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The new worlds of electronic geography*

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Resumen. *Las disciplinas y organizaciones académicas, y sus profesionales y practicantes,están afectados por la introducción de nuevas tecnologías en el aula, en el lugar de trabajo, en los sectores públicos y privados. La geografía ha sido siempre una disciplina que adopta y utiliza tecnologías para escribir, describir, analizar y predecir acerca de patrones y procesos espaciales. El mapa es una de tantas tecnologías que hemos utilizado en nuestras pesquisas geográficas. Otras son la cámara fotográfica, las imágenes de percepción remota, y ahora los sistemas SIG. Las tecnologías las empleamos para cartografiar paisajes, actividades, interacciones hombre/medio, regiones y sistemas a escalas locales y globales. Lo que está surgiendo en el mundo académico y en los mundos reales de las economías,de la cultura, la política pública y de la geopolítica, es la emergencia de tres "vueltas", la espacial,la ambiental y la de información/comunicación. La geografia está asumiendo un papel nuevo e importante en estas pesquisas transdisciplinarias, en parte porque ella es una disciplina "flúida" cuyos conceptos, teorías y metodologías resuenan con campos nuevos y viejos en las humanidades, en las ciencias sociales y naturales. Muuchas de estas interfaces emergentes están asociadas con "geografías electrónicas", esto es, los impactos de las ICT (tecnologías de la información y las comunicaciones) sobre el lugar que ocupan la investigación pionera, la comunicación profesional y avances en la carrera, disponibilidad de materiales recursivos, entrenamiento y certificación, y ética profesional Estos avances también ponen algunos retos para la actual y futuras generaciones de geógrafos del "mundo electrónico"; de esto hacen parte los pasos hacia una mayor inclusividad, crecientes membresías disciplinarias y organizacionales, la adquisición de nuevas habilidades técnicas y tecnológicas, enfatizando la importancia del aprendizaje visual, con crecientes aplicaciones en las comunidades científica, de las políticas y del sector corporativo. El desafío para la geografía y para los geógrafos es explorar maneras de mostrar la importancia del conocimiento espacial, locacional y de la interacción hombre/medio, a todas las escalas, conocimiento que es parte del terreno común que compartimos con colegas en las humanidades y las ciencias.*

Epígrafes: investigaciones transdisciplinarias – límites fluentes – mundos electrónicos – sabiduría del siglo XXI - retos disciplinarios .

Advances in communications technologies change the world of the scholar and of scholarship. This statement has special relevance to geography, as geography is at its root a discipline concerned with communication. It communicates information about the earth, that is, space, place, region, and environment. The Greek roots of geography, *geo* – earth and *graphos* – writing, attest to this early linkage between information, communication, and the very nature of our discipline. Whether the geographer is writing about a place, sketching it, photographing it, or mapping it, that person is conveying information about locations, environments, and places to others. The earliest geographers may have used a bone or hard stone, and even metal, to make markings on stone, bone, or other hard surface to communicate information to her/himself about nearby or distant places, but also to others. And later the geographer (even if not called by that label) would by hand construct maps, charts, and tables about features and places on the planet. And, in a present context, we find the geog-

rapher scientist using laptop computers and laboratory databases containing satellite imagery to collect and share information and use GIS to examine weather, crop, or disease patterns. All are examples of geographers or others, who not even aware they are geographers, using information and the technologies of communication to describe, illustrate, analyze, and forecast earth conditions and environments.

Introduction

The information and communication technologies or ICTs that we associate with today's world of the investigator and scholar are but a few of many that have been developed and utilized in the past. Other forms in the past include the stylus or pen, the use of parchment to preserve the word or symbol, the development of special inks and colors, the printing press, moveable type, and much more recently the typewriter and computer. These innovations in information production and reproduction, which represent ways to communicate, have been supplemented by other technologies, including the telegraph, telephone, cable (underground and under water), satellite, television, fax machine, and even today wireless technologies. While we may not think of these as geographical technologies, they are because they affect the information we collect, describe, digest, process, analyze, export, and share with others. Space-adjusting technologies not only affect how we see, analyze, describe, and predict the future of places and environments, but also how we map. The map is basically a product of information, a product that has been constructed on the basis of information collected and prepared in some way for illustration, analysis, and sharing. The map in this context is also a product of communication and a communication between the producer and the consumer. Maps have "languages" around them and in them, languages that are familiar to the producer, the reader, and the user. Those maps that are most useful have a common language (information) that is easily understood; that language may be symbols, words, objects (shapes, coastlines, etc.), but also useful data about places familiar and unfamiliar. While the earliest humans constructed maps of familiar places nearby (often mere sketches) and the 21st century cartographer prepares maps of planets and universes beyond Earth, the maps have some underlying similarities. They are depictions of places on surfaces that are designed to communicate information about places. Whether using low or high tech devices, the reader, user, and producer all are integrally involved in the production, depiction, and dissemination of information.

