22 The Emerging Geographies of Cyberspace

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Since the invention of the telegraph in the early nineteenth century, information and communication technologies (ICTs) have become increasingly sophisticated and integral to social and economic life. The successive developments of the telephone, telex, fax, and mobile telephone have enabled significant space-time compression through instantaneous communication over great distances (Brunn and Leinbach 1991). Over the last thirty years, since the creation of the internet,[1] the role and importance of ICTs has grown significantly; an estimated 304 million people are connected to the internet, with this figure growing 30 percent annually (Nua 2000), and billions of dollars are being invested in infrastructure and content production by large corporations and venture capitalists. As discussed in chapters 2 and 21 of this volume, it is now well recognized that ICTs, and in particular the internet and intranets,[2] are instigating significant cultural, social, political, and economic effects at all geographic scales from the body to the global (Kitchin 1998). It has been argued recently that ICTs and the conceptual space they support – cyberspace – have a number of implications for how the following are constituted, conceived, and theorized: identity (Turkle 1995); the body (Haraway 1991); community (Smith and Kollock 1999); democracy (Loader 1997); employment (Castells 1996); urban and regional development (Graham and Marvin 1996); and accessibility to goods and services (Janelle and Hodge 2000).

In many of these accounts it is hypothesized that the changes are occurring because the role, importance, and nature of space is changing, with the relations between people and space being reconfigured in complex ways. It is contended that ICTs are important transformative agents which are helping to reconfigure the spatial logic of modern society (Mitchell 1996). ICTs are leading to massive time-space compression, with the instantaneous communications of the internet, intranets, and mobile telephony precipitating the large-scale reconfiguring of spatial and temporal boundaries. This reconfiguring, some speculate, will eventually lead to the eradication of geography (the death of distance) as a central organizing modality of society,

in relation to both space and place (Cairncross 1997). Consequently, commentators such as Benedikt (1991: 10) have begun to question the "significance of geographical location at all scales," with ICTs seen as liberating and transcendent tools, freeing human life from the tyranny of material space.

Others have countered that while undoubtedly space-time relations are being reconfigured, the importance of space as an organizing principle and a constituent of social relations is not being eliminated and spatial differences and inequalities between places are, on many measures such as economic growth, becoming more pronounced (Dodge and Kitchin 2000). Moreover, there are still significant tensions and resistances between processes operating at different spatial scales, from the local to the global, so that while a complex global economic system is in place, significant variations in culture, social and political relations, and wealth remain across the globe. In this manner ICTs and cyberspace are inherently complex and often contradictory in their spatial outcomes.

Interestingly these debates over the changing nature of geographical relations and their role in understanding contemporary society have barely been extended to cyberspace itself. To date, cyberspace has been conceived and examined as largely aspatial and tellingly the *lack* of geography is considered one of the key features in the development and sustenance of online social relations. As such, many commentators have argued that cyberspace is essentially spaceless and placeless (Rheingold 1993). Indeed much of the populist rhetoric about cyberspace focuses on spacelessness as the key to its revolutionary potential (as in discussions of the marketing of online shopping and e-commerce). In this chapter we argue that this could not be further from the truth and that, to the contrary, cyberspace is ripe for geographic enquiry. We contend that the many domains of cyberspace possess both spatiality and geometry and illustrate this by examining the emerging geographies of cyberspace in relation to two themes: (1) community and (2) maps and spatializations. These are by no means the only geographies currently being examined by scholars, but they suffice to illustrate our arguments (Dodge and Kitchin 2000).

