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Arguments, debates, and dialogues: the GIS–social theory debate and the concern for alternatives

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The chapter provides an historical overview of the emergence of the debate in geography about the disciplinary and social implications of GIS: its theory of science, technological capacities, and social uses. It describes the epistemological, methodological and at times political positions that have guided both practitioners and theorists of GIS on the one hand, and those who have expressed concern about these positions and the social implications on the other. The chapter charts these debates from opposition arguments through lively debates to recent critical engagements and joint projects between scholars of GIS and social theory. The chapter ends with discussion of Research Initiative 19 of the US National Center for Geographic Information and Analysis (NCGIA) on 'GIS and Society' and some of its contributions.

1 GIS AND SOCIETY

In recent years GIS practitioners have begun to argue for the importance of building a more flexible, open, and theoretical science of geographic information systems and geographic information – a geographic information science (Goodchild 1992, 1993, 1995; Openshaw 1991, 1992, 1996; Wright et al 1997). This theoretical turn has emerged as GIS itself has changed from an enterprise involving the development and testing of software and hardware, to the application of GIS and the study of data structures and visualisation techniques, to a field that has become so generalised in everyday life and in academic research that the specific role of any single discipline – especially one with a special relationship to GIS (geography) has to be rethought (Pickles 1997; Wright et al 1997). This chapter maps out the parallel evolution of responses to these phases of GIS development in geography, and geographers' attempts to come to grips with the changing possibilities and problems that GIS has brought to the discipline and the wider society (see also Forer and Unwin, Chapter 54; Martin, Chapter 6).

Specifically, the chapter seeks to locate the GIS social theory debate in geography (and their respective claims to method, science, and

knowledge) in terms of a decade of changing technological and institutional ensembles, discourses, and practices which have brought about different responses and forms of engagement. We seek to capture something of the dynamism in the debate that occurred in the transition from the mid 1980s to the mid 1990s. This debate ranged from GIS as a research tool and scholarly practice (and the epistemological grounds on which these battles were fought), to debate about its fundamental assumptions and transformative capacities, to dialogue about alternative pathways for a technology that is increasingly realising both its utopian and dystopian possibilities.

The chapter outlines briefly the nature of the opposition arguments that emerged as a result of the disciplinary impacts wrought by GIS in the 1980s. It then shows how these opposition arguments – while they still continued in some quarters – gradually began to take the form of a constructive debate about the real material and intellectual effects of GIS. We go on to show how this debate is currently leading to experiments in dialogue among individuals and groups with quite distinct goals and perhaps different conceptions of GIS as technology, practice, and body of ideas. A different understanding of the

possibilities and constraints of GIS as a tool, and of the study of GIS as a social practice, emerges from these engagements (Gilbert 1995).

The primary goals of this kind of work should be spelled out briefly, given the suspicion about the critique that has emerged within the field:

- to contribute to a theory of GIS which is neither technical nor instrumental, but locates GIS as an object, set of institutions, discourses, and practices that have disciplinary and societal effects;
- to show how these disciplinary and societal effects operate;
- to push against the limits of GIS and its unacknowledged conditions and unintended consequences of development and practice (e.g. corporate influence, epistemological assumptions, and understanding of appropriate applications);
- to ask whether GIS could have been different, or in what ways it may be made different in the future.

2 GIS AND GEOGRAPHY: NEW SCIENCE OR OLD WINE?

GIS is not only big business, it is becoming bigger and bigger business with every passing year. In the 1980s and 1990s GIS and related spatial data handling and imaging systems became central elements in the restructuring of economic activity, the modernisation of the state, and the administration of social life by public and private organisations (Cowen 1995). In the 1960s most geographers would probably have welcomed such changes and lauded as progressive the rationalisation of planning. In the 1990s these matters have given rise to deep divisions within the discipline about the role and function of social engineering and the information revolution that makes it possible in new forms. Although a substantial part of the discipline cannot understand why the geographic profession displays such distrust of the developments in GIS and why it remains sceptical about motives, potential value, and political consequences of adoption, another part of the discipline cannot understand why these questions have not yet been asked within the GIS community, how practitioners cannot see the problems raised by corporate control, proprietary systems, limitations on available data, and the uses to which GIS has been put in recent years. For some the revolution in spatial data processing and digital

imaging systems offers new opportunities for constructing 'informed' societies and pursuing rational and efficient social planning; for others the new systems of knowledge engineering and social engineering raise serious questions about freedom, civil society, and democratic practice (for further discussion see Curry 1994, 1995, 1996, 1997; Goss 1995a, 1995b; Harris et al 1995; Lake 1993; Miller 1995; Pickles 1991, 1992, 1993, 1995, 1997; Sheppard 1995; Sui 1994). Thus, as GIS has become a more significant element in restructuring public and private life, it becomes crucial to ask what impacts these technologies and applications have on the ways in which people interact with one another.