Geography emerged as a formal discipline in the academy because of its focus specifically on the writing and communicating about places. It was recognized for its unique perspective, viz., looking at where things were, what was where, why was something where it was, and why things were just the way they were, are, or might be? This perspective made it a catholic discipline, that is, one that considered a wide variety of subject matter that dealt with places, regions, landscapes, environments, and the geometries of spatial features (networks, nodes, hierarchies, and systems). While geography became an institutionalized discipline focusing on the "whereness" and "environmental" nature of things, other disciplines were also making use of the geographic information that was produced. That is, there was and is "a geography" produced beyond geography" beyond our traditional ways of defining geography. That information might be about places, regions, landscapes, and environments, but it also was about how that information was communicated, viz., through maps. Maps because recognized as a legitimate, popular and acceptable way to portray, display, analyze, and predict information, but they also became an integral in how other disciplines studied a

topic, problem or region. In this way maps were more than simply documents with graphical information about places or regions, but they also served as ways to communicate information to scholars within their own discipline, but to other disciplines, governments, organizations, and a wider public.

It is thus important to recognize that even before formal university disciplines were created and included in their instructional and research missions, there were scholars undertaking questions related to what became identified as geography. Some acknowledged themselves as geographers because of their primary focus on features, topics, and problems geographical, but also many others identified themselves as geologists, anthropologists, economists, sociologists, linguists, historians, political scientists, artists, and writers. These individuals became part of the larger community of those studying, writing about, illustrating, and analyzing information about places and environments. The information they studied was earth-related, whether a village, a culture, an ecosystem, a shoreline, a livelihood, a transportation network, a sacred space, or a state. They communicated that information about these places, environments, and what we would today call networks and systems, through words, drawings, engravings, paintings, and later photographs, film, television, and today, the World Wide Web.

Emergence of three "turns;" spatial, environmental, and information/communication

This emerging inquiry into scholarly questions about places and environments can be seen in two other contexts. One is the focus on questions about information and communication. The second is the "fluid" nature of disciplines. In regards to the first, a term used by critical social theorists today is the "spatial turn," that is, a recognition that space or place matter or are important in looking at human interaction, agency, identity, and organization. While geographers have long recognized that space, place, and environment are important in human welfare and understanding, that nongeographers are also recognizing that this fact is significant in the human equation. When scholars studying culture, language, religion, identity, gender, representation, and human interaction recognize the role of place meaning, territory, human/environment interfaces, and social space, they are beginning to relate to some key concepts long understood by geographers. These scholars may be linguists, novelists, film critics, anthropologists, sociologists, intellectual historians, and political scientists. The results of these cross-disciplinary and interdisciplinary discourses and dialogues tends to blur the distinctive nature of not only formally recognized disciplines, but more importantly, a search for common subject matter. Geographers, with or without other scholars recognizing these concepts, are part of these newly developed common grounds.

In the same way that the "spatial turn" is emerging in the social sciences and humanities, one could present a similar case for an "environmental turn" in the evolving dialogues between the natural or environmental sciences and the social sciences and humanities. Geographers, as noted above, are not the only specialists who study the environment. Entire disciplines have been constructed focusing on one or more sets of phenomena relating to the natural world; geology, biology, meteorology, hydrology, and oceanography come to mind. The recognition that human/environment relations or interfaces are significant in understanding most human cultures, identities, and interactions is becoming apparent. This recognition comes after earlier deterministic writings and analyses which used various "isms" (environmentalism, probabilism, possibilism) to explain why and how physical/ environ-

mental features determined, controlled, or influenced human decision making. Getting beyond this reasoning was critical for geographers and others studying human populations, cultures, economies, and organizations. In moving beyond this thinking, geographers and especially geographers, as they were interested in studying human/environment interfaces, sought to negate the importance of environment in understanding human patterns or occupance, organization, and interaction. The overreaction contributed to formal separation of human and physical/environmental geographers and what they studied. Those few who sought to understand the "bridges" between the human and physical/environmental geography were often in lonely and marginal positions in the geography discipline. But the scholarly worlds have changed in the past decade. Today one notes that major questions of human/environment relations and pressing environmental issues being studied by those in the humanities and social sciences, not just the environmental or natural sciences. Questions are raised about sustainable agriculture, machine-altered landscapes, environmental mismanagement, indigenous farming knowledge, religions and cultural heritage, derelict landscapes (from mining, forestry, and unwise farming), biodiversity, disaster mitigation, and global warming. All beg for inquiries by more than inquiries only by those in one discipline or broad categories such as social sciences or natural sciences. Rather, disciplines that seek to bridge the divisions or gaps in understanding have an opportunity to play distinctive and important roles in scholarly inquiry and scholarly organizations. And geography, because of its long and rich traditions in studying both space and place issues and human/environmental relations stands poised to play a key role, not only in building bridges to other disciplines, but in creating bridges.