Communities in Cyberspace

> [Virtual communities are] social aggregations that emerge from the Net when enough people carry on those public discussions long enough, with sufficient human feeling, to form webs of personal relationships in cyberspace. (Rheingold 1993: 5)

Over the past decade it has frequently been argued that cyberspace allows the formation of communities that are free of the constraints of place. Instead of being founded on geographic propinquity, communities in

cyberspace are sustained and grounded by communicative practice – a sense of community is based upon new modes of interaction (computer-mediated communication) and centered on common interests and affinity. As such, Rheingold (1993) suggests that personal intimacy, moral commitment, and social cohesion replace ties arising from shared location as the key constituents of maintaining a community identification and spirit. For him, cyberspace offers the unique opportunity of marrying *gemeinschaft* (where community relationships are tied to social status, public arenas, and bounded, local territory) and *gesellschaft* (where community relationships are individualistic, impersonal, private, and based on "like-minded" individuals), so that individualistic, like-minded people join forces to form public-based communities.

Online communities, according to Rheingold and others, are constructed around what their members think, say, believe, and are interested in, rather than on where they live or what the participants look like. These communities are facilitated by online media such as email, mailing lists, chat rooms, bulletin boards, and web pages within which it is thought that individual participants can circumvent the geographical constraints of the material world and take a more proactive role in shaping their own virtual community and their position within it. Jones (1995: 11) thus proclaims: "we will be able to forge our own places from among the many that exist, not by creating new places but by simply choosing from the menu of those available."

There is now little debate as to whether virtual communities exist: Anderson (1983) suggests that at a basic level all communities are imagined, and as long as members share a common imaginative structure, a community exists. Moreover, most commentators agree that many of these communities are self-sustaining and rich in diversity. Indeed Rafaeli and Sudweeks (1996) point out that people would not invest so much time and effort into online social interactions if they did not gain some sense of social cohesion or community from their virtual actions. They contend that the form and depth of interaction mean that many virtual communities are neither pseudo nor imagined, despite claims from critics (Robins 1995; Sardar 1995) because, for Rafaeli and Sudweeks, cyberspace possesses the qualities of what Castells (1996) terms "real virtuality," a reality that is entirely captured by the medium of communication and where experience is communication. Where there is significant divergence of opinion, however, is over the extent to which (1) these online communities provide an alternative to geographic communities and (2) they are really placeless. We deal with each of these debates in turn.

Cyberspace communities as an alternative to geographic communities

To Rheingold (1993), Mitchell (1996), and others communities in geographic space are fragmenting and losing cohesion due to cultural and economic globalization – a coalescing of cultural signs and symbols, increased geographic mobility, a designificance of the local, and changing social relations. In Relph's (1976: 90) terms, society is suffering increasingly from a condition of placelessness: "a weakening of the identity of places to the point where they not only look alike, but feel alike and offer the same bland possibilities for experience." For them, geographic communities no longer provide a coherent "sense of place"; instead, online communities (for the reasons discussed above) provide an alternative and an antidote to social alienation and placelessness experienced in geographic communities.

Robins (1995) has severely criticized this notion of online communities as alternatives to geographic communities. He argues that the former are at the very best self-selecting, pseudo-communities and that it is a serious misnomer to directly equate communication with communion and community, thereby questioning the quality of relationships forged and sustained through cyberspace (e.g., issues such as responsibility and respect), a sentiment echoed by Gray (1995):

> We are who we are because of the places in which we grow up, the accents and friends we acquire by chance, the burdens we have not chosen but somehow learn to cope with. *Real* communities are always local – places in which people have to put down some roots and are willing to put up with the burdens of living together. The *fantasy* of virtual communities is that we can enjoy the benefits of community without its burdens, without the daily effort to keep delicate human connections intact. Real communities can bear those burdens because they are embedded in particular places and evoke enduring loyalties. In cyberspace, however, there is nowhere that a sense of place can grow, and no way in which the solidarities that sustain human beings through difficult times can be forged. (Ibid: our emphases)

