

Epicenters 2, 3, 4 had an individual author's research format. Pravda called epicenters 2 and 3 as "young" and promising ones, epicenter 4 - hypothetical one (based on geoiconics according to Berlyant). Epicenter 2 was based on the work of Bocharov, Aslanikashvili, Kolachny and others. Epicenter 3 was based on the work of Nebesky, Palek, Schlichtmann and Wolodtschenko. It should be noted that the works of Bertin (1967, 1974) had their own branch from epicenter 1.

2. Epicenters of metacartography concept

The term "metacartography" was used by the American geographer W. Bunge (1962) within the framework of theoretical geography when studying the most general spatial properties of maps, photographs, drawings, etc. at the intersection of pre-maps and maps, maps and mathematical models.(photo from:

<https://geografiamungia.wordpress.com/2012/09/13/geografo-interesgarri-bat/>



Bunge W. (1928-2013)

The famous Soviet and Georgian geographer and cartographer A.F. Aslanikashvili (1968, 1974), used the general principles of semiotics in his research on the theoretical and epistemological aspects of the map language. His map-centric metacartographic concept was focused on the logical and methodological basis of geocartographic knowledge through the map language and the cartographic method.(photo from:

https://en.wikipedia.org/wiki/Alexander_Aslanikashvili)



Aslanikashvili A.(1916-1981)

If Bunge (1962) in his research used the term "metacartography" for one of the sections of theoretical geography, Aslanikashvili (1974) went further and identified a new theoretical direction in cartography and a new concept of "metacartography".

One can assumed, that first metacartographic ideas are contained in the work of Max Eckert (1922, 1925) entitled "The Science of Maps"/Kartenkunde. It can also be considered that Eckert's master work formed the first metacartographic epicenter in Germany and Europe in the 1920s and 1930s. (photo from: https://de.wikipedia.org/wiki/Max_Eckert-Greifendorff)



Eckert M. (1868-1938)

