Section 01

Keynotes
Discours-programme

Joint Plenary Session 1
Séance plénière conjointe 1

Touch the Past

David Woodward

If cartography had no history, why would it matter? We've actually been quite successful in destroying that history—what difference would it make if all final vestiges were removed? Why should we value what remains?

Removing history is a favored means of destroying the memory and identity of a people. The past matters to cartographers because their memory provides context or meaning for what they do, allows them to measure the progress they value in their technology, and occasionally makes them humble when the flaws in their latest technology are revealed.

With the help of visual aids, I will trace a few important issues in cartography, starting with the present and suggesting similarities or radical differences in the past. Histories usually start with the old and end with the new. I will reverse the order so that the depth of the roots can be observed. I will not confine myself to the last 1000 years, because many interesting precedents took place before that.

I will show that the search for an all-encompassing global cartographic model has been developing for some centuries; the "digital earth" was not invented by Al Gore. I will discuss the lure of precision in measurement, and the values that have been placed on its by various cultures as well as the ways in which it has been satirized in history. At a time when good map design seems to be underrated, I will explore other periods where aesthetics have similarly been discounted. I will inquire what seems to have made maps beautiful in the past, while avoiding a definition of beauty that excludes function. In an era when it is fashionable to say that everyone can make a map, I will trace the uncertain trajectory of professional cartography. In a period when maps are increasingly paid for by private enterprise, I will ask how the public and private patronage of maps was negotiated in the past. At a time when the representation of the third dimension is increasingly valued, I will explore how this problem was tackled in the past. At a moment when the four-dimensional possibilities of cartography are being highly touted, I will enquire when the representation of time got separated from that of space and why this happened.

If we cannot learn from these examples, then there is something radically wrong with the way we tell the story of maps. It is high time to revitalize this history and reveal its richness in our teaching and research. It is an opportunity that has not been taken, and it could enrich cartography's future.

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Joint Plenary Session 2
Séance plénière conjointe 2

Cartographic Futures on a Digital Earth

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Introduction

This paper is written with some trepidation, since I am not a cartographer, and would certainly not want to be perceived as trying to prescribe cartography's future. But the organizers of the conference have asked me to address the second part of the conference theme, "Touch the Past, Visualize the Future", and I hope what follows will be of some interest. It is written from the perspective of someone who cares greatly about the cartographic aspects of what we do, who like many of us grew to love maps at an early age, and who sees cartography as an indispensable part of any future for my own discipline of geography, and the broader enterprise that we variously know as geomatics, geoinformatics, or geographic information science.

The paper begins by introducing two broad trends that provide a context of vital importance for cartography: the digital transition, which began some decades ago but seems to dominate more and more of our vision of the future; and what appears to be an increasing interest in society generally in geography, the stuff of maps, and in all things geographic. These two themes come together in a discussion of how the digital transition will affect the production, dissemination, and use of maps; the institutions that manage and regulate those activities; and ultimately, the nature of maps themselves. This leads to the identification of a basic paradox, between the increasing marginalization of cartography within the larger digital geographic enterprise; and the increasing need for good cartographic practice in visual communication, as more and more people are empowered by new technology to make maps. The final section of the paper discusses the concept of Digital Earth, a popular idea that seems to serve both as a conceptual framework for much of the preceding discussion, and as a 'moonshot' that can mobilize a substantial technical and scientific effort.

The digital transition

The idea of communicating in code is as old as language itself, requiring only the establishment of standards within a community regarding the code's meaning. An even older code is the alphabet of four bases used to communicate genetic information between parent and offspring; incredible as it may seem, the entire architecture of the human body, and the instruction to a chick to begin pecking after 21 days of incubation, are somehow successfully coded in a permutation of A, C, G, and T. But the explosive growth of digital communication that has occurred in the past 30 years relies on several other factors besides a universal code of zeroes and ones. The code is readily processed at great speed by digital computers; it can be stored virtually indestructibly (although practice often falls well short of theory); modern standards include automatic error-checking; and it

can be transmitted at close to the speed of light. Today, virtually all human communication-at-a-distance passes through digital coding and decoding steps. Telephones, FAX, written text, photographs, music, all have associated and generally accepted standards of coding in digital form. Only the mail remains as a predominantly analog method of communication ("sending atoms rather than bits"), although most sorting of the packages themselves is now digital. In principle, the entire contents of a major research library in the form of printed text could now be digitized, stored on a device no larger than an average office, and made available to everyone connected to the Internet at a cost roughly comparable to that of a Boeing 747-400.

Digital technology is already pervasive, but its impacts are only just beginning to be felt in the ways humans organize and conduct their activities. Take, for example, the case of geologic mapping. Figure 1 shows the stages of mapping in somewhat idealized form, from the work of the field geologist through to eventual use, storage in libraries, and archiving. Each person or group in the chain communicates with the next person or group: the field geologist gives notes and sketches to the cartographer, while the printer sends paper maps to the distributor and on to the library and user.

The first infection by the digital virus occurred among cartographers, who were persuaded as early as the late 1960s that the time and cost of preparing and editing maps could be greatly reduced by adopting digital technology, initially by fixing simple encoders to the arms of plotters to capture locations, and later by replacing drafting tables by digitizers. Today, it is hard to find a single drafting pen in many map production operations and cartography classrooms, and drafting tables are also in danger of disappearing. Then the users of maps began to demand digital product, because of the obvious potential of digital analysis and the simultaneous growth of geographic information systems (GIS) as analysis engines for map data. But this second round of infection had a more significant impact, since it created a new path that bypassed the traditional printing and dissemination arrangements. More recently, the World Wide Web strain of the digital virus has further infected the distribution function, as data centers, digital spatial data libraries (such as the Alexandria Digital Library, *alexandria.ucsb.edu*), and spatial data clearinghouses (such as the U.S. National Geospatial Data Clearinghouse, *www.fgdc.gov*) provided an alternative to the traditional library as a source of archived information.

Digital technology has yet to infect the work of the field geologist to a significant degree, although it is common today to find laptops at field sites. The sketches and field notes that a geologist passes to a cartographer are still largely in analog form, and suitable software for capturing and processing such information is still primitive. But the technology already exists to allow the field scientist to download images of a project area from the WWW, to annotate it digitally with sketches and notes, and to link digital photographs to field locations. Information technology in the field promises to improve greatly one of the most severe impediments to the various stages of communication shown in Figure 1, and one that underlies much of the subsequent discussion in this paper: the inability of the field geologist to communicate more than a small fraction of what he or she discovers in the field to the eventual end user, because of the highly restricted nature of the traditional communication channels. In the longer term, extensive application of information technology in the field promises to open up novel channels of communication. For example, it will be possible for field scientists to share information remotely as soon as it is collected or interpreted; to communicate directly with end users; and in the long run to bypass entirely the traditional stages of cartographic production.

In recent years massive investments have been made in digital libraries, metadata (data about data, the digital equivalent of the catalog record), new search mechanisms, and other developments aimed at making it possible to find geographic data in the massive, distributed archives of electronic networks. Moreover, it seems clear that investments to date are tiny compared to what is to come, as the information economy grows. Surfing the Web for data is providing an increasingly effective alternative to visiting one's local map librarian.

The digital transition is affecting the *geography* of map production as well, as the traditional arrangements break down or are modified by new technology and changing economics. Much cartographic software is now cheap and affordable, allowing anyone with a personal computer and access to the Web to make maps. Farmers with access to the technology of precision agriculture can build maps of their fields and growing crops at much

higher resolution than traditional soil maps, and can capture and compile detailed spatial information on inputs and yields using devices attached to harvesters and tractors. Local governments can rent vans equipped with GPS units, drive along every street, and produce street maps at higher accuracy and much lower cost than the traditional production arrangements of central governments. In short, changing technology and economics are moving map production from a system of unified central production to a local patchwork, and the old centrifugal, radial system of dissemination is being replaced with a complex network.

In the early stages of the digital transition much use was made of the new technology to perform operations more quickly, at lower cost. But as the transition advances it is the operations themselves that come into question, along with the organizational structures and arrangements that evolved around them. The survivors in this world will be those who can think beyond past practices, and adapt quickly to new opportunities.

The stuff of maps

As a U.S. citizen I share what is now a widespread feeling of awe for the sublime geographic ignorance of many of my fellow citizens, and nowhere is this better revealed than in U.S. ignorance about Canada. Yet this is a period in political history of devolution of power down the geographic hierarchy. We are encouraged to think globally but act locally; increasing local autonomy makes it more and more difficult to achieve widespread consensus. There are new standards for teaching geography (Bednarz *et al.*, 1994), greater interest in travel, more interest in the diversity of places and less in standardization.

In the past few years many new services based on geographic information have appeared on the Web. Microsoft's Terraserver (*www. terraserver.com*) began as an effort to build and demonstrate a capability to serve information at a massive scale, with geographic data chosen as the content because it was cheap and comparatively unencumbered by issues of intellectual property. But Terraserver has been very successful as a pioneering effort to serve imagery to a vast population of users many of whom had never had access to easy-to-use Earth imagery before. Microsoft's Home Advisor (*www.homeadvisor.com*) provides GIS-like services in the form of home listings and social data about surrounding neighborhoods. MapQuest (*www.mapquest.com*) is one of many sites offering maps, georeferencing, and optimal routing services.

One of the greatest impediments to effective use of geographic data has been the inability to integrate information about a place. Our traditional arrangements for production of geographic information emphasized horizontal uniformity; one government program produced all topographic maps, another all soil maps. Integration was provided by the library and the map store, which acquired data from many sources, and serviced many distinct but locally based needs. But in the digital world the library and the map store have been largely bypassed, along with their integrating roles, so that one goes to one site to obtain an image (e.g., the MIT server of digital orthophoto quadrangles, *ortho.mit.edu*), and another site to obtain a topographic map, and still a third to obtain a soil map. It has been virtually impossible to approach a digital data store, or the Web, and ask for all information about one place; and equally difficult to integrate such data once obtained because of variations in formatting and terminology, and positional inaccuracies.

The U.S. Geological Survey provides an interesting case in point. The traditional organization of the Survey into four divisions (with responsibilities for mapping, geology, water resources, and biological resources) has also determined the face it presents to the world as a source of information. Thus a user approaching the USGS Web site finds it much easier to obtain information about one theme for places, than information about many themes for the same place. The Survey's Gateway to the Earth project proposes to replace this external view by a more integrated one that will allow the user to find everything the Survey knows about a place. This idea of *place-based search* is already implemented to a degree in the U.S. Environmental Protection Agency's site (see the ZIP code search feature of *www.epa.gov*).