Wellman and Gulia (1999) critique the idea of cyberspace communities as alternatives to geographic communities using a different tack. They note that online and geographic communities are remarkably similar in some respects. For example, due to developments in long-distance transportation and telecommunication technologies throughout the modern period, it has long been the case that a person's community (their kith and kin) does not necessarily live within walking distance. Instead, geographic communities have been replaced by social networks spread out over a wide terrain, and sustained by letter writing, telephone conversations, and now various modes of computer-mediated communication. They observe that even when people share the same geographic space most social networks are actually sustained through telephone conversations and face-to-face contact. As such, they contend that the division between geographic and virtual is not helpful – one is simply an extension of the other. The relationship between people is what's important, not the medium of communication. Networks maintained exclusively in cyberspace are thus not pale imitations of "real" networks, or substitutions for these networks; they are merely another form of

network, a subset of an individual's total network, much as pen-pals were in the era of letter writing.

Moreover, it should be noted that cyberspace is often used as a means to try to "reconnect" members of a community and foster a sense of place in a particular locale. Many Western cities now have websites and PENs (public electronic networks) devoted to community relations and development, many allowing citizens to discuss issues among themselves and with local statutory and voluntary agencies (Graham and Aurigi 1997). Further, many communities are using cyberspace to develop cross-community and cross-issue alliances to help fight particular concerns. Probably the most widely documented case of such use was by the Zapatistas of Chiapas (Mexico), who used the Web to garner international political support (Froehling 1997). In these cases, in contrast to Rheingold's replacement thesis, geographic communities are being augmented by online interactions.

## Cyberspace communities as placeless communities

As noted in the introduction, cyberspace is commonly conceived as aspatial; it has no spatiality and thus no sense of place. This conception is now being challenged by a number of academics who argue that online interactions are often structured through a variety of geographic metaphors, employed to help create a "sense of place" and to provide a tangible spatiality. For example, cyberspace is replete with the vocabulary of place: nouns such as rooms, lobbies, highway, frontier, cafes; and verbs such as surf, inhabit, build, enter (Adams 1998). Couclelis (1998) describes the use of these geographic metaphors – the spatialization of cyberspace – as an attempt to translate information and communication media into domains familiar and comfortable to users. Cyberspace, these analysts contend, is literally built out of the ideas and language of place, and the employment of these metaphors to create sites of interaction engenders an online spatiality.[3] As a consequence, Taylor (1997: 190) states that "to be within a virtual world is to have an intrinsically geographic experience, as virtual worlds are experienced fundamentally as places." Indeed, if we take the definition of place provided by Jess and Massey (1995) – places are characterized as providing a setting for everyday activities, as having linkages to other locations, and providing a "sense of place" – then there can be little doubt that new places, and new spatialities, are being formed online. Batty (1997: 339) thus states that the many components that comprise cyberspace – web pages, mailing lists, chat rooms, bulletin boards, MUDs (multi-user domains), virtual reality environments, information databases, online stores, and game spaces – each have "their own sense of place and space, their own geography." As yet these spatialities have been little considered by geographers, but they are becoming increasingly prevalent in people's lives, particularly as businesses provide online services to reduce transaction costs (e.g., the promo-tion of online banking to facilitate the reduction of expensive physical premises). Here, we illustrate the extent to which online social relations are contextualized by spatiality, and the importance of understanding this spatiality in order to comprehend online communities, through the reporting of two case studies.

Correll's (1995) study of an online lesbian cafe describes how patrons constructed an elaborate cafe setting using textual descriptions and contextualized all their interactions within this setting (for example, patrons would "buy" drinks and hang out round the jukebox). She suggests that the construction (spatialization) of this shared setting created a common sense of reality which grounded communication. In essence, the locale needed for community in geographic space was simulated online, so that place and setting remained important. Indeed, for her the spatialization of the online meeting space was the secret to the community being a success, suggesting that without the shared "reality" of the bar the community might have dissolved. This bar, however, differed in significant ways from gay bars in geographic space, "where the games are for real" (ibid: 281). Here, patrons could explore their ideas and thoughts without fear of physical or mental retribution. As such, the bar served to augment offline lives by providing a surrogate community for a group who are often marginalized within geographic communities (Bell and Valentine 1995). In this case, the cafe was providing a relatively safe space, often denied to the women offline, in which they could express and explore their sexuality.

