Paradigmatic Tendencies in Cartography and Mapping during the Scientific and Postmodern Periods

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Abstract. Within contemporary cartography this paper covers from traditional to post-modernist cartography. The first period includes scientific cartography - from Arthur Robinson to Alan MacEachren - where the following tendencies are proposed: cartographic language, cartographic communication, analytical cartography, and cartographic visualisation. In a second period, framed in a post-modernist context, alternative tendencies have been established, especially since the 1980s. Critical cartography arises with J.B. Harley and his successors offering an optional cartography and mapping in comparison with the scientific point of view. Nowadays, also in this so-called postmodern period, post-representational cartography is presented as another alternative trend to the scientific perspective. According to the difference of the study objects, approaches, research aims and results - which in this study are called "criteria of contrast" - all these tendencies can be considered as paradigmatic shifts during the developing of the discipline.

Keywords: cartographic tendencies, traditional cartography, postmodern cartography, alternative approaches

1. Introduction

A theoretical analysis in cartography and mapping since the 1950s until today shows several tendencies which are considered paradigmatic, emphasising the technological changes that occurred in the discipline. Nevertheless, this study incorporates the Thomas Kuhn's paradigm concept, which has been taken from the epistemology of sciences, opening a space to analyse cartography in terms of the paradigmatic shift. Also, this paper considers the application of so-called "criteria of contrast" as a methodological proposal for identifying paradigms in cartography. Criteria such as study object, method/techniques (approaches), research aims, and results are considered. For example, linguistic-semiotics, perceptual-cognitive, analytical-mathematical and cognitive-semiotics approaches have prevailed during the development of scientific cartography. On the other hand, approaches such as hermeneutic-deconstructive and ethnographical-processual, correspond to the post-modernist period of the discipline. In this way, the tendencies proposed in this paper, according to the difference of the study objects, approaches, research aims and cartographic results (products), can be considered as paradigmatic shift during the developing of the discipline.

2. Diversity of tendencies and paradigmatic ideas in cartography

A bibliographical revision shows that main tendencies and changes in cartography and mapping during the second half of the twentieth century and the first decade of the twenty-first century are varied. From a theoretical point of view, Raul Ramirez (2004) establishes a difference between *traditional* components and *modern* components in cartography (cf. Ramirez 2004). Traditional cartography is composed of cartographic language, cartographic modelling and cartographic communication. On the other hand, modern cartography is emphasised especially in geo-spatial data: their manipulation, processing and visualisation. This approach is based on the technological changes experienced by the discipline during the last decades. Indeed geo-

spatial data is a key aspect in his classification. In the context of geo-technology information, the manipulation and processing of spatial data acquire relevance owing to the increase and diversity of sources to obtain it (e.g. remote sensing, global positioning system GPS).

In their work three *traditions* in cartography, Daniel Sui and James Holt mention: communicative/cognitive tradition, analytical tradition, and critical tradition. This sequence is given during the development of the discipline. Each tradition, having enough of the paradigmatic shift, conceives maps in different ways: 'map as an image' in communicative/cognitive tradition, 'map as a model' in analytical tradition, and 'map as intent/social construction' in critical tradition (cf. Sui & Holt 2008). The authors declare that the research focus can differ substantially depending whether it is on 'map construction' or 'map use'. This map classification can be considered paradigmatic because cartography has different *study objects* from a disciplinary point of view. In other words, in classification there are three clearly separated epistemological visions of maps.

By taking into consideration Thomas Kuhn's arguments, Michael Peterson explicitly mentions paradigms in cartography. Indeed, Peterson argues that the concepts of paradigm and paradigm-shift are related to the rapid changes in cartography produced by the introduction of the Internet (Peterson 2002). In the same line of Sui and Holt (2008), Peterson distinguishes some paradigms in cartography: 'cartographic communication', 'analytical cartography', and 'power of maps' (i.e. critical cartography). He adds 'cartographic visualisation' (in concordance with Ramirez 2004), and 'maps and Internet'. The latter is considered by the author as an influential paradigmatic tendency that pervades all aspects in cartography and mapping. Peterson claims that research in cartography will cover a new area which is the potential of the Internet as a major technological means for cartography, especially in *map distribution*. The author considers the introduction of the Internet in cartography as a paradigmatic change because 'this would mean that all work related to the print medium - essentially everything we know about maps and their construction – would need to be thrown out' (Peterson 2002: 6). It means that the traditional maps could be replaced, losing their validity. According to Kuhn the above mentioned occurs when some discipline is impacted by paradigmatic

shift (cf. Kuhn 1962). In other words, with the Internet all our map conceptions can be changed (e.g. Web Mapping 2.0) from an epistemological point of view.