These place-based search mechanisms resemble what I have called a *geolibrary* (Goodchild, 1998), or a library that one can approach with the query *what do you have about there?* Place-based search has been very difficult in the traditional library, for numerous reasons, but promises to be comparatively easy in a digital world, and provides yet another instance of how the digital transition is changing our arrangements for producing, disseminating, and using geographic information.

Geographic information and maps

But maps are only one form of expression of geographic information. Very broadly, one could define geographic information as information about well-defined locations on the Earth's surface; in other words information associated with a geographic *footprint*. But that definition fits guidebooks, photographs of landscapes, even pieces of music with geographic associations. Possession of a footprint is the minimal requirement for place-based retrieval. Maps, on the other hand, are:

- *Visual* forms of geographic information, rather than textual, verbal, acoustic, tactile, or olfactory; though tactile maps have been developed to address the needs of the visually impaired.
- *Flat*, requiring the Earth's surface to be expressed in a distorted manner.
- *Exhaustive*, expressing a uniform level of knowledge about every part of the area covered by the map.
- *Uniform in level of detail*, although no flat map can ever have a perfectly uniform scale.
- *Static*, since a map once drafted and printed cannot be substantially changed.
- *Generic*. The strong economies of scale in map production ensure that maps will be produced only when demand reaches a sufficient level. Thus maps tend to be produced to satisfy many uses and users simultaneously. They present a *shared* perspective that cannot be user-centered, and thus is almost always vertical to be independent of any user location.

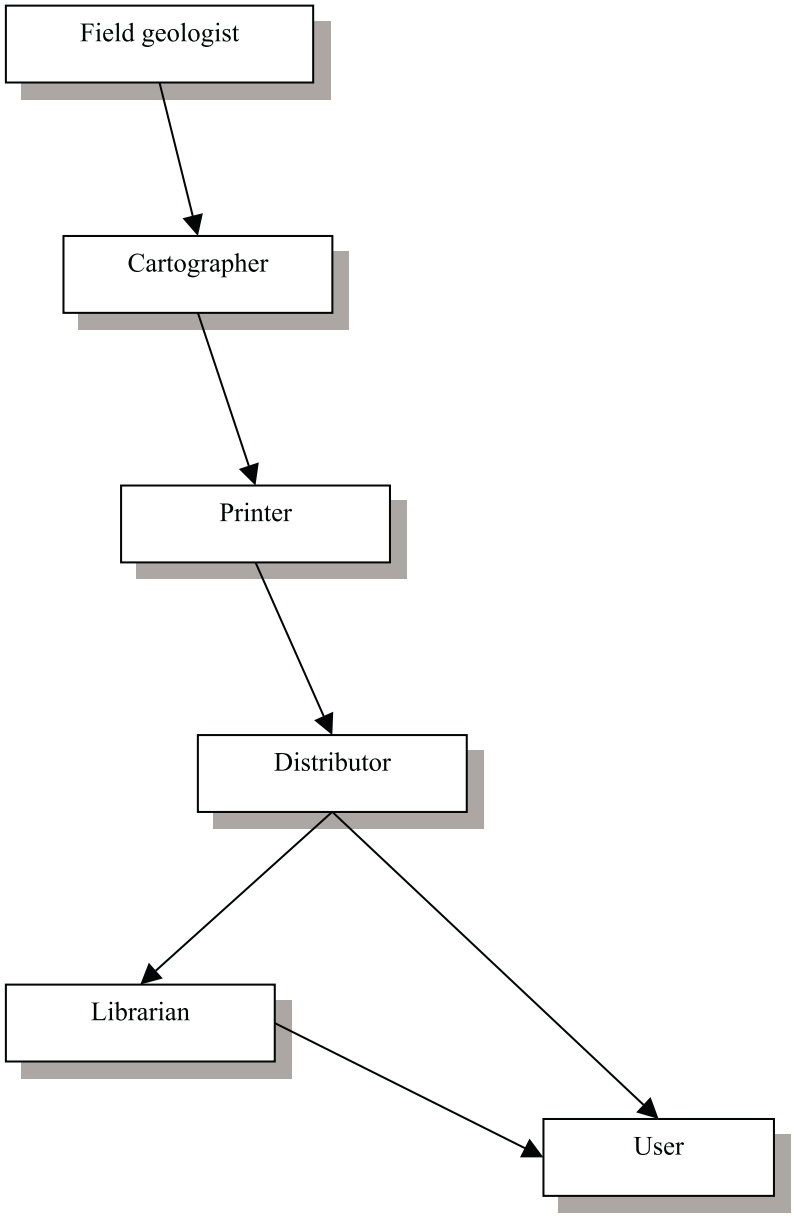

Figure 1: Schematic of the geological mapping process as communication

- *Precise*, few methods being available for display of uncertainty.
- *Slow*, due to the lengthy time required for all of the different stages of production, as shown for example in Figure 1.

None of these constraints is inherent to geographic information, however, especially in a digital world that changes the economics of map production, provides the tools for interacting directly with information, and allows information to be compiled and delivered at electronic speed. In the digital world all information is expressed in bits, whatever its origins; it is stored in the same places, and transmitted using the same techniques. It matters not at all to the Internet whether a 'bag of bits' represents text, an image, or a map. Thus we hear more and more about multi-media systems, that handle data irrespective of the media on which they were traditionally stored in the analog world. The term *multi-valent document* (Phelps and Wilensky, 1996) refers to the ability to link images, text, sketches, notes, etc., that refer to the same subject, and to handle them as if they were a single unit. In this multi-media world, old arrangements based on the problems of handling different media will be challenged, and may be abandoned completely.

The paradox of contemporary cartography

It follows from the previous discussion that the map[1] is only one form of expression of geographic information in a digital world, competing with other forms on a playing field that is increasingly level. For example, flat views of the world and the distortions they embody must compete with orthographic views such as those provided by the current version of Microsoft's Encarta atlas. To the average citizen, working with and manipulating a digital globe may be far more straightforward and comprehensible than working with a digital Mercator projection; and children may be able to understand a globe more easily and at an earlier age than its projected version.

It is widely believed that geographic information systems are being absorbed into the information technology mainstream: that in the near future such standard applications as spreadsheets, e-mail, and word processors will include support for geographic information. The magazine *GIS World* recently changed its name to *GeoWorld*, to reflect "GIS's transition from a standalone technology to one benefiting from the integrated nature of today's spatial technologies and the enterprisewide solutions they offer." (Hughes, 1998). GIS has made it possible for anyone who can afford a basic personal computer and cheap software to display geographic information in the form of a map; by offering these functions through such common applications as Microsoft's Excel, or through the recently announced MapPoint 2000, a Microsoft product integrated with the Office suite, software developers are now putting these tools into the hands of everyone, irrespective of their credentials and sensitivity to cartographic principles. In a world in which everyone can make a map, who needs the cartographer?

Only a few institutions have had the wisdom to elevate cartography to the status of a department; instead, cartographers have historically found themselves rubbing shoulders with geographers or surveyors. Today, rapid growth in interest in geographic information systems and related fields has led to an emergence of new collaborations, under a variety of names: geomatics, geoinformatics, or geographic information science. Cartography finds itself a small part of a larger academic enterprise, and at the same time increasingly marginalized by the rapid spread of map-making tools.

Much of the attraction of GIS lies in its visual focus: colorful maps appear on the screen, to be manipulated and explored by the user at the touch of a mouse. GIS communicates primarily through the visual sensory channel, especially when used in efforts to influence public opinion and policy. But such communication is never simple and straightforward. Only one color can be assigned to each location in the visual field, which is then mapped through the optics of the visual system to the human retina. While a database makes the link between an object and its name explicit, the eye-brain system does this through complex rules of visual association that must be understood by the map designer and made the basis of map design. Map designers must devise complex and sophisticated rules to make it possible for a map to communicate more than one attribute of an object;

and yet none of these rules are needed when information is communicated in other forms, such as through tables.

Yet despite this complexity, or perhaps because of it, a large number of the maps produced using today's software are simply awful. As David Rhind has been known to remark, GIS technology lets us produce rubbish faster, more cheaply, and in greater volume than ever before. Paradoxically, then, the world that is marginalizing cartography is also the world that needs cartographic principles and skills more than ever. It is also a world of unprecedented opportunities for cartography as the digital transition removes many of the inherent barriers and impediments of the traditional map, and makes communication of geographic information between people richer and more efficient than was previously possible. To restate the previous list, communication of geographic information need no longer restrict itself to the visual field; flatten the Earth; cover every part of an arbitrarily defined area that happens to include the area of interest in uniform detail; maintain a uniform level of detail and a vertical perspective irrespective of the content's focus; remain static irrespective of the acquisition of new information or change in the landscape; serve the interests of a large number of users to overcome high fixed costs; fail to reveal anything of its own inherent uncertainties; or take substantially longer than any other form of communication.

Digital Earth

The term *Digital Earth* has a number of meanings. U.S. Vice President Al Gore, in the text of a speech, described an immersive environment that would allow its users to explore and learn about the Earth and its human and physical environments (the full text is at *www2.nas.edu/besr/238a.html*; a summary was delivered in Los Angeles in January 1998):

> "Imagine, for example, a young child going to a Digital Earth exhibit at a local museum. After donning a head-mounted display, she sees Earth as it appears from space. Using a data glove, she zooms in, using higher and higher levels of resolution, to see continents, then regions, countries, cities, and finally individual houses, trees, and other natural and man-made objects. Having found an area of the planet she is interested in exploring, she takes the equivalent of a 'magic carpet ride' through a 3-D visualization of the terrain. Of course, terrain is only one of the numerous kinds of data with which she can interact. Using the system's voice recognition capabilities, she is able to request information on land cover, distribution of plant and animal species, real-time weather, roads, political boundaries, and population. She can also visualize the environmental information that she and other students all over the world have collected as part of the GLOBE project. This information can be seamlessly fused with the digital map or terrain data. She can get more information on many of the objects she sees by using her data glove to click on a hyperlink. To prepare for her family's vacation to Yellowstone National Park, for example, she plans the perfect hike to the geysers, bison, and bighorn sheep that she has just read about. In fact, she can follow the trail visually from start to finish before she ever leaves the museum in her hometown.
>
> She is not limited to moving through space, but can also travel through time. After taking a virtual field-trip to Paris to visit the Louvre, she moves backward in time to learn about French history, perusing digitized maps overlaid on the surface of the Digital Earth, newsreel footage, oral history, newspapers and other primary sources. She sends some of this information to her personal e-mail address to study later. The time-line, which stretches off in the distance, can be set for days, years, centuries, or even geological epochs, for those occasions when she wants to learn more about dinosaurs."