Until recently, discussions of the social impacts of GIS have been limited mainly to an internal analysis of technique and methodology: improving accuracy, extending capabilities, and widening the scope of applications that are possible. Little attention has been given to the broader discussions in geography about the interests that influence scientific research, the socially constituted nature of objects, categories, and concepts, the gendering of science, or the differing commitments of empiricist, hermeneutic, and critical epistemologies (Johnston, Chapter 2; Gregory 1978, 1994). Instead, much of the discussion has taken the form of a theoretical advocacy and an almost evangelical celebration of the possibilities offered by GIS to save geography – from its marginal economic position in universities, from its weak professional status in areas of public policy, from its underdeveloped technical capacities in applied fields, and from its humpty-dumpty like fragmentation in the discipline (Abler 1993; Openshaw 1991, 1992). In each of these domains GIS, it is claimed, offers rigorous science, useful technique, and universal possibilities for application. An objectivist epistemology and a pragmatic politics combine to reject any broader theorising of the consequences of this form of knowledge production and management.

Other geographers sometimes disagreed. Jordan's 1988 Presidential column in the newsletter of the Association of American Geographers (Jordan 1988) signalled the first reaction on the part of the old guard in the discipline to what was perceived as the pretension of GIS and its claim to intellectual standing: GIS was, in his view, merely a technical field without intellectual vigour or promise. Moreover, the need for large investments in capital equipment, personnel, training, and recurring costs for maintenance and upgrade was not matched

initially by quality output and clear results. Indeed, the points of contact with GIS for most geographers in the 1980s were requests for budget and faculty lines on the one hand, and faint, Cubist- and Futurist-like map images on the other hand. As a result, many Realists in the discipline greeted the emergence of GIS with quiet resistance and the knowing scepticism of the bourgeois critic, comfortable in the assurance that the fad would pass.

One unfortunate and unnecessary side-effect of such opposition positions has been the tendency of one side or the other to reject as 'unreasonable' the arguments of the other. The result has been a closing down of constructive and open debate on both sides, and the emergence of 'cultures of indifference' on both sides. Since the personal, institutional, and social stakes are high this is not unexpected, but what was lost in this opposition was any serious debate with some important issues on each side. Where a fuller engagement with the ideas and claims of each has occurred, the result has been an 'energising' of both communities and an opening of new avenues of research.

3 EPISTEMOLOGICAL CRITIQUE: DEBATING THE ASSUMPTIONS

The first serious engagements between GIS and social theory occurred over issues related to the politics of knowledge and the social impacts of use (Lake 1993; Miller 1995; Pickles 1991, 1995; Sheppard 1995; Sui 1994). In his trenchant critique of GIS as the new imperialist geography, Taylor (1990) suggested that GIS emerged as a two-part strategy on the part of unreconstructed 'quantifiers' who had 'bypassed' the critiques levied against the empiricism of spatial analysis, and at the same time captured the rhetorical ground of a progressive modernism by readily accepting the switch from knowledge to information:

'Knowledge is about ideas, about putting ideas together into integrated systems of thought we call disciplines. Information is about facts, about separating out a particular feature of a situation and recording it as an autonomous observation . . . The positivist's revenge has been to retreat to information and leave their knowledge problems – and their opponents – stranded on a foreign shore. But the result has been a return of the very worst sort of positivism, a most naive empiricism.' (Taylor 1990: 211–212)

In this (re)turn the geographical is defined as the study of anything that is spatial:

'GIS is a technological package that can treat any systematic collection of facts that are individually identified spatially. These facts may be medical statistics, remote-sensing images, crime files, land-use data, population registers or whatever. In terms of the package, spatial patterns can be produced irrespective of what the information is about . . . Such quantifiers can produce a maverick geography dealing with crime one week, bronchitis the next, and so on.' (Taylor 1990: 212)

The colonising aspirations of such claims are, for Taylor, transparent. But many practitioners of GIS saw these claims as exaggerated at best and false at worst, or, as Openshaw (1991) argued they represent reductionist assertions and derogatory and confrontational language; 'knockabout stuff' that emerges from a reactionary desire to protect a particular system of order and power. Thus, for Openshaw the crisis to which Taylor points is redefined as 'contrived' and should be replaced by a notion of 'creative tensions' between at times complementary, at times competing, but equally productive intellectual projects. In place of any narrow delimitation of the possibilities of GIS, Openshaw (1991) offered an expansive vision of emerging GIS practice:

