

Chapter Two

Delineating the Map

A map is, in its primary conception, a conventionalized picture of the Earth's pattern as seen from above.

-- Erwin Raisz, *General Cartography*, 1938.

Every map is someone's way of getting you to look at the world his or her way.

-- Lucy Fellowes, Smithsonian curator (quoted in Henrikson 1994).

2.1 Introduction

Mapping provides a uniquely powerful means to classify, represent and communicate information about places that are too large and too complex to be seen directly. Importantly, the places that maps are able to represent need not be limited to physical, geographical spaces like cities, rivers, mountain ranges and such like: maps can be used to represent virtual spaces of cyberspace and their supporting network infrastructures. This chapter seeks to delineate the nature of maps and outline the major theoretical perspectives that have been used to understand and critique cartography in Western academia in the last fifty years.

The ability to create and use maps is one of the most basic means of human communication, at least as old as the invention of language and, arguably, as significant as the discovery of mathematics. The recorded history of cartography clearly demonstrates the practical utility of maps in all aspects of Western society, being most important for organising spatial knowledges, facilitating navigation and controlling territory. Some have gone further, to argue that mapping processes are culturally universal, evident across all societies (e.g., Blaut *et al.* 2003), although the visual forms of the resulting map artefacts are very diverse. At the same time, maps are also rhetorically powerful graphic images that frame our understanding of the human and physical world, shaping our mental image of places, constructing our sense of spatial relations. So, in a very real sense, maps make our world.

Conventionally, maps are material artefacts that visually represent a geographical landscape using the cartographic norms of a planar view - looking straight down from above - and a consistently applied reduction in scale. However, it is impossible neatly to define maps according to the type of phenomena mapped or the particular mode of presentation, or their medium of dissemination (Dorling and Fairbairn 1997). Maps have traditionally been used as static paper repositories for spatial data, but now they are much more likely to be interactive tools displayed on a computer screen. (Some national mapping agencies are contemplating discontinuing the printed topographic map products as customers increasingly use digital geospatial data¹). Today, we live in a map-saturated world (Wood 1992), continually exposed to conventional maps, along with many other map-like spatial images and media (e.g., animated satellite images, three-dimensional city models, MRI scans of the brain).

Maps have long been used in scholarly research into social and physical phenomena. They provide, of course, a primary technique in geography² but they are also used widely in other disciplines such as anthropology, archaeology, history, and epidemiology, to store spatial information, to analyse data and generate ideas, to test hypotheses and to present results in a compelling, visual form. Mapping as a method of enquiry and knowledge creation also plays a growing role in the natural sciences, in disciplines such as astronomy and particle physics, and in the life sciences, as exemplified by the metaphorical and literal mapping of DNA by the Human Genome Project (cf. Hall 2003). This work is not limited to cartography; many other spatial visualisation techniques, often using multi-dimensional displays, have been developed for handling very large, complex spatial datasets without gross simplification or unfathomable statistical output (e.g., volumetric visualisation in atmospheric modelling, three-dimensional body imaging in medical diagnostics). “More mapping of more domains by more nations will probably occur in the next decade than has occurred at any time since Alexander von Humboldt ‘rediscovered’ the earth in

¹ For example in Canada, see “Ottawa plots making maps without paper”, *Globe and Mail*, October 4, 2005, <www.theglobeandmail.com/servlet/story/RTGAM.20051004.wxmaps104/>.

² Although denigrated methodologically in some quarters; see Dodge and Perkins (2008a).

the eighteenth century, and more *terra incognita* will be charted than ever before in history” (Hall 1992, 22). Cyberspace cartographies form one of the most significant new domains of this mapping activity.

2.1.1 Mapping processes

The production of cartography and other spatial visualisation involves a whole series of mapping processes, from the initial selection of what is to be measured to the choice of the most appropriate scale of representation and projection, and the best visual symbology to use. The concept of ‘map as process’ is useful methodologically because it encourages particular ways of organised thinking about how to generalise reality, how to distil inherent, meaningful spatial structure from the data, and how to show significant relationships between things in a legible fashion. Mapping provides a means to organise large amounts of, often multi-dimensional, information about a place in such a fashion as to facilitate human exploration and understanding. Yet, mapping practices are not just a set of techniques for information ‘management’, they also encompass important social processes of knowledge construction. As scholars have come to realise, maps and culture are intimately entwined and inseparable.

Mapping not only represents reality, it has an active role in the social construction of that reality. Map-makers should be seen as creators rather than copyists of the landscapes represented. However, people are often not conscious of this constructive role when they use maps. Sparke (1998, 466) calls this the ‘recursive proleptic effect’ of mapping, “the way maps contribute to the construction of spaces that later they seem only to represent”. The power of maps comes from the fact that they are both a practical form of information processing and also a compelling form of rhetorical communication.

Maps work, essentially, by helping people to see the unseen. This is achieved through the act of visualisation, premised on the simple notion that humans can reason and learn more effectively in a visual environment than when using textual or numerical descriptions. Maps provide graphical display which renders a place, a phenomenon or a process visible, enabling our most powerful information-processing abilities - those of spatial cognition associated with the

human eye-brain vision system - to be brought to bear. Visualisation is thus a cognitive process of learning through the interaction with visual signs that make up the map and it differs from passive observation in that its purpose is to discover unknowns, rather than to see what is already known. Effective cartographic visualisation can reveal novel insights that are not apparent with other methods in terms of spatial relations, patterns and trends. In an instrumental sense, then, map use is a powerful prosthetic enhancement for the human body: “[l]ike the telescope or microscope, it allows us to see at scales impossible for the naked eye and without moving the physical body over space” (Cosgrove 2003, 137). The ideal of obtaining a reliable capacity to see the unseen is particularly applicable to much of cyberspace cartography, because of the invisibility of the infrastructure and the intangibility of the virtual spaces (see chapter three).

The power of map use as spatial visualisation to elucidate meaningful patterns in complex data is well illustrated by some of the ‘classics’ of pre-digital era, such as Charles Joseph Minard’s ‘Napoleon map’ of 1869 or Harry Beck’s ‘Tube diagram’ of 1933 (see Garland 1994; Tufte 1983). Even though these were hand-drawn on paper, they are nonetheless still powerful today and show the potential of visualisation to provide new understanding and compelling means of communicating to a wide audience. Through their novel visual forms they also demonstrate the extent to which mapping can be a creative practice in and of itself. The best maps also go beyond merely representing to become a kind of cognitive shorthand for the actual places and processes themselves, as illustrated in Beck’s celebrated diagrammatic design of the Underground (the Tube map) which has become such a powerful cartographic imaginary and spatial template for the ‘real’ layout of London in the minds of many visitors and residents. The ‘problem’ is that while Beck’s map works well for underground movement, it can be confusing for surface navigation because it famously sacrifices geographic accuracy for topological clarity.

Map effectiveness is also engendered because they are visually appealing objects. As Keates (1996, 174) argues art “is fundamental to cartography itself” and the aesthetic of cartographic representations is central to their success in

rhetorical communication and means they are widely deployed as persuasive devices to present ideas, themes, and concepts that are difficult to express verbally (cf. Edsall 2007; Keates 1996). The result, according to Francaviglia (1999, 155) is that “[c]artographers draw maps that have the power to both inform and beguile their users”. Most of the maps encountered on a daily basis (often with little conscious thought given to them) are used in the service of persuasion³, ranging from marketing maps and city-centre tourist maps to the more subtle displays such as states’ claims to sovereign power over territory, implicitly displayed in daily weather maps seen on the news. Maps work because they are able to *sell* a particular vision of the world and because people are willing to *buy* into this vision because they believe in the authority of the image as a trustworthy representation.

The persuasive power of ‘informative-yet-beguiling’ maps is equally applicable to cyberspace cartography projects. Indeed, much of this mapping is used precisely because it has an appealing visual sense of what cyberspace *should* look like, matching the metaphorical preconceptions of the designers, journalists and editors. (See chapter four for discussion of the visual tropes used to spatially imagine Internet infrastructure.) Yet, the lack of established conventions in mapping aspects of cyberspace (what should a map website look like?⁴) have provided significant scope for design and aesthetic experimentation. And in this regard, some of the most innovative cartographies of cyberspace are pushing the definitional boundaries of the map (as opposed to a graph or merely a ‘pretty picture’). As such, I would argue, cyberspace cartography is one of the few genuinely ‘cutting edge’ developments in map design practice in the twenty-first century.

³ Many of these illustrations are what is known as ‘popular’ maps and they use figurative infographics style rather than geometrically accurate representations (see Holmes 1991).

⁴ A diversity of metaphors and design styles have been developed, see Kahn (2000) for examples and discussion of some of the issues.

2.2 Cartographic history, mapping modes and the digital transition

Attempts to historicize the nature of (Western) cartography through categorisations of map forms and taxonomies based on purpose often implicitly use the notion of evolutionary advancement driven by technological development as an explanation. The end result, often conceptualised as a tree (Figure 2.1), narrates cartography as a beneficent pursuit, characterised by improving accuracy and comprehensiveness with each new generation of map. Examples of this conceptualisation are quite common in the literature, such that “[t]he normative history of cartography is a ceaseless massaging of this theme of noble progress” (Harley 1992, 234). For example, Crone (1953, xi) notes, “[t]he history of cartography is largely that of the increase of accuracy with which ... elements of distance and direction are determined and the comprehensiveness of the maps’ content.”.