In his seminal book, "How maps work", Alan MacEachren distinguishes *representation* and *visualisation* in cartography. He proposes cartography as geo-visualisation (with a semiotic/cognitive approach) in comparison with cartography as a graphic communication belonging to the Robinson's tradition. MacEachren points out a fundamental dichotomy in the approaches to the study of how maps work. First, he considers issues in the *private* realm of the map percipients with emphasis on the perceptual and cognitive processing of sensory information. Second, the author balances this approach with an analysis of maps' semiotics on functional and lexical grounds, and the analysis of the map's *public* realm. Then, MacEachren concludes how this proposed integrated perspective might be applied to an emerging area of cartographic concern: how maps work as visualisation tools (in the early 1990s) (cf. MacEachren 1995). It refers to how maps are used as applications in geographic visualisation. Also, authors such as David DiBiase, Menno-Jan Kraak, and Ferjan Ormeling had considered the term visualisation applied in cartography and mapping since the 1990s (DiBiase 1990, Kraak 2008, Kraak & Ormeling 2003, 2010). By considering Kuhn's view, it is possible to distinguish two distinct tendencies in the discipline: cartography as graphic communication (traditional tendency) and cartography as geo-visualisation (new proposal).

David Taylor introduced the concept of Cyber cartography in the International Cartographic Conference ICC-1997 in Sweden. The author sees 'the paradigm of cyber cartography not as a break from past ideas and practices, but as an evolutionary and integrative process which incorporates important elements from the past, redefines others, and introduces new ideas and approaches to both cartographic practice and theory' (Taylor 2005: 2). These ideas also are shared by Maria Del Carmen Reyes when she sees 'the emergence of a new paradigm in cartography that is transforming the manner in which a map is conceived, produced and used' (Reyes 2005: 65). Additionally, Taylor argues that cyber cartography represents a new paradigm in cartography based on the fact that there is a group of researchers that share an epistemological point of

view and generate a new body of knowledge in the discipline. Taylor employs cyber cartographic atlases where it is possible to observe a shift from map user to map creator. In other words, cyber cartographic users can become *creators* (GCRC 2008). The author analyses cyber cartography as a paradigmatic shift in metaphoric terms: historically in the Age of Exploration map was a key navigational tool, in the same way, nowadays the *cyber map* can provide an aid to navigation in the information era (Taylor 2009). It means two paradigmatic visions during the development of the discipline: a break between traditional cartography and the so-called cyber cartography. Nevertheless, the arguments given by Taylor and his followers have not been sufficient for the concretion of a new technological paradigm in cartography. The main reason is that technological information and communication (TIC) had pervaded all scientific fields and disciplines, and it is not an exclusivity of cartography and mapping.

Ferjan Ormeling analyses general cartographic practice until 2010. During the first half of the twentieth century, cartography merely encompassed the *production of maps*. In the 1960s cartography was defined as the *communication of spatial information*, containing specific rules in the design of maps for an accurate presentation of geographic information. Then in the 1980s, with the earlier experience in the application of Kolácný's model (Kolácný 1969) and psychological research, the term cartography referred to the *production and use maps* (Ormeling & Kraak 1987). Furthermore, in 1992 Ormeling analysed core concepts in cartographic communication when he pointed out two revolutions in cartography. In the first revolution, called *communication revolution*, he sees maps as a means of spatial communication; in the second one, the *digital revolution,* he implies a separation of storage and display functions (cf. Ormeling 2007). The aforementioned can be considered a paradigmatic shift in the discipline because, for the first time in cartography, it was possible to separate the *storage function* from the *communication function* of the map. It represents a technological revolution in the map conception, similar to the paradigmatic change proposed by Taylor with his concept of cyber cartography. Finally, Ormeling proposes a third paradigm: *spatial information to support decision making*. This new tendency implies practical applications of the discipline (e.g. territorial planning) in the current society of information (Andrieko et al. 2007).