'A geographer of the impending new order may well be able to analyse river networks on Mars on Monday, study cancer in Bristol on Tuesday, map the underclass of London on Wednesday, analyse groundwater flow in the Amazon basin on Friday. What of it? Indeed, this is only the beginning.' (Openshaw 1991: 624)

This new order geography needs GIS in order to 'put the pieces of geography back together again to form a coherent scientific discipline':

'It would appear then that GIS can provide an information system domain within which virtually all of geography can be performed. GIS would emphasise an holistic view of geography that is broad enough to encompass nearly all geographers and all of geography. At the same time it would offer a means of creating a new scientific look to geography, and confer upon the subject a degree of currency and relevancy that has, arguably, been missing.' (Openshaw 1991: 626)

In this view, GIS has an overreaching technology and approach broad enough to allow any geographer to pursue his or her research questions: GIS offers the epistemological and methodological flexibility to the creative researcher to be adapted to any practical circumstance.

The divide is not, in this sense, between GIS and social theory, but between a social theory and notion of science rooted in empiricism (in which theory is that which accounts for the outcome of model testing) and social theory in which theory is the precondition for any understanding and analysis in the first place.

For these reasons, several commentators have argued strongly against the particular view of the discipline, of science, and of research practice and application that ties the development of GIS to the 'resurrection' of a rational model of planning and a positivist epistemology (Lake 1993; Sui 1994):

'. . . the unrelenting embrace of the rational model by planning and applied geography is not adequately described merely in terms of the tenacity and inertia of convenient and familiar practices. The rational model has been actively resurrected and rehabilitated by the ascendance of GIS to a position near to or at the core of both planning and geography.' (Lake 1993: 404)

In the 1980s, human geography developed strong critiques of the reductionist ontology of spatialism and turned to questions of contextual knowledge, contingency and necessity, society, space, and Nature, the (social/political/gendered) construction of space, and the production of scale, each of which in various ways problematised aspects of Cartesian science and the ontology of spatial analysis. These approaches questioned the overemphasis on pattern, challenged geographers to rethink the meaning of space, problematised the dominance of natural science method in the study of social phenomena, and raised questions about the underlying ontology of objects, location, and application on which spatial analysis was predicated. Yet, in his 1993 review of the field, Lake found few publications on the part of GIS proponents which consider these epistemological, political and ethical critiques of positivism, or any serious engagement with what he terms the 'fundamental disjuncture growing at the core of the disciplines'.

By the decade of the 1990s, social theorists within the discipline began to take aim at what they saw as the transformative capacities of GIS, both in disciplinary and broader social terms. The author's own 1991 essay on 'The Surveillant Society', Gregory's (1994) claim that GIS positivists represented the 'new Victorians', and Smith's (1992) charge that the war against Iraq – the Gulf War – represented the first GIS war, incensed many practitioners and theorists of GIS. How could these neophytes and outsiders levy such charges, particularly against the only part of the discipline that really exercised rigour in its work and power in regard to other disciplines and funding agencies?

Such concern turned to outrage as more GIS practitioners interpreted claims about GIS and its origins in surveillance and battlefield logistical needs in the military (Pickles 1991) as a direct attack on their own credibility and commitments, and 'GIS über Alles' (the title of the first section in *Real wars, theory wars*: Smith 1992) and the purposeful ambiguity in the first two sentences: 'The war against Iraq in 1990–91 was the first full-scale GIS war. It put geography on the public agenda in a palpable if unpalatable way as it claimed an estimated 200 000 Iraqi lives' as suggesting that GIS, fascism, and imperialistic warmongering were somehow synonymous.

There was a double irony here. First, in the *declarations of war* against social theory and the expressions of the need to *mobilise in defence* of GIS against this onslaught that ensued in various gatherings of geographers. Second, that these responses occurred at the very time when, for example, Dangermond was bringing Ralph Nader to speak to the ESRI Users' Conference to argue for a 'vigorous GIS' – that is, one that recognised its current embeddedness within the institutions of government, military, and corporate interests, and instead sought to foster democratic access and public participation. This at a time when Openshaw (1991, 1992) was calling for a more open, *flexible* GIS, and when Goodchild (1992) was arguing for the need for a geographical information science that would address the impacts, as well as the possibilities, of the use of GIS. In one sense, social theorists and theorists of GIS had reached similar conclusions but by different paths.