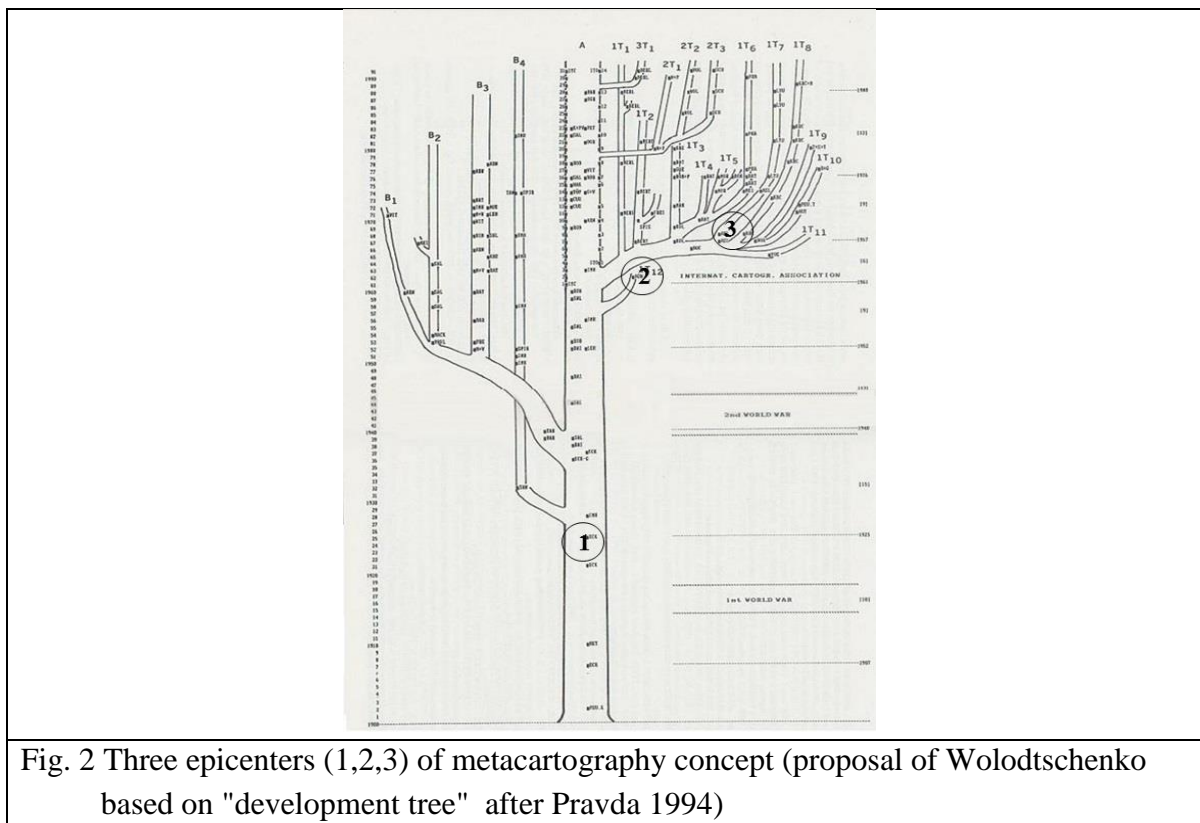


Fig. 2 shows three concept metacartographic epicenters: 1) “The Science of Maps” epicenter after Eckert (1922, 1925); 2) Bunge (1962, 1967) metacartographic epicenter and 3) metacartographic epicenter after Aslanikashvili (1968, 1974).

Amid the stagnation of theoretical cartography in the ICA since the mid-2010s, Morita (2022) reported new research on metacartography in Japan. It should also be noted that in 1998 the Japanese cartographer Tositomo Kanakubo translated the book "Metacartography" by Aslanikashvili (1998) into Japanese and published it in Tokyo. It is still too early to talk about the new metacartographic epicenter in Tokyo but its formation is real in the 2020s.

One more metacartographic epicenter can be formed in Irkutsk at the Institute of Geography of the Siberian Branch of the Russian Academy of Sciences. However, the metatheoretical studies in the article of this collection (Cherkashin 2022) have not yet found a conceptual completion in terms of their place in relation to metaatlasgraphy. This approach is rather map-centric and is formed to provide atlas-mathematical layer-by-layer modeling and geoinformation mapping of geospatial systems.

3. Derivative metacartosemiotics concept

Metacartosemiotics is a conceptual construction in cartography based on the "new cartosemiotics" (Wolodtschenko 2008). The conceptual development of the "new cartosemiotics" in the late 1990s included a system of language maps (s), which was based on a four modular map language system or system of four sub-languages (fig. 3), as well as a structural division of cartosemiotics into general and applied. Metacartosemiotics was a new

conceptual "beacon". This concept had a huge interdisciplinary potential for forming a new generation of cartosemiotic concepts in geoinformation and outside geoinformation space.

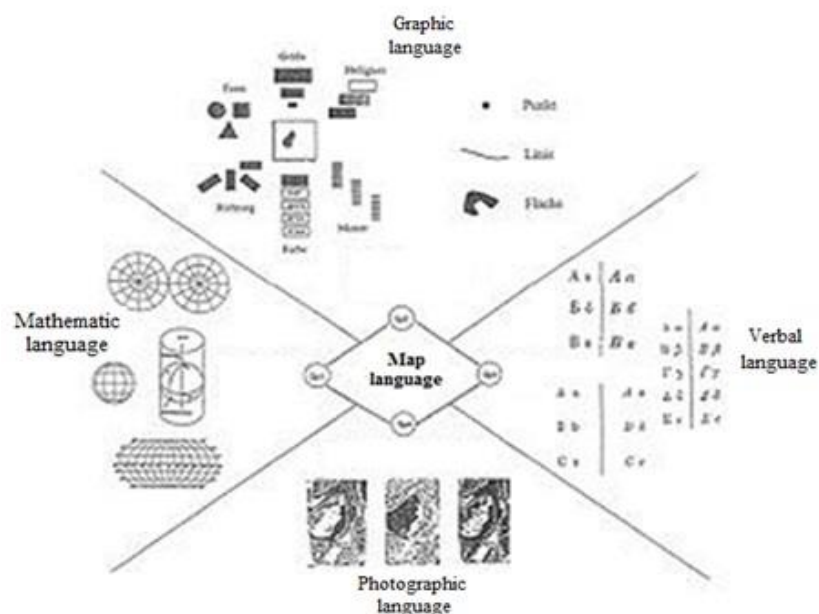


Fig. 3 Four modular map language system (after Wolodtschenko 1999)