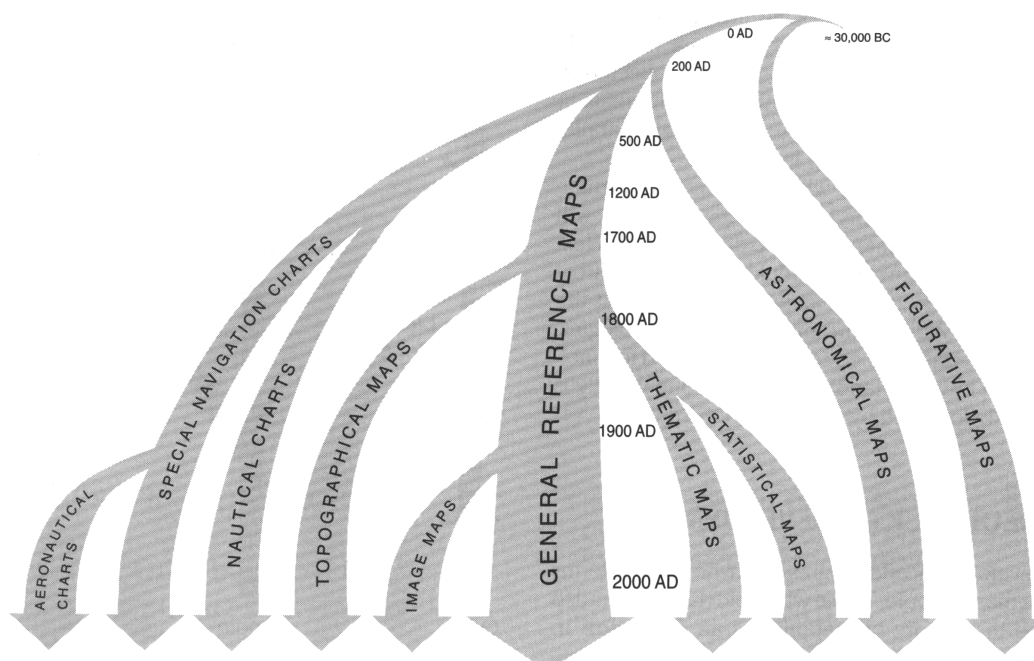


Figure 2.1: Cartography explained as a ‘story of progress’. Mapping is shown to evolve over time with the development of increasingly complex forms. (Source: Robinson *et al.* 1995, 22.)

Histories of cartography tend to be written as a history of technique, with an underlying assumption that rational decision-making leads to the adoption of improved technologies and institutional practices when they become available. In

some narrative histories cartographers are portrayed as benign artisans and later skilled technicians striving to make ever more accurate depictions of space. Technical development is conceived as a continuous path of improvement, punctuated with particular bursts of intense innovation and progress (e.g., John Harrison's 1761 invention of the chronometer and the reliable production of longitude at sea; cf. Sobel 1995). Within this 'onward march' view of map-making history, distinct phases are conveniently identified: the Eurocentric sequence runs typically through primitive medieval cartography based on religious imagination, followed by revolutions in measurement and projective geometry, flowing from Ptolemaic geography, leading to Renaissance mapping and the first atlases, then moving forward with the scientific formulations of the Enlightenment and geodetic national surveys, ending up with the most 'advanced' digital map-making founded on GIS and GPS technology. Above all else, such 'progressivist' narratives stress the changes in (Western) cartography's state from essentially a descriptive art to a thoroughly scientific endeavour embracing the doctrine of objectivism. This 'cartographic reformation' in which map-makers strove for intellectual respectability as 'men of science' was inscribed on the maps themselves in terms of the "decline in florid decoration and the rise of the factual neutrality of white space" (Edney 1993, 56). This 'reformation' marked a shift in authorship from named cartographers (the individual artisan map-makers) to the anonymised mass-produced maps of print capitalism, paralleled by an economic reorganisation of map production from small-scale, uncoordinated and sporadic efforts to systematic and later industrialised methods of large cartographic institutions working to formalised standards, typically in the service of the state.

The apparent 'naturalness' of this account belies the politics behind the conceptualisation of the progressive development of cartography from a primitive past to the sophisticated present (Edney 1993; Pickles 1999). The underlying goal of this kind of construction of cartographic history - achievable only through a carefully selective reading of extant map artefacts according to Edney (1993) - is to 'prove' that the objectivity of *current* scientific methods is predestined. It grants an important legitimisation to the positivist notion of contemporary professional cartography as the 'best' and provides a discursive

mechanism to dismiss maps that do not fit ‘acceptable’ scientific standards (e.g., dismissal of non-Western mapping practices). Social studies of science have shown that this type disciplinary ‘storytelling’ is a form of scientism, a metanarrative underlying modernist science’s claims to exclusive truth based on the superiority of empirical measurement to describe reality and the privileging of the resulting representations. Scientific worldviews see technological progress almost like a force of nature that somehow operates outside society and beyond the political concerns of money, power, and ego. The way one approaches cartographic history is therefore worthy of consideration, as it is at the heart of the recent political theorisation of cartography and directly informs our understanding of the nature of the map and contemporary positivistic epistemological foundations of cartography (including much of the work mapping cyberspace).

There are alternative ways to conceptualise cartographic history that are not so wedded to modernist narratives. One of the most useful is provided by Edney’s (1993, 54) theorisation of ‘cartography without progress’, in which mapping is read as “a complex amalgam of cartographic *modes* rather than a monolithic enterprise”. For Edney, a cartographic mode is not simply a time period in a linear chronological sequence, but is a unique set of cultural, social, economic and technical relations within which cartographers and the map production processes are situated. The mode is the milieu in which mapping practices occur. Each cartographic mode gives rise to its own kind of map artefacts, and these may well look different from other modes, but critically this conceptualisation does not assume that one is inherently better than another, or that one mode will inevitably evolve into a ‘better’ mode. As Edney (1993, 58) says: “[t]he mode is thus the combination of cartographic form and cartographic function, of the internal construction of the data, their representation on the one hand and the external *raison d’être* of the map on the other”. Modes are unique to their time and places, and are transitory. There can be multiple distinct cartographic modes operating at the same time, in the same place. Modes can interact and may well overlap, merge or split. The boundaries between modes are likely to be fuzzy and permeable.

Cartographic history, according to Edney's theorisation, is a pluralist and relational network of activities rather than a single linear process. The end result is not the unidirectional evolutionary tree but a complex, many-branching, rhizomatic⁵ structure (Figure 2.2). In contemporary cartographic epistemologies, a diverse range of mappings is seen to emerge from a shifting creative milieu rather than in a systematic fashion.

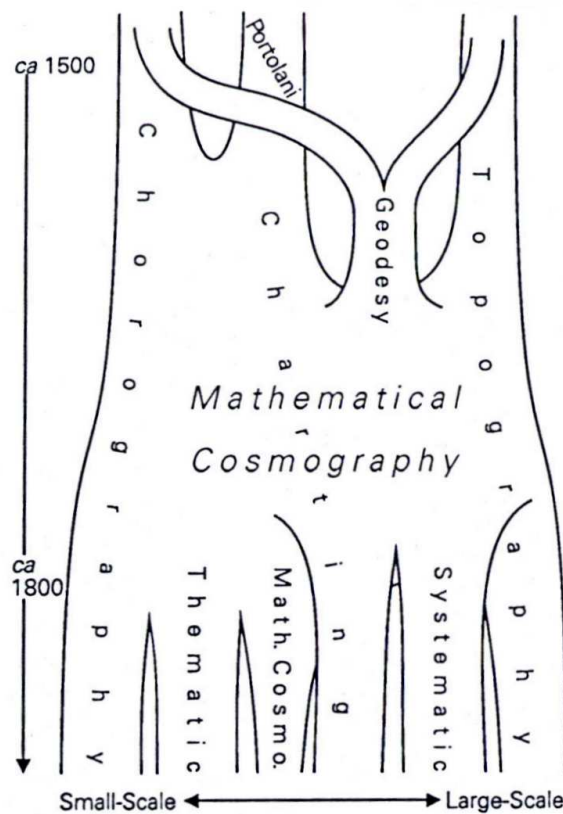


Figure 2.2: Cartography alternatively characterised as a rhizomatic network of competing and overlapping modes of mapping. This example shows the post-Renaissance convergence of modes into mathematical cosmography and then the gradual bifurcation into several more distinctive modes following the Enlightenment. (Source: Edney 1993, 59.)

As stated in the introduction, the theorisation of this thesis is built on modes rather than trees. The development of new forms of contemporary mapping practices and artefacts - what I term cyberspace cartographies - is best conceptualised as three distinct modes rather than a new branch at the end of the

⁵ A rhizome is a tangled root system that develops horizontally, and in a non-hierarchical fashion.

family-tree of cartography history. The rhizomatic notion of cartographic modes suits the emergent and variegated nature of cyberspace mapping, which has drawn on many disparate ideas, approaches and visualisation forms; it is thoroughly situated in wider socio-technical changes (particularly the diffusion of the Internet throughout map production and the use of the Web as the primary media of dissemination). The empirical analysis (presented in chapters five and six) tries to unpack the some of cultural, social, and technological relations which determine the cartographic practices of one of these modes, the ‘maps of cyberspace’ mode, using a range of cartographic genres from Internet network infrastructure mapping.

2.2.1 Digital transition and cartography

The development and rapid diffusion of information and communication technologies in the last three decades has affected all modes of mapping, changing methods of data collection, cartographic production, and the dissemination and use of maps. This has been termed the ‘digital transition’ in cartography (Goodchild 1999; Pickles 1999) and it is continuing apace (for example, developments in satellite navigation displays and mobile mapping services). As such it is a vital component in understanding the milieu in which new modes of cartography are emerging.

While the detailed social and technical histories of the digitisation of the cartographic industry are complex and largely unwritten, it would be fair to say that in the last decade cartography has been almost wholly subsumed in a rapid convergence of spatial technologies, such that today, professional cartography is seen as little more than an ‘end-service’ component of the multi-billion dollar GI industry. Nowadays, the majority of maps are digital and created only ‘on demand’ from geospatial databases for temporary display on screens. The days of the unwieldy folded map sheet and heavy paper atlases are quickly becoming a thing of the past, replaced by the rapid technological development of GIS, spatial databases and real-time navigation systems. The Web mapping portal MapQuest.com, for example, has already generated more digital maps than any other publisher in the history of cartography (Peterson 2001); the huge popularity

of Google map's API⁶ in the summer of 2005 has inspired an explosion of new online mapping tools and hacks (see Gibson and Erle 2006), and there is even the prospect that GIS itself will begin to adapt and evolve around such a Web services mapping model.