The newest "turn" that is emerging might be termed the "information/communication turn." The evolution of this turn can be traced to western societies with postindustrial or quaternary economies. In these economies information or knowledge is the hallmark. That information might be about land use and land values, but also banking (where money is information), health care (health is information), entertainment (movies, tv, books, magazines, etc.), advertising (all advertising is information), publishing (what is published is information), and broadcasting (radio, television). The growth of these "information economies" was evident in the production, consumption, exchange and manipulation of information of all kinds. Whereas journalism and broadcasting were early identified as disciplines that studied these information economies, some other disciplines have entered the fray. These included marketing, telecommunications, advertising, computer science, leisure studies, distance education/learning, and new fields, such as photojournalism, software development, technology transfer, election forecasting, and information/communications technologies. Geographers also entered the arena, not only because spatial relations between and among cities, countries, and places have changed with faster and improved modes of transportation and communication, but because they were interested in mapping these information spaces. As stated above, the map has always been a powerful tool in the arsenal of those who produced them and used them. And what would be more valuable than using the map or map projections or elements of maps (colors, symbols, languages) to once again illustrate the importance of information in shrinking worlds. Geographers through the use of Geographic Information Systems (GIS) and Geographic Information Science (GISci) have pioneered the uses of many innovations about maps and map projections for use by others interested in information production, dissemination, manipulation, and use. Maps with modern technologies can be produced instantly of almost any subject at any scale, sent anywhere, and used for almost any purpose by anyone. The same applies to visual images:

photographs, television images, or images on the Internet. All are all information products. Understanding these information depictions today in the world today, and how they relate to globalization, imperialism, hegemony, or tyranny, one has to recognize their linkages with information. And while geography contributes to our understanding of information networks, flows, production and consumption, so do other disciplines Geography is in a good place to benefit from these developments precisely because inherently place, space, region, and landscape information is highly sought after by those in many fields of study. Not only those studying weather patterns and stock markets, but also real estate investments, immigration flows, spread of diseases, environmental destruction, selling of tourist destinations and flows of local and global tourists. All producers of information are also interested in "geography questions," such as, where can I sell my magazines, my music and videos, sports equipment, new foods and drinks, new fashions and hairstyles, biotech products, television programs, and cellular phones? All these are information products in which one utilizes various communications technologies to "sell" the product.

Geography as a "fluid" discipline

Because of geography's focus on studying subject matter in common with the humanities and sciences or the human and natural sciences, it has sometime been called *the* bridging discipline or an *interfacing* or *fusing* discipline. That is, it is the discipline most concerned with studying the *relationships* between the human and physical phenomena. While these are perspectives or definitions that many professionals in the past and present can and will agree with, I prefer to think of geography today as a *fluid* discipline. It is "fluid" in three senses. First, there are less sharp demarcations or divisions between human and physical geography; the intellectual boundaries have indeed become blurred, which is all to the good. Seldom is scholarship within any discipline, and even between disciplines, easy to carve out in nice, neat "information" (intellectual) packages. Second, it is fluid in the sense that the intellectual content of many disciplines is less easy to define and organize. This description fits those who work on the interfaces between physics and chemistry, biology and anthropology, health care and environmental science, immigration law and geopolitics, planetary sciences, and the visual arts (photography, painting, sculpture, and landscaping). We also witness this fluidity emerging in geography's linkages with biology, sustainability, medicine, gerontology, geophysics, marketing, and regionalism (a field that half dozen disciplines can claim legitimacy). Third, there is a recognition that the new paradigms or "turns" as described above, are leading to a rethinking of what exactly is a discipline's core? How distinctive is it? And a more basic question is what do all these questions really tell us about the intellectual landscape today?

While there are scholars in many disciplines (not only geography) who probably bemoan the "loss of their core" and despair the "fragmentation of knowledge" (which really means how they view the world) all around them, there are others who consider the worlds of scholarship and knowledge now as more open. They welcome alternative perspectives, views, models, and theories. That is, there is no "retreat" from a core, rather an awakening or reawakening of some new ways, models, and theories to describe, analyze, forecast, and map what they have long studied. The state of learning today is looking at the interstices or those places where new fields and subfields are emerging. This statement applies just as much to the physical and natural sciences as to the social and behavioral sciences and humanities. In each of the "turns" mentioned in the previous section, there are some new and

possibly different ways of looking at human relations, cultures, landscapes, events, economies, activities, and organizations. These perspectives are inherently different "information" packages. They may come packaged in different ways or familiar ways to geographers; there may be new vocabularies, theories, paradigms, and systems. But there may also be new ways of looking at photographs, paintings, films, advertisements, and maps, as well as symbols, graphs, colors, and images (satellite and cartoon-like). Inherently these are all information products that are being communicated to others, some to disciplines with similar intellectual heritages (the sciences or humanities), but also to those forging new intellectual terrains.

Geography is one of those disciplines that, because of its transcending and overarching intellectual heritage, viz., a focus on earth phenomena and human/environmental phenomena, can easily assist other disciplines to learn about what these intellectual "turns" mean in studying the human condition. But geography also can easily learn from those other disciplines which are environmental or information/communication based. They can assist geographers studying such topics as quality of life, religion and identity, social justice, or a deeper understanding of the human condition. In this sense, geography's "fluidity" is positive and contributing to the blurring and fuzzy nature of scholarship today. Geographers are both exporters and importers of knowledge, but also they are "gatekeepers" in the sense that they can demonstrate the key importance that space, environment, and information/communications technologies play in studying earth phenomena. The map is but one example of this new found importance of geography in many academic, policy, and private sector environments. While the map is inherently part of the "genetic makeup" of almost every geographer, we also recognize that maps, whether hand drawn or GIS produced, are important to those in studying comparative planetary systems, the human anatomy, circulation patterns in cities, erosional processes, siting controversial facilities, simulating the effective delivery of human social services, or defining land, sea, and air boundaries.