Colette Cauvin, Francisco Escobar and Aziz Serradj divided the second half of the twentieth century and the first decade of the twenty-first century into three periods and pointed out, among others, dominant paradigms or ideas (Cauvin et al. 2010). In the first period (1950-1975) two prevailing paradigms were observed: 'the map as a channel of communication' and the 'rules of graphical semiology'. In this period, fundamental changes take place in cartography in aspects such as graphic concept, language, perception of signs, and the function of maps. During the second period (1975-1995) the discipline experienced three dominant paradigms or ideas: 'theory of symbolisation and design', 'experimental and exploratory cartography', and the 'inclusion of ethical and social aspects'. Here graphical perception and cognition take place regarding that the map reader should be stimulated by the map and no longer considered as a simple recipient of its message. Exploratory use of maps is important as visualisation of scientific computing allows for a new role in maps: a useful means of obtaining spatial information for the users. In this period, the context in which maps are produced is also an important consideration. In other words, the historical, political and social context – implicitly or explicitly – interferes in map production and map interpretation (i.e. critical cartography). In the third period (1995-2005) the authors distinguish 'geovisualisation' as a paradigmatic change. Here two changes can be identified: the 'integration of cartography into GIS' and the 'shift from the communication paradigm towards scientific visualisation'. Geovisualisation allows for the exploration of information in a dynamic way by means of the development of human-computer interaction - from 'optimal map' to an 'efficient map' based on visual perception and spatial thinking (cf. Cauvin et al. 2010, Andrieko et al. 2007)

For the same period, in his Doctoral Thesis about theoretical cartography, Pablo Azócar distinguishes some paradigmatic tendencies in cartography. In agreement with Matthew Edney, who considers empirical and critical paradigms (Edney 2007), Azócar adds a gestation paradigm: the so-called post-representational cartography. From the epistemological and philosophical point of view, he claims a paradigmatic shift in the discipline: from 'representational cartography' – that includes scientific-empirical, and critical paradigms – to post-representational cartography (cf. Azócar 2012). This

tendency involves the current map conceptions especially framed by Rob Kitchen, Christ Perkins, and Martin Dodge (cf. Perkins 2003, 2004; Kitchin & Dodge 2007; Kitchin 2008; Kitchin et al. 2009). Azócar points out that from a sociological-historical perspective (regarding to Kuhn's conception) there exist two paradigms in cartography: scientific-empirical and critical. Moreover, considering an ontological perspective - essence of map- there are two paradigms: representational cartography (or traditional cartography) and post-representational cartography (Azócar 2012). Thus, there is a paradigmatic shift between the aforementioned paradigms in Kuhn's terms.

All the tendencies above are shown in Table 1. This compilation and examination of authors imply the identification of tendencies, paradigms and paradigmatic shift in cartography. This paper has mainly considered English literature on cartography. However, important statements come from German-speaking authors such as Max Eckert, Erik Arnberger, Rudy Ogrissek, Gyla Papáy, Ulrich Freitag, Wolf G. Koch, Alexander Wolodstchenko, Florian Hruby (cf. Eckert 1921-1925; Arnberger 1966, 1970; Ogrissek 1987; Freitag 1985; Pápay 2005, 2009; Koch 2003; Wolodtschenko 2011, Hruby 2011). These authors have mentioned important changes during the development of the discipline, some referring to them as explicit paradigms and others, like Hruby, rejecting the term of paradigm in cartography (Hruby 2011).

This diversity in tendencies, map conceptions and paradigm shift is largely a consequence of technological changes. Ramirez's classification, Peterson's Internet paradigm, Taylor's cyber cartography paradigm and Ormeling's map production concept, are statements framed in the technological changes. Similarly, when MacEachren sustains cartographic geo-visualisation in opposition to traditional cartography (cartographic communication), both the technological factor and the cognitive aspect are significant. The aim of this article is showing the idea that paradigms in cartography go beyond the technological impact that occurs in the discipline. The following methodological proposal, which considers some criteria applied in the epistemology of science, aims at identifying paradigmatic shifts from the epistemological point of view.