As the map itself has become a fully digital text, many of its basic properties have changed. The digital map is infinitely copiable, infinitely transportable, and a highly mutable representation (switching thematic layers on and off, easy modification of symbols, the ability to make selections by spatial/attribute queries, and so on). Cheap, powerful computer graphics on desktop PCs, and increasingly mobile devices, enable much more expressive and interactive cartography, potentially available to a growing number of people. The pervasive paradigm of hypertext as a way to structure and navigate information has also influenced digital maps. Increasingly, maps are used as core components in larger multimedia information resources where locations and features on the map are hotlinked to pictures, text and sounds, to create distinctively new modes of map use (Cartwright *et al.* 1999). In design terms, the conventional planar map form itself is, of course, only one possible representation of spatial data and new digital technologies have enabled much greater diversity of forms including pseudo three-dimensional landscape views, interactive panoramic image-maps, fully three-dimensional flythrough models, and virtual globes (e.g., Fisher and Unwin 2001; Goodchild 2008; Hudson-Smith 2008).

Developments in computer graphics, computation and user interfaces have begun to fundamentally transmute the role of the map from the finished product to a situation where the map is displayed within a visual tool to be used interactively for exploratory data analysis (typically with the interlinking of multiple representations such as statistical charts, three-dimensional plots, tables, and so on). This changing conceptualisation of the map is at the heart of the emerging field of geovisualization, which in the last five years or so have been one of the leading areas of applied cartographic research (cf. Dodge *et al.* 2008; Dykes *et al.* 2005; MacEachren and Kraak 2001).

⁶ An API (Application Programming Interface) allows technically savvy users direct access to the database enabling sophisticated and novel third-party applications to be developed.

As well as making maps more interactive, information and communication technologies (ICTs) are also helping to give many more people access to cartography as map-makers themselves, be it via the ‘map charting’ options in spreadsheets to produce simple thematic maps of their own data or through desktop GISs such as ArcView or MapInfo. As more and more people ‘by-pass’ professional cartographers to make their own maps as and when required, it is likely that the diversity of map forms and usage will expand. Of course, access to ‘point and click’ mapping software itself is no guarantee that the maps produced will be as effective as those hand-crafted by professionally-trained cartographers (C. Board, PhD examiners report, 24th October 2006).

Developments in networking and computer-mediated communications, and the rise of the World-Wide Web in the mid 1990s, means that digital maps are now very easy to distribute at marginal cost and can be accessed ‘on demand’ by many (see Kraak and Brown 2001; Peterson 2003a and 2008; Plewe 1997). One of the first examples was the Xerox PARC Map Viewer⁷ online in June 1993 and the threshold of online mapping continues to rise (e.g., in June 2005, Google Maps service provided seamless satellite image coverage of the world). These Web mapping services are free at the point of use and are encouraging the casual use of cartography⁸.

The provision of Web mapping and online GIS tools is significantly shifting the accessibility to mapping and spatial data, as well as altering the user perception of what a map should be. There are clear signs that cartography will be seen as simply one of many available ‘on demand’ Web services. As the digital map display becomes more flexible and much more accessible, it is also, in some respects, granted a less reified status than analogue map artefacts of the past. Maps are increasingly treated as transitory information resources, created in the moment, and discarded immediately after use. In some senses, this devalues the

⁷ Created by Steve Putz. The map is no longer online, however further background details are available at <www2.parc.com/istl/projects/www94/iisuwww.html>.

⁸ Although, there are many much thornier, political, issues about access rights and intellectual property, especially so in the UK; see for example Dodson 2005.

map as it becomes just another form of ephemeral media, one of the multitude of screen images that barrage people everyday. Cartographic knowledge itself is just another informational commodity to be bought and sold, repackaged and endlessly circulated⁹.

The production of cartographic knowledge has always been dependent, to large degree, on the available methods of data collection. These are being greatly augmented in the digital transition. The wide-spread importance of new digital measurement was noted by U.S. National Science Foundation Director Rita Colwell (2004, 704): “new tools of vision are opening our eyes to frontiers at scales large and small, from quarks to the cosmos.” Cartography’s ability to ‘capture’ the world has been transformed by digital photogrammetry, remote sensing and GPS-based surveying. Cartography can not only ‘see’ the world in greater depth (Pickles 2004b), but it can also ‘see’ new things (including virtual spaces), and with new temporalities.

Vast geospatial databases underlie the modern digital topographic maps, such as the Ordnance Survey’s Digital National Framework comprising over 400 million features.¹⁰ These are growing as part of the ‘exponential world’, being fed in particular by high-resolution imagery from commercial satellites. Interestingly, in the future, much of this growth will come from people gathering geospatial data as they go about their daily activity, automatically captured by location-aware devices that they will carry and use. From this kind of emergent mobile spatial data capture it will be possible to ‘hack’ together new types of maps rather than be dependent on the map products formally published by governments or commercial firms. Such individually-made, ‘amateur’ mapping may be imperfect in many respects (not meeting the positional accuracy standards or adhering to the TOPO-96 surveying specifications for example), but could well be more fit-for-purpose than professionally produced, general map

⁹ The emergence of open-source cartography, as exemplified by the OpenStreetMap project, has the potential to challenge the commercial commodification of geospatial data by developing a ‘bottom-up’ capture infrastructure that is premised on a volunteerist philosophy (Perkins and Dodge 2008).

¹⁰ Source: <www.ordnancesurvey.co.uk/oswebsite/media/news/2001/sept/masterchallenge.html>.

products¹¹. There is also exciting scope for using locative media to annotate our maps with ephemeral things, personal memories, messages for friends, that are beyond the remit of governmental cartography or the commercial cartography industry¹².

In some respects, then, the outcome of the digital transition can be read as a democratisation of cartography, widening access to mapping and breaking the rigid control of authorship by an anonymised professional elite. However, if one looks more closely (and sceptically), the freedom for people to make their own maps with these types of software tools is strongly inscribed in the design and functionality of the software itself. The maps one can make in Excel or ArcView are only the maps the program allows one to make. The majority of people still do not have the time or skills to break free from the functional constraints that the software imposes¹³. Google may currently make a vast amount of mapping freely available online (supported by advertising) but it is subject to their terms and conditions of use and raises risks of monopolistic provision (cf. Zook and Graham 2007).

Furthermore, interpreting the digital transition should not merely be about plotting technical ‘impacts’, but should also involve assessing the political implications of changing social practices in data capture and map authorship. Being wary of linear narratives of progress, one should not read the digitisation of the map as seamless, unproblematic or inevitable (Pickles 1999; 2004a). Technological change is always contested, driven by competing interests and received in different ways and at different speeds in particular institutional settings. Technology is never a neutral actor. It is shaped by social forces and is bound up in networks of power, money, and control of new institutional practices

¹¹ Of course, many would argue that Ordnance Survey mapping is not perfect or perfectly accurate (source: C. Board, PhD examiners report, 24th October 2006).

¹² An example would be Christian Nold’s on-going emotion mapping project, <www.emotionmap.net>.

¹³ See Fuller’s (2003) analysis of the framing power of Microsoft Word on writing and Tufte’s (2003) trenchant critique of Microsoft PowerPoint on how people give presentations. The effect of the software ‘defaults’ on the look of maps produced by GIS packages such as ArcView and MapInfo is also evident in a good deal of generic presentation cartography produced these days.

in the processes of cartographic digitisation - and the benefits and costs are never felt evenly. “The mappings of the digital transition have their own geographies” Pickles (2004a, 149) argues, which are intimately bound-up with “new Americanism, a thorough-going post-Fordism, and a resurgent geopolitics of global hegemony.” Government agencies and large commercial mapping firms have invested heavily in digitisation not from enlightened ideals to improve cartography but because it serves their interests (such as to maximise efficiency, to reduce costs by de-skilling production), and to boost revenues. The popular discourses of digitisation in cartography and elsewhere are often uncritical, driven in large part by the boosterism of the vendors of hardware, software and IT consultants offering ‘solutions’. The reality of the ‘messy’ social aspects of digitisation are glossed over in techno-utopian fantasies.

As such, the transition has made it more urgent to understand the wider social milieu in which maps are produced and disseminated, because as Harley (1992, 231) argued at the start of the 1990s, digital cartography and GIS works “to strengthen its positivist assumptions and it has bred new arrogance in geography about its supposed value as a mode of access to reality.” One needs to realise that the path of digitisation in cartography has been driven in large part by militaristic interests in various guises (e.g., Cloud 2002). The underlying geospatial technologies and capture infrastructures (such as earth imaging and GPS) are still dependent on state funding and imperatives of territorial security. Rather than becoming more democratic, one could argue that the surveillant power of the cartographic gaze is deepening, particularly after 9/11 (Monmonier 2002), accompanied by a fetishization of the capability of geospatial technologies to ‘target terrorism’. The mundane disciplining role of the digital map in systems of computerised governmentality continues to grow, for example in consumer marketing and crime mapping (Crampton 2003). Such surveillance requirements are also a key driver in the development of new mapping techniques for cyberspace (e.g., Gorman’s (2004) work mapping infrastructure networks in the U.S. to assess their vulnerability to attack). In conclusion, Pickles (2004a, 146) notes cautiously: “As the new digital mappings wash across our world, perhaps we should ask about the worlds that are being produced in the digital transition of

the third industrial revolution, the conceptions of history with which they work, and the forms of socio-political life to which they contribute.”

2.3 Cartographic theories

The theoretical perspectives in academic research that seek to understand the nature of cartography - both the map as object and wider conceptions of mapping practices - can be grouped into three broad but distinct paradigms, each based on a common set of beliefs about what represents a valid area of research¹⁴. These respectively conceptualise cartography as (1) a means of communication, (2) a form of representation, or (3) an expression of power. These three different theoretical approaches provide a useful way to begin to understand how scholars have interpreted, analysed and read the nature and meaning of cartography in recent history.

These theoretical positions have framed the types of ‘questions’ that are asked of the map and, therefore, the ways of approaching empirical cartographic research, and they have also informed the way cartography is taught¹⁵. It is clear that scholarly cartography research remains a contested subject, with significant alternative epistemologies in play, and offers no definitive answers (there is no ‘true’ nature of the map in some senses). As such, I concur with Perkins (2003, 342) when he says “it makes more sense to understand contrasting approaches as representing different knowledge communities telling very different stories.” As outlined in the introductory chapter, I employ a hybrid theoretical ‘story’ which uses concepts from both the ‘maps as representation’ and the ‘power of maps’ knowledge communities. This theoretical frame is applied to interpret the

¹⁴ It should be acknowledged that attempts to impose simple paradigm categories inevitably means the lost of much detail and nuance in such narratives. Describing trends through paradigms can also be problematic as it creates sharp divides, where scholar often come to see those work in supposedly ‘opposing’ paradigms as threats to their ideas and unjustly undermine their work through caricatures and ‘straw-men’. As Keates (1996, 192) put it: “the arguments are sustained by all sorts of unproven assertions, and the well-known ‘rhetorical’ device of misrepresenting the views of the ‘opponent’ in order to demolish them.”