Several principles and challenging ideas underlie this piece of technological fantasy. First, the immersive environment provides a very rich form of communication between the information store and the learner, unimpeded by the constraints of a single medium, and not limited to the visual channel or to the narrow concept of *map* defined earlier. Second, the vision mixes types of data that are readily communicated by *rendering* into

something resembling their true appearance, such as topography and land cover, with other types that will have to be communicated symbolically. This second type includes information on population, health, or environmental quality. Cartographers are familiar with the problems of mixing these two types through their experience with symbolic enhancement of orthographic images. Other information mentioned in the speech is geographic only in the sense of having a footprint; the contents of newspapers and oral histories will have to be represented iconically, and their contents communicated in some appropriate way, since they are not geospatial and therefore cannot be mapped onto the Earth's surface.

More fundamentally, perhaps, DE embodies a novel metaphor for the organization of digital information and construction of user interfaces. The current generation of computer operating systems, such as Windows 98, makes use of the metaphor of the desktop, with its clipboards, filing cabinets, and briefcases, because this is the environment most familiar to office workers. This tradition goes back to work at the Xerox PARC laboratories in the 1960s, but came to dominate Microsoft operating systems only in the late 1980s with Windows. Yet the office is not a natural environment for thinking and learning about the surface of the Earth, and *office* is not the first thing that comes to mind when we think of Shackelton, or von Humboldt. Since all such information relates to some geographic location, it would be far more effective to use the Earth's surface itself as the organizing metaphor. For example, rather than look in a filing cabinet under Z, someone interested in Zimbabwe would find it much easier conceptually to reposition a digital globe to the right part of Africa (or to look up Zimbabwe in a digital rendering of the back-of-the-atlas gazetteer, and see the globe repositioned automatically). DE replaces the office with the Earth as the dominant user interface metaphor.

DE seems an appropriate focus for this discussion not because it is real (although several prototypes have appeared since the text of the speech was released), but because it provides a vision for the future communication of geographic information that reflects the removal of all of the impediments identified above. It also presents some very substantial challenges:

- The range of scales implied is over at least four orders of magnitude, from a resolution of 10km that would be appropriate for rendering of the entire globe, to the 1m resolution needed to render a local neighborhood. Cartographers have long struggled with relationships between maps at different scales, but not over this large a range.
- Perspectives in DE will be user-centered, whereas almost all cartographic tradition is focused on user-independent perspectives (vertical, with uniform detail). We know very little about how to vary resolution with distance for effective communication, although much work has been done on the necessary algorithms in computer graphics.
- As noted above, DE will have to mix rendering with symbolic and iconic representations. We have little in the way of cartographic technique for indicating the *presence* of information, rather than the content. New forms of representation of metadata are called for.
- The speech implies that a DE environment would somehow know about and have access to some significant portion of the information that exists about a given place. This raises a host of interesting technical questions about information search and discovery in digital libraries, clearinghouses, and the WWW; institutional questions about quality assurance and credibility; and societal questions about privacy and intellectual property.
- Although the child in this scenario enters an immersive, virtual environment, the principles of DE could be applied equally well to the conventional configuration of a user, keyboard, screen, and pointing device. Although the screen renders images in two dimensions, a user with the ability to manipulate rendered objects has no difficulty imagining the object as three-dimensional. But the conventional configuration clearly misses the potential for tactile communication.
- Although the speech refers only to historic data, it is easy to imagine DE being used to communicate simulations of Earth processes that could help the child learn the principles of geomorphology or urban planning and growth; or help decision-makers deal with the projected impacts of current actions.

DE appears to have many attributes that qualify it as a suitable *moonshot*, a vision or rallying point for a rather ill-defined collection of disciplines and interests, comparable to the 1960 commitment to "put a man on the moon before the end of the decade." Moonshots like these are not grand challenges in the sense of fundamental unsolved problems for a discipline, but they can help to orient a community, such as the current community interested in geographic information, in pursuit of a common goal and the research problems that will have to be solved to reach it. Moreover, many of those solutions are likely to have benefits far beyond the immediate context of the moonshot.

Conclusion

A technology that began as a way of making large numbers of numerical calculations possible has turned into something that, if the pundits are to be believed, has the potential to reorganize much of what we do. Cartographers first felt that impact in the early 1970s when computers began to be used to reduce the production costs of paper maps. Since then, digital technology has affected almost all aspects of mapping, created an entirely new application in geographic information systems, facilitated many other new geographic information technologies, and spawned a new partnership of the mapping sciences known variously as geomatics or geographic information science.

For the traditional cartographer, what began as a useful aid has turned into a monster, empowering virtually everyone with access to the tools that used to be the exclusive preserve of specialists. In a world in which everyone can make a map, who needs cartography? Or as Judy Olson titled her Presidential Session at the Association of American Geographers annual meetings in Charlotte in 1996, "GIS has killed cartography". But paradoxically, the need for good cartographic design is now stronger than ever.

Faced with this situation, it seems to me that a suitable strategy for visualizing the future while touching the past would have the following components:

1. Establishment of clear principles underlying the communication of geographic information. Such principles should be independent of media and technology, and thus robust against a major technological transition such as the one we are currently experiencing. These would not be the principles of paper maps alone, or of digital displays alone, or of visual communication alone, but of the communication of geographic information from one person to another, or between a person and a store. Different communication channels and media would be represented through different parameters, constraints, and rules within this general framework.
2. Anticipation of the full impact of the digital transition. It is hard to see the wood for the trees in times of fundamental change, and to think beyond the immediate impact of computerization on a single task. But in the long term the world will reorganize itself according to principles such as those suggested in (1) that are truly fundamental. These include function, economics, and the basic forces that drive society, including the distribution of power and influence.
3. Identification of a moonshot, an articulated vision of what communication of geographic information might mean at some point in the future. Without such a vision it is difficult to see how a prioritized agenda for cartographic research can emerge. Curiosity will always be around to drive research, as will immediate economic gain, but it is much more difficult to identify a clear sense of common purpose that can both drive research and appeal to potential sources of funding.

End Note

[1] As used here, the term implies a paper product or its direct digital equivalent produced by scanning or digitizing; both are therefore subject to the constraints identified earlier.

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Joint Plenary Session 2 - Response 1
Séance plénière conjointe 2 - Réponse 1

Cartography, Digital Transitions, and Questions of History

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Introduction

In his 'Cartographic Futures on a Digital Earth' Professor Goodchild describes how cartography and broader fields of geographical inquiry are currently coming to grips with what he calls 'the digital transition'. He stresses how this transition can also be seen as an opportunity – indeed a necessity — both for a rapprochement between GIS and cartography and for an extension of the scope and effectivity of the two together. This transition provides unprecedented opportunities for reworking cartography's traditional commitments to forms of mapping that are bound by the visual, flat, exhaustive, uniform, static, generic, precise, and slow. In practice, the transition has already occurred and GIS and cartography have already merged. In describing the nature of this transition Professor Goodchild offers a diagnosis of a pathology: the infective stages of the digital virus, barriers to its diffusion, and the possibilities attendant upon its adoption. Left to be sorted out is how the merger will be rationalized to increase efficiency of operations and what new goals can be achieved as a result of this merger. In this view, Professor Goodchild sees the real possibility of bringing into being long-held "technological fantasies" of being able to provide upon demand all information about one place, using the Digital Earth as the equivalent of a geographical 'filing cabinet' for a global geo-library, and a corresponding transformation of the ways in which geographical and place-based information are provided and used. The future American world of digital place-based information envisaged by Vice President Al Gore thus offers an unprecedented opportunity for mobilizing efforts for the equivalent of a 'moonshot' – a vision and rallying point around which GIS and renewed cartographic imagination and practice will be able to flourish. The possibilities offered by this transition are made even more pressing and powerful by the general increase in interest by the wider society in maps and things geographic.

I have been asked to say a few remarks by way of response to these ideas – in the organizers' words to say a few words about how I "beg to differ" with Professor Goodchild's reflections, visions, and challenges. I would like to thank the organizers of the conference and Professor Goodchild for this invitation, and for Professor Goodchild's forebearance at yet another pesky commentary from Pickles: as he knows by now I rarely turn down the chance to "beg to differ" and in so doing I often spin-off in directions that might not appear very helpful to the projects at hand. But, in fact, in many respects and up to a point I agree entirely with Professor Goodchild's diagnosis and prescriptions of the present condition and future opportunities for cartography, GIS, and related geo-informational fields. Moreover, I find his linking of the opportunity structures that unite GIS and contemporary cartography to be extremely exciting. His remarks clearly and accurately signal the challenges posed and opportunities available to cartographic practice by the digital transition and his proposals for mobilizing effort around the Digital Earth project are – I think – exciting (especially given the emergence of structures and institutions of the kinds he describes, such as the Alexandria Digital Library, the U.S. National

Geo-spatial Data Clearinghouse, Terraserver, MapQuest, the MIT server of digital orthophoto quadrangles, and the U.S. EPA's place-based search systems). Moreover, I do think that Professor Goodchild's prognosis of the ways in which the digital transition will actually unfold is probably correct. In this sense, U.S. government officials (such as Vice-President Gore), state agencies, and public organizations have already begun to put the pieces of the 'moonshot' together. But I have been asked to be a discussant and to be provocative in "begging to differ" and so I shall take issue with some issues raised by "Cartographic Futures on a Digital Earth."

I will make four central arguments:

- much contemporary discussion of the digital transition presupposes only one path to the future;
- like other transitions, the 'digital transition' produces geographies of its own, patterns of combined and uneven development, and – as a result – multiple and open paths to future worlds of geo-information;
- all mappings (traditional and digital) have the potential to produce new social relations, but often they hide these relations. As with the information revolutions of the past, they become fetishes;
- in thinking about and working towards projects such as the Digital Earth, that combine digital spatial information with renewed cartographic practice, can we evacuate from these projects the fetishized ideologies of progress? Can we think of democratic transformations in the ways we map and use information in different ways than the History of Progress and the Sciences and Politics of Representation allow?