Views on Cartographic Development	Tendencies and paradigm shifts Cartography and Map Conception
Traditional components and modern components (R. Ramirez, 2004)	Cartographic language Cartographic modelling Cartographic communication Geo-spatial data manipulation Geo-spatial data processing Geo-spatial data visualisation
Cartographic research paradigm and research focus (D. Sui & J. Holt, 2008)	The map as image The map as model The map as intent/social construction
Paradigm in cartography: cartographic research and internet (M. Peterson, 2002)	Cartographic communication Analytical cartography Cartographic visualisation Power of maps Maps and Internet
Cartography: representation and visualisation (A. MacEachren, 1995) (J-M. Kraak & Ormeling, 1996, 2003)	Cartography as graphic communication Cartography as geo-visualisation
Cyber-cartography paradigm (D. Taylor, 2005)	Traditional cartography Cyber-cartography
Paradigm changes in cartography (F. Ormeling, 2007)	Production of maps Map production and map use Spatial information to support decision making
Cartographic trends and paradigms (C. Cauvin, F. Escobar & A. Serradj, 2010)	The map as a channel of communication Rules of graphical semiology Theory of symbolisation and design Experimental and exploratory cartography Ethical and social aspects Geovisualisation
Paradigms in cartography and mapping (P. Azócar, 2012)	Scientific paradigm (traditional cartography) Critical paradigm (critical cartography) Post-representational cartography

Table 1. Main tendencies and changes in cartography and map conception during the second half of the twentieth century. After P. Azócar (2012) and modified by the author

3. Methodological proposal for identifying paradigms in cartography

Aiming at solving the chaos produced by the diversity of opinions, tendencies in cartography, and map conceptions, a methodology based on epistemological aspects is proposed. This methodological proposal implies the application of the so-called *criteria of contrast* (Azócar 2012). These criteria are: Study Object, Research Aims, Methods and Techniques, Research Results, and (Cartographic Product) Results, showing each tendency with its own identity. The determination of a unique and own study object allows for the identification of - such is the case for other sciences and disciplines - several cartographic tendencies. In turn, each study object comprises its own research objectives and approaches for its analyses. In this process, research results, which are materialised through cartographic products as concrete and visible results, are provided. Since each tendency has its own map conception in consequence, it will generate a different cartography (e.g. map type).

Table 2 shows cartographic tendencies in comparison with the criteria of contrast above mentioned. Cartographic Language (or Cartosemiotics), Cartographic Communication, Analytical Cartographic, Cartographic Visualisation, Critical Cartography and Post-representational Cartography are the tendencies proposed in this article.

The six cartographic tendencies contrast with respect to the study object. *Map language* and *map symbolism* are key subjects of cartosemiotic in comparison with *map image* and *map design,* which belong to cartographic communication. Map language/symbolism generates an internal cartographic alphabet, grammar, reading and writing as a cartographic result while map image/design aims at generating functional and optimal map effectiveness for its reading and comprehension in the communicative context. Cartosemiotic achieves this result through the application of the *linguistic-semiotics* approach while cartographic communication uses a *perceptual and cognitive* one with the help of the application of psycho-physical tests especially addressed to the users. Both tendencies intend to achieve *rules and generalisations*; the former in the context of map language and the latter in the

context of cartographic communication. In Cartosemiotics, research results are aimed at the development of a graphic mode for expressing geospatially related data while, in cartographic communication, they are aimed at cognitive map-design and map use (or map reading). The latter represents the Western school in cartographic communication led by Arthur Robinson (Robinson 1952, Ratajski 1977, Morrison 1997, cf. Montello 2002). Cartosemiotics, on the other hand, originates from the Russian school and the East European countries. Most of the authors mentioned in this study agree that cartographic communication is a traditional tendency in cartography and cartosemiotic or cartographic language has its own particularities (cf. Schlichtman 2008, 2009; Wolodtschenko 2001). However, in light of the criteria of contrast both are separable tendencies.

Similarly, *map model* and *map-use space* have distinct study objects of analytical cartography and cartographic visualisation, respectively. Map model is the mathematical and analytical tradition initiated by Waldo Tobler and continued by Harold Moellering (Tobler 1976, 1979; Moellering 2000, 2001; Clarke & Cloud 2000), while map-use space as study object is analysed by Alan MacEachren in his famous 'cartographic cube' comparing the relationship between visualisation and communication (MacEachren 1995, MacEachren & Kraak 2001). In analytical cartography a *mathematical/logical-analytical* approach is applied to achieve a representational and conceptual model of the real world through a virtual map, which possesses deep and surface spatial structure and several data levels as a cartographic product result (cf. Moellering 2000, 2001). Criteria of contrast establish that in cartographic visualisation a *cognitive and semiotics* approach is considered with the idea to elucidate how maps work as a visualisation tool in the technological computational context. As research results, visual thinking and visual communication mapping are achieved; as cartographic product, maps are generated for synthesis and presentation (i.e. public users) as opposed to maps for exploration and analysis (i.e. private users). This perspective was initiated by David DiBiase when comparing *visual thinking* to *visual communication* (DiBiase 1990). Therefore, analytical cartography and cartographic visualisation are contrasting tendencies such as cartographic language and cartographic communication. Even the cognitive/semiotics approach, proposed