¹⁵ Although, they have often had little impact beyond the academy on practising cartographers; as Petchenik (1983, quoted in Keates 1996, 188) says “specialization in cartography has developed to the point where academic studies of map design and map use may be completely divorced from the non-academic, routine map production milieu.”

cartographies of cyberspace as both sign systems with important connotative meanings and as social constructions that do work in the world. I review the major focus of the three paradigms in turn as these shed light on the types of analytical work that has been done in analysing different modes of cyberspace mapping.

2.3.1 Cartography as communication

It is a truism to assert that maps are vehicles for the flow of information. Some are better vehicles than others, but the functions they perform are nevertheless similar, irrespective of their quality. It is instructive to look at the role of maps in an adaptation of a general communications system. (Board 1967, 673)

The dominant theoretical paradigm in academic cartographic research in the last forty years or so (1960s-90s) has been based the ‘map communication model’. Developing from initial but significant conceptualisations espoused by Moles (1964), Board (1967) and Koláèny (1969), the goal of this theoretical approach, broadly speaking, was to work to improve cartography by determining how map representations communicate geographic information to the user, primarily through psychological testing. The appeal of such an experimentalist approach was its potential to systematically determine the parameters of the map user’s capabilities in reading, comprehending and remembering information from different types of cartographic representations. Board and Taylor (1977, 19), in their review of preliminary work on design and map perception, argued it was important for advancing cartographic communication research that, “realistic map-reading tasks should be used in experimental evaluations”. Such work would generate robust psychophysical data which could, in turn, form the basis for quantifiable, consistent rules for the most appropriate cartographic design decisions (such as symbol sizes, colour ranges, classification schemes and so on; see, for example, MacEachren’s (1982) work on design parameters and complexity in thematic maps). Such striving for objective rules in map design was premised on the positivistic belief that it was possible to produce *optimal* mapping for a given purpose and the acceptance of cartographic research was able to produce more ‘accurate’ mapping in terms of effective communication to the reader.

In the communications model there is a clear distinction made between the map-maker and the map user, with the map representation itself being essentially a neutral medium of one-way information transmission between the two. Accordingly, Robinson and Sale (1969, 18) asserted: “Maps today are strongly functional in that they are designed, like a bridge or a house, for a purpose. Their primary purpose is to convey information or to ‘get across’ a geographical concept or relationship; it is not to serve as an adornment for a wall.” The model was often depicted in a summary flow chart as a linear process with distinct entities and a directed flow of information from originator to receiver (Figure 2.3). The role of the cartographer in the model was cast as someone who essentially works in a technical, impartial way, taking a body of geographic data and applying rules of functional design, which resulted in a map that works as a ‘scientific’ tool for the visual communication of the information in the public realm. Map users were accordingly afforded a relatively passive role of readers as receivers of a fixed message from the cartographer.

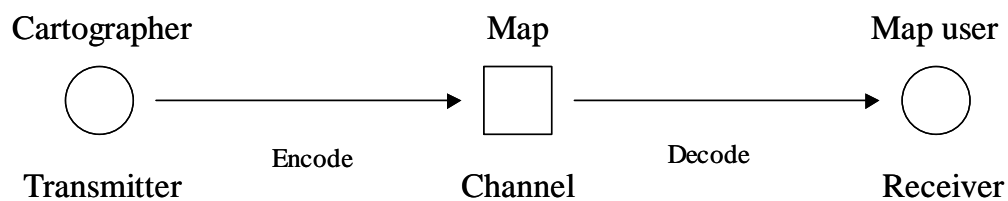


Figure 2.3: The basic map communication model, conceptualising cartography in terms of stages in the transmission of spatial data from cartographer to reader via the map. (Source: redrawn from Keates 1996, 114.)

The ‘map communication’ paradigm marked a significant epistemological shift in cartographic research and its advocates, led by Arthur H. Robinson, wished to remould cartographic scholarship as a scientific practice, moving it away from its existing interpretative, qualitative and artistic nature. This major modification to map theorisation was itself bound-up with rapid quantification and a rush to more ‘scientific’ methods of research in the late 1950s in other social science disciplines, including human geography and psychology. The basic premise of the ‘map communications model’ held sway for decades in Anglo-American

academia and was a major influence in cartographic education, as can be clearly seen in the content of leading English-language textbooks such as Robinson's *Elements of Cartography* (which went through six editions, with various coauthors, from 1953 to 1995) and Dent's *Cartography: Thematic Map Design* (which went through five editions).

By the 1990s, the dominance of the 'map communication' paradigm had waned considerably, as the focus of scholarly cartography research shifted direction and methods of behavioural psychological testing were discredited as excessively reductionist. Although it contains much of practical value, especially in teaching notions of effective map design, the tide of academic ideas has moved against its agenda, driven in part by rapidly changing technology (many researchers having moved into research in GIS and geographic visualisation), and also the 'cultural turn' in theoretical perspectives in the social sciences. Some of the key concepts of 'map communication' theory have been challenged in the last decade or so by scholars advocating a different cartographic theorisation, in which mapping is conceptualised cognitively as spatial representations that can have multiple semiotic meanings and uses, and where the map reader actively constructs knowledge from the representation in relation to their particular experience, skills and circumstances. The role of the cartographer as the primary arbiter of a single message encoded in the map is questioned.

Having said this, the 'map communication' paradigm still has influence, particularly in U.S. cartographic research (Montello 2002) and important work being done around map perception (such as Brewer's influential work on optimising colour selection on thematic maps¹⁶). Much of the recent work on Web cartography, for example, has a distinctly 'communicative' epistemology, with its focus on testing users and determining new map-design guidelines for optimum graphical presentation for Internet media (e.g., Kraak and Brown 2001; various chapters in Peterson 2003a and 2008), Fabrikant work on evaluative testing of the informational meanings users gain from spatializations (Fabrikant

¹⁶ One of the novel outputs of this research is the online tool called ColorBrewer that mapmakers can use to select colours for their own cartographic design work; available at <www.personal.psu.edu/cab38/ColorBrewer/ColorBrewer_intro.html>.

et al. 2004; Fabrikant and Montello 2008); while Jiang and Ormeling's (1997, 112) initial analysis of 'cybermaps' is premised on the notion of optimising map design, in which they claim: "in long standing cartographic practice, maps have been considered as communications tools".

2.3.2 Cartography as representation

The map is examined here.... not as a communications vehicle but as one of many potential representations of phenomena in space that a user may draw upon as a source of information or an aid to decision making and behaviour in space. (MacEachren 1995, 12)

A new paradigm has emerged in academic cartographic research, since the early 1990s, that views the map as a representation which should be analysed and understood through a combined cognitive-semiotic lens. The paradigm is best articulated by MacEachren's (1995, 12) book 'How Maps Work' where he argues, "[e]mphasis is placed on how the map 'represents' in both a lexical and a semiotic sense and how vision and cognition represent that representation in forms that allow the map viewer access to meaning."

In some respects the 'representation' approach has significant commonalities with both the other two active cartographic research paradigms identified here. In terms of the focus on the cognitive understanding of visual processing, particularly through experiments using visualization software, the 'representation' paradigm has strong methodological and ontological overlaps with the 'communication' paradigm. While the semiotic component of the 'representation' paradigm, seeking to understand the meaning of representational signs has significant accordance with the 'critical cartography' agenda to expose the 'hidden' power of the map.

Given the dual aspects of the 'representation' paradigm, and there potential relevance to the analysis of various aspects of the cartographies of cyberspace, it is worthwhile to discuss, firstly, how semiotics might have utility in unlocking meanings in the map and, then, to consider how an interest in the cognitive basis

of cartography is being advanced in applied research on visualization, particularly building and testing realistic and multi-modal interactive mapping software.

2.3.2.1 Lexical understanding of representation through semiotics

Semiotics is the study of signs, concept-objects that, it can be argued, are fundamental units of understanding that humans use to make sense of the world and to communicate ideas and exchange information. Language and visual representations (including maps) are lexical, being composed of signs that carry messages/meaning about things or concepts. As Pierce, one of the founders of semiotics, put it: “something stands to somebody for something else in some respect or capacity.” (quoted in MacEachren 1995, 213). A sign on a map represents things from reality to somebody. The ‘sign’ has been theorised in a multitude of ways in different areas of scholarship, but in simple terms can be thought of as concept-object comprising three distinct parts which work in relation (Figure 2.4).

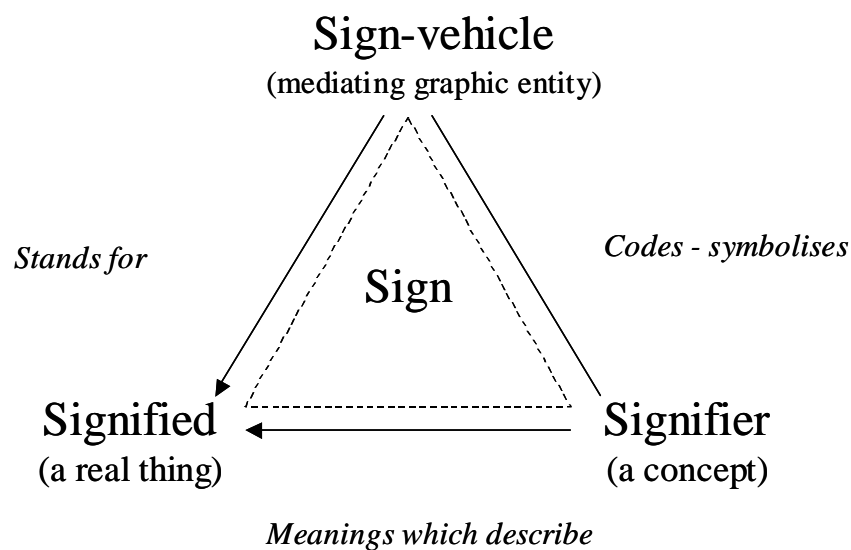


Figure 2.4: A simplified notion of a sign as a triangular relation.