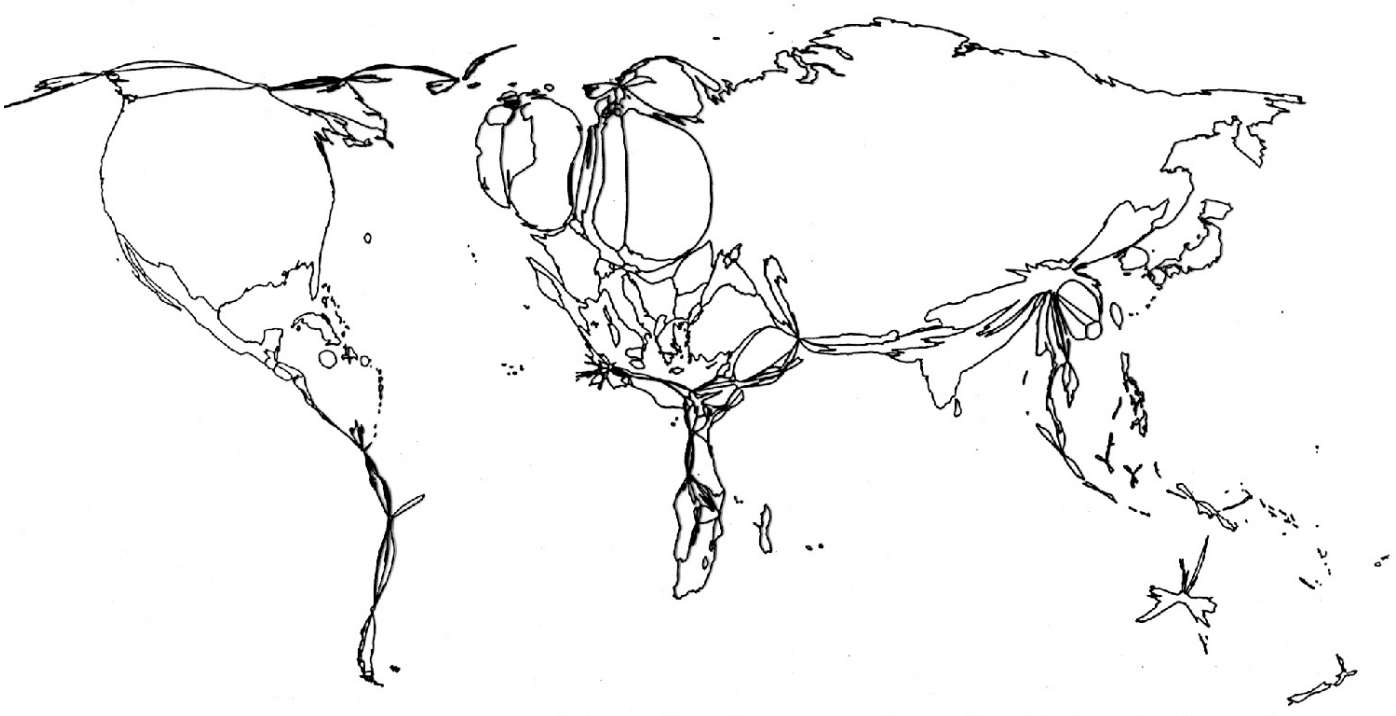
Geographies of Transitions

Since I am by profession and vocation a geographer and political economist of regional change and geopolitics, I will begin my remarks with some comments about transition theory. As an economic geographer and political economist, my work focuses on questions of democratic transitions variously involving transitions from industrial capitalism to monopoly and late capitalism, from Fordism to post-Fordism, from apartheid to post-apartheid, and most recently from communism to post-communism. In this post-1989 period, I find it particularly interesting that Professor Goodchild avoids the more common boosterist language of '*digital revolutions*' in favor of the phrase 'digital transitions.' Knowing his efforts over the years at building constituencies, opening dialogues, and extending the range of ideas brought to GIS, the turn to 'digital transitions' at one level signals a 'Realpolitik' in regard to the current and future relations between GIS and cartography. It certainly represents a recognition of the 'sea-change' in thinking about mapping practices and the growing importance and potential of geo-information. As Stephen Hall (1993, 8) has argued in *Mapping the Next Millenium* we are in the middle of "arguably the greatest explosion in mapping, and perhaps the greatest reconsideration of 'space' (in every sense of that word)" since the times of Babylon, a redefinition that requires a rethinking and broadening of our conceptions of maps and mapping, one that signals "nothing less than the reinvention of the idiom of geography" (Hall, 1993, 4-5). And so 'digital transition' signals a complex set of images and opportunities for building a better world.

But, in the term 'digital transitions' we can – I think — also see a signaling of something else. The deployment of the discourse of 'transitions' also brings to our conversations about the future of GIS and cartography a metaphorical political economy of 'democratization' and a particular notion of History. Michael Burawoy (1992) has recently warned that the language of transitions (what he calls 'transitology') has – especially since the events of 1989 – been triumphalist in nature, signalling a break with a constrained and drab past. (What better way to describe communism than using Professor Goodchild's own descriptions of the traditional commitments of cartography — flat, exhaustive, uniform, static, generic, precise, and slow.) In transition studies this 'break' has usually been seen as inevitable, motivated by the more flexible, dynamic, responsive, differentiated, and strategic structures and practices of democracy and capitalism. Transitions are, then, about a certain type of reading of the dynamics of political economy and presuppose a particular conception of History that is progressive and usually singular and linear.

Thus, when Professor Goodchild asks us to think about the opportunities of the 'digital transition' as a student of 'transitology' I am immediately on my guard. 'Transition-talk' evokes for me a liberal progressivist ideology of 'breaks', overcomings, and new universal futures (market capitalism and representative democracy), what Jacques Derrida in *The Specters of Marx* spoke of as the new specter haunting Europe, the specter of a new hegemony of neo-liberalism. To 'transition-talk' then, I would want to add questions about the geography of socio-technological change and the political economy of mapping: what are the geographies and the interests of the 'digital transition' and what seems to be presupposed in this particular triumphalist rendering of History? This is no revelation: Professor Goodchild and I have been collaborating indirectly through the National Center for Geographic Information Analysis for eight years now to foster precisely this kind of GIS-Society studies.

The cartographer Brian Harley (1989, 1990) has already opened up the spaces within which I want to think this political economy of transitions and representation. In his various essays on 'deconstructing the map' and the 'power of the map' Harley reminded us that the act of representing the world is an interested act that brings certain issues to light and submerges other possibilities. Behind the pretensions of objectivist and universalist cartography and GIS lay a variety of culturally determined and socially conditioned interests. Of necessity, the map is a tool whose form and context are selected, partial, and vested with a variety of such interests. This is, in many ways, an unavoidable situation, but it does require that the pretensions of universalism and disinterestedness be unmasked, the map be deconstructed, and its representations denaturalized. In parallel vein, Denis Wood (1993) has shown how the *Power of Maps* resides in political and social power as well as in the technical capacities of the cartographic project, Svetlana Alpers (1983) has shown how Italian perspectival painting and the cartographic impulse that emerged in contradistinction in the low countries of the Netherlands and Belgium have to be thought of as distinct (though related) systems of representation, and more recently Martin Jay (1993) has shown how the universal goals of a single 'God's Eye View' must be 'disseminated' and understood in terms of multiple, different, and competing 'scopic regimes.'



Cartogram of the worldwide coverage of topographic mapping (approximately mid 1990s). Each country has been distorted in proportion to the area of the map sheets of the most detailed coverage for the whole country. The base value of 1:1,000,000 is assumed everywhere. Most detailed complete coverage assembled from UN and International Cartographic Association reports. (International boundaries of 1987).

Source: Nicolas Chrisman, *Exploring Geographic Information Systems*, John Wiley and Sons, 1997, pp. 258-259.

The geography of the 'digital transition' is, of course, difficult to describe, in part because it is changing so quickly. Last year's cautions about the 'over-reaching' claims of boosters are over-matched by far by the growth, diffusion, and accessibility of this year's products. So, writing any geography of the transition is fraught with danger and likely to be overly conservative in its judgments. But there are some things we can say. The last great universalist state-led project of mapping – the topographic surveys of the nation states – itself produced a highly uneven geography (Figure). The current 'digital transition' has its own uneven development. Harry Cleaver, for example, has calculated that the bulk of the growth of the U.S. economy in the 1990s can be attributed to restructuring resulting from the computerization of every aspect of economic, political, and social life. This is not a surprise to North Americans in 1999 who have seen stock market bubbles expand on the back of internet and internet related stocks, companies whose stocks have risen from $8 to $180 but which will not make a profit for another 2-3 years, and where America On-Line now has a capital value greater than IBM.

These illustrations should give us pause for thought about the nature of the 'digital transition' so richly described by Professor Goodchild. First, what will be the geography of the Digital Earth project and its spin-offs, and second what is and what will be the political economy of investment and use in GIS and cartography in the years ahead? I have been dealing with these issues elsewhere (see, for example, Pickles 1995) and so for the present I shall simply say that for me one of the overwhelming facts of contemporary GIS is the paradox that on the one hand there seems to be an overriding concern in discussing the 'digital transition' to emphasize the democratizing of information and access to it that new digital information and geo-referenced technologies offer, and on the other hand the overwhelming evidence seems to point to the fact that its diffusion, use, and further development seems increasingly to be in the hands of state bureaucracies, businesses and research centers of military strategic planning. I shall have more to say later about its use as a 'public' good and how we might re-conceptualize the new cartographies in terms of direct action and participatory democracy. For the present I want to focus on one aspect of this paradox, the assumption of the democratizing capacities of the digital transition.

Digital Earth and Mirror Worlds

If I am correct that Professor Goodchild's embrace of the 'digital transition', place-based cartography, and the Digital Earth project may also entail an embrace of the attendant political economy of Vice President Gore's "technological fantasy" of a world in which a new Americanism (thoroughly post-Fordist in nature) is in the making, can we think of the 'digital transition' differently. This is certainly a difficult undertaking. Vice President Gore's own understanding of the 'digital transition' is presented by Professor Goodchild (Gore *www2.nas.edu/besr/238a.html)*:

> "Imagine, for example, a young child going to a Digital Earth exhibit at a local museum. After donning a head-mounted display, she sees the Earth as it appears from space. Using a data glove, she zooms in, using higher and higher levels of resolution, to see continents, then regions, countries, cities, and finally individual houses, trees, and other natural and man-made objects. Having found an area of the planet she is interested in exploring, she takes the equivalent of a 'magic carpet ride' through a 3-D visualization of the terrain. Of course, terrain is only one of the numerous kinds of data with which she can interact. Using the system's voice recognition capabilities, she is able to request information on land cover, distribution of plan and animal species, real-time weather, roads, political boundaries, and population. She can also visualize the environmental information that she and other students all over the world have collected as part of the GLOBE project. This information can be seamlessly fused with the digital map or terrain data. She can get more information on many of the objects she sees by using her data glove to click on a hyperlink. To prepare her family's vacation to Yellowstone National Park, for example, she plans the perfect hike to the geysers, bison, and bighorn sheep that she has just read about.

> In fact, she can follow the trail visually from start to finish before she ever leaves the museum in her hometown.
>
> She is not limited to moving through space, but can also travel through time. After taking a virtual field-trip to Paris to visit the Louvre, she moves back in time to learn about French history, perusing digitized maps overlaid on the surface of the Digital Earth, newsreel footage, oral history, newspapers and other primary sources. She sends some of this information to her personal e-mail address to study later. The time-line, which stretches off in the distance, can be set for days, years, centuries, or even geological epochs, for those occasions when she wants to learn more about dinosaurs."