by MacEachren, is an alternative to the communication tradition paradigm. On the one hand, the basis and statements proposed and developed in analytical cartography have been applied in geographic information sciences, geospatial data infrastructures, and data acquisition and sensor networks (Moellering 2012). On the other hand, the approaches from cartographic visualisation are the basis of the current internet cartography, Web Mapping 2.0 (Haklay et al. 2008, Gartner 2009) location based-services, ubiquitous computing and real-time cartography, among others.

Nevertheless, at the beginning of the 1990s it was possible to formulate an alternative cartography labelled critical cartography whose main exponents were John Brian Harley and Jeremy Crampton and John Krygier as one of the important followers (Harley 1988a, 1988b, 1989, 2001; Crampton 2001, 2010; Crampton & Krygier 2006; Wood & Krygier 2009). Critical cartography, analysed in the light of the criteria of contrast, presents several particularities. Here, the study object is *map content* and its main research objective is to uncover the power-knowledge practices which are embedded in maps. Using *hermeneutic* and *deconstructive* approaches allow for the reading and interpreting of map *beyond* the accurate representation of territories and mathematical coordinates system. Harley interprets the cartography and maps' drawing statements of Michel Foucault and Jacques Derrida (Harley 2001). Hence, the research results conceive maps as *social construction* and as instruments that *exert power*. The aforementioned would be validated throughout the history of cartography and maps (Wood 1992, Monmonier 1996). In this respect, cartographic product results of critical cartography correspond to maps as historical *devices or artefacts* that depend on the context in which the map is created (i.e. social, political, cultural, philosophical context). Critical cartography is considered a paradigmatic tendency due to the fact that the criteria of contrast are different enough from the previous cartographic tendencies. Furthermore, the critical aspects come from outside of the discipline - i.e. *undisciplined cartography*, considering that all mentioned tendencies had arisen in the heat of academia.

Nowadays, *Post-representational cartography* is a new perspective in cartography which involves the current map conceptions especially formulated

by Rob Kitchen, Christ Perkins, Martin Dodge, and John Pickles (cf. Perkins 2003, 2007; Pickles 2004; Kitchin & Dodge 2007; Kitchin 2008; Kitchin et al. 2009). The statements of these authors come from social critic and are applied in map analysis. There also exist several map conceptions conceived by authors such as Emanuela Casti, Bruno Latour, Veronica Della Dora, James Corner, Tim Ingold, and Vincent del Casino and Stephen Hanna. They claim new interpretations for maps that go beyond traditional cartography (cf. Casti 2005; Latour 1987, 1990; Della Dora 2009; Corner 1999; Ingold 2000, Del Casino & Hanna 2006). In this respect, it is significant to analyse current perspective in cartography in the light of the criteria of contrast. It is outstanding that the study object of post-representational cartography is the *map itself*. It means that neither its accurate spatial representation (technical aspect) nor its contingent content (ideological aspect) are important, but the *being* of the map – from an *ontological* point of view. In terms of research, the aims are to analyse how maps *emerge* through cultural, social and spatial practices. The map is not a *stable product* - it emerges according to a *set of practices*. In this case, the adequate method, or technique, is an *ethnographical* and *processual* approach (especially from the social sciences). As research results, it is claimed that a map is always in a *state of becoming* - in constant process- only existing in the practice. This means that cartography, as a representational science, becomes a processual science, having an *emergent* map as cartographic product (Kitchin et al. 2009). In other words, a map is considered of-the-moment, transitory, fleeting, contingent and context-dependent; very different from the map obtained in the previous tendency - i.e. neutral, precise, and accurate. The so called post-representational cartography is analysed in these terms, applying the criteria of contrast. This tendency constitutes a particular and singular way for the analyses and interpretation of cartography and mapping. In Kuhnian terminology, it is a perspective totally opposite to traditional cartography (i.e. visualisation, analytical, communication, and language tendencies) and also with respect to critical cartography. Owing to the fact that post-representational cartography considers the ontological aspect: 'the map *happens* or *occurs* only when someone interprets a given visual form' (Kitchin & Dodge 2007: 335), it is important to bear in mind this epistemological aspect as a paradigmatic change in the discipline.