In essence, the speed at which the technology was changing, the breadth of adoption and use, and the depth of the impacts of contemporary GIS had changed the terrain on which the discussion would occur. The opposition logics of the 1980s were no

longer practically helpful. User-friendly software had increased the number of GIS users. GIS had grown institutionally strong and – with its own conferences, journals, and funding sources – no longer took the arguments of disciplinary theorists seriously. At the same time, few critics followed sufficiently closely the emerging capacities and the new applications to understand the changes they wrought. In particular, few understood that while the instrumental logics and positivist justifications they attacked were being ever more deeply ingrained, they were also being fundamentally challenged by new practices and notions of space, object, and science that did not fit within such positivist frameworks: GIS itself was beginning to experience contradictions in its own claims and practices.

Despite last ditch efforts on the part of the traditionalists (Jordan 1988), GIS could not be wished away, nor could the hard resource decisions be avoided by departments and individuals in their research and teaching. When the Chancellor of the University and Manager of the Office of Facilities Planning both pull up GIS for the day-to-day management of their campus, when city planners are digitising every street in the city, when city engineers are GPSing every waterline and powerline they manage, when new forms of red-lining using GIS maps have become second nature to insurance companies, and when the US Department of Defense solves complex peace negotiations over delimiting territorial borders in Bosnia with digital terrain models and repeated flyovers for negotiators, there can be no question that geographers must take GIS seriously as a set of tools, institutions, ideas, and practices that are shaping our lives and landscapes, and that are transforming the possibilities for certain types of research in the discipline. How to ask these questions was the crucial issue.

4 GIS AND SOCIETY: DIALOGUE AND ENGAGEMENT

In response to the sterile binaries of uncritical support and outright denial, Brian Harley and the author decided (following two sessions of 'GIS and Society' held at the Annual Conference of the Association of American Geographers in 1991) to edit a book of essays that attempted to theorise the impacts of GIS in the discipline and in the wider society as a means of stimulating students to begin to think about alternatives to the rather sterile pro and con positions that dominated discussions at the time. To our

surprise, the 'idea of the book' *Ground truth* (Pickles 1995) achieved some of these goals prior to publication. This 'idea of the book' began to circulate on list servers like GIS-L, and concerns were expressed that such a book could undermine the growing position of GIS in the field: the book was somehow to be thought of as a dangerous attack on GIS.

One outgrowth of these discussions was an NCGIA-sponsored workshop 'GIS and Society'. The workshop addressed the kinds of questions that needed to be asked to understand the growing influence and social implications of GIS development and use, to consider how and in what ways such questioning might be sustained, and to investigate the possibilities for future critical engagements among GIS and social theory (Poiker 1993).

Perhaps the single issue that causes confusion in geography over the possibilities and limits of GIS use is what generally is represented as the debate about positivism, a term that has served geographers as a recurring moment for mobilisation or vilification. The concept itself stands as a signifier for something broader and it is here that the problem needs to be located. The apparent incommensurability between GIS and social theory critiques has its origin, perhaps, in how one understands the appropriate scope for inquiry (see also Johnston, Chapter 2). Most discussion of GIS operates within a very circumscribed understanding of the appropriate domain of inquiry, and this bounding of the field has variously been criticised as technicist, instrumentalist, and positivist. Social theorists have gradually broadened their own understanding of the appropriate scope within which inquiry must be situated, and currently any single social theoretic critique might operate at any one scale ranging from theories of geography, and science, to theories of society and technology (including the role of commerce, planning, and strategic thinking), to theories of modernity (including political theories of liberalism and critiques of masculinism, imperialism, and observer epistemologies) to Enlightenment thought itself. For each of these domains distinct literatures and languages have been carefully developed to enable critical thought. *Ground truth* aimed to locate discussions of GIS in a variety of these possible interpretative frameworks, and thereby to provide illustrations that might lead others to deepen the analysis of the intellectual and practical commitments and impacts of GIS.