This is eerily reminiscent of David Gelernter's *Mirror Worlds*. In *Mirror Worlds* Gelernter "describes an event that will happen someday soon. You will look into a computer screen and see reality. Some part of your world — the town you live in, the company you work for, your school system, the city hospital — will hang there in sharp color image, abstract but recognizable, moving subtly in a thousand places" (Gelernter, 1992, 1). The mirror world of virtual reality and spatial images is a "true-to-life mirror image trapped inside a computer — where you can see and grasp it whole" (p.3). These images "engulf some chunk of reality" (p.6) and the mirror world "reflects the real one" (p.6). "Fundamentally these programs are intended to help you *comprehend* the powerful, super-techno-glossy, dangerously complicated and basically indifferent man-made environments that enmesh you, and that control you to the extent that you don't control them" (p.6).

How is this to happen? How will the "place" of mirror world permit one to enter, stroll around, and retrieve archival and live-medium information?

> The picture you see on your display represents a real physical layout. In a City Mirror World, you see a city map of some kind. Lots of information is superimposed on the map, using words, numbers, colors, dials — the resulting display is dense with data; you are tracking thousands of different values simultaneously. You can see traffic density on the streets, delays at the airport, the physical condition of the bridges, the status of markets, the condition of the city's finances, the current agenda at city hall and the board of education, crime conditions in the park, air quality, average bulk cauliflower prices and a huge list of others.
>
> This high-level view would represent - if you could achieve it at all — the ultimate and only goal of the *hardware* city model. In the software version, it's merely a starting point. You can dive deeper and explore. Pilot your mouse over to some interesting point and turn the *altitude* knob. Now you are inside a school, courthouse, hospital or City Hall. You see a picture like the one at the top level, but here it's all focussed on this *one* sub-world, so you can find out what's really going on down here. Meet and chat (electronically) with the local inhabitants, or other Mirror World browsers. You'd like to be informed whenever the zoning board turns its attention to Piffel Street? Whenever the school board finalizes a budget? Leave a software agent behind. (Gelernter, 1992, 16-17)

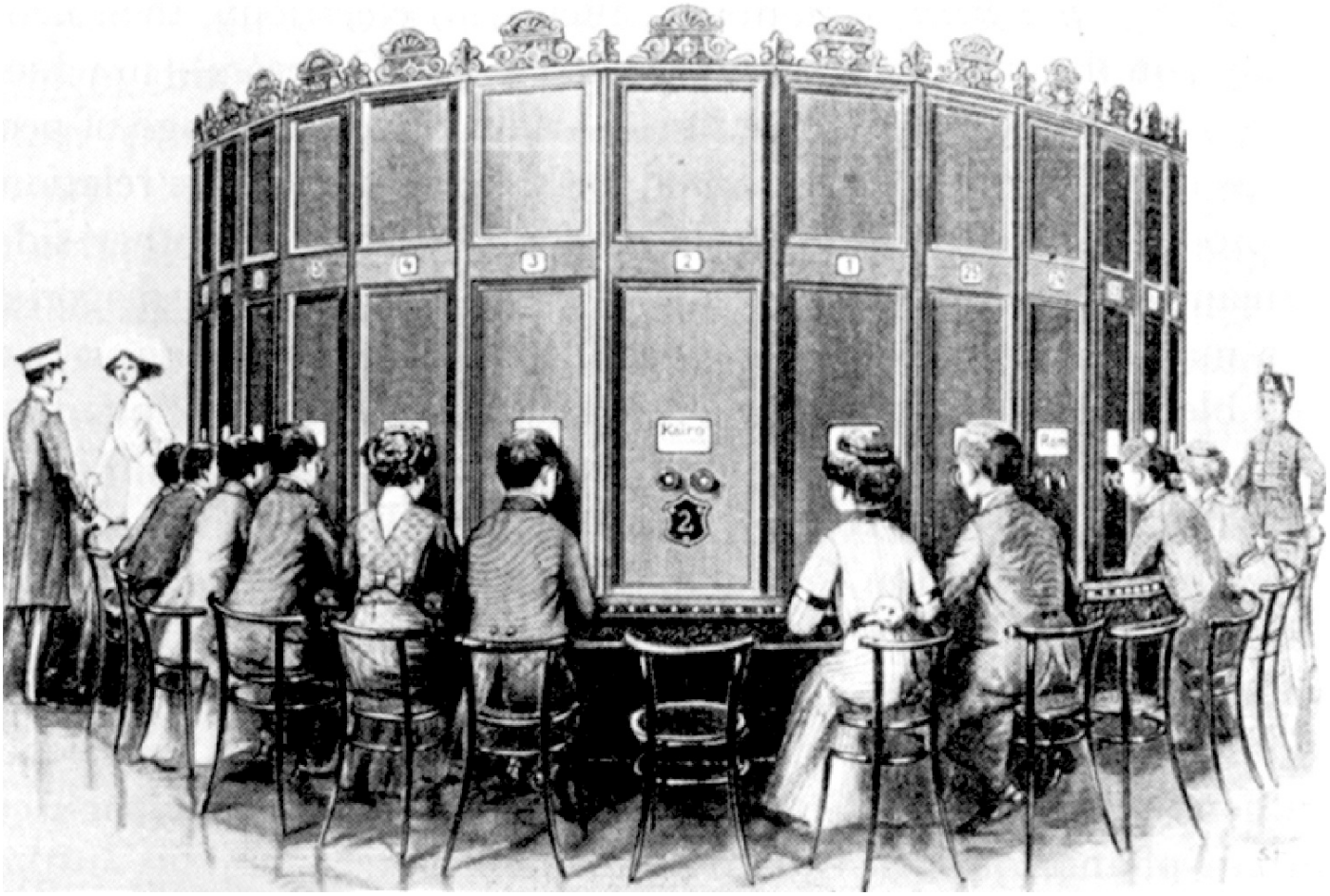
Gelernter's world (and perhaps the world of the Digital Earth) is one of all information about place available and mapped almost immediately, limited only by the speed of moving the mouse and dropping the agents. The new digital world is a mirror world – a world of hyper-textual information, geo-coded to a virtual globe, and devised to provide, as Professor Goodchild says, "all information about one place." But what does it mean to accept the grand narratives of the mirror world and the 'Digital Earth', and what kinds of epistemological alternatives are available to us?

Maps Precede Territory and Produce Identities

If the geography and political economy of the 'digital transition' pose questions for the project of building the Digital Earth and related mapping practices, the epistemological assumptions at work pose even more challenging questions. It is to these epistemological issues that I now turn.

I think it is now fairly well established in critical studies (if not in practice) that the 'Cartographic Anxiety' of modernist, universalist cartography has been pretty much laid to rest. In its place we have a much more nuanced and multiform understanding of cartographic practice and use, and one in which the production of geographical images is understood to be a thoroughly social project. In this view, maps do not simply represent territory, but they also produce it. As Baudrillard (1981, 2-3) asserts, in important ways 'maps precede territory' (see also King 1996). That is, maps construct objects that in turn become our realities. Far from being a mere representation of private property, cadastral mapping gave legal and material form to the new territories and landscapes of private property. Booth's maps of London did not merely mirror the socio-spatial patterns of working class neighborhoods, but produced them as spatialized social categories in which new ways of thinking and representing the population as poor and unhealthy came into being, categories that have been the foundation for much urban social research since. What worlds are being produced in the digital transition and what conceptions of History are at work?

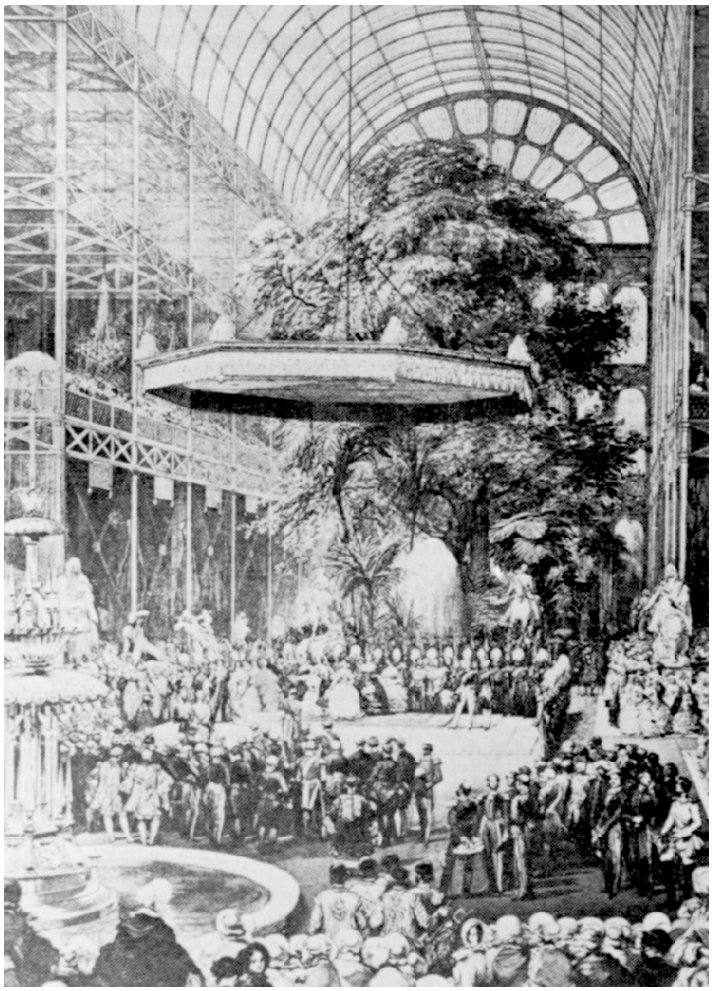
There is much that could be said here. For the sake of brevity I will illustrate the kinds of issues that 'the digital transition' seems to me to evoke through a brief reading of Allucquere Rosanne Stone's *Desire and Technology at the Close of the Mechanical Age* and Walter Benjamin's *Passagen-Werk*, specifically his notion of History and Progress, and his discussion of four representational technologies – part of a previous representational transition —taken from nineteenth century Paris.



Source: Susan Buck-Morss, *The Dialectics of Seeing: Walter Benjamin and the Arcades Project*, MIT Press, 1989.

