in Barnaul) and special cartosemiotic courses for students of cartography, geography and ecology.

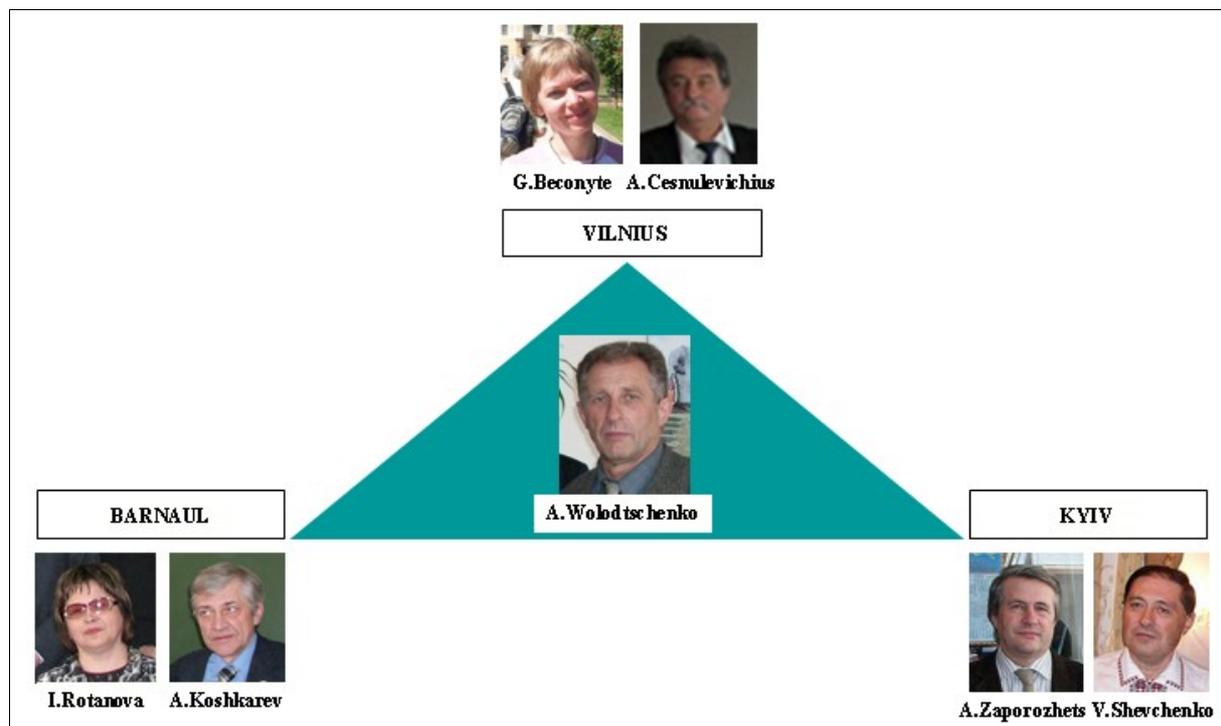


Figure 4: “Cartosemiotic triangle” of the enthusiasts project

3.5.4 Ranking of theoretical cartography (1999-2011)

The ICA conferences (ICC) reflect theoretical and technological frontlines of research, activities and traditions of cartographic community. The topics of the ICC between 1999-2009 were analyzed and are presented in table 11. The “ranking” of the topic “theoretical cartography” in the themes list of the five last ICA conferences ranged between the first and the last position and has been completely ignored recently.

For the ICC 2011 in Paris, 38 themes (T0-T37) were nominated; the terms: theory, neocartography, neogeography, cartosemiotics etc. have been ignored in this list. One can assume that two themes T0 (Jacques Bertin: Cartographic work and influences) and T1 (Semiotics, map perception, cognition and knowledge) did not cover all questions on cartographic theory in Paris.