By the end of the 2000s, the concept included three types of models and methods for their study: cartographic models (CM), cartosemiotic models (CSM), and metacartosemiotic models (fig. 4).

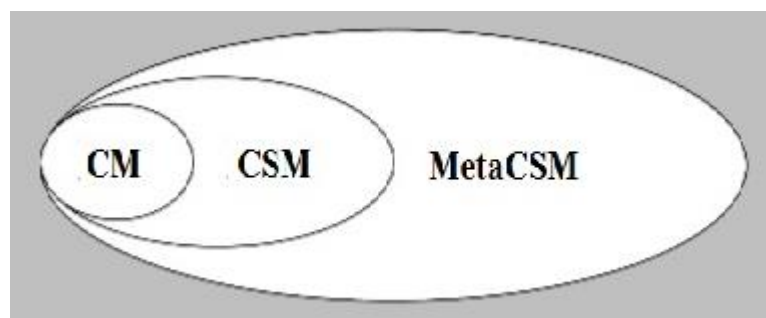


Fig. 4 Semiotic development of concept (Wolodtschenko 2008)

The new conception of cartography „metacartosemiotics” is a derived model of metacartography and represents new semiotic - epistemological orientations and priorities in research; it includes new objects to be examined (apart from maps, photomaps and globes,) e.g. various atlases as semiotic knowledge models and a new semiotic-quantitative analysis of atlases.

4. New metatheoretic epicenters

In the 21st century, two new concept epicenters appeared - metacartosemiotics and metaatlasgraphy, which are marked on the "development tree" (fig. 5) as epicenter 4 and epicenter 5, and as a continuation of the development of the cartosemiotic branch of 1990s.

Epicenter 4 was formed on the basis of the author's cartosemic activities (publications) in the 1990s-2000s and the emergence of a new metacartosemiotic concept (Wolodtschenko 2008). Tab. 1 shows the author's selected monographs on cartosemiotics.

The metacartosemiotic concept can be considered a derivative concept from metacartography according to Aslanikashvili (1974), where the methodological approaches of geocartographic knowledge through the language of the map and the cartographic method dominate.