Benjamin's *Passagen-Werk* project was carried out in Paris up to and during the early years of the Second World War. The explicit goal of the project was an investigation of the cultural and economic transformations at work in nineteenth century Paris at a time of major capitalist restructuring, a time very much akin to our own end of century period of restructuring and change. In this project Benjamin was concerned with debunking mythic theories of history and overcoming "the ideology of progress…in all its aspects" (Benjamin quoted in Buck-Morss, 1989, 79):

> It can be considered one of the methodological objectives of this work to demonstrate a historical materialism within which the idea of progress has been annihilated. Precisely on this point historical materialism has every reason to distinguish itself sharply from bourgeois mental habits. Its basic principle is not progress, but actualization.



Source: Susan Buck-Morss, *The Dialectics of Seeing: Walter Benjamin and the Arcades Project*, MIT Press, 1989.

In turning to Paris it is significant for our purposes to note that what was new at the time was not the urban brilliance and luxury of the city, but secular public access to them (Susan Buck-Morss, 1989, 81). Paris was, in this sense, a "looking-glass city" and a Mirror City that dazzled the crowds, reflecting images of new consumer goods and consumers, but "keeping the class relations of production virtually invisible on the looking glass's other side." This spectacle of Paris Benjamin called "'phantasmagoria' – a magic lantern show of optical illusions, rapidly changing size and blending into one another" (Buck-Morss, 1989, 81). In this system everything desirable came to be transformed into fetishized images of commodities-on-display, and when newness itself became a fetish "history itself became a manifestation of the commodity form."

Benjamin sought to unmask this fetishized Mirror World of end-of-century Paris by describing what he called the 'ur-forms of the phantasmagoria of progress.' Four such ur-forms are of direct interest to our present discussion: the panorama, the arcade, the world exhibition, and the plate-glass shop window. Each represents elements of the informational transition that was occurring in the late nineteenth century as Western capitalist economies internationalized and new global imperial geographies were built. The panorama was a new technology of visual representation organized and moved around different cities to present spectacles of one form or another to eager middle-class consumers (Figure). The panoramas providing sweeping views that rolled by the viewer at varying speeds, giving the impression of movement through the world at accelerated speed (Buck-Morss, 1989, 82). Panoramas were a common feature of the new commercial arcades springing up throughout the city ('the original temple of commodity capitalism'), and it was in the arcades that the flow of images and the flow of commodities came together (Figure). The arcades are the precursors of the department store and, in more contemporary form, the panorama and the arcade have conjoined as precursors for the Digital World of the internet and on-line shopping. But it is not just shopping that is commodified. Information itself has been rendered into a fetishized commodity.

The culmination of the panorama and arcade experience was the emergence of the great world exhibitions, the first being in London in 1851 – a Mirror World of a different kind; a Chrystal Palace (Figure). It was in these great international exhibitions and fairs that the 'pleasure industry' has its origin and it is they that:

> …refined and multiplied the varieties of reactive behaviour of the masses. It thereby prepares the masses for adapting to advertisements. The connection between the advertising industry and world exhibitions is thus well-founded.

The exhibitions and arcades incorporated another technology that became fundamental to a modernist sensibility: the large plate-glass window. This leant to sellers the ability to display goods for view, but prevented consumers from touching. Pleasure was now to be derived from the visual spectacle alone. The representation of far away places and possible ways of life came, in itself, to be a source of pleasure, as was the broadening experience and promise of movement, global reach, and speed. Exhibitions and arcades were, then, for Benjamin the source of a broader phantasmagorical politics: "a promise of social progress for the masses without revolution" (Buck-Morss, 1989, 86). "Each successive exhibition was called upon to give visible 'proof' of historical progress toward the realization of these utopian goals, by being more monumental, more spectacular than the last" (Buck-Morss, 1989, 87), and each show-cased the technologies that enabled the movement of goods around the globe. Speed, information, and access came to symbolize progress.

Source: Susan Buck-Morss, *The Dialectics of Seeing: Walter Benjamin and the Arcades Project*, MIT Press, 1989.

For myself as an American professor at the end of the twentieth century looking forward to the restructurings of the next millenium, the Digital Earth project holds exciting possibilities. But it also sounds disturbingly like the display technologies of panorama, arcade, world exhibition, and shop-window of end-of-century Imperial Paris. For Benjamin the mythic history of progress embedded in these exhibitions was so generalized that the possibilities for dislodging its hold on the masses was extremely limited. He resolved his dilemma by a search for 'counter-images' and through these small, discarded objects (the trash of history) he sought to illustrate a different conception of history from which all traces of progress and development were eradicated. Paul Klee's painting, 'Angelus Novus', provided a map for this vision of history, which stood in marked contrast to the futurist myth of historical progress which could only be sustained by forgetting its past (Buck-Morss, 1989, 95)

There is a picture by Klee called 'Angelus Novus.' An angel is presented in it who looks as if he were about to move away from something at which he is staring. His eyes are wide open, mouth agape, wings spread. The angel of history must look like that. His face is turned toward the past. Where a chain of events appear to us, he sees one single catastrophe which relentlessly piles up wreckage upon wreckage, and hurls them before his feet…. The storm [from Paradise] drives him irresistibly into the future to which his back is turned, while the pile of debris before him grows toward the sky. That which we call progress is this storm.

At the heart of mythic notions of history are a series of metaphors and images. These Benjamin called 'wish-images', and they remain at the core of modernist and liberal conceptions of history as progress.

> These images are wish images, and in them the collective attempts to transcend as well as to illumine the incompleteness of the social order of production. There also merges in these wish images a positive striving to set themselves off from the outdated – that means, however, the most recent past. These

> tendencies turn the image fantasy, that maintains its impulse from the new, back to the ur-past. In the dream in which every epoch sees in images the epoch that follows, the latter appears wedded to elements of ur-history, that is, a classless society…. Out of it comes the images of utopia that have left their traces behind them in a thousand configurations of life from buildings to fashions.
>
> *Benjamin (V, p.1224-5 m version of the 1935 expose) quoted in Buck-Morss (1989, 114, 118).*

In this new world of images, commodity fetishes and dream fetishes become indistinguishable. Food and other commodities drop magically onto the shelves of stores, and advertising and commerce come to be seen as the means of social progress (Figure). The democratization of culture is now seen to derive from the mass media, and they too become fetishes (Buck-Morss, 1989, 120).

The 'digital transition' is, of course, thoroughly embedded in these concepts of mythic History and the dissemination of wish images and fetishes. It remains an open and interesting question to what extent the universalizing mantra of digital information and mapping constitutes a new set of global exhibitions for the dissemination of information and goods; shop-windows for accessing information about all places or all information about one place. It remains for us to consider whether these are necessarily wish images and fetishes that reproduce a mythic promise of social progress.

Conclusion: Digital Transformations, Guerrilla Epistemologies, and Fragmentary Cartographies

Like Walter Benjamin, Allucquere Rosanne Stone (1995) also seems to have grown tired of trying to think of these issues in terms of utopian or dystopian perspectives, and — like Benjamin — she asks in *The War of Desire and Technology at the Close of the Mechanical Age*, what is happening in the deployment of emergent digital technologies? What kinds of 'counter-images' are available to us and what new forms of identity are being produced?

The War of Desire and Technology is about science fiction, in the sense that it is about the emergent technologies, shifting boundaries between the living and the nonliving, optional embodiments… in other words, about the everyday world as cyborg habitat. But it is only partly about cyberspace. It is also about social systems that arise in the phantasmatic spaces enabled and constituted through communication technologies…. I am interested in prosthetic communication for what it shows of the 'real' world that might otherwise go unnoticed. And I am interested because of the potential of cyberspace for emergent behavior, for new social forms that arise in a circumstance in which *body, meet, place*, and even *space* mean something quite different from our accustomed

Source: Susan Buck-Morss, *The Dialectics of Seeing: Walter Benjamin and the Arcades Project*, MIT Press, 1989.

understanding. I want to see how tenacious these new social forms are in the face of adversity, and what we can learn from them about social problems outside the worlds of the nets.

Maps precede and produce territories and social identities. But what kind of objects and identities are being produced in the digital transition? What forms of territorialization are at work in the Digital Earth project? I have already suggested that Vice President Gore's vision is both about a digital informational world *and* it is about retraining and recomposition of the U.S. labor-force and the restructuring of the U.S. economic and geopolitical position in the world. It is, in a Gramscian sense, a new Americanism – a thorough-going post-Fordism, with important implications for the ways in which notions of social progress are being written, global relations understood, and an American (and global) future is being mapped.

There are many opportunities in this new digital world of geographical information and representation, but we cannot be silent about the real class and national politics at work in constituting and disseminating a vision of a classless future of digital information. But perhaps we can say that another kind of transition is at work in the digital transition, one that Professor Goodchild both describes well, but does not directly acknowledge. The turn to "things geographic" and the desire for place-specific information is – in this view – a different 'transition' that provides a serious challenge to the epistemological and political underpinnings of modern cartography and GIS, and the fetishized nature of the Digital Earth project.

Bruno Latour has recently asked, 'Have we ever been modern?' By this he means to ask whether the project of modernity was, or could ever be, fulfilled. Through a discussion of the debate between Boyle and Hobbes in the mid-seventeenth century, Latour shows how a modern notion of representation comes into being at this time and with it a binary distinction between science and politics that frames the geometry of the modern world. The Boyle-Hobbes debate stands, in this discussion, for an originary moment from which spring two related but separate notions of representation, underpinned by a single modern anxiety about the necessity of moulding and controlling the masses. One notion of representation is that which involves the political representation of the views of citizen in an emerging democracy – representative democracy. In this notion of representation, a modern notion of 'Society' is born as that structure of social relations that *must be* represented and regulated politically. The Leviathan will require maps of its territory and information about its citizens and places. A second notion of representation is that which involves the representation of natural objects and in this move 'Nature' as we now know it is produced. The 'constitution' of modernity is the structure of science and politics that keeps Society and Nature distinct and subject to regimes of representation by experts: political leaders on the one hand and scientific scholars on the other.

Latour's point is that even our most basic categories of 'Society' and 'Nature' have been produced historically as what he calls a governing 'constitution' of the modern world. However, as the title of the book indicates *We Have Never Been Modern*, Latour believes that the constitution and binary geometry of modernity have never been, and can never be, the structure of practice of everyday life of actual citizens. Instead, the constitution that keeps Society and Nature, Politics and Science, Representer and Represented separate has given birth to at times uncontrollable and unrepresented/unrepresentable monsters and hybrids.

What kind of transition is at work then in this spatial turn? It is certainly one that – as Derek Gregory (1994) has argued – puts into question the Cartographic Anxiety of modernist thought and practice. In this sense, it challenges many of the assumptions of cartography and GIS about its origins in representational thought, or as Richard Rorty (1979) has suggested a modernist epistemology of science (and mapping) as the Mirror of Nature can no longer be sustained. In its place we need ways of thinking about geography and mapping that do not presuppose the master narratives of modern cartography, that do not seek to hide the politics in science (or the interests behind the map, as Brian Harley taught us). The task is one of constructing a post-representational cartography and GIS.