Table 11: “Ranking” of *theoretical cartography* in the themes list of the last ICCs

ICA Conferences (ICC)		"Ranking" of <i>Theoretical Cartography</i> in themes list	Number of papers/posters
1999	Ottawa/Canada	-	-
2001	Beijing/China	5	14
2003	Durban/South Africa	11	18
2005	A Coruña/Spain	1	26
2007	Moscow/Russia	1	52
2009	Santjago/Chile	31	7
2011	Paris/France	0	-

3.6. *Theoretical conceptions in cartography in the 20th and 21st centuries*

The 20th century has left various conceptions on theoretical cartography (cf. tab 12). They reflect semiotic and map-language related trends and map-focused traditions in cartography of the last century. All conceptions focus on maps as basic reference models of cartographic research. But Bertin’s graphic semiotics as conception was the first semiotic-based conception that included three basic models: maps, diagrams and networks. His conception of graphic semiotics takes an important position within theoretical cartography. Two other conceptions by Aslanykashvily and Ratajski marked, accordingly, gnoseological (map- language related) and linguistic directions. In my opinion, the generation of theoretical conceptions in the 1980s and 1990s (by Schlichtmann, Liouty, Pravda, Wolodtschenko etc.) included diverse map-related components with new semiotic-methodical focuses.

Table 12: Selected theoretical conceptions

Author	Conception	Year	Reference models
20th Century			
J. Bertin	Graphic Semiotics	1967	Maps, diagrams, nets
A. F. Aslanikashvili	Metacartography	1968	Maps
L. Ratajski	Cartology	1976	Maps
H. Schlichtmann	Map symbolism	1985	Maps
A. A. Liouty	Cartonomy	1988	Maps
J. Pravda	Map language	1990	Maps
A. Wolodtschenko	Cartographic “paradigm”	1996	Maps
21st Century			
A. Wolodtschenko	Meta-cartosemiotics	2009	Cartosemiotic models (maps, atlases, globes, etc.)

The first decade of the 21st century brought a conceptional lull in the realm of theoretical cartography. This can be explained by the growing importance of technology over theory and conception. But, as is well-known, tools do not generate conceptions. Conceptions are born in the depths of the scientific disciplines.

3.7. On meta-knowledge: a new conception „meta-cartosemiotics“

In 2009, I proposed a new conception in theoretical cartography - meta-cartosemiotics (Wolodtschenko 2009). Each new theoretical concept needs for its nomination and approval a powerful accumulation of knowledge and its practical use. The concept of meta-cartosemiotics is still at the beginning of this process, undergoing a formation phase.

The conception has semiotic-methodical fundamentals: a cartographic (map-related) method (CM), a cartosemiotic method (CSM) and a meta-cartosemiotic method (Meta-CSK) (cf. Fig. 5). The methods form a semiotic chain. The cartographic (map-related) method of research was the principal method in cartosemiotics of the 20th century; the maps-as-sign-element-model and knowledge models were focuses in cartosemiotic research.

During the first decade of the 21st century, the cartosemiotic method dominated as research method with cartographic and non-cartographic traditions. The CSM characterizes changes from sign-element-models (map) to poly-system model (atlas, 3D globe etc.). The Meta-CSM deals with meta-knowledge models or models of the semiotic knowledge model.