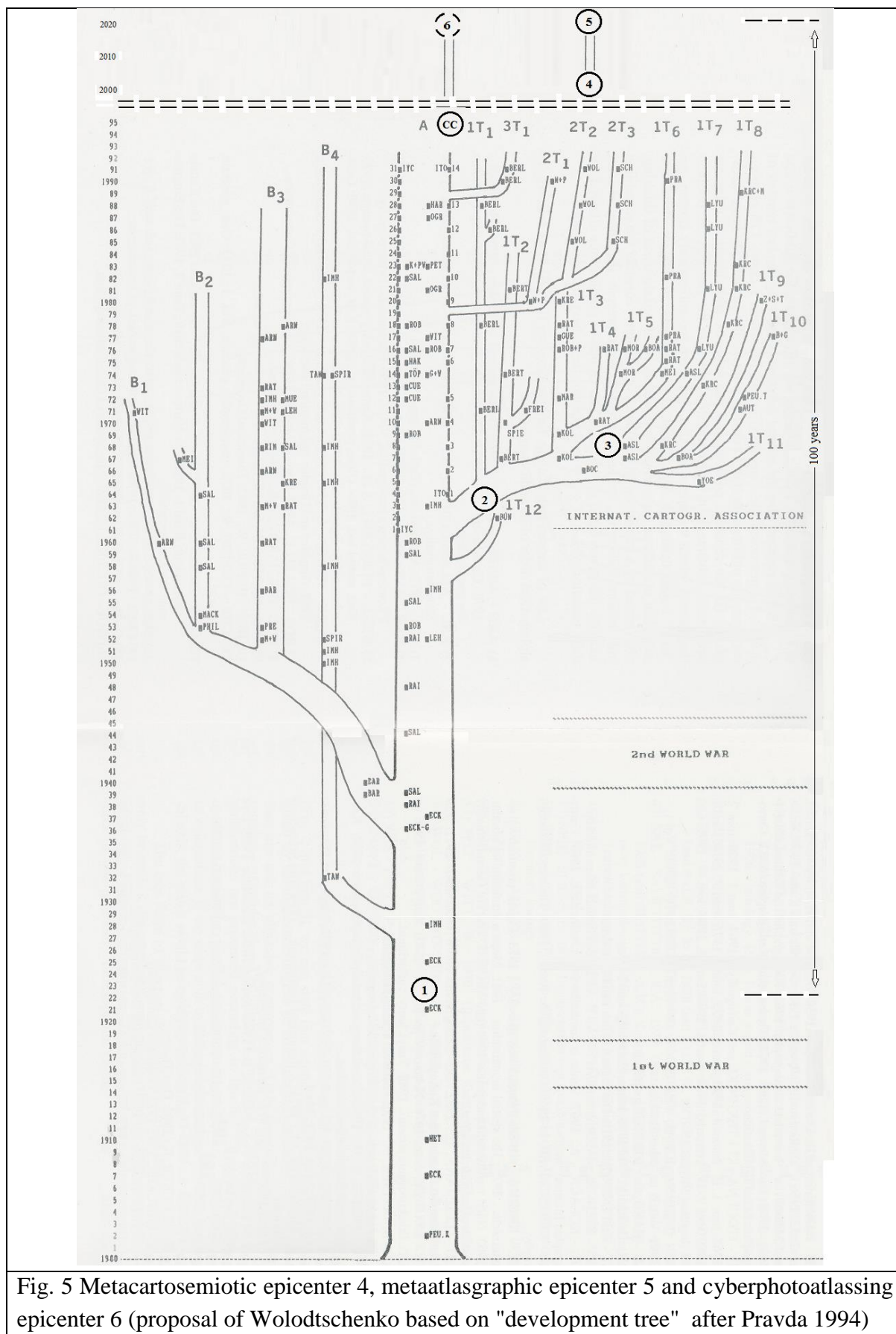
The metaatlasgraphic concept is derived from the metacartosemiotic one. The concept of metatlasgraphy "lit up" in 2021-2022, almost 100 years later, when in 1921 the fundamental monograph by Max Eckert "Scientific Cartography" (Eckert 1921) appeared in Germany, laying the foundation for the theoretical concept of scientific cartography.

Tab. 1 Selected monographs of the author on cartsemiotics (1990-2010)

Author, year of publication	Title of the monograph
Wolodtschenko A. (1993)	Problemy yazyka kart i kartosemiotika. Dresden 1993. (in Russ.).
Wolodtschenko A. (1997)	Kartosemiotika i doistoriceskie karty. Brnau-Dresden 1997. (in Russ.).
Wolodtschenko A. (1999)	Kartosemiotische und konzeptionelle Aspekte der 1990er Jahre. Dresden 1999.
Wolodtschenko, A. (2002)	Kartosemiotik in Europa. Dresden 2002.
Wolodtschenko A. (2003)	Ausgewählte Beiträge zur Kartosemiotik und zur Theorie der Kartographie.(Habitation). Dresden 2003.
Wolodtschenko A. (2006)	Atlasnaya kartosemiotika. Dresden 2006. . (in Russ.).
Wolodtschenko A. (2007)	Nationalatlas Deutschland: ein kartosemiotisches Portraet. Dresden 2007.
Wolodtschenko A. (2011)	30 Jahre mit und für die Kartosemiotik. Dresden 2011.