But in this task, Professor Goodchild has highlighted precisely the possibilities of bringing together cartographic imagination and skill together with the information handling abilities of digital GIS. I would argue that

this is as much a possibility to rethink the constitution of representational science and politics, as it is the possibility of creating a larger Leviathan – the Digital Earth. It is a possibility for an iconographic, not representational, cartography. It is the possibility for an epistemology that Stengler (1997, 118) has called 'guerrilla' epistemology:

> …the problem of the contemporary sciences is not, for me, one of scientific rationality but of a very particular form of mobilization: it is a matter of succeeding in aligning interests, in disciplining them without destroying them. The goal is not an army of soldiers all marching in step in the same direction; there has to be an initiative, a sense of opportunity that belongs rather to the guerrilla. But the guerrilla has to imagine himself [sic] as belonging to a disciplined army, and relate the sense and possibility of his local initiatives to the commands of staff headquarters.

It is the possibility for a renewal of direct democratic practices that destabilize, and have the tools to always challenge, any and all hegemonies – be they created by Representational Science in the name of Nature or by Representational Politics in the name of Society. "[I]t leaves us free to work at modifying these institutions without burdening ourselves with atemporal problems like those of Reason, Understanding, or the West" (Stengler, 1997, 118). It opens the possibility for a different epistemology and politics of 'digital transformations'.

Gillian Rose (1993) has suggested that the conception of the mirror and the Imperial Eye, so prevalent in the history of modern cartography, is also thoroughly masculinist in nature (Figure). In its place she suggests we need to think in terms a different epistemology of mapping, one in which the mirror has been broken into a thousand pieces, each shard still reflecting, but without coherence, without the possibility of the universal view, without the possibility of control. Is this a future that is possible or even desirable in the 'digital transition/transformation'? Is this a future way of thinking about mapping practice? Is this a new cartography?

George Landow (1992) has – in a different context – come to a similar conclusion. For Landow, digital information systems and specifically hypertext promise new ways of theorizing information and representation. The apparently infinite malleability and reproducibility of spatial information in digital systems allows, even forces, us to rethink the relations among objects and practices that have been set in concrete for hundreds of years under the regime of print capitalism (Anderson 1991). Textuality, narrative, margins, inter-textuality, and the roles and functions of readers and writers are all reconfigured in the digital text. The digital transformations of geo-mapping in Roland Barthes' terms point to the possibility of the production of writerly (rather than readerly) texts, which do not dominate the reader and insist on particular readings, but engage the reader as an 'author' and insist upon the openness and inter-textuality of the text — that is, its openness to other texts and readings. That is, digitality opens up again the question of the participation of the masses and provides new opportunities for interactivity lost to an earlier nineteenth century information revolution. It became a transition and it commodified media, information, and images, and in the process it built the large state and corporate empires – the monopolies – that eventuallyled to Walter Benjamin's death.

How are we to think the current opening offered by a digital revolution now still only about 20 years old? Certainly the opportunities offered by digital information and mapping systems are lost on few practitioners of geography and cartography today. New work habits, new research opportunities, new languages, new ways of governing ourselves, even new forms of the university are now all in process, if not in place. GIS has generalized and GIS and cartography are increasingly united on a common front (see Pickles 1999). But the question posed to us in 1974 by David Harvey remains, I think, especially pertinent today: what kind of digital transition (he said public policy), by whom, and for whom? What kind of GIS and cartography do we want to see in the new millenium, by whom will it be constructed, for what purposes, and whose interests will it serve: whose voices will it represent? At one level, this is precisely the question that enervates Initiative 19 (GIS and Society) of the NCGIA, and it is the democratic potential of the digital transition that is, in part, explicitly the goal of the Public Participation GIS Project (NCGIA/I-19/Varenius). In one of the meetings of these groups Stan Openshaw suggested that what we were seeking was a GIS-2 (a thoroughly decentered, user-accessible, and

delinkable public GIS infrastructure). Efforts at building a GIS-2 might emerge on principles different from those that fetishize media, information, and the public. Indeed in town after town, village after village, and NGO after NGO experiments are going on adapting new digital mapping devices to local needs. But they can, I think, do this only insofar as their efforts are not monopolized and fetishized. These grassroots cartographers and analysts certainly need access to information, and this seems to me to be precisely the pregnant possibility that Professor Goodchild's account of Digital Earth 'represents' for them.

At the end of his report on the condition of knowledge (*The Postmodern Condition*) Jean Francois Lyotard (1984, 67) left us with a warning that seems particularly pertinent today as we consider the forms of mobilization appropriate to building new geo-information and mapping systems for a truly democratic world:

> We are finally in a position to understand how the computerization of society affects this problematic. It could become the 'dream' instrument for controlling and regulating the market system, extended to include knowledge itself and governed exclusively by the performativity principle. In that case, it would inevitably involve the use of terror. But it could also aid groups discussing metaprescriptives by supplying them with the information they usually lack for making knowledgeable decisions. The line to follow for computerization to take the second of these two paths is, in principle, quite simple: give the public free access to the memory and data banks. Language games would then be games of perfect information at any given moment. But they would also be non-zero-sum games, and by virtue of that fact discussion would never risk fixating in a position of minimax equilibrium because it had exhausted its stakes. For the stakes would be knowledge (or information, if you will), and the reserve of knowledge — language's reserve of possible utterances — is inexhaustible. This sketches the outline of a politics that would respect both the desire for justice and the desire for the unknown.

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Joint Plenary Session 2 - Response 2
Séance plénière conjointe 2 - Réponse 2

Business, governments and technology: inter-linked causal factors of change in cartography

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Abstract

This paper responds to the keynote address[2] *to ICA by Professor Michael Goodchild. It argues that he has focussed to too great an extent on the technology under-pinning changes in map-making. It is claimed here that understanding of what has happened and might happen in the future can only be achieved through much greater consideration of the role and interests of business and of governments.*

Backcasting is easy: can intelligent people forecast accurately?

Like Professor Pickles[3], I too (sadly) found many things to agree with in Professor Goodchild's keynote speech. Evidence for my consistency of view can be seen in the key points I made to the 1993 ICA conference in Cologne (Rhind 1993) where I predicted that:

- cartography will be hugely affected by changes in technology
- customers will dominate
- globalisation of commerce will change 'the map business'
- consistent mapping and geographic information will increasingly be needed for the whole world and for major regions
- standards will become crucial.

As a result, I will concentrate here on the things on which we differ, acknowledging that we may well all be wrong[4]. In a recent major publication, Messrs. Longley, Goodchild, Maguire and Rhind (1999, p.11) confessed that in their previous, extremely successful, first edition of the 'bible of GIS' they had totally failed to anticipate the changes wrought by the advent of the World Wide Web only a year after its publication! This 'error' does not compare with many others in the literature about the impact of technology; I set out below two from the UK but there are many others from most other nations (see, for instance, http://www.startribune.com/stonline/html/digage/forcast.htm and http://www.foresight.org/News/negativeComments.html#loc048).

> 'The Americans may have need of the telephone, but we do not. We have plenty of excellent messenger boys.'
>
> *Sir William Preece, Chief Engineer of the British Post Office, in 1876*

> 'If the current growth in use of telephones continues, by 1950 we shall need all of the women of working age as telephone operators'
>
> *Sir William Preece, (still) Chief Engineer of the British Post Office, 1886*

The message is clear – the future will not be a linear extrapolation of the past. We should also recognise that not everything changes. Shapiro and Varian (1999) for instance point out that the principles of the economics of trading on the Internet are little different from those in more traditional commerce. Some things also go back to what they were – the *Economist* leader cited below pointed out that we are now back to the low levels of privacy typical for the vast bulk of the populace in agrarian societies. Despite all this, much *has* changed and will go on changing.

Some things wrong with the Goodchild thesis

In specifying eight characteristics of a map (a visual representation, flat, exhaustive, uniform in detail, static, generic, precise and slow to produce) Mike Goodchild implies that this is how mapping has to be. It does (and is) not. There are examples where mapping of information collected in the field can be speedy (such as routine delivery to customers within 24 hours of data collection) *and* tailored to particular needs. I agree of course that this has only become routinely possible with the advent of 'new technologies' ('new' in practice only; many of the concepts were defined in the nineteenth century).

A speedy reading of the Goodchild paper might also lead the unwary to believe that we already all live in a digital world. This is manifestly not so nor is it totally certain that this will occur everywhere as a single construct. Consider for example the following quote:

> 'If the world were reduced to a village of 1,000 people:
>
> There would be 584 Asians, 124 Africans, 136 from the Western Hemisphere (both North and South America), 95 Eastern / Western Europeans, and 55 Russians. 520 would be female, and 480 would be male. 650 would lack a telephone at home. 500 would never have used a telephone. 335 would be illiterate. 333 would lack access to safe, clean drinking water. 330 would be children. 70 would own automobiles. Ten would have a college degree. Only one would own a computer.'
>
> *Source: http://www.ntia.doc.gov/ntiahome/speeches/ntca120198.htm*

Perhaps echoing John Pickles, I also believe that the wider aspects of these technological changes have not been emphasised enough in the Goodchild treatment. These have crucial indirect impacts. Consider, for example, the following quotation:

> 'Remember, they are always watching you. Use cash when you can. Do not give your phone number, social security number or address, unless you absolutely have to. Do not fill in questionnaires or respond to telemarketeers. Demand that credit and data marketing firms produce all information they have on you, correct errors and remove you from marketing lists. Check your medical records often. If you suspect a government agency has a file upon you, demand to see it. Block caller ID on your phone, and keep your number unlisted. Never use electronic toll-booths on roads. Never leave your mobile phone on - your movements can be traced. Do not use store credit or discount cards. If you must use the Internet, encrypt your email, reject all 'cookies' and never give your real name when registering at web sites. Better still, use someone else's computer. At work, assume that all calls, voice mail, email and computer use are all monitored.'
>
> '..Anyone who took these precautions would merely be seeking a level of privacy available to all 20 years ago….Yet…all these efforts to hold back the rising tide of electronic invasion will fail…Faced with the prospect of its [privacy] loss, many might prefer to eschew even the huge benefits that the new information economy promises. *But they will not, in practice, be offered that choice*.' [my emphasis]
>
> *Source: Economist 1 May 1999*

This neatly introduces my main point: both Goodchild and Pickles almost totally ignore two of the key factors in how our world is being re-shaped – business and government (as table 1 shows). I now address these points, with particular reference to cartography.