All the technologies mentioned above, whether cartography, satellite, computer or wireless, have changed geography. But they have also changed geographers and how geographers look at themselves, their own training and what they can contribute to helping others understand human/environment relations.

The evolution of the electronic geography

Disciplines, and scholars within their ranks, change as a result of intellectual exchanges that occur within, between and among related fields and subfields. The economic geographer would be influenced in her/his instruction and research by its transpiring in economics, marketing, finance, industrial management science, but also possibly in women's studies, regional economics, and public policy. The fluvial geomorphologist would follow closely what research is being conducted in hydrology and surface geology, and also likely in landscape ecology, biometeorology, public policy, and social engineering. And the geographer interested in maps and images would find that her/his interests in remote sensing, GIScience, and automated cartography would resonate with those in photojournalism, film studies, advertising, forestry, and archaeology. These, and other examples we can think of, illustrate that the topics, techniques, models, theories, and methods used by traditionally and contemporary trained geographers have an appeal outside our disciplinary boundaries.

What we are witnessing today in society, at least in much of the rich, developed, and urbanized worlds, are the introduction of new information/communication technologies that

are changing not only one's private life, but one's academic and professional life. I am not speaking of the telephone, typewriter, radio, and television, all which changed the space, environment, and information/communications content of individuals, households, rural areas and cities, and states. Rather I am addressing the impact of Information Communications Technologies (ICTs), that is, computers, the internet, the World Wide Web and wireless technologies (including cellular phones and battery operated laptops). These are technologies that convey various kinds of information: numerical (datasets), visual (photographs, images, maps, graphs), sounds, and words (text). How have these technologies changed geography and geographers? How are they changing *what* geographers do, how they do it, and *where* they do it? And how have these ICTs changed the nature of teaching and learning, information generated and disseminated, the intellectual ties to our disciplines and professions, our professional organizations, and a world still defined by state boundaries?

Below I focus on some of the salient features of the new worlds of electronic geography. This discussion is followed by some of the challenges facing scholars, organizations and institutions, and the state. Before proceeding, it is worth mentioning that I believe geography can provide an essential role in understanding these new worlds and the challenges they pose. That is because the features, developments, problems, and futures of new ICTs are inherently spatial. That is, while some places (households, universities, cities, regions, and countries) may first experience these new worlds, others later, and perhaps some much later. In another context, there are still places (households, universities, cities, regions, and countries) that are poorly or little connected to some older ICTs, even in the rich developed industrial worlds. There are places that are without electricity, let alone refrigerators, phones, and televisions; they also are without Internet connections, WWW access, and satellite news coverage. But these places may utilize wireless technologies, provided someone can afford them and know how to operate them. I state these caveats as I am very much aware of the technological "gaps" in the world that individuals, households, universities, businesses, and cities experience. While the glamour of ICTs in the rich and "neo-rich" world receives much publicity and visibility, there are many more places in the developing world where these advances are rare and even unknown.

Ten key features of the electronic worlds

There are a number of distinguishing features that define the electronic worlds. For each below I discuss its importance to the worlds of scholarship and the individual scholar. Many, in fact most, of these are not only of importance to geography and geographers. Rather they could, might, and will apply to scholars in many fields.

1. **Global networking**. Advances associated with the Internet change the scale and dimensions of scholarly life and communities. That libraries, laboratories, offices, and individuals are electronically and globally connected means there are new and more "worlds" available than previously. In an ideal sense (which does not exist in reality), one could contact "anyone anywhere at any time about anything" or access "anything ever written about any subject by anyone." One could send or receive information while living on a remote (traditionally) island in the South Pacific, have a meal at a cybercafe in Amsterdam, vacationing aboard a cruise shop in the South Indian Ocean, or reporting on environmental destruction in the Sahel.

The realities of the electronic networking permit those who are connected to exchange ideas, tabular data, photographs, and maps, with others (individuals or groups) easily, quickly, and inexpensively. (This latter point is debatable.) Whereas transactions between scholars or between scholars and libraries and organizations required weeks or months in pre-Internet days, that transportation and communication space in many cases is reduced to less than ten seconds. (That assumes systems operate and we know how to use them!) That any place may be reached within seconds has contributed to the demise of distance or the tyranny of distance as an impediment to the acquisition of information (not necessarily to understanding).

2. **Electronic scholarly communities and communication**. The nature of scholarly communication is changing the configuration of academic organizations and societies. Whereas earlier these were strongly national and included many who knew each other personally as well as professionally, the ICTs have changed communication and communities. Word of mouth, letter writing, and conversations at national conferences have been supplemented by email correspondence, subscriptions to listservs where some are active, and others less active, and still others "lurkers," and where subscribers "drop in" and "drop out" of scholarly discussion groups. The "membership" of these electronic and virtual communities could be anyone who shares an interest on that topic or problem; they may be professionals in a given field with many years of experience and a lengthy list of scholarly publications, but they could also be students (young and old), interested bystanders, and professionals in related fields who "join" to learn new methods, vocabularies, databases, and information about forthcoming articles, books, and conferences. The professional listservs also replace much "paper" information distributed previously by national organizations and associations.