The three parts of the triangle operate in unison to represent something by creating a unit of understanding. This is done by assigning a meaning (signifier) to something (signified) by a mediating sign-vehicle. In the cartographic case, a sign-vehicle is a graphic element on the map itself (a blue line symbol say) which

is a signifier (for rivers) which describes, through meaning, a signified instance (a 'real' river, with attributes and located in space and time). (At another scale, the map as a whole could be viewed as a single sign within a large system of signs, such as a book.) The relations between the sign-vehicle and signifier are potentially made up of multiple codes (e.g., symbols to code a river); and for visual representations have been classified into various kinds typologies of design codes (which are often complex and hard to apply to real data). Codes of sign-vehicles for cartographic design can be classified in various ways, including according to their visual iconicity, running on a continuum from wholly mimetic symbols which are pictorial equivalents of the real thing (e.g. a bike representing a cycle path) to completely arbitrary symbols which only represent the real thing when specified to be so (e.g., a triangle symbol representing a post office).

Of more interest for understanding cartographic representations is the outcome of the relationship between signifier and the signified (mediated by the sign-vehicle) as this gives rise to meanings in mind of the reader about mapped reality. Such meanings can be multiple, unstable and unanticipated by sign maker (i.e., cartographer). Meanings are dependent, in varying degrees, on the social context of the sign and the experience of the reader, i.e., meanings often lie beyond the map and are brought to it. As MacEachren (1995, 311, original emphasis) notes, therefore, "a lexical approach to cartographic representation accepts a potentially broad range of *legitimate meaning* for individual or groups of signs. The issue of correct or incorrect signs becomes secondary to that of exploring the various perspectives from which, or levels at which, map signs might be understood."

There is no universal set, or guaranteed single, meaning for a given sign, although social convention and lived experience means that most people, most of the time, will get broadly similar meanings from the same signs. For understanding maps then, one of the goals of semiotic analysis is to trace out the multiple levels of meaning created by a sign and think through the implications of this for how maps are used in the world.

In tracing out meaning in signs, researchers have found it useful to try to categorise them. One useful categorisation, that has been applied productively for cartographic interpretation, is a division of meaning into two levels,

Denotative

Explicit, primary
(overt, obvious)

Connotative

Implicit, secondary
(hidden, unspoken)

The difference in levels is significant, as Guiraud (1975, quoted in MacEachren 1995, 229) puts it: “A uniform denotes rank and function; it connotes the prestige and authority attached to rank and function.” Moreover, in maps, according to MacEachren (1995, 311), “denotative meanings [are] either specified precisely in a map legend or assumed to be part of the normal reader’s general map schema”, (e.g., the blue line has specific meaning of ‘rivers’). Connotative meanings are latent and contingent, but can be as important, and on occasion more important, than the denoted meaning of a sign. For example, Vujakovic (2002b, 372, original emphasis), in his interpretation of world maps in textbooks, says about the (problematic) different meanings of the Mercator projection: “[w]hile direction, and to some extent continental shape, are (correctly) *denoted*, the choice of this projection for a map would create, through its usual centring on Europe, its orientation, and its exaggeration of higher latitude landmasses, a false *connotation* of the importance of Europe.” Connotative meanings can be picked up unconsciously and can be obscure (they exist only in the ‘eye of beholder’ but are nonetheless real meanings; this has methodological issues for decoding them), and may not have been in the mind of the sign maker (cartographer). The kinds of intention that lies behind a connotative meaning attached to a sign is an important philosophical/ethical divide between the ‘critical’ and ‘representation’ paradigms. Critical deconstruction would typically see connotative meanings as insidiously hidden, manipulative and created with malicious intent on the part of the cartographer. A representational point of view, as espoused by MacEachren (1995) for example, would tend to see connotative meanings as largely ‘innocent’ and unintended by the cartographer.

Accepting that connotative meanings can be of different kinds also implies the potential to derive potentially useful and useable typologies of meanings. MacEachren (1995, 336-338) presents his initial typology of map connotation, which he acknowledges is tentative. The typology schema has two high levels and then a five level subdivision, as follows:

1. Connotations about the map

- 1.1. Connotations of veracity (people believe maps because they think they are free from error),
- 1.2. Connotations of integrity (people believe maps, especially official ones, because they think they are free from bias),

2. Connotations about the topic mapped:

- 2.1. Valuative connotation (maps proffer a value judgement),
- 2.2. Incitive connotation (maps are intended to arouse emotions and prompt particular actions),
- 2.3. Connotation of power (maps often exert control over places or people)

MacEachren only provides limited hypothetical examples to support each category in his typology and they remain largely untested. It is also apparent that they overlap with map deconstruction espoused by ‘critical cartography’ paradigm, discussed in section 2.3.3 below.

The classification of denotative and connotative meanings of map signs is an analytic that begins to get at the different affects maps have on people’s understanding of what is being represented, of how people understand the mapped reality. Given that connotative meanings are not explicit, a method of analysis is need to expose them. MacEachren (1995) advances two routes, firstly, that of intensive and careful individual reading and hermeneutic interpretation by the researcher and, secondly, a more quantitative semantic differential testing using multiple human subjects. The second method has been applied to map signs, for example in classic early work by Petchenik (1974) and more recently by Harrower *et al.* (1997) investigating the meanings of online maps. The first method for decoding connotative meanings has also been profitably applied to

understanding cartographic representations, often drawing on an intertextual reading of map materials from competing sources; examples include Vujakovic's (1999a and b) work interpreting the mapping of changing European geopolitics as presented in newspapers; Edsall's (2007) work on the meanings of national and world maps as deployed in U.S. political campaigning; and Kosonen's (2008) analysis of the meanings of maps portraying the emerging Finnish national identity in the first half of the twentieth century. As noted previously semiotic analysis of connotative meanings is one of the methods used in this thesis to understand the two different genres of maps of Internet infrastructure. Chapter five analyses statistical maps of Internet globalisation using a four fold typology of connotative meanings based around axis of 'difference' and 'complexity'. Chapter six considers marketing maps used by Internet network operators to promote their infrastructure and deploys a typology of eight connotative meanings that work to demonstrate that the company has the 'biggest and best' network, that the network is a tangible entity and that the network can be trusted.

2.3.2.2 Cognitive understanding of representation through visualization

Besides an interest in semiotics, another central focus of the 'representation' paradigm has been on the visualization of geographic data (rather than on its communication), which according to one of its leading practitioners, is focused on researching "human-centred methods and technologies that make it possible for scientists and decision-makers to solve scientific, social and environmental problems through computer-supported, visually-enabled analysis of the growing wealth of geospatial data" (Peterson 2003b, 441). To a large degree its research questions and methods of work have been driven by computer technology, with the digital transition of the map and rise of GIS being the crucial catalysts for new research questions. In this sense, visualization research in the 'representation' paradigm can be characterised as a tool-driven epistemology.

A core concern for visualization research has been to examine the potential of interactivity and multi-modal computerised graphic displays of cartographic information and how this can facilitate so-called 'knowledge discovery' by users. Consequently, the typical separation of reader from cartographer inherent in the communication paradigm collapses. Map users make their own map; they are

actively engaged using their innate cognitive capability, combined with interactive displays, to analyse geographic patterns and visually explore spatial relationships in the data. The map is not a fixed communicative artefact for public presentation, but an element in a process of individual exploration in private environments (Figure 2.5). The research goal is no longer to produce optimal map design rules, but to develop better visualisation ‘toolboxes’ that can most effectively support ‘visual thinking’ - “the generation of ideas through the creation, inspection, and interpretation of visual representations of the previously non-visible” (DiBiase 1990, 4). A great deal of this work is influenced by ideas, techniques and experiences from scientific visualisation and computer science research in interactive graphics and virtual environments. A good amount of research being undertaken in terms of visualisation is also relevant to understand the interactivity and user-controlled representations produced to map cyberspace.

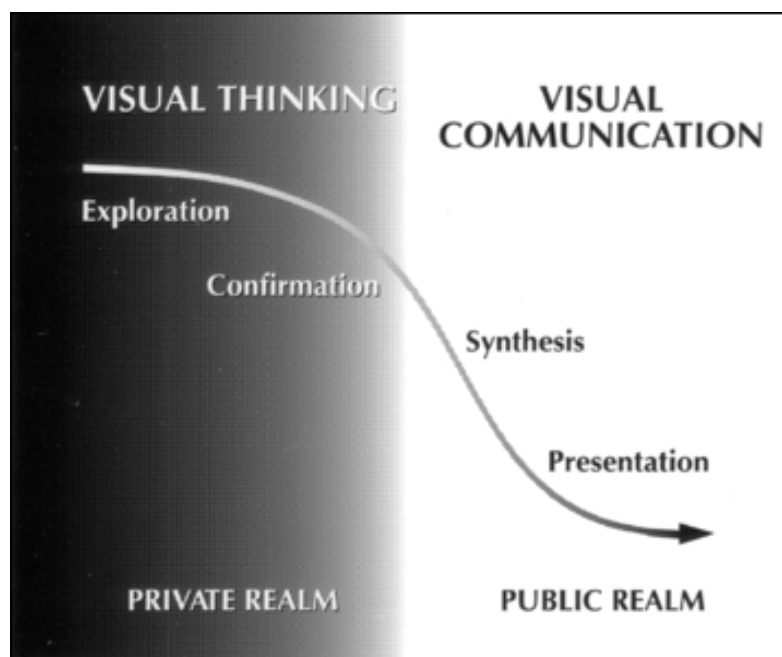


Figure 2.5: DiBiase’s conceptualisation of role of cartography in the research process. The focus of the ‘map communication’ paradigm is on optimising cartography for use in the right hand side of the diagram, more recent work under the rubric of cognitive geovisualisation is concerned with developing cartographic tools for use in the left hand part of the process. (Source: DiBiase 1990.)