Table 1 Incidence of key words in the Goodchild and Pickles papers (excluding references)

	Goodchild	Pickles
Cartography	12	24
Money	0	0
Business	0	1
Government/governments	3	1

It's all about money, stupid![5]

Almost all of the changes to our world are being made through the actions of business and government. It is of course true that much of this is underpinned by new science and technology which are driving significant fractions of the Anglo-Saxon economies. Some of this originates in universities; some in government research laboratories. But increasingly much comes from private sector bodies, notably the pharmaceutical and defence companies – and spin-offs from them like Space Imaging.

The growth in the big players of capitalism in the last decade, especially the funders of new developments, has been staggering; BankAmerica for instance has increased its market capitalisation by a factor of 22. Such growth enables ever-greater global reach and, in turn (assuming no serious errors in investment policy) still greater accumulation of resources for investment in new business activities. Thus major new developments like high resolution satellites are being introduced on the basis of business cases predicated on selling imagery and related services across the whole world, leading to substantial predicted profits for the investors - especially for those early into what is seen by its proponents as a potentially huge market.

We are then seeing the globalisation of certain businesses, including some aspects of cartography, with a growth in multi-nationals trading in almost all markets. The most obvious of these are the oil companies, software firms (notably Microsoft, but many others exist), banks and retail businesses. Despite many small local enterprises, a very large and growing fraction of the GIS and mapping market is supplied by Autodesk, ESRI, Intergraph, MapInfo and Microsoft. Indeed, more maps per day are probably made by a 100,000 or so sub-set of the 2 million or more users of AutoCad than by all trained cartographers; the former group have perverted the use of tools designed and bought for other purposes to map-making (V.V. Lawrence, Pers. Comm. March 1999). It also seems likely that the greatest (but unknown) number of maps of any kind plotted daily are those in encyclopaedia such as Encarta. Do-It-Yourself cartography is now commonplace.

One key to the world as we now know it has certainly been the 'massification' of cheap computer resources. But the reason why these developments have occurred and been important is not because they are desirable ends in themselves – their importance is predicated upon other, more generic business drivers. The key drivers have been quite simple: the advantages which come from the exchange of business-critical information, the ability to make elegant presentations in order to persuade bosses and peers, and the need to examine at least the financial consequences of different actions through 'what if' scenarios implemented on spread sheets. From these tools and, just as important, from the organisational procedures, knowledge and societal norms emerging from their use have been spawned quite different ways of operating in many disciplines.

As Mike Goodchild rightly says, there has been a move towards regarding GIS (and cartography as a sub-set of it) simply as another branch of the IT industry. The driver for this is that the greatest business benefits can not

arise without destruction of the idiosyncratic and separate nature of the GIS (and to a less visible extent, the cartography industry). To integrate the geographical information dimension permits business-beneficial links between technical and customer files; it externalises the need for software expenditure and it minimises the risks of having a clutch of technical experts who can influence organisational business policy.

There have also been significant commercial developments at the micro-scale which have impacted upon cartography. We have seen many small 'start-ups' in cartography focussed often on market niches and exploiting standard software and hardware through innovative use of traditional skills. More generally, the advent of niche player 'start ups', often highly flexible in market positioning and carrying low overheads, has been a feature of many European, North American and Australasian economies. The shift to out-sourcing many activities, with much work being contracted out to smaller firms or the self-employed, has played a significant role in fostering these new small businesses. In cartography as elsewhere this reduces overheads, minimises the need for tying up of capital and minimises social costs in the event of an economic slowdown. In short, it can reduce business risk.

One particularly important aspect of all this is the nature of Intellectual Property Rights since these influence how much money can be made under conditions of fair competition within the 'knowledge industries'. Such IPR is important to business and governments alike. The US federal government's global commitment to eradicating unlicensed use of software and 'pop' music – markets currently much larger than cartography ones – demonstrates that national commercial interests are high on politicians' agendas. There is nothing new in this: it is, for example, alleged that the apparently altruistic 'open skies at all resolutions' stance of the US government in the crucial 1966 UN debates actually reflected both political and nascent commercial advantage to Americans as one of the two countries with sophisticated surveillance technology.

Academic inputs have only had a modest influence on the digitally-based developments in cartography, these – as argued above - being mostly business-driven. What changed our world was not Waugh's creation of GIMMS (Rhind 1998) in the 1970s or the work at the Harvard Computer Graphics Lab. (Chrisman 1998). The advent and successful selling of ARC/INFO – the most astonishing marketing success of the 1980s in our field - was far more important. Arguments about whether these earlier academic developments influenced the latter are little more than pedantry; what made the difference was the expansion of the market and the 'routinisation' of the tasks. Goodchild has cited the recent burgeoning of new map or image websites as evidence of the importance of our field – yet the bulk of the ones he cites are from the private sector.

I conclude, with some reluctance given my own career history, that we in academia and in cartography have almost all been 'bit players' in an unfolding historical drama. Much of this has been business-driven but one other set of entities has played a key role. I can introduce this by an example: my signing of the British government's National Interest in Mapping Service Agreement one day in 1998 was far more important to the mapping world than the cumulative impact of 200 plus published papers and articles in the rest of my career!

I'm from the government and I'm here to help you

Governments remain the major employers of cartographers world-wide, at least in so far as can be determined from available sources of information. In the European Union, for instance, it seems likely that no less than 45,000 staff are employed in official national and state mapping agencies. This figure swells by a factor of about three if cadastral enterprises are included.

This commitment to and interest in mapping is not surprising: cartography – or at least Geographic Information - underpins many government activities. Thus, as Ratia (1999) reports,

> 'When the European Commission invited representatives from the ministries in charge of mapping in member countries to a meeting in Luxembourg, at least the following ministries were represented:

Ministry of Environment, Ministry of Agriculture and Forestry, Ministry of Housing and Physical Planning, Ministry of Finance, Ministry of the Interior, Ministry of Defence, Ministry of Justice. This shows how mapping and geographic information issues cover all the sectors of administration and it is in many cases a matter of taste which is the most natural ministry for these issues'

But even – perhaps especially – within government, dramatic changes have occurred in recent years. Some of this is usually attributed to the effects of technology e.g. the diminution in Ordnance Survey staff from 3,500 in 1979 to almost half that 20 years later. The real reason for such changes is however much more complex, especially when the much higher levels of certain kinds of skills now needed are factored into account (in Ordnance Survey, the work force now has ten times as many graduates as 20 years ago). The inter-acting factors include:

- *Changes in societal attitudes towards governments*, with decreasing trust in the ability of central governments to act effectively. This has evolved alongside a widening recognition that individuals can only prosper by taking more responsibility for the future of themselves and their families, rather than leaving it to the state;
- A growing unwillingness on the part of the citizenry to pay for increasing government expenditures (Foster and Plowden 1996); and
- *Changes in government's own views of themselves*, typically evolving from a 'doing' role to one of facilitating, enabling and regulating – 'steering not rowing' to paraphrase Osborne and Gaebler (1991). Thus effectiveness and efficiency have joined probity, propriety and equity of treatment in the lexicon of governments such as those of Australia, Canada, New Zealand, Sweden and the UK.

The consequences of all this have been dramatic: Ordnance Survey, for example, now does more with far fewer human resources, thanks to the combination of digital databases, business-like management, contracting out and market imperatives. Technology may have been a necessary factor but it has been far from the only driver of the change in map-making.

Globalisation of cartography

Mike Goodchild quotes with evident approval Al Gore's vision of a digital earth (unsurprising since he had some hand in forging that vision). In one sense, achieving this vision is already well-advanced. We can safely anticipate the advent of detailed imagery of many (but not all) parts of the world delivered to us in near-real time. We can move maps and other information now around the world at the press of a button. But we are still in a dire situation in regard to the quality, availability and accessibility of mapping in many parts of the world. On the best available estimates, only about half of the world is mapped at 1:50,000 scale, much mapping of sensitive areas is unavailable, and what is available is often 20 or more years out-of-date. And, even where mapping is available and up-to-date, the nationally-based nature of the mapping so far as datums, content and depiction are concerned render cross-border analyses, monitoring or business application a difficult and costly matter.

There are two different approaches to remedying this situation. The first is for nations or business enterprises to collaborate in creating consistent, coherent, comprehensive and current mapping. This has already occurred in the commercial domain, with the creation of consortia to create and market road information for car guidance systems. Much discussion has also occurred within and between governments, in fora such as the European Union and the UN. Binding treaties such as Agenda 21 contain commitments to improving the quality and availability of environmental information – which necessarily includes mapping. Yet so far as most governments are concerned there is little real incentive to expend considerable financial sums on recreating mapping (which already broadly suits national needs) onto a basis which facilitates regional or even global activities.

The two obvious exceptions to this statement both involve the United States. Almost alone, the government of that country has the need for and the capability to acquire high quality global mapping. The National Imagery and Mapping Agency (or NIMA), the geographic intelligence information arm of the US military (http://www.nima.mil/) has made clear its determination to secure the best available information in support of any activities of US and NATO forces. Lencowski (1997) has summarised some of the military's strategies to achieve 'the information edge'. It is important to note that some low resolution digital geographic information is already made available to the public by the military; but the idea that 'best available' information is made generally available is counter to any sane military strategy. NASA however has made clear its commitment to collecting detailed global topographic information and disseminating it widely in the interests of science. There may well be some policy conflict in these two different approaches.

Conclusions

You can not sensibly consider what has happened and what might happen in cartography without considering the interests and express needs of business and government. It is not clear just how these interests will be manifested over the next few years – feasible alternative scenarios exist and the reality may well differ in different countries. But money and politics are embedded in decision-making within both of these sectors and these decisions impact upon the lives of all people, including cartographers. Technology is not a 'given' which changes the world in a predictable fashion: human beings change the world when they have the necessary incentives, skills and technologies. That is as true in cartography as it is anywhere else.

Acknowledgements

I have long enjoyed working and arguing with Mike Goodchild; his paper stimulated these thoughts. John Pickles' paper I also found thought-provoking and enjoyable (though, for reasons given above, I am confident both he and Mike have been blinded to the most important factors relevant to our debate!).

End Notes

[1] Vice-Chancellor and Principal, City University, London (formerly Director General of Ordnance Survey 1992-98 and Vice-President of ICA 1984-91)

[2] 'Cartographic futures on a digital earth' Michael F Goodchild, presented to Ottawa ICA Conference.

[3] 'Cartography, digital transitions, and questions of history' Rejoinder to M.Goodchild by J.Pickles

[4] Appropriately, I too will use the first person in this provocation.

[5] The title of a brutal but effective cameo article on drivers of the GI industry by Lobley (1999)

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