3. **Electronic publishing**. Electronic journalism is already a reality. One might anticipate that the future "electronic journal" will be more "visual" in content, rather than written text. The "text" will be more "bullets" than paragraphs. We already observe this trend in many reports issued by the private sector, that is, they are short, factual, and succinct. (This visual, graphical, and colorful format is behind the success of the daily newspaper *USA Today*, which presents "news" items in appealing [almost playful and seductive] formats.) The worlds of electronic publishing will see the emergence of truly "niche" journals, some which may have a very small circulation, and a short "life span." Mainline disciplinary journals will remain important places to publish, but so will the electronic journals where one can submit an "electronic manuscript" and have findings appear in electronic format with one or two weeks after a discovery. An unanswered question that is already surfacing in the academy is how does one "count" electronic journals "publications" when being considered for promotion and tenure? Does an "electronic publication" have as much influence as an article or report published in a paper journal? Do "citations" in electronic journals count as much as those in paper journals?

4. **The origins of cutting-edge knowledge**. An electronic scholarly world is changing the locations where new knowledge is produced. This may be knowledge about familiar topics, but also topics that are emerging as a result of the rapid dis-

semination of information produced by those in one's own specialization, and those in related fields. Whereas traditional "big name" universities with well connected faculty, huge libraries, and major research laboratories were once considered the sources of major breakthroughs, this picture has changed dramatically with the rise of the Internet. The ease with which scholars anywhere can communicate (the "democraticization of scholarship"), the easy access to journals, reference works, and data bases, and the availability immediately of new findings in electronic form (that is, before printed journals) has meant that new discoveries can emerge from lesser known universities, laboratories, and professional offices anywhere in the world. The individual producing the new knowledge or product would not have to be a recognized leader, but could be an unknown to the scholarly community. It could even be someone just starting a career who did not have the professional pedigree or necessary professional connections that earlier would have been necessary to publish in a major professional journal. And it could be a breakthrough achieved by an international and interdisciplinary team that only knows each other electronically. And in some fields, the breakthrough may come from someone working in her/his home.

5. **The rise of virtual libraries**. Libraries are attaining a different "look" that those we are traditionally accustomed. As permanent structures, often with ornate architecture and comfortable interiors, filled with books and journals, the library of the electronic present and future contains recorded information on disks and computer files, computers, and rooms for scanning texts, reproducing images, and translating documents. The librarians and technicians assist in accessing and retrieving electronic information (visual, numerical, text). The sources one might consult in working on a project could come in electronic form from anywhere in the world. Even one's personal library in the electronic world is likely to have much space devoted to computers of various capabilities and space for electronic files rather than printed materials (journals and books). Many public and private libraries are already preparing their holdings for electronic access anywhere. The same is true for commercial publishers and organizations. Universities, governments, private companies, and individuals will develop materials for electronic use and make them available inexpensively or at a cost to users. These may be historical documents and databases, maps and charts, photographs, as well as written texts. In short, one could access a map or photograph about anything on any subject (for a cost !!) from someone holding that information in a public library or private holding. Project Alexandria (a global virtual library) is a step I in this direction.

6. **Virtual programs, degrees, and certification**. The availability of more information from more sources, the ease with which sources (individuals, societies, libraries, etc.) can be accessed electronically to provide information of all kinds (maps, texts, documents, photographs, archives, databases, etc.), and use of such information by specialists and aspiring professionals will change the educational terrain. Two examples. One could take a course on tropical biogeography that is offered for credit by the University of Ibadan or the University of the West Indies. The content would include on-line materials provided by professors residing in universities in Côte d'Ivoire, Kenya, Madagascar, Indonesia, Brazil, Costa Rica, Haiti,

and Trinidad. The required reading list would include materials one could access electronically from libraries in Paris, Rome, Geneva, Mombasa, Accra, Mexico City, Miami, Belém, Havana, Singapore, and Suva. Professors who live in thirty universities around the world and who specialize in tropical botany, biodiversity, taxonomy, ecosystems modeling, and vegetation mapping would be available to answer questions from those taking the class. Example two. Someone could enroll in a virtual field methods class on Comparative Squatter Settlements, in which the students, working with professors and NGO specialists in different cities in Africa and Asia, would use high resolution satellite photography to map the land uses, population densities, microclimates, transportation movements, and water availability in major cities. There are two other dimensions of the virtual learning on the horizon. First, one could obtain certification for programs that are geared to professionals or paraprofessionals wanting expertise offered by specialists in different countries. These might be short-term (4-6 weeks) programs on sustainable agriculture in the mid-latitudes, disaster preparedness in megacities, monitoring elections in regions of cultural conflicts, and gender empowerment in rural Southwest Asia. These could be academic "minors" that would supplement or complement one's degree from a university where one attended official classes in person. These could be tailor made for the generalist and specialist, regardless of background. Some could have a more formal structure, others basically "self-taught." Second, one could earn a "virtual degree" from a single or multimodal university that functions as an electronic university. That is, all exams, credits, payments for instruction, degree verification etc. are handled by a university whose official mailing address and electronic office could be anywhere in the world.