This was also the goal for the 1995 special issue of *Cartography and Geographic Information Systems* – 'GIS and Society' – edited by Sheppard (1995). In his introduction Sheppard argued that the opposition nature of the debates occasioned by the emergence of GIS was full of heroic images and cruel caricatures, and that supporters and critics of GIS could learn from each other. Sheppard demonstrated how the origins of GIS affect the ways of thinking that can be employed. First, the dependence of GIS on digital computing (as opposed to analog computers, for example) constrains GIS by the structure and logic of the Turing machine, which employs deductive, Aristotelian logic. Second, the link between GIS and computers means that GIS is embedded in a broader set of social relations within which the computer is deployed:

'A major theme of the post-war era, in both the first and second worlds, has been extending the ability of both public and private institutions to control and organise the production and delivery of goods and services effectively. The principles of operations research as a methodology for optimally achieving well-defined goals, so effectively demonstrated in the armed services during the second world war, have been promoted as facilitating the rationality of both private enterprise operating in a free market and of public planning in a welfare or socialist state.' (Sheppard 1995: 8)

The result is that 'large institutional actors favour, and finance, those developments meeting their needs' (Sheppard 1995), and thus influence the development of computing and the directions taken by applications such as GIS. Since these large institutional actors have primarily been corporate, military, or public administration institutions, it should be no surprise that applications that favour surveillance, private sector interests, and control functions have been more common than those favouring public participation, data access, and community-defined goals. Such biases may be unproblematic for some, but for others they present a serious challenge to the possibility of a critical and rigorous science. Either way, GIS is a product of such technological and social constraints and its capacities have been influenced and delimited by these constraints.

5 GIS AND SOCIETY – NCGIA INITIATIVE 19 (I-19)

Following the Friday Harbor workshop, and in part stimulated by it, a group of interested individuals proposed that the US National Center for Geographic Information and Analysis dedicate one of its research initiatives to the issues now known as 'GIS and society'. A proposal was submitted to the NCGIA Board of Directors and approved, and a meeting of specialists convened in early 1996 (Harris and Weiner 1996). This section examines the continuing work of the initiative in some detail.

What marks the Friday Harbour and I-19 workshops as unique and important in the emerging theory of GIS is that Friday Harbour ended with, and I-19 began with, a set of assumptions that have been absent from debates about GIS until recently. Questions of origins, epistemology, data selection and data access, forms of representation, and the politics and ethics of information have generally been seen as marginal to the more technical questions of systems development and application (Martin, Chapter 6; see also Raper, Chapter 5). At these meetings they were seen as essential for any discussion of GIS and society. GIS is thus seen as a set of institutionalised systems of data handling and imaging technologies and practices situated within particular economic, political, cultural, and legal structures. They can thus be thought of as spatial data institutions (Curry 1995) and sociotechnological ensembles (Latour 1993). Understanding GIS as both a set of social practices and institutions embedded in a particular discourse is, perhaps, unique in the history of the engagement between GIS and social theory. Certainly, such social constructionist, genealogical or post-positivist theoretical frameworks have been virtually absent until recently in the debates over GIS.

Deploying such frameworks has been an important part of an emerging theory of GIS and society in which description (of the development of particular logics, systems, and uses of GIS), analysis (of the limits of access, range of diffusion, and effects of use) and critique (focused on the epistemological assumptions embedded in systems and use, conceptions of language in use, and logics and representations) are all present.

5.1 Critical social history of GIS

The written history of GIS is quite limited and few detailed case studies have appeared in print (Coppock and Rhind 1991; Goodchild 1988; Petchenik 1988). But it is vital to any critical field of inquiry that its practitioners know about the origins of the choices made and those rejected in defining and delimiting the field. In particular, it is vital that the technical, logical, and epistemological constraints on what GIS does, and the ways in which particular logics and visualisation techniques, values systems, forms of reasoning, and ways of understanding the world have been incorporated into existing GIS techniques are understood. It is equally important that practitioners and theorists understand the ways in which alternative forms of representation have been filtered out.

In the first instance, this has to do with the development paths taken within GIS and the possible alternatives that were not chosen but were available.

- Accepting that scientific knowledge is socially produced and rejecting any linear path of technical development, what were the debates and decisions leading to certain system choices and foundational logics rather than others within GIS over the past 30 years?
- Second, if alternatives were not pursued or accepted at the time, what were these and what were the conditions under which they were rejected or not pursued?
- Third, if there are always choices being made in the design and implementation of any technology and research tool, can alternative cultural and social conceptions of objects (property, land, resource relational values, historical meaning) be incorporated within GIS, and what are the actual possibilities for extending GIS to incorporate new ways of understanding the world?
- Fourth, since system and procedural choices have already been made and are now rooted in place through technical, financial, and practical inertia, what are the limits on what present-day GIS can do and what any reformed GIS might achieve?