Smith's (n.d.) study charted the process of virtual place-making as performed in shared and immersive internet VR-type environments, such as AlphaWorld.[4] These virtual worlds are popular and AlphaWorld has been visited by over 800,000 unique users since its inception in the summer of 1995, many of whom have built homesteads (as of August 2000, 64.2 million objects had been placed by the inhabitants). In order to undertake his study, Smith created a new virtual world that any person could inhabit and build within. He then monitored in detail the building of urban structures and the social interaction of inhabitants over a 30-day period (starting November 30, 1998). The plot of land he used was 3 million square meters in size and capable of supporting 32 simultaneous users. No specific guidelines were provided, although inhabitants were encouraged to visit a website[5] which detailed the experiment, and a prize was offered for the best structure built during the 30 days. Inhabitants entered the world in a town square surrounded by message billboards. Nearby a builder's yard provided a wide range of generic building blocks from which users could build structures.

The experiment revealed a number of interesting results about the sociospatial construction of virtual worlds. Most importantly, users built a diverse range of structures, and a strong core community, who met and interacted regularly, developed. The extent of the building is evident in figure 22.1, showing "satellite"-type land-use images of urban growth over the 30 days. The first 24-hour period in particular experienced considerable
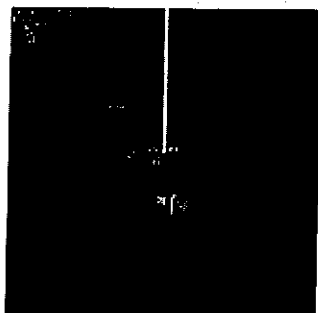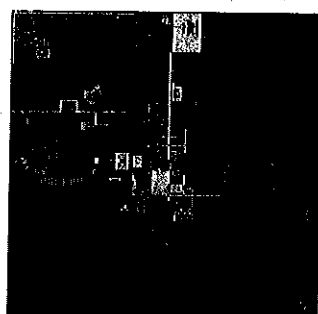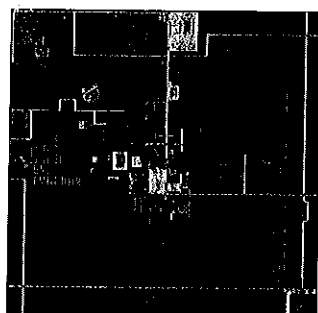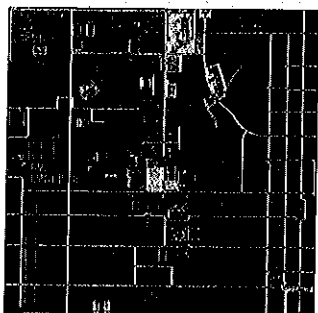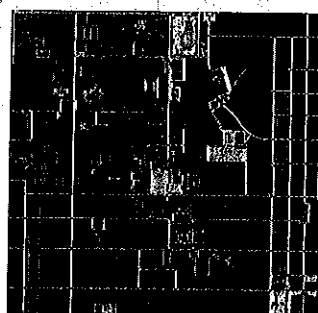
Day 1
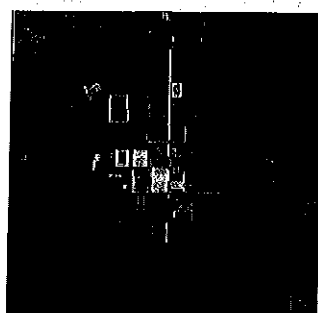
Day 2
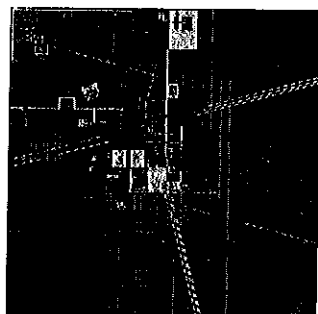
Day 4