7. **English as the international language of scholarship**. The Internet has ushered in English as the dominant language of international dialogue. Those who already know how to read, write, and speak English are at a distinct advantage in being able to use the Internet for communication and learning the information that comes across the screen. For those who do not know English, they may use the Internet to learn not only subject matter, but equally as important to improve their reading and writing skills. Scholars publishing articles in English ensure are guaranteed that their research will reach a larger geographical and numerical audience than any other language. Journals not publishing in English commonly include English language abstracts. Also since most of the "traffic" on the Internet is in English, it is advantageous to be able to learn to use this language. Scholarly listservs, discussion groups, and chat rooms, etc. are also English dominated. While English (and it is usually American rather than British English in spelling) is assuming this almost imperialistic role in international scholarly community, it does not negate the importance of learning other languages and using other alphabets. Different keyboard formats and software packages are available. The international scholar in almost any field in the present and future would be someone who is able to read, write, and speak in more than two (preferably four or five) major languages. We can also expect that future scholars will practice more "code switching" (that is, speaking phrases and sentences interchangeably in multiple languages) in conversation, in publishing, and presentations.

8. **Team research.** The ease in communicating with colleagues, known and unknown within and outside one's discipline, facilitates undertaking projects that may have been a difficulty previously. Distance, language facility, unavailable and inaccessible data or resource materials, all which were barriers to professional interaction and scholarly communication in the past are lessened with advances in electronic technologies. Even issues of cost in obtaining available data or travel to libraries or for field research cease to become obstacles, especially where comparative research is highly desired. For those "lone scholars" who undertook research on topics because there was no colleague in her/his department or university with the same interests, they now can connect electronically with those in distant locations, in different departments and universities, and in the private and public sector. One could anticipate that interdisciplinary and international team research would be able to tackle some problems that have evaded examination previously; these might include the causes of biodiversity decline or increase, human-animal disease ecologies, sustainable land use-land cover development, and reducing global warming. (The same holds true for those studying the human anatomy, circulation system, and brain.) Very few problems are truly "discipline specific," rather, they call for reaching out or extending beyond one's own formal disciplinary training and thinking. Evidence of these cross-national team undertakings will be seen in the university and disciplinary affiliations of those publishing research reports and articles, the applications for research funding to regional and international foundations, and the permutations of research findings by research teams in multiple languages.

9. **Preplexing ethical issues.** Advances in ICTs are ushering in a new set of professional ethical concerns. These emerge not only because of the volume of material that is free (not really free !) on the Internet on almost any subject, but because of a change in behavior of some scholars, viz., that they must demonstrate or "prove" their professional success to others. And they "prove" their success by engaging in conduct that is clearly unprofessional and unacceptable. There are various examples of what might term unprofessional conduct in an electronic world. These include publishing results (data and analysis, including maps and photographs) that are not one's own and not giving proper professional citations and credit. Copying another's work without citation is plagiarism; and copying one's own previous work and not citing the source is self-plagiarism. For those who have multiple language skills, an ability to translate their or another's work into another language without citation is relatively easy. Fabricating results, whether based on field or lab data, to agree with one's hypothesis or to question another's hypothesis, is also possible, especially if the data collected were costly to analyze (lab analysis too expensive) or nearly impossible for another to obtain (perhaps from little researched areas or infrequently surveyed human populations). Even for those who prize words more than numbers or maps, it is not difficult for someone to copy the wording and phrasing of another. When those who are "accused" of professional wrongdoing of the types just described are confronted by their peers, students, or professional societies, there are usually self-righteous denials. Or if the evidence of plagiarism or unethical behavior is presented, the "defense" may be that "everyone does it" or "it is so easy to do, that I did not think I would get caught." Regardless of the nature of the behavior or the causes, it is recognized that ICTs can contribute to such behavior. It also

means that scholarly organizations and communities have to confront the ethical issues head-on, including instructing our students into acceptable professional scholarship. The nature of scholarly inquiry and reporting are basically at issue. These issues are of concern to those in all professional fields today.

10. **The State remains important.** While critical social theorists, including some geographers, discuss the "hollowing out" the state, viz., its demise or disappearance on the international scene because of globalization and the diffusion of ICTs, the state is far from disappearing as a major actor in the scholarly world. Without question, international phone calls can be made easier, faster, and cheaper than even a decade ago, fax machines permit textual materials and documents to be sent almost anywhere, individuals have personal computers to connect them with colleagues (known and unknown) around the world, and libraries and scholars can access databases (maps, census reports, journals and books) using the World Wide Web at little or no cost to some individuals. These developments mean that the international political boundaries have much less meaning in the daily life of the academic and the university. While this "rich world" or "western" view may be assumed to exist everywhere, it does not, not even in the rich world, where "gaps" or "digital divides" (class, occupation, gender, language, and region) remain. The state plays a crucial role in ICT decisions, including where fiber optic lines will be constructed, which offices, departments and laboratories will be connected first, who receives personal computers and WWW access first and second, and who is able to use fax machines and the WWW, if uses are restricted? The state is also the entity responsible for the curricula and establishing the criteria and qualifications for degree programs (whether real or virtual courses), the qualifications for those officially certified as professionals (engineers, architects, planners, et al.), the content of information seen or read on electronic media, and authorized to use satellite imagery for economic development, and licensing ownership of media technologies (radio, television, Internet usage). There are states on the contemporary world political map that are basically open to the flows of information and communication associated with the latest technologies. But there are other states that monitor closely the ownership of and access to electronic media, and the content of what can be seen, heard, and read. Fear of electronic technology is not a phenomenon that emerged with the Internet. Thus a paradox persists, viz., that the electronic worlds lessen the role of the state in regards to what electronic information enters, stays, and exits, but the state also plays an important funding, licensing, regulatory, and "filtering" or gatekeeping role.