There is a broader context that is also relevant here. This has to do with the issue of historical antecedents. GIS does not spring full blown or completely new into our world (Coppock and Rhind 1991; Goodchild 1988; Petchenik 1988). It emerges out of systems of land surveying, mapping, and data collection each with long heritages, and each having been centrally placed in the systematising and formalising of social life under capitalism. It is a constant surprise to social theorists in geography that the published histories of GIS tend to be what Livingstone (1992) referred to as 'internalist' and 'hagiographic', and do not deal with these historical antecedents, the ways in which GIS developed and diffused (who funded development, what options were considered and rejected, what institutional and intellectual linkages were forged in the development of GIS, etc.) and the patterns of production, marketing, and use that emerge in different cultures and settings. This would seem to be vitally important for any area of science in assessing the effectiveness, value, and limitation of its own technical and theoretical practices. Moreover, such questions locate the study of GIS at the heart of contemporary geographical issues (Wright et al 1997).

Recognising that GI comprises a series of institutions, discourses, and practices (as well as a set of tools) means that any theory of GIS must account for its origins and effects. In other words, GIS as a socially embedded and historically produced set of practices must account for its own history. It is to this question that the Critical History of GIS (CHGIS) Group, an activity initiated under I-19, has recently turned its attention.

Attempting to write a history of GIS that is not internalist or hagiographic, the CHGIS Project aims to bring a variety of theoretical perspectives from contemporary social theory to bear on the question of GIS as social practice. It also attempts to contextualise GIS in its social, political, and economic context, to locate GIS in terms of a broader history of science and technology than heretofore – and specifically to do so through an engagement with the systems and logics that were developed, the paths that were not taken, and the institutional linkages that provided the context for that which emerged.

5.2 Marginalised groups and the politics of access, exclusion, and control

In recent years, new technological capacities and an expansion of the scope of their application in many areas of social life have made it increasingly important to think about the ways in which the logics, systems, and representations deployed by contemporary GIS support particular types of social practice and inhibit others. What effects are GIS having? If GIS has been influenced by the demands of their developers and funders, many of them tied to large institutional and corporate interests and high-cost applications, what forms of access to information do these systems promote and deny? Specifically, how has the proliferation and dissemination of databases associated with GIS, as well as differential access to these databases, influenced the ability of different social groups to gain access to and use this information for their own purposes (see Rhind, Chapter 56)? Second, what types of knowledge and forms of reasoning are not well represented within GIS and what are the consequences of their exclusion (Onsrud 1992a, 1992b)?

A theory of GIS and society must address the impacts of these limits and impediments on groups or individuals where unequal access to software, hardware, and technical skills present real barriers to use, and seriously affect the types of outcome that result from the use of GIS in making decisions.

Differential access to databases is, clearly, becoming one of the central issues facing scholars and users of GIS and all forms of electronic data. As spatial data handling capabilities increase in power, the social impacts become more important. Geodemographic spatial data handling, for example, is already raising serious questions about privacy and access to databases (Curry, Chapter 55; 1997; Goss 1995a, 1995b). Until very recently, the primary sites at which GIS have been developed have been at national and local (in the USA, the state) level. In Britain, GIS has been used for land-use applications related to zoning, long-term planning, and the like. But the increasing availability and ease of use of GIS, accelerated by the development and deployment of global positioning systems and remote sensing systems, now constitute a powerful means of systematically tracking a wide range of natural and social phenomena, and in particular of developing monitoring systems for tracking populations (Graham 1997; Pickles 1991). The development of these systems raises a wide range of questions about the types of assumption, data, and representation that are incorporated in any GIS. Who decides which data are to be collected? Who decides how those data are collected, which categories (of race, gender, species and so on) are to be used? How will the accuracy and validity of those data be measured and guaranteed, not in the technical sense of data error, but in a political sense of data appropriateness? Finally, because state agencies are both users and regulators of software, hardware, and data, questions arise concerning the ways in which these agencies adjudicate their sometimes competing responsibilities of protecting citizens and promoting use. (See Goodchild and Longley, Chapter 40, for a discussion of the technical implications of some of these issues.) In summary, how is the balance between rights to access and rights to privacy currently being struck (Curry 1995)?