Proponents of ‘representation’ as a form of geographic visualisation (so-called geovisualisation), have argued ebulliently that it represents “the most important development in cartography since the thematic mapping ‘revolution’ of the early

nineteenth century. For map users, [it] represents nothing less than a new way to think spatially” (MacEachren 1995, 460). The direction of this paradigm through the last five years or so has been set, in large part, by the work of International Cartographic Association (ICA) Commission on Visualization and Virtual Environments¹⁷ in developing a comprehensive geovisualization research agenda (see Dykes *et al.* 2005). Leading proponents of ‘representation’ paradigm, MacEachren and Kraak (2001, 4) argued geovisualisation’s agenda should be focused on supporting researchers dealing with data-rich human-environment problems, to “provide ‘windows’ into the complexity of phenomena and processes involved, through innovative scene construction, virtual environments, and collaboration, thus prompting insight into the structures and relationships contained within these complex, linked datasets.” Key issues of concern were providing map-based visualisation tools that could be distributed amongst diverse research teams and used in group working tasks; research into three-dimensional representations and immersive modes of interactions (the ‘fly-thru-map’); along with empirically driven work on evaluation and usability of these software tools. In evaluating geovisualisation, the concern has been on the fidelity of representation (often with a concern for mimetic ‘reality’), issues of scale and level-of-detail on cognitive perception and the potential of 2d-to-3d transformations and linked representations to expose novel spatial data relations. There are also growing linkages with other innovations in representing non-geographic data using spatial metaphors in the field of information visualisation (see Skupin and Fabrikant 2003). Although the map as a graphic image is central to the geovisualisation paradigm, there are also wider concerns with facilitating analytical methods within a visualisation environment (such as interactive parameter testing in spatial statistics and simulation modelling). This concern overlaps heavily with the development of GIScience. Whilst distinctly positivist epistemologies underlie the geovisualisation paradigm, some have tried to open up the scope of visualisation in more politically progressive directions, for example Kwan’s (2002; 2007) work in fusing geospatial technologies with feminist theory to map affect and emotional geographies.

¹⁷ Commission’s homepage at <<http://kartoweb.itc.nl/icavis/index.html>>.

Many of the most interesting developments in cyberspace cartographies have clear linkages and overlaps with developments in geovisualisation, in terms of using interactive spatial representations – the ‘map’ – as an interface tool for data exploration and knowledge discovery. Developing new forms of interface and interaction that let the analyst explore and cognise cyberspace in terms of spatial patterns and semantic relationships that are not readily apparent in the raw data (very often large databases of automatically logged records); for example, the visualisation of Internet infrastructure by three-dimensional geographic visualisation of network address ownership (Shiode and Dodge 1999).

2.3.3 *Cartography as power*

Robinson tried to describe how maps are, whereas Harley asks why maps are as they are, and how else they can be. It is this latter project which is the political one. (Crampton 2002, 15)

No sooner are maps acknowledged as social constructions than their contingent, their conditional, their ... arbitrary character is unveiled. Suddenly the things represented by these lines are open to discussion and debate, the *interest* in them of owner, state, insurance company is made apparent. (Wood 1992, 19)

Cartographers would agree that all maps are, by necessity, selective and that all maps are designed to serve particular purposes. This somewhat innocuous admission, however, can - depending on the philosophical position one holds - lead to a significant re-interpretation of the nature of mapping. In the last fifteen years or so, a new strand of critical cartographic theory has emerged, which takes a fundamentally different viewpoint as to what is the purpose of maps is and the social significance of human agency in map-making. The thrust of this perspective is twofold: first, the acknowledgement that the map is a form of power-knowledge, and second, the rejection of the cartographic orthodoxy of representational objectivism and communicative efficiency. The concern of this paradigm, as Crampton alludes to in the quote above, is not to accept normative cartographic discourses, but to “subvert the apparent naturalness and innocence of the world shown in maps both past and present” (Harley 1992, 232).

Scholars advocating a critical theory concerning the ‘power of maps’ argue that maps are social constructions that reflect the ideological structure of their production and work actively in the ongoing reproduction of these structures. Maps are never neutral ‘scientific’ representations, instead they are powerful heuristic devices serving particular interests. Furthermore, the consequences of what Wood (1992) conceptualises as the ‘interested selectivity of cartography’ flow well beyond the semiotics of the map image itself. These consequences of map power on human lives have been largely overlooked by earlier academic cartography discourses focused on design and technique. To reverse this, critical scholars sought to bring concerns for cultural, social and ethical issues into the centre of the academic cartography discipline. Indeed, strident advocates of critical cartography view the map with suspicion, seeing it as a hegemonic object in struggles for social domination, and regard cartographers as guiltily implicated in the production of social difference (such as governance of populations, enforcement of property rights, imperial conquest and colonial exploitation, and military violence and environmental destruction). Mapping for them is a deeply politicised process.

The socially constructed nature of contemporary cartography itself is not readily apparent because the reader shares, often at the subconscious level, much the same values as the map-maker. Most conventional map representations are ‘in-step’ with norms of the society in which they are made, agreeing on what is and is not important in that socio-political milieu. Occasionally, however, the map-maker’s social values will be at odds with the reader’s, so that the map will be viewed as unconventional or controversial (e.g., Bunge’s (1975) maps from the Detroit Geographical Exploration or CCTV maps produced by the New York Surveillance Camera Players¹⁸). Similarly, maps from earlier historical periods, when viewed from the perspective of contemporary cultural norms, often seem ‘wrong’ (people can see them as social constructions). Contemporary politically-

¹⁸ See <www.notbored.org/scp-maps.html>.

motivated counter-mapping¹⁹ projects set out to produce maps that reveal ‘truth’ by deliberately unsettling the pact of shared social values between reader and map-maker.

To begin to understand the politics of cartography, advocates of the ‘power of maps’ paradigm argue, one must ‘deconstruct’ and ‘demystify’ the implicit and explicit power relations imbedded in the representation, questioning why the map was made, who paid for it to be made, exposing who gains from the map, and, equally, who loses from the map’s work in the world; it is necessary to expose what point-of-view the map takes while it assiduously pretends to be a ‘view from nowhere’. Harley (1992, 232), set out in his methodological agenda to, “show how cartography also belongs to the terrain of the social world in which it is produced. My key metaphor is that we should begin to deconstruct the map by challenging its assumed autonomy as a mode of representation.”

The critical paradigm emerged in academic cartographic research, particularly from the sub-discipline of the history of cartography, in the late 1980s, propelled in large part by the influential work of Brian Harley and Denis Wood. It can be seen as following along with a much broader critical ‘project’ across the social sciences, focused on rethinking the nature of representations within contemporary visual cultures. Harley, and other cartography theorists, drew on a range of poststructural ideas to question the Cartesian surety of the map as a ‘natural’ representation of reality, particularly the influential work of the social theorists, Roland Barthes, Jacques Derrida, and Walter Benjamin in analysing texts, sign systems and the political economy of images. Besides such textual deconstruction, other concepts have been drawn from feminism (particularly the work of Donna Haraway) and governmentality (especially the work of Michel Foucault). Critical ideas on the politics of mapping have informed a number of

¹⁹ Counter-mapping is the conscious deployment of maps to exploit the authority embedded within cartographic representation to challenge established power relations. As Peluso (1995, 387) argues in relation to struggles over natural resources in Indonesia, “[c]ounter-maps ... have the potential for challenging the omissions of human settlements from forest maps, for contesting the homogenization of space on political, zoning, or property maps, for altering the categories of land and forest management, and for expressing social relationships in space rather than depicting abstract space in itself.” See also, Aberley (1993) and Harris and Hazen (2005).

substantive, theoretically-driven ‘archaeologies’ of cartographic knowledges in specific geopolitical contexts²⁰.

The ‘crisis of representation’ as it pertains to maps, seeks to undermine the truth claims of mainstream ‘scientific’ cartography in at least three ways. Firstly, it questions modern (Western) science’s privileging of representations of real-world phenomena based on empirical observation, overlooking the social and cultural conditions within which such observations are grounded. Fundamental to this privileging is the ontological dualism of observer and subject, which is replicated in cartography as the separation of the map from the territory it represents. As Edney (1993, 54) put it: “[t]here is a world of geographic facts ‘out there’ - separate and distant from the observer - which are to be ‘discovered’ by the explorer and surveyor”. If there are errors in the map, these are technical and do not effect the representational essentialism of cartography, i.e., maps can capture faithfully the details of the landscape, they are ‘mirrors of nature’ (Rorty 1980).

Secondly, critics dispute the possibility of producing ‘mirrors of nature’, arguing in many ways that the map *precedes* the territory. As Pickles (2004a, 145) asserts: “[f]ar from being a mere representation of private property, cadastral mapping gave legal and material form to the new territories and landscapes of private property”.

Thirdly, the fallacy of modern representationalist logics has been highlighted by alternative measurement methodologies. From a philosophical point of view, the application of fractal analysis to geographic features, for example, breaks the faith in being able measure ‘facts’ with certainty. Benoît Mandelbrot’s (1967) simple question about ‘how long is the coastline of Britain?’ exposed the scale-dependent nature of capturing cartographic data. While the increasing diversity

²⁰ Examples include: Schulten’s (2001) in-depth study of U.S. mapping institutions, focused on popular world maps and atlases produced by Rand McNally and National Geographic, and their role in the social construction of modern American geographical imagination; Edney’s (1997) detailed study of British colonial mapping in India; Winichakul’s (1997) examination of the role of cartography in the construction of national identity of nineteenth century Thailand; Herb’s (1997) reading of map use in Weimar and Nazi Germany.

of data sources, from surveys, sensors, and satellite imaging, means the appearance of empirical unity and universality in state-produced topographic representations dissolves. The ease with which aerial photographs can now be directly compared to topographic maps, using for example Google Maps, is powerful exemplar (Dodge and Perkins 2008b). Ultimately, the technologies of cartographic measurement are dialectical. As Turnbull (2004, 209) argues: “Our devices for measuring the world frame our understanding of nature but cannot by themselves lead to greater correspondence with reality, rather they require the proliferation of evermore sophisticated technical devices and social strategies to keep our conceptions and nature in line.”

The focus of critical cartography deconstruction has been principally historical in character, rather than focused on contemporary mapping practice (although, see Pickles 2004a, chapter 8). There has been little published research that has applied the ‘power of maps’ theoretical perspective to begin to understand the ideologies of cyberspace cartographies (although, see Crampton 2003, chapter two; Dodge and Kitchin 2000b; Harpold 1999).