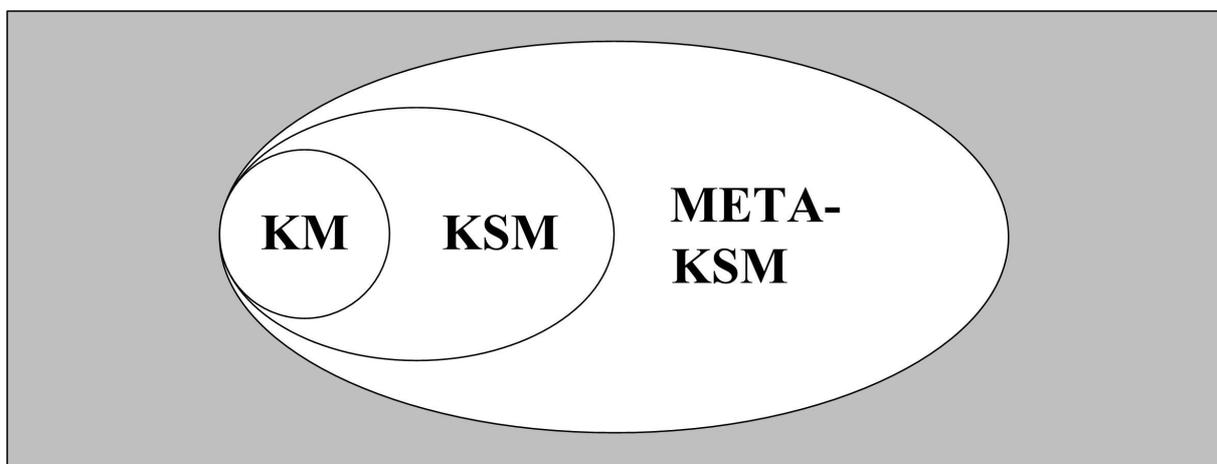


Figure 5: Semiotic-methodical research fields of modern theoretical cartography (Wolodtschenko 2008)

Visual and mental communication will dominate in these models. These models present cartosemiotic meta-knowledge. Table 13 shows main model-system-characteristics with communication priorities in a temporal perspective: visual communication in the 20th century; visual, acoustic and haptic communication in the first half of 21st century and visual, acoustic, haptic and mental interactions (communication) in the second half of the 21st century.

The concept of meta-cartosemiotics has no ambitions to be(come) a general conception of cartography. This goal was pursued by former conceptions: “Metacartography” A. Aslanykashvily), “Cartology” (L. Ratayski), Cartonomy (A. Loiuty) and “Map Language” (J. Pravda).

Table 13: Selected model system characteristics with interaction priorities

model system characteristics	20 th century	21 st century	
dominant semiotics	<i>semiotics of map signs</i>	<i>semiotics of multimedia spatial models</i>	<i>semiotics of meta-models</i>
dominant language	<i>map languages</i>	<i>languages of cartosemiotic models</i>	<i>languages of cartosemiotic meta-models</i>
dominant variables	<i>visual graphic variables</i> <i>(shape, size, brightness, grain, colour, direction)</i>	<i>semiotic meta-variables</i> <i>(map, text, image)</i>	<i>semiotic meta- metavariables:</i> <i>meta-maps, meta-texts, meta-images</i>
priority interactions	<i>visual communication</i>	<i>visual, acoustic and haptic communication</i>	<i>visual, acoustic, haptic and mental communication</i>

“Meta-cartosemiotics” has several pragmatic goals, e.g. “semiotic-analytical monitoring” of cartographic applications and cartosemiotics' developments, creation of conditions for new applied disciplines with cartosemiotic profiles, for example atlas cartosemiotics, which studies analog and electronic atlases as models of semiotic knowledge etc.

The new conception “meta-cartosemiotics” has cartographic and map-language related roots; it forms a new semiotic space-time system of knowledge models, characterizes static and dynamic space-time knowledge models, reflects new methodical ways from space-time knowledge models to meta-knowledge models and unites diverse knowledge models with cartographic and non-cartographic traditions. The concept belongs to a new generation of theoretical conceptions in cartography and cartosemiotics in the 21st century.

4. Conclusion

The 20th century was the century of classic cartography with graphic semiotics and visual cartographic applications. It was a century of map-focused and map-language semiotics. Map-language was and still is an important object of research on maps and cartography, but not the only one. While cartography's competence for atlases is still limited on map-related atlases, cartosemiotics is competent for all atlases as semiotic models.

Atlases are an object of study of many disciplines, not just cartography. What are the language of an atlas, the language of the atlas information system, the language of geoportals etc. as phenomena of human culture? Semiotic potential of maps – What is it? And what semiotic potential has an atlas information system? What semiotic potential has Google Maps? And what semiotic potential has Google Earth? These and many others questions wait for their answers and for analytical investigations from a (carto)semiotic point of view.

In the 21st century, technological cartography will dominate with geospatial applications; cartosemiotics of the 21st century will be a cartosemiotics of multimedia knowledge models. It is a new discipline with theoretical and applied profiles and enormous potentials; it is a “bridge” between classical (analog) and modern (electronic) sign systems.

It is also necessary to collaborate, cooperate and integrate technological cartography. Unfortunately cartosemiotics was not requested and accepted from modern society.

In the second decade of this century, a generation change within cartography will be realized. The digital generation (“generation D”) will dominate in many positions. Consequently, an important question remains: where does the road for “generation D” and modern cartography – with or without theoretical cartography – go?

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