The emergence of geodemographic information systems (GDIS) as targeted marketing strategies has already pointed to the emergent dangers of the use of GIS to further the commodification of everyday life (Curry 1997; Goss 1995a, 1995b). In the case of GDIS the issues go beyond the increasing efficiency of marketing agencies to target consumers with particular tastes and purchasing habits. They involve questions about the constitution of identity. GDIS consumer profiles, are aggregate profiles based on neighbourhood level data from which individual profiles are constructed. The targeting of commercial, political, and public service materials to individuals based on neighbourhood-derived profiles in turn 'produces' new identities (in that it channels and restricts the information individuals in that neighbourhood receive). Thus, even beyond questions of access and privacy, GDIS raises fundamental questions about the ethics of using information systems in ways that presuppose (and in turn contribute to the development of) socially homogeneous neighbourhoods.

There is a basic paradox in using GIS to address issues of land-use planning of any sort. On the one hand, conflicts over the use of space typically involve competing sets of values, assumptions, and interests. Not unexpectedly, the representations incorporated in GIS models of landuse conflicts tend to reflect the views, values and interests of dominant sectors of society. Ethnic, racial, and sexual minorities whose values and interests differ

from those of culturally or economically dominant groups may be doubly disadvantaged when attempts to resolve conflict involve a significant GIS component (see Fisher, Chapter 13). Not only are their interests not intrinsic to the models on which technical solutions to complex problems are based, but they may lack access to the tools used by planners and politicians in making their decisions (Aitken and Michel 1995; Lake 1993; Miller 1992; Yapa 1991).

5.3 Ways of knowing

Beyond questions of access and exclusion is a related set of issues having to do with the ways in which knowledge and information are represented. An interesting change in the thinking of geographers seems to have occurred as GIS has been applied to more and more questions of this sort. Geographical information is increasingly assumed to refer to that which is captured or could be captured by GIS. Since GIS typically assume a universal set of objectifiable and 'self-evident' components of the processes they model (Sheppard 1995), GIS representations are often based on the assumption that there is a single version of reality to be modelled, and that land-use planning and conflict resolution principally involve the discovery of the most efficient solution to this objectifiable location problem. The use of GIS in locational conflict resolution has, in one important sense, poorly served the interests of those whose viewpoints and values differ from those incorporated in GIS models. Other forms of geographical information: place-based information, local knowledge, historical memory of land-use struggles, past events etc., are being marginalised as subjective information, *doxa*, or opinion (Curry 1996, 1997; but see Fisher, Chapter 13, and Veregin, Chapter 12, for discussions of uncertainty and data quality, respectively).

One example already addressed in literature is the case of the use of GIS to revisit claims of North Americans whose lands were ceded to the government in the nineteenth century, and whose abrogated treaty rights are now a basis for re-evaluation of that land alienation process. A basic problem emerges in the fact that GIS is far better at incorporating certain types of variable than others (Fischer, Chapter 13; Poiker 1993). Clearly, the variables incorporated in GIS representations are

not always tangible: for instance, both physical forest resources and conceptual property boundaries are included in GIS databases used in adjudicating land disputes. However, intangible factors related to competing value systems are not usually present in such analyses. How factors such as emotional attachments and the sacredness of place, the role of place in creating and maintaining community, use rights versus property ownership rights, and alternative views of nature are incorporated adequately into the GIS analysis of such conflicts has a huge impact on the types of claims and decisions that can be made (Rundstrom 1991). Rundstrom (1995) has even gone so far as to ask whether decisions should be based on GIS analysis at all in cases where such calculi are not amenable to incorporation into GIS models.

It is not yet clear how any technical systems can deal with alternative knowledge systems in cross-cultural settings. Some ways of knowing are privileged in existing GIS approaches, but it is not clear how different types of knowledge and information can be included. Nor is it clear whether the apparent technical and epistemological limitations of present systems could incorporate different ways of knowing without reducing one to the other, or whether new, different system logics, configuration, and practices need to be developed. The possibilities and the difficulties involved in these efforts are well documented by Harris et al (1995) and Weiner et al (1995).

With the inclusion of locationally fuzzy knowledge many issues arise as to how the multi-objective goals, based on multiple criteria, and using spatially imprecise and possibly conflicting data might actually achieve what is assumed to be consensus decision-making. Perhaps one reason why GIS has achieved such astounding 'success' to date in decision-making support roles is that it is based on only one seemingly non-contradictory perception of reality. Collaborative spatial decision-making is a complex issue even among participants with similar world views and knowledge. In the absence of this commonality the difficulties are qualitatively greater. But these difficulties are also opportunities; they arise as such partly because of new technical capacities for handling large datasets and displaying and disseminating spatial images. What a 'pluralistic GIS' (one containing multiple views of resource value, potentially fuzzy, and conflicting information) would look like and what it would imply for the ways in which GIS can be used in collaborative decision-making remain open questions.