Epicenter 5 is associated with the formation of a new concept "metaatlasgraphy", a derivative one. Its development is yet to come. The new methodological framework of metaatlasgraphy (Wolodtschenko 2022) is related to the study of metaatlasographic democratic principles of various carto/atlasgraphic models.

The next epicenter 6 is in progress. This epicenter bases on the cybercartographic concept (CC) of Taylor (1993, 1997), which presented as CC symbol on the "development tree" after Pravda 1994.



The theory-technological concept of cybercartography was introduced at the 1997 ICC Conference and the Geomatics and Cartographic Research Centre (GCRC) was launched in 2002 at Carleton University, Ottawa, Canada. Professor Taylor was a “father” this concept. Cybercartography of the 2000s evolved as a multimedia, multisensory and interactive online cartography developed on the innovative Nunaliit Atlas Framework Platform, an innovative open source technology that facilitates participatory atlas creation (Taylor et al 2021).

Epicenter 6 has a draft name of concept “cyberphotoatlassing” (Wolodtschenko et al 2022). This concept is also derivative one from metaatlasgraphy and reflects a synthesis of cybercartography and photoatlasgraphy (after Wolodtschenko 2021). It characterizes a new phase of multidisciplinary cooperation in practice and methodology. The research-theoretical focus of this concept is creation and semiotic analysis of storytelling, methodical and commemorative photoatlas series (Thumbadoo, Wolodtschenko 2021; Thumbadoo, Wolodtschenko 2022; Wolodtschenko et al 2022).

5. Meraatlasgraphic democratic principles

The beginning of the 2020s is characterized by the concept evolution of metacartosemiotics into metaatlasgraphy. Metaatlasgraphy (as derivative concept of metacartosemiotics) proposes a new parity methodology for all atlases, for semiotic analysis and portraying, classification of all atlases, atlas traditions, cluster functions and carto/atlasgraphic knowledge (fig. 6).

Parity of Atlas Classification (1)			
Map-atlases	Photoatlases	Text-atlases	Mixatlases
Parity of research methodology for all atlases (2)			
Creation and using of map atlases	Creation and using of photoatlases	Creation and using of text-atlases	Creation and using of mixatlases
Parity of Semiotic Analysis and Portraying (3)			
Maps		Atlases and Metaatlases	
Parity of Function Clusters (4)			
Education cluster	Science-research cluster		Publishing and popularization cluster
Parity of Traditions (5)			
Cartographic traditions		Non Cartographic traditions	
Parity of Acquire Knowledge (6)			
Mapping and Cartographic knowledge		Atlassing and Atlasgraphic knowledge	

Fig. 6 Examples of metaatlasgraphic democratization principles

Parity of atlasclassification is a basic principle of evolutionary-carto/satlassemiotic development. The **research methodology** is based on semiotic classification for all atlases, i.e

such atlas technique is based on the democratic principle of parity of all four classes/groups of atlases as carriers of information and knowledge. The **classification** clearly reflects the information-semiotic nature of atlases.

The concept metaatlasgraphy implements the atlas-semiotic democratization semiotic **analysis and portraying** for all maps, atlases and metaatlases.

The principle of parity for the three **functional clusters** (education, research and publishing/popularization) reflects the carto/ atlassemiotic development of modern society.

Metaatlasography forms new views on its role in the study of atlases as basic semiotic-epistemological models with cartographic and non-cartographic **traditions**. Metaatlasgraphy democratizes cartographic and non-cartographic traditions.

Metaatlasgraphy reflects the evolutionary processes of transformation of **knowledge** from map to atlas, from mapping to atlassing and photoatlassing, from cartosemiotics to atlas semiotics, from the language of maps to the language of atlases, from graphic (syntactic) variables to semiotic atlas metavariables, etc.

6. Conclusion

The development of theoretical thought in cartography can be documented and illustrated in many ways. One of them is the diagram "development tree". Jan Pravda (1994) used such diagram to present the results of the analysis of the literature on theoretical cartography, which reflected the development of cartographic thought in concepts, scientific schools, etc. The metatheoretical studies and their epicenters were left without attention.