Day 5

Day 6

Day 12

Day 18

Day 29

development, with 7,219 objects placed. In total, 27,699 objects were placed by 49 registered users and an unknown number of tourists, with 49 percent of all available land built on. Smith reports that a recognizable community of about ten users had already developed by the third day, appearing much sooner than he predicted. This group used the same nicknames and avatar appearances over the course of the 30 days.[6] The community developed throughout the experiment, and produced a number of communal structures (such as a temple) and undertook a number of communal events (such as all adopting Smith's avatar for a day).

In addition, the world experienced some of the more anti-social phenomena of virtual worlds like AlphaWorld. For example, on day 4 it was subjected to attack from what was self-described as the Activeworlds Terrorist Group. On this occasion over 85,000 objects were added to the world, as evidenced by the patterns of dashed lines in figure 22.1. Also some inhabitants took to "sky writing" – claiming sizeable tracts of land to spell out a message when the world is viewed from the air. The first of these appeared on day 5 ("Hi").

Using Smith's work it is possible to think of AlphaWorld as consisting of hybrid places lacking the materiality of geographic and architectural space, but yet having a powerful mimetic quality, containing enough geographical referents and structure to make them tangible. This, we suggest, engenders a level of spatiality beyond that found in other virtual media (such as email and web pages), with social interaction explicitly situated and grounded in a geographic context. As with textual MUDs, the place-like qualities of AlphaWorld provide a context in which specific forms of social interaction and experiments with identity are played out. In AlphaWorld the "sense of place" is centered around the activity of claiming land, designing and building homesteads, the means by which the space is transformed into meaningful *places*, and by social interaction between the inhabitants. Both lead to specific forms of sociospatial practice: the playing with identity, the creation of community, land disputes, virtual vandalism, and policing. These in turn are framed within a regulatory structure centered on citizenship. In essence what Smith's experiment reveals is that space, place, and sociospatial processes are central to online interactions within the Alphaworld environment, and by extension other social milieux (although the forms of spatialities might differ between domains: see Adams 1998).

The importance of spatiality in these communities is highlighted by Foster's (1997) analysis of an attempt to create a virtual community which he thinks failed because it did not achieve a "sense of place." In this case, the community was a PEN (public electronic network) seeking to revitalize a geographic locale. Instead of fostering integrated social interaction, however, the PEN disintegrated into monologues and separate spaces.

One of the principal reasons that so many analysts, particularly those of a utopian persuasion, have misunderstood cyberspace as placeless, spaceless media is because they have conceived cyberspace as a separate realm

divorced from geographic space. This conception falls into the trap, as identified by Bingham (1999), of treating cyberspace as locations of the sublime (as powerful, dislocated, deterministic paraspaces).[7] We believe that cyberspace, rather than being a separate realm to geographic space, is merely an extension of it – as argued by Wellman and Gulia (1999). As such, we suggest that cyberspace is better conceived as embodied spaces (Dodge and Kitchin 2000).

Our reasoning for theorizing cyberspace as embodied spaces is because online and offline identities are not divorced. Donath (1999), in an application of Goffman's (1959) famous thesis, argues that online social interactions exhibit many of the same characteristics as those elsewhere, distinguished by "expressions given" (how one wishes to be perceived) and "expressions given off" (often unintentional messages that reveal aspects of character). In playing with identity in cyberspace many users are intentionally seeking to manipulate "expressions given" and limit those "given off." Messages "given off" almost inevitably translate disembodied spaces into embodied spaces. This is because we enter cyberspace from geographic space, and although we can play with our identity and seek to deny our geographic point of entry, our online personae are grounded in our experiences and memories of geographic space (which in turn adapt to accommodate online experiences); our online and offline identities are thus not divorced but are situated in relation to each other.