Eight challenges confronting the new electronic worlds

In light of the new electronic worlds that already face the geographer and other scholars, I envision eight challenges that will need to be addressed. These are for the individual scholars and their teaching, research, and service agendas, but also for professional organizations and societies. Those listed below are presented in any rank order of importance.

1. **Towards more inclusiveness and boundary sharing.** There are many other professionals in the academy, government, and private sector who are not professionally trained geographers, but who study many of the same problems and issues as professional geographers. These work on environmental quality, biodiversity, sustainable development, health care and epidemiology, mitigating disasters, legal reform and criminal justice, the delivery of social services, allocation of resources (human and financial), urban and regional policy. Also there are those who study information and communications topics; these include distance learning, telemedicine and teleconferencing, media reporting, advertising, and tourism place promotion. The fields or subfields share much in common with geographers because they work with or study landscapes, places, regions, and systems. These fields of inquiry would be strengthened by geographers reaching out to them to apprise them of useful concepts, methods, and techniques. In like manner, geography itself would benefit from these creative dialogues. The successful, contributing, and viable disciplines in the future will be those that are both "knowledge exporters and importers." Many scholars already recognize that the frontiers of any fields are in those "porous spaces" between disciplines; these are where new programs or "hybrids" emerge.

2. **Expanded professional networks and organizations.** In light of the points made above, it would behoove geographers to explore creative and meaningful ways to expand our intellectual horizons. Expansion can be attained in several ways, including engaging in team-instruction, team-research, and team-service assignments, but also through active participation in professional meetings, associations, and organizations of other scholarly communities. Geographers by their very training and perspective have an appreciation of subject matter from those in the natural and social sciences and humanities, as well as those who study spatial techniques. It would seem desirable for geographers to attend regularly the professional conferences of related disciplines; the contribution could be organizing and chairing sessions, presenting papers, and serving as discussants. These initiatives could be expanded to include membership on commissions and foundations making decisions on research funding, serving on journal and book editorial boards, and publishing research results with others in non-geography and interdisciplinary journals. Another initiative would be for disciplinary professional societies and associations to make efforts to recruit scholars in related fields as members, possibly at costs less than those who are professional geographers; we need to encourage those who are "geography friendly" to publish in our major journals. That there are already geographers who participate in conferences of other disciplines, especially area studies (which are cross-disciplinary) is a step in the right direction. We can also expect that many academic and professional associations will drop "national" labels in their organizational titles, for the simple reason that they are more than national in membership, research, and mission.

3. **Knowledge sharing.** With the wide variety of data being produced about places, environments, cultures, economies, and individuals at local, national, and international scales, questions arise as to their collection, availability and access. Geographers need to be among those who are actively involved in the data collection,

distribution, and acquisition. This need applies to those who are using visual and numerical data, especially electronic data bases since they will continue to be much in demand. While many data are and will be collected by both government and private sources, it leads one to question whether they will be available to scholars and governments, that is, outside of those that collected them. While researchers in universities and those in the private sector in the rich world may be able to acquire these data for multiple uses, what about those in poor countries? Will their planners and scholars, whether geographers, biologists, economists, anthropologists, health care professionals, and those running elections or managing cities be able to acquire data and reports, or will they be too costly to purchase? The knowledge sharing also applies to those who make maps and utilize GIS for resource or planning purposes. In worlds where ICTs permit the easy transfer of information about almost any topic to almost any location, some rudimentary questions about equitable delivery systems need to be addressed. Scholarly organizations, which are represented by many of those collecting the data, are in a good position to be advocates for widespread and inexpensive or low cost distribution.