While this body of critical writing on cartography has been forceful (and sometimes polemical), it is not without its problems, inconsistencies and critics (e.g., Andrews 2001; Belyea 1992; Godlewska 1989). Keates (1996, 194), for example, undermines the methodological agenda of Harley and ‘critical cartography’ paradigm more broadly, commenting: “The question of how the production and publication of maps is controlled in any society is an interesting and important issue, but it is not illuminated by uttering clichés about hidden agendas.”

Ideologically-driven cartographic deconstruction can also be seen as unproductive in that it offers little in the way of an agenda for map-making *practice* to carry forward (Crampton 2001; Kitchin and Dodge 2007). Indeed, the influence of new critical theoretical approaches within academic discourse is in marked contrast to the work of the large majority of cartographers in practitioner communities, in university drawing offices, in government departments and in commercial design firms. The profession has not followed this new

epistemological line as it offers little of value for those tasked with real world demands of making effective maps²¹ and they have little reason to contribute to theoretical debates; as Petchenik (1985, quoted in Keates 1996, 190) wryly notes: “Practising cartographers tend to be so busy earning their living by making and selling maps that there isn’t ‘free’ time or energy left to be expended on research and writing projects: as a consequence, their point of view is not accurately reflected in the literature.” Equally disappointing in terms of effecting progressive change in the nature of cartography is the failure of human geographers to make critical *use* of maps in their researches. Accordingly, Perkins (2004, 385) laments: “[d]espite arguments for a social cartography employing visualizations to destabilize accepted categories most geographers prefer to write theory rather than employ critical visualization”. The humanistic cartography of Dorling, discussed below, is a notable exception to this (the Worldmapper cartograms project he leads has enjoyed considerable success; also Dodge and Kitchin 2008a).

Other accusations levelled at critical cartography include: a misreading and superficial misusing of social theories, of simply jumping on the cultural ‘bandwagon’ of deconstruction and the foisting of a false ‘conspiracy’ view of cartography through biased sampling of empirical evidence (Black 1997). “In contrast to Harley’s experience of cartographers”, Godlewska (1989, 97) notes, “I have found that most have a subtle and critical sense of the nature of their work and do not perceive cartography as an objective form of knowledge”. Of course, the critical scholars themselves had an agenda in their attacks on mainstream cartography, being “propelled by an odd mixture of cynicism and idealism” (Lemann 2001, no pagination).

It is also worthwhile noting, that besides the ideologically-driven ‘deconstructionists’, this paradigm includes other socially-informed and progressive scholarship. One might term this work ‘map scepticism’ rather ‘map

²¹ Much the same situation pertains to the case of GIS research and the ‘Ground Truth’ debate (cf. Schuurman 2000).

criticism’²². It is significant work, I think, as it has tried to move mapping *practice* forward in addition to commenting on the politics of map-making. The position is highlighted best by Monmonier’s empirically-informed works which consistently pointed up the social implications of mapping across a range of pertinent topics. His work is also valuable as it is consciously written to reach beyond the confines of academia to inform a wider readership. In addition to Monmonier, the work of quantitative social geographer Dorling (1995; 1998) is noteworthy in questioning conventional statistical mapping practices and also offering up a range of alternative, more ‘democratic’ visualisation techniques (especially the use of cartograms). Dorling (2005), for example, produced socially-informed mapping applicable to educating the next generation of geographers and also to influence public policy by more effectively highlighting the extent of social inequalities across space; “[m]aps are powerful images”, acknowledges Dorling (1998, 287), but this can be exploited in a progressive way, “[f]or people who want to change the way we think about the world, changing our maps is often a necessary first step”.

2.3.3.1 Three levels of map ‘deconstruction’

In terms of undertaking a deconstructive type of interpretation of cartography, it is useful to think of the process as working on three levels: ‘power on the map’, ‘power in the map’ and ‘power through the map’. We consider each level in turn.

- ‘Power on the map’

“Maps are stories we tell about ourselves, but they are stories with political payoff” notes Crampton (2004, 41) and “the question for map criticism is then to expose who is getting the payoff and how it is achieved.” To begin this work, one needs to focus on the power exerted on the map in its production. Maps are embedded within a relational network of power/knowledge. The map-maker is not a lone individual or organisation, but encompasses a whole set of actors - explorers and surveyors, designers and printers, publishers and politicians - all with interests and particular agendas working in ongoing processes. The map

²² This kind of realist conceptualisation of cartography as an imperfect enterprise has a longer pedigree of course, for example dating back to J.K. Wright’s 1942 paper, *Map makers are human: comments on the subjective in maps*.

necessarily emerges from this milieu, as a codified and conventionalised text that stabilises the network into visual form at a particular point in time. Within the network geometry of the map's production there are unequal relationships, with much power resting on the patrons (be they the military, local government, commercial firms or the patronage of kings and princes of times past)²³. The power exerted in the network of cartographic production leave visible traces, to varying degrees, in the actual content and graphic form of map text itself. Power resides within the map's image. Critical analysis seeks to reveal the traces.

- 'Power in the map'

The application of epistemological tools from social theory can provide a new reading of map artefacts as texts. This analysis looks beyond the aesthetic connoisseurship of the map collector or the Tufte-type rules of good design and focuses on the 'second text' of the map. As such, deconstructing the map means exposing the reasons underlying the selectivity of what is displayed and demystifying the origins of the signs used. This focus has clear links to semiotic concern for connotative meanings examined by the 'representation' paradigm.

Everything about the look of a map is subjective and to some extent arbitrary in semiotic terms, but people usually ignore this because they read modern maps as 'natural', having been thoroughly indoctrinated into the conventions of cartographic sign systems (i.e., a blue line for a river)²⁴.

The power in the map text through the conventionality of sign systems can be deconstructed in terms of 'rules of cartography' (Harley 1992). These rules enable certain map texts to be conceived and made, whilst at the same time making other maps unacceptably unconventional and, therefore, unmade. The rules are generally not openly acknowledged and many operate in unspoken and unconscious ways (i.e. 'this the way we always represent churches'). Traditions,

²³ When talking critically to individuals at Ordnance Survey (the epitome of professional map-makers in many respects) one often discovers the severe limits on their freedom of action in terms of what gets mapped and what is left unmapped by the 'government'.

²⁴ Furthermore, as noted by Board, the "very existence of conventions allows the 'counter-mapper' to shock by breaking with conventions." (Source: Chris Board, PhD examiners report, 24th October 2006.)

customary working practices, professional standards, institutional cultures, all help to simultaneously mask the rules and enforce the rules, as well as ensuring their perpetuation. The ways of ‘policing’ the rules become more overt, with external threats (the reaction by some in the mapping ‘establishment’ to the Peters projection and his agenda, for example; cf. Vujakovic 2002 for discussion and sources). Even though these rules are very powerful, they are never universal and are also contingent on the time and context of production. Such rules also provide opportunities for resistance by exposing their conventionality.

Harley (1992) advances two exemplars of these subtle yet powerful cartographic rules: the ‘rule of ethnocentricity’ and the ‘rule of social ordering’. The first rule is premised on the tendency for any society to place itself (its territorial base or metropolitan heartland) at the centre of its maps, thereby, granting more significance to itself and ‘pushing’ other peoples and places to the periphery. The subliminal geometry of the map image is used to achieve this. For example, it is evident in the choice of orientation and projection used on world maps. Eurocentric dominance in cartography means a map of the world conventionally centred on the Atlantic, with north at the top. While Mercator ‘biases’ in relative apparent sizes of nations are long-lasting in the cartographic imaginary and as Stewart (1943, 589) noted more than sixty years ago: “Children studying elementary geography should be warned that a Mercator map of the world, .. is *not* a picture but a representation in code; specifically, the ‘Mercator code’.” Breaking the convention on world maps (such as ‘upside down’ projections like McArthur's Universal Corrective Map) shows just what a powerful hold the ‘rule’ of Eurocentricism has on cartography.

In the second rule, the sign systems employed on maps encode an implicit hierarchy of space based on social power rather than objective measures of importance. So, the “distinctions of class and power are engineered, reified and legitimated by means of cartographic signs” (Harley 1992, 237). The palace, cathedral, and castle have, historically, been most prominently represented on maps because they are classified as socially significant (i.e. powerful). The rule of thumb is that the more powerful you are, the more visible you will be on the map. A stark example of this is the urban mapping in apartheid South Africa,

where small typefaces were used to label large black townships, while much larger, more prominent labels were used to show white settlements which often had far fewer inhabitants (Stickler 1990). However, there are many other more subtle examples, such as the prioritising of mapped landscapes for car drivers in almost all general cartography, at the expense of other forms of mobility (Perkins and Thomson 2005).

Another important concept elaborated by Harley (1988b) to deconstruct the power in the map was the theory of cartographic silences. The idea that what is *not* shown on a map can be as revealing to the implicit agenda as what *is* shown. The absence of a feature on a map that one would normally expect to see (i.e. it is technically possible to survey and represent it at the nominal scale of the map) is read as a *positive* statement in the mapping process, rather just a passive gap in representation. There is a range of intentional and deliberate silences, where geographic information is suppressed and censored from maps - often, due to strictures of security or exigencies of commercial confidentiality. So, for example, certain military bases and security installations in the UK have been absent or masked on successive official maps (cf. Board 1991; Hodson 1999), even though they are evident on aerial photographs (Dodge 2004). Increasing fears of terrorism following 9/11 have led to a much wider definition of 'sensitive sites', including various infrastructure networks, and the 'chilling' of previously published map information on these (see Zellmer 2004 for the perspective of map librarians).

Beyond such wilful censorship there is a range of subtle and insidious silences that operate as a 'hidden' rule. Certain aspects of the material landscape of society are silenced because they are not appropriate – they are 'not the things we put on our maps'; "objects outside the surveyor's classification of 'reality' are excluded" (Harley 1988b, 65). These objects might be inconvenient, embarrassing or deemed insignificant and are made to disappear figuratively from the map. The active denial of indigenous place-names on colonial cartography or the erasure of politically-incorrect toponyms on official maps are examples the power of silencing (cf. Monmonier 2006) .