Mapping and Spatializing Cyberspace

In the previous section we discussed the extent to which cyberspace is placeless. In this section we continue that analysis to examine the extent to which it can be considered spaceless. Again, a number of analysts have speculated that cyberspace lacks space, that it is lacking geometrical (space-time) properties and is thus closed to cartographic visualization and geographic analyses. For example, Mitchell (1996: 8–9) describes cyberspace as

profoundly *antispatial* . . . You cannot say where it is or describe its memorable shape and proportions or tell a stranger how to get there. But you can find things in it without knowing where they are. The Net is ambient – nowhere in particular but everywhere at once. You do not go *to* it; you log *in* from wherever you physically happen to be . . . the Net's despatialization of interaction destroys the geocode's key. (Original emphasis)

This, to a degree, is true. Many parts of cyberspace, due to their form (structured by the underlying network protocols and the end-user interface), lack a spatial quality (e.g., email or bulletin boards), and other spaces possess a very chaotic geometry that lacks Cartesian logic (e.g., websites). It is clear, however, from the wealth of research being conducted (Dodge and Kitchin

2000 provide an overview) that cyberspace is amenable to, and benefits from, geographic visualization and analysis. This is because cyberspace does possess space-time geometries; that in all cases there is a geography of sorts that bounds and helps define a domain and the interactions occurring within and between. For example, some domains clearly display recognizable spatial geometries, such as MUDs and virtual worlds; in other cases domains that lack a formal spatial quality have been (and can be) given one through processes of spatialization (a spatial structure is applied where no inherent or obvious one exists through the application of concepts such as hierarchy and proximity).

As such, cyberspace does have space-time geometries but they are highly complex and we are only just beginning to chart and understand them through techniques of mapping and spatialization. As we illustrate below, this project of mapping and spatializing cyberspace is important because (1) it has the potential to make cyberspace easier to search and navigate through and (2) it reveals more fully the complex relationships that exist between data and/or people online (relationships that are often hidden or difficult to determine when viewing text or hypermedia documents).

ET-map is a prototype spatialization application that provides a "big picture," an overview of the whole information space; it was developed by Hsinchun Chen and a research team in the University of Arizona's Artificial Intelligence (AI) Lab (Chen et al. 1998).[8] Its aim is to provide a navigable map of the Web, using the power of map categorization and visualization to make browsing for information easier. (It also reveals the wider, overall structure of a very complex site.) Essentially, ET-map constructs a hierarchical set of "category maps" which act as visual directories that can be interactively browsed to find particular web pages of interest (Chen, Schuffels, and Orwig 1996). Figure 22.2 displays the spatialization of over 110,000 entertainment-related web pages listed by the *Yahoo!* directory (Chen et al. 1998). The three images reveal how the maps are nested and can be browsed, in this case to locate websites related to jazz music. At each level the "category map" displays groupings of similar web pages as regularly shaped, homogeneous "subject regions," which can be thought of as virtual "fields" which all contain the same type of information "crop." The spatial extent of the subject regions is directly related to the number of web pages in that category. For example, the MUSIC subject area (figure 22.2a) contains over 11,000 pages and so has a much larger area than the neighboring area of LIVE, which only has some 4,300 pages. Clicking on a subject region with less than 200 pages takes one to a conventional text listing of the page titles. If a region has more than 200 pages, then a sub-map of greater resolution is created, with a finer degree of categorization (figure 22.2b and c). In addition, a concept of neighborhood proximity is applied so that subject regions that are closely related in content are plotted close to each other. For example, FILM and YEAR'S OSCARS, at the bottom left of figure 22.2a, are neighbors.