By the end of the 20th century, significant accumulations of cartosemiotic knowledge took place. Cartosemiotics has become a component of theoretical cartography (Wolodtschenko 1994). The appearance of metacartosemiotics in the late 2000s (Wolodtschenko 2008) and metaatlasgraphy in the early 2020s (Wolodtschenko 2022) clearly reflects the further development of carto/atlasgraphic thought.

The three concepts (metacartography, metacartosemiotics and metaatlasgraphy) characterize the semiotic-oriented conceptual transformation in cartography and atlasgraphy. Figure 7 shows the chronological trajectory of the three concepts from the 1960s to the 2020s.

Metacartography (Cartography) Primary concept		
→ 1960-1970	Metacartosemiotics (Cartosemiotics) Derivative concept	
	→ 1990-2000	Metaatlasgraphy (Atlasgraphy) Derivative concept 2020s

Fig. 7 Trajectories of cartography-cartosemiotics- atlasgraphy concept transformations (Wolodtschenko 2008, 2022)

The theoretical-cartographic and cartosemiotic challenges were not always heard. Challenges of "Theoretical Geography" by William Bunge (1962) were also heard later (Goodchild 2008). Theoretical cartography and carto/atlassemiotics are out of fashion in mainstream cartography and geoinformatics today. But theoretical ideas and concepts in cartography and cartosemiotics are developed further and new challenges, for example, to be expected with metaatlasgraphy.

The concept of metatlasgraphy "lit up" in Germany at the end of 2022, when a small monograph entitled "From metacartography to metaatlasgraphy" (Wolodtschenko 2022) was published in Dresden. It should also be noted here that almost 100 years ago in 1921 in Germany, the fundamental work of M. Eckert "Scientific Cartography" (Eckert 1921) was published, which, according to the author of the book, laid the conceptual foundation for scientific cartography. In 2022, in Germany, the metaatlasgraphy symbolically took over the conceptual and theoretical baton from M. Eckert's *Kartenkunde* (Scientific Cartography).

Another interesting fact deserves attention - 45 years ago, in 1987, the Dresden professor of cartography R. Ogrissek prepared and published in German the world's first textbook "Theoretische Kartographie".

Metaatlasgraphy has entered a multidisciplinary semiotic "orbit" and will represent the interests of many disciplines with both cartographic and non-cartographic traditions. The concept cyberphotoatlas as derivative one from metaatlasgraphy is a good example of cartographic and non-cartographic traditions. The formation of new metacartographic epicenter in Tokyo also is real in the 2020s. Also one more metacartographic epicenter can be formed in Irkutsk at the Institute of Geography of the Siberian Branch of the Russian Academy of Sciences in the 2020s.

In the early 21st century, two new semiotic-related metatheoretical epicenters emerged: metacartosemiotic and metaatlasgraphic epicenters. They reflect the development of carto/atlassemiotic thought. The process continues and the dialectics of semiotic development from map to atlas and further to metaatlas raises the question: what follows after the metaatlas? What new information-semiotic knowledge model will be proposed for modern digital society?

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Summary

On metatheoretical research and metacartographic epicenters

The article presents the results of the author's metatheoretical research. The metacartographic epicenters of the 1960s and 1970s and the formation of new epicenters - metacartosemiotics in the 2000s and metaatlasgraphy in the 2020s are described.

Kurzfassung

Zu metatheoretischen Forschung und metakartographischen Epizentren

Der Artikel stellt die Ergebnisse der metatheoretischen Forschung des Autors vor. Die metakarto-graphischen Epizentren der 1960er und 1970er Jahre und die Bildung neuer Epizentren – Metacartosemotics in den 2000er Jahren und Metaatlasgraphie in den 2020er Jahren – werden beschrieben.

Резюме

О метатеоретических исследованиях и метакартографических эпицентрах

В статье излагаются результаты метатеоретических исследований автора. Описаны метакартографические эпицентры 1960-х и 1970-х и становление новых эпицентров – метакартосемиотики в 2000-х и метаатласографии в 2020-х годах.