- ‘Power through the map’

The power relations encoded semiotically within the map text do not exist in isolation, they (re)project outward from the image onto the space and social lives they purport to represent. The map can create power itself - just like the power of a photograph, film or song - by changing opinions, stirring the emotions and inspiring and enabling action in the world. As such, cartographic knowledge has often been jealously guarded because it is perceived to be so powerful (Harley 1988b).

“Cartographers manufacture power: they create a spatial panopticon” (Harley 1992, 244) and use of official cartography, according to critical deconstructionists, demonstrates that the map to be a pre-eminent device of social domination by manufacturing not just visibility over space but also legibility throughout the social-material landscape, “rendering the broad swathes of worldly complexity and enormity in miniature form for a discrete purpose” (Pickles 2004a, 80). Hegemonic power exercised through the map is evident in the conduct of wars, the delineation and enforcement of property rights (at all different scales), for counting and monitoring population, and maintaining law and order. The instrumental role of government mapping in European imperial exploitation through the erasure of indigenous peoples from the colonisers’ maps provides strong evidence of exercise of power through cartography. In the partition of India, the annexation of Palestinian land or the ‘*terra nullius*’ of Australia, cartography has been integral to colonial practices, providing both spatial justification and a rationalising tool for colonisers, past and present. For example, Bassett’s (1994, 333) analysis of maps made by European imperial powers at the end of the nineteenth century demonstrates how effectively they “promoted the appropriation of African space under the rhetoric of commerce and civilization.”

An important way that the power of the cartography works in the world is by dehumanising the landscape, allowing powerful groups to exercise power at a distance, “removed from the realm of face-to-face contacts” (Harley 1988a, 303). Maps are foundational to modern systems of governmentality, as evidenced in the extensive use of statistical mapping by bureaucracies and businesses (see

examples related to Internet in chapter five and appendix two). Maps have come to actually symbolize the governmental processes of regimentation, in which people and places are rendered as mere dots. This kind of de-socialisation of space through cartographic abstraction is seen most brutally in the military. Modern war making is now frighteningly like a game played out on digital map interfaces that render human landscapes into an impersonal terrain of targets and threats that can be engaged by so-called precision-guided weapons (cf. Vujakovic 2002a).

Beyond war fighting, states also actively uses cartography to foster national identity and legitimate the sovereignty over territory (cf. for European nations, Vujakovic 1995 and 1999b; for Finland, Kosonen 2008; for the U.S., Edsall 2007). The map provides one of the most potent images of unity between people, territory and the government (Biggs 1999). Anderson's (1991, 175) thesis of nationalism as imagined community, for example, highlights the extensive symbolic power of 'map-as-logo', deployed in an "infinitely reproducible series, available for transfer to posters, official seals, letterheads, magazine and textbook covers, tablecloths, and hotel walls. Instantly recognisable, everywhere visible." Maps showing the world divided geopolitically have become so ingrained as 'natural' template that such borders are present even in maps which are not explicitly political (e.g., weather maps). (See also discussion in chapter five on the connotations arising from the use of nation state as the mapping template for representing the Internet.) The symbolic power of cartography to make borders is endlessly exploited in the 'grand games' of geopolitics between states, including Halford Mackinder's cartographic articulation of the 'Eurasian heartlands' thesis at the height of British imperial power (Mackinder 1904).

The myriad ways that the state has come to rely on 'power through the map' to govern means that it is far and away the largest patron of cartography, but mapping is also integral in the processes of capitalist accumulation by (re)ordering lived lives into markets, potential markets or obstructions to markets. For example, geodemographic mapping reductively profiles individuals, fitting them into idealised consumer types, fixing them into a spatial grid of quantifiable economic value and ranking them based on 'worth' or 'risk' (see

Curry 1997; Goss 1995). This easily leads to discriminatory practices of 'redlining' - the term is derived from the mapping practice - where whole communities deemed unprofitable or high risk and are denied services (e.g., see Hillier's (2005) historical analysis of mortgage loan discrimination in Philadelphia).

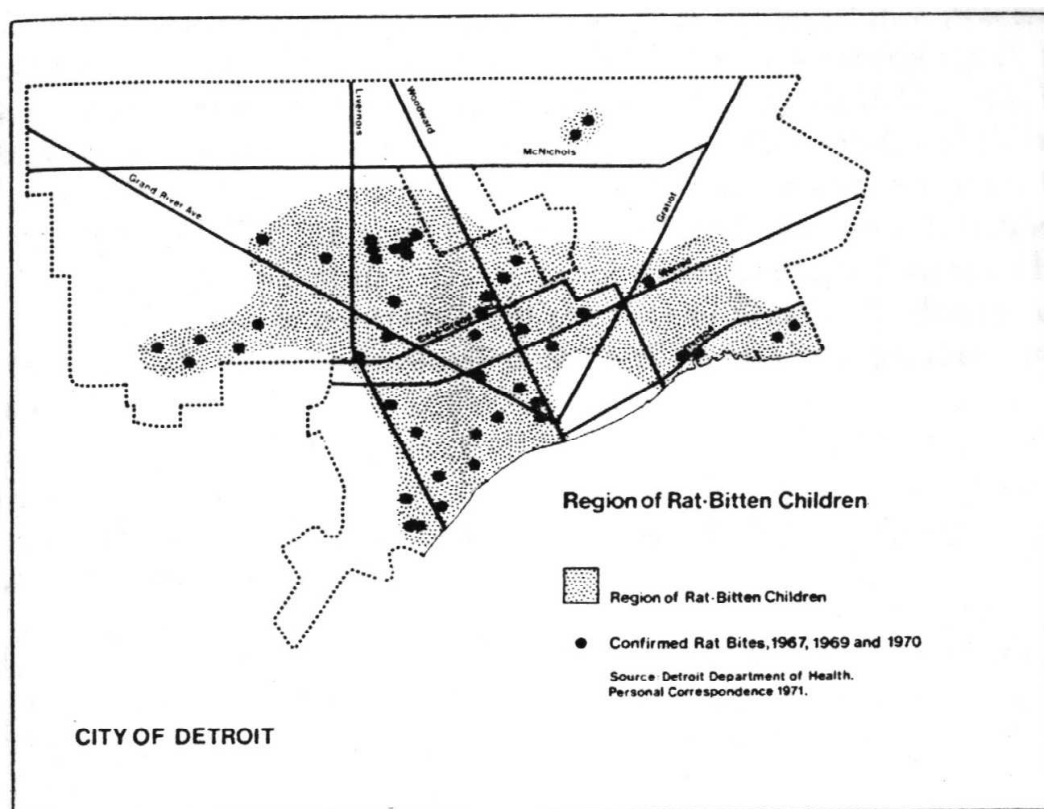


Figure 2.6: Example of the counter-cartography of William Bunge showing the rhetorical power of thematic maps to challenge the status-quo. (Source: author scan from Bunge 1975, 161.)

The potent role of cartographic power in social domination by states and corporations is certainly strong, such hegemonic mapping is also dialectical because it always opens up ways to resist. The practical and rhetorical power of maps to articulate alternative perspectives is always available. The power of the map can be used to re-frame the world in the service of progressive interests and to challenge inequality (such was the overt goal of the Peters projection project), while the logo-map used to bolster the state can re-imagined as a potent emblem in anti-colonial struggles (Huggan 1989). Cartographic power has also been exploited by environmental pressure groups and anti-globalisation activists to

counter the dominant corporate discourses, usurping the authority of the map against hegemonic interest (e.g., ‘scientific’ maps of the global temperatures and shrinking ice sheets have become potent images for climate change campaigners). This kind of counter-hegemonic cartographic potential was evident in the work of radical geographer Bunge (1975, 150) and his expeditionary geography, mapping socially-polarised urban America, to “depict a region of super-abundance adjacent to a region of brutal poverty”; an example in Figure 2.6 uses a conventionally designed statistical map to challenge convention²⁵. The distinction that marks these mapping projects as ‘subversively’ powerful is that they exploit the authority of cartography to ask difficult questions by mapping the types of human phenomena (war, poverty, racism violence against women) and landscape features (toxic waste sites, rat bites) that are usually deemed insignificant, inappropriate or otherwise ‘difficult’ by mainstream government and commercial cartography and, therefore, left unmapped. They confront the norms of society by using the conventional signs of the society’s elite. Another significant tactic in counter-cartography is changing scale and opening up authorship, for example in eco-mapping, which stresses the importance of mapping local areas by local people (Aberley 1993), and the empowering of marginalised groups, such as having physically disabled people participate in mapping their experiences of navigating streetscapes (Vujakovic and Matthews 1994).

2.4 Conclusions

In conclusion, one might ask to what extent can the ideas from the ‘map as representation’ and the ‘power of maps’ paradigms be productively applied to cyberspace cartographies? To answer this, I would argue, firstly, that ideas on semiotic interpretation from the ‘representation’ paradigm can highlight the conventional notions that underlie much cyberspace mapping and lead to analytical insights on the partial nature of new maps, and the contested social

²⁵ Vujakovic (notes on thesis draft, October 2006) observes that Bunge also uses deliberate cartographic design “slight of hand” in terms of widely extrapolating the extents of the rat-bite area from a sparse distribution of data points.

meanings of the map signs, the wider social milieu in which they are embedded, and how they work as cartographic imagination shaping the perception of cyberspace for users.

Secondly, that concepts from the ‘critical cartography’ paradigm can and should be connected to understanding these new modes of mapping, not least because the hegemonic work of cartography is being replicated to a large degree in cyberspace. The luxury of hindsight and the distance of time seem to make the political agendas and social consequences of old maps more apparent, but there is a need to critically read contemporary maps because they are the ones directly affecting people’s lives today. Many of the implicit purposes of today’s maps of cyberspace are the same as those of maps from earlier times – to control space and exert sovereignty, to legitimate private property rights, to surveil people, to defend social difference, to make a profit. The theoretical ideas, such as rules of ethnocentric geometry and social ordering, the concepts of mapped silences, spatial governmentality and dehumanisation through cartographic abstraction, along with the focus on authorship and contested practices, can open up cyberspace cartographies critically and as shown in the empirical analysis presented in chapters five and six help reveal the ideology of the maps of Internet infrastructures.