Entertainment (1st level)

(c) Jazz
(3rd level)

(b) Music (2nd level)

22.2   ET-map: the hierarchical category map.

The maps are created using a sophisticated AI technique that automatically (i.e., no human supervision) analyses and classifies the semantic content of text documents like web pages (Chen et al. 1998). While quite successful, the technique is not without problems; for example, it is difficult to classify pages automatically from a very heterogeneous collection and it is not clear that the automatically derived categories necessarily match the conceptions of a typical user. From the limited usability studies conducted it appears they are good for conducting unstructured, "window shopping" browsing, but less useful for undertaking more directed searching.

There also have been attempts to spatialize the wider Web landscape with whole websites represented as singular, graphical objects. Figure 22.3 displays one such landscape created by Tim Bray (1996). In order to answer four questions (How big is it? How wide is it? Where is the center? How interconnected is it?) Bray used a large search engine index to calculate the key metrics on the structure of the known Web in 1995.[9] Examining the hyperlink structures of the Web, he found that interlinking between sites was surprisingly sparse. Most links were local, within a site, and a few key sites (e.g., *Yahoo!*) acted as super-connectors tying sites together. Bray

Figure 22.3   Webspace landscape.

derived two intuitive measures of website character based on hyperlinks: visibility and luminosity. Visibility is a measure of incoming hyperlinks, the number of external websites that have a link to a particular site. In 1995 the most visible website was that of the University of Illinois, Urbana-Champaign (UIUC), the home of the Mosaic browser. The vast majority of sites had very low visibility and nearly 5 percent had no incoming links. Measuring the reverse, the number of outgoing links, determines a site's luminosity. The most luminous sites carry a disproportional amount of navigational workload. *Yahoo!* was the most luminous site in 1995, and probably still is today.

Using these statistical characteristics Bray spatialized the key landmarks of the Web in 1995, highlighting the largest, most visible and connected sites. The resulting information landscapes, shown in figure 22.3, are dotted with 3D models which he termed ziggurats (ancient stepped pyramidal temples). Each ziggurat visualized the degree of luminosity and visibility of a single site, along with the size of the site and its primary domain (e.g., government, education, commercial, etc.). The basic graphic properties of the ziggurat – size, shape, and color – were used to encode these four dimensions. The overall height represented visibility; the width of the pole represented the size of the site, in terms of number of pages; the size of the globe atop the ziggurat indicated the site's luminosity; and color coding displayed the primary domain (green for university, blue for commercial, red for government agencies). The ziggurats were also labeled with the site's domain name for identification. The spatial layout of the ziggurats across the plane was based on the strength of the hyperlink ties between them. The

model is three-dimensional and can be "flown through" and viewed from different positions. Figure 22.3 displays a field of ziggurats at the very core of the Web in 1995. Further from this core region there would be many thousands of other ziggurats, but most would be minuscule in relation to those at the heart.

These two examples demonstrate that cyberspace is not spaceless and reveal how spatializing cyberspace can aid navigation and provide a wider understanding of the Web. They are just two examples from a rapidly developing field being driven by strong commercial pressures to deliver better information interfaces and navigation tools. Interestingly, most research teams do not consist of geographers or cartographers, but information scientists (Dodge 2000 has a full catalogue of these efforts; Dodge and Kitchin 2000). At present, most maps and spatializations are experimental in nature, often with limited scope, and there is a long way to go before we really start to understand how cyberspace is organized spatially and how it might be more effectively reorganized. This has led some commentators to suggest that present maps and spatializations are little more than "eye candy" and are not effective, functional navigational aids (Nielsen 2000). While we concur with this sentiment, we are of the opinion that, over time, mappings and spatializations of cyberspace are going to become increasingly important tools for both navigating cyberspace and understanding relationships between people and data in cyberspace; in short, plotting the space-time geometries of cyberspace will be a significant area of study for geographers, cartographers, and others.