5.4 Public participation and GIS-2

If it is the case that the systems and logics that underpin much GIS emerged in response to the requirements and influence of large institutional supporters (be they public or private), then issues of surveillance, ownership, and control raise questions about the possibility of access, participation, and community-based involvement in GIS. This is even more pressing if one is not willing to reduce such issues of access and participation to the logics already present in existing systems. If GIS has emerged in its present form as a result of influences from a variety of financial and institutional interests, and if it does operate (through its technical demands, cost structure, types of data, and differential access) as a top-down technology and practice, can it be democratised? The democratisation of GIS means that the emerging possibilities of the technology must be considered. What must also be considered is how the types of systems and logics emerged within contemporary GIS and whether they can be changed.

If these forms of embeddedness do function as real constraints on public participation, can alternative social relations, ways of knowing, and marginalised groups be represented or given access in ways that do not reduce their own positions and logics to those of current GIS practice? How can the knowledge, needs, desires, and hopes of marginalised social groups be represented adequately as input to a decision-making process, and what are the possibilities and limitations of GIS as a way of encoding and using such representations?

If contemporary GIS can be thought of as predicated on the computerisation of the cartographic industry (GIS-1), can alternatives (GIS-2) be thought of which might range from 'knowledge creation environments' (Goodchild 1995) to public access centres and which address these issues? Also, how should people, space, and nature be represented? Who should have the right to speak on the nature of the representations that are created (Latour 1993)? What criteria might govern the emergence of such a GIS-2?

This question was raised and discussed at Friday Harbor and has become a central focus of I-19 research. The issue of system design is being addressed in the public participation project at the University of Maine, headed by Schroeder and Onsrud. Questions of legal and ethical conditions that enable and prevent intrusion are being addressed in a joint project between UCLA and the University of Minnesota – specifically by Curry, Sheppard, and Miller. The nature of geographical information in situations involving social conflict, and its relationship to the present capacities of GIS, is being addressed variously in projects in Minnesota and UCLA, and at the University of Kentucky and West Virginia University.

These efforts are aimed at asking what GIS-2 might look like. It would certainly have to be cheaper, more accessible, and sufficiently flexible to be of use to a wider range of users. But it would also have to address public concerns about privacy and access to information. Such a public GIS would have to guard against the reduction of multiple ways of knowing to a single logic and the premature resolution of differences. Instead, it will have to develop ways to represent different conceptions of space or Nature, and preserve contradiction, inconsistency, and disputes. Finally, a more flexible and accessible GIS-2 needs to be capable of integrating all data components, such as WWW, data archives, parallel and counter texts in diverse media, standard maps and datasets, and sketch map and field notes, all from one interface (Harris and Weiner 1996; *http://ncgia.spatial.maine.edu/ppgis/ppgishom.html*).

6 CONCLUSIONS

What are the results of the engagements described above? In the first place, these are early days in each of these projects and concrete research results are limited. Several conceptual advances have, however, been made.

- The relationship between the speed of developments and depth of the impacts of GIS technology, theory, and practice can now be seen in the context of a field that has been reticent to acknowledge the conditions of its own production, that has been lax in building its own archive, and that has by and large failed to develop sustained and detailed critical reflection upon its own practices. The discussion around GIS until the late 1980s remained focused largely on technical issues, unreflective in nature, and theoretical only insofar as theory referred to either empirical findings or internal technical concerns (but see, for example, Chrisman 1987a, 1991a; Coppock and Rhind 1991; and Goodchild 1995).

- The debate thus far has broadened discussion of GIS practice so that it now encompasses the social impacts of GIS. This is particularly important as new cyberspaces emerge and new forms of geographical information are finding a home through which important reconfigurations of material life are being affected.
- The need to think of GIS as a social object with its own institutional contexts, discourses, and practices has been demonstrated. This is not, however, an argument for a form of exceptionalism or professionalising of GIS as a discipline. Instead it calls for the necessity of locating those institutions, discourses, and practices in terms of broader debates in social theory about science/technology/society, theories of science, and the political economy of informatics on the one hand, and the recontextualising of GIS practice within the broader debates about geography on the other hand.
- The engagement has rectified one important absence within GIS communities (the legitimacy of 'GIS and society' questions and the availability of sites and groups among whom such discussion can continue).

The emergence of critical dialogue between GIS and social theory offers great promise for the emergence of a critical GIS aware of its own effects and striving to open its capacities to the needs, questions, and ways of knowing of broader and different 'publics'.

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