Finally, it is important to mention that the neo-cartography concept arose during the first decade of the twenty-first century. Neo-cartography emphasises the application of advanced computer technology and the public participation in the process of up-date and content of maps (cf. Kraak 2011, Faby & Koch 2010, Cartwright 2012). This public or citizens participation is known as 'volunteered geographic information' (VGI) (Goodchild 2007). Similarly, for Geog Gartner, the term Neo-cartography is used to express the collaborative character of the integrative possibilities in modern Internet Cartography (Gartner 2012). The aforementioned is linked with Taylor's Cyber-cartography, who considers it as a paradigm in the discipline. Applying the criteria of contrast, however, it is difficult to distinguish for each one of them, whether cyber-cartography is a paradigm or not. Further analysis is needed in this area. Therefore, it is more suitable to use the neo-cartography term, which involves new development in the technological context as well as a *second generation* of users, who are not aware of traditional cartographic rules and standards. It implies a *democratisation* for accessing and participating in map creation. However, authors framed in critical cartography, complain about this participation. Neo-cartography also responds to the technological changes. In this case, it is considered a mixture between cyber cartography and critical cartography.

TENDENCIES CRITERIA OF CONTRAST	Cartographic Language	Cartographic Communication	Analytical Cartography	Cartographic Visualisation	Critical Cartography	Post-Representational Cartography
STUDY OBJECT	Map language/ Map symbolism	Map image/ Map design	Map model	Map-use space	Map content	Map *itself*
RESEARCH AIMS	Rules and generalisations in map language	Rules and generalisations in cartographic communication	Analytical modelling and hypothesis testing of mapped phenomena	How map work as visualisation tools	Uncover the power-knowledge practices embedded in maps	How maps emerge through cultural, social and spatial practices
METHODS AND TECHNIQUES (APPROACHES)	Linguistic-semiotics	Perceptual/ cognitive (psycho-physical)	Analytical/ mathematical	Cognitive/ semiotics	Hermeneutic-deconstructivist	Ethnographical – processual
RESEARCH RESULTS	Graphic mode for expression of geospatially related data	Cognitive map-design and map use (map reading)	Representational and conceptual model of the "real" world	Visual thinking and visual communication mapping	Maps as social constructions, and instruments that exert power	Maps in a state of becoming (in process) only existing in the practice
CARTOGRAPHIC PRODUCT RESULTS	Cartographic alphabet, grammar, reading, and writing	Functional and optimal map effectiveness	Virtual map with deep and surface spatial structures and data levels	Synthesis/ presentation maps and exploration/ analysis maps	Historical devices/ artefacts, context-dependent	Emergent maps

Table 2. Tendencies in contemporary cartography analysed by the criteria of contrast (After P. Azócar 2012)

4. Conclusion

After revising the perspectives, tendencies and some paradigms established during the last sixty years of the history of cartography, it is possible to analyse the development of the discipline in Kuhnian terms. Thomas Kuhn focused his analysis in the historical development of several disciplines and sciences identifying abrupt breaks from epistemological view-points. In the previous analysis there is an agreement with Edney (2007) in the identification of an empiricist paradigm and a critical paradigm. The former occurs during the modern or scientific period of cartography and the latter during the so-called postmodernism period of the discipline. Here the term empiricist has been changed to scientific-empirical. Nevertheless, within the scientific paradigm it is possible to observe the following tendencies: cartographic language, cartographic communication, analytical cartography, and cartographic visualisation. These tendencies are paradigmatic because their criteria of contrast are different from each other. Besides, it historically corresponds to the scientific period of cartography. On the other hand, in a postmodernist context, critical paradigms from the social sciences have enriched cartography through critical cartography, which has been analysed in the light of the criteria of contrast. As a result, a critical perspective arises in opposition to traditional or scientific cartography - in Kuhn's terms. Finally, post-representational cartography emerges as a new way of thinking and interpreting maps where the being of the map is emphasised - in an ontological and emergent point of view. It is not a paradigm itself, but it has interesting statements for theoretical analysis and discussion in the discipline.

ACKNOWLEDGEMENTS

The author wishes to thank Prof. Carmen Gloria Hadermann (Department of Humanities, Universidad Tecnológica Metropolitana, Santiago-Chile) for her unselfish help in the revision, correction and suggestions of this paper.

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