Conclusions

In this chapter we have countered the claims of some analysts that cyberspace has no geography and is essentially placeless and spaceless. We have done this through an examination of two key areas of study – community and mapping – detailing some of the emerging geographies of cyberspace with reference to both spatiality and geometry. Through these examples we have demonstrated the need for and utility of a geographic approach to cyberspace. At present, research with geographic perspectives is nascent, and while it would be unfair to say that cyberspace is a neglected area of research, more research is certainly needed before we understand more fully its spatialities and geometries.

In relation to the two areas of research, we have discussed briefly in this chapter how research needs to focus on exploring the relationship between space and online community, seeking to uncover the ways in which communities and spatialities are constructed, maintained, and disrupted, plus examining the nature of space in cyberspace and how to effectively measure and map its geometries. In the case of the former, it is important to remember that cyberspace is not a paraspace, a realm divorced from geographic

space. Rather we need to consider it as a continuum, as the extension of geographic space into cyberspace, and how this affects social, cultural, political, and economic relations. We need to conceive of cyberspace as an embodied space, where online interactions are not divorced from those offline, but rather are contexted by them. This allows us to understand and embed the use of cyberspace into the context of other aspects of daily life, a practice that is lacking in much analysis, particularly that which is utopian in conception. Taking this approach, following Wellman and Gulia (1999), it is clear that cyberspace does not provide alternative communities to geographic ones, but rather supplements and augments social networks. A key research area is to investigate the processes of supplementation and augmentation.

In the case of the latter, we need to consider how cyberspace sits in relation to traditional conceptions of space and the practices of Western cartography. It is quite clear that cyberspace poses an ontological question of traditional understandings of space and those that seek to map and chart it (for a full discussion, see Dodge and Kitchin 2000). Composed of billions of lines of computer software, cyberspace is entirely a social production – it can be designed with various forms of spatial geometries that lack materiality and which are highly mutable. Charting these geometries is a difficult but an exciting challenge, which needs careful thought. As noted in relation to the traditional practice of mapmaking, this process and the products constructed also need to be scrutinized. As a consequence, we suggest five significant questions that need to be asked of those maps and spatializations that have so far been created: How "accurate" is the map? Is the map interpretable? What does the map *not* tell us? Why was the map drawn? Is the map ethical? We provide initial answers to these questions in Dodge and Kitchin (2000), but a more rigorous application is needed that extends our understanding of the spatial geometries of cyberspace and the means by which to measure and interpret them.

Notes

1   The internet consists of a global network of computers that are linked together by "wires": telecommunications technologies (cables of copper, coaxial, glass, as well as radio and microwaves). Each linked computer resides within a nested hierarchy of networks, from its local area, to its service provider, to regional, national, and international telecommunication networks. The links have all different speeds/capacities, and some are permanent, while many others are transient dial-up connections. While some networks are relatively autonomous, being self-contained spaces, almost all allow connections to other networks by employing common communication protocols (ways of exchanging information) to form a global system.

2   Intranets have the same functional forms as the internet, but are private, corporate networks linking the offices, production, and distribution sites of a company around the world. These are closed networks, using specific links leased from telecommunication providers, or employ new virtual private networking technologies with no, or very limited, public access to files (company employees with knowledge of the correct password might gain entry from a public network). For example, most banks and financial institutions have national, closed intranets connecting all its branches, offices, and ATMs (Automatic Teller Machines) to a central database facility which monitors transactions.

3   Note, there is a long history of using familiar metaphors and analogies to explain new, strange, and potentially hostile phenomena.

4   AlphaWorld is owned and managed by Activeworlds.com, Inc., a small firm based in Newburyport, MA, USA (http://www.activeworlds.com/).

5   http://www.casa.ucl.ac.uk/30days/

6   An avatar is a visual character that represents the user online.

7   Paraspace means "other space," a sublime space that has forms and practices alien to that in geographic space.

8   http://ai2.bpa.Arizona.edu/ent/

9   Comprising a mere 11 million pages from about 90,000 sites, compared to 800 million-plus in 1999 (Lawrence and Giles 1999).

Part V
Geoenvironmental Change