4. **Developing the appropriate skills**. What skills will be desirable and essential for the future geographer? This question always surfaces when there are new technologies in any field, whether in the health, biological, earth, or social sciences. Must one be able to construct a map using computer software? Is field training required in both human and physical geography? Should one know how to prepare social surveys? And have intimate knowledge of GIS? It would seem that for the foreseeable future, the human geographer should have some familiarity with quantitative, qualitative, and visual methodologies. Also some knowledge of GIS packages, applications, and theories would also seem desirable as will the social dimensions of GIScience. A strong case could also be made that the future professional should have multiple language training

5. **Sharing of skills.** Geography has a strong tradition of developing specializations in skills, especially those relating to maps. Maps are and remain a cornerstone of the discipline. We are not the only field of study that uses maps. While geographers make use of maps both to depict patterns and processes, other disciplines may use them primarily for locational or descriptive purposes. The cartographic skills, which include map presentation and interpretation, would be useful to share with other disciplines that may not be aware of the importance of space or spatial relations or visually representing data. The new or renewed interest in space in non-geography communities, or what was described above as the "spatial turn," should ideally be accompanied by the importance of spatial skills, especially cartography, remote sensing imagery, and GIS. Adding a "mapping dimension" to the thinking of those concerned with environmental pollution, land use planning, administrative redistricting, health care delivery would be lessons that geographers could provide others. These professionals would come to appreciate that geography is more than simply representing materials from census data or satellite imagery, but one that seeks to understand the whys and wherefores of the way things are.

6. **Visual Learning**. Geography is a discipline that historically has been and still is visually oriented. That focus is evident in our use of maps of various types, whether sketch maps, or maps of local areas, continents, oceans, or world. An integral part of cartography during the past, and today, is how to present and represent materials in ways that will be most useful to the reader or consumer. To many geographers the map remains equal or more important than the word or text. But geographers also have utilized other illustrative forms, especially photographs. It is not unusual for the geographer to include photos of landscapes, economic activities, habitations, people, and built environments in textbooks, chapters, and articles. Photos are also incorporated frequently into presentations, whether those illustrations be slides or PowerPoint presentations. And those utilizing GIS also rely heavily on presenting integrated material in appealing and attractive ways. While visual information is a major component of how geographers communicate, we are not the only discipline that engages in visual learning. Others include photography, advertising and marketing (whether places, people, or products), the print (newspapers and magazines) and visual (television), film studies, and designers of WWW pages. One could even make the case that visual learning is replacing learning by reading narrative. Should this be the case, geographers need to devote more time to "reading and interpreting" visual presentations, including maps and photos, and learn from other "visual" fields how to critically read photographs (including in our textbooks), webpages, advertisements, museum displays, and television. Earlier importance of "the visual" based on films and later television has been supplemented by the WWW, in which information is "seen" on computer screens and easily transmitted elsewhere. A component of the visualization includes the psychology of colors and how colors, even seductively used, can convey images about places, peoples, and cultures. Think of the colors used on maps governments produce to depict friends and enemies, as well as the map projections that depict that state's place on the world political map.

7. **Expanded applications.** The directions suggested above present new and renewed opportunities for geographers, and geographers working with others, to engage in some practical applications facing humankind. Granted that geographers already have place and region knowledge and knowledge of geographical processes at local and global scales. But what is done with that knowledge will be a challenge facing the discipline's practitioners in the coming years. Will geographers operate in isolation (like oysters) or will they "reach out" and make deliberate efforts to collaborate with others on addressing pressing issues, including environmental deterioration, unsustainable economies, ensuring basic human needs (housing, water, nutrition, education), inadequate health care delivery, and an inequitable allocation of human resources. Will the geographer provide instruction and strategies in empowering (that is, "bottom up") technologies, especially ICTs, to those who are marginalized, landless, poor, and victims of discrimination because of age, gender, class, language, religion, ethnicity, or nationality? Will the diffusion of ICTs lead to a "democraticization" of information access? These and many other questions are inherently spatial and environmental problems that geographers working in concert with others could provide constructive solutions. The arsenal of techniques and technologies geographers have available, including administering social surveys,

map making, and GIS, could result in geography playing a major policy role in local, regional, and global problem solving.

8. **Persistent "gaps" and "divides."** The advances in technology, subject matter, and applications of new theories that have been discussed above will not occur in all places at the same time. Nor will they be adopted by everyone simultaneously. Rather there are likely to be multiple and serious "gaps" or "divides" that will continue to persist at all scales. Those will be evident at the scale of the individual scholar and what she/he will know about new technologies and subject matter, and what one's university or workplace is willing to invest in, for example, the latest computers, on-line data bases, electronic journal access, Internet and WWW usage. The "divides" may also be within universities, that is, some departments are favored over others, and within university systems in a country. Some colleges and universities will be the "pacesetters," others will be the laggards. Some will provide instruction on how to use the latest technologies, others will not. Some may charge (and perhaps expensive) for Internet use and downloading of GIS for classroom instruction and research use, others will simply be unable to purchase any recent information or technologies. The "end result" of these investments in information and ICTs may be greater inequalities and inequities in knowledge availability and technological acquisition than now exist. Some countries and universities that are constrained by budgets limiting the purchase of journals, books, data, maps, and computers are engaged in cooperative sharing with other universities or partnering with colleagues or universities in other countries. These latter universities could "adopt" programs, departments and universities in other countries to empower their faculties and students to become integrated in the emerging electronic worlds. More of these grassroots efforts at regional and international scales are desired.

Where we go from here?

This paper explores the emerging worlds of electronic scholarship by focusing on the changes occurring within one discipline, geography, and how its face or shape is likely to change in the coming decade. Many changes, not even on the horizon at this time, are anticipated. While I have listed ten features of these emerging world, one could easily think of another eight or ten. The same holds true for the challenges. A careful retrospective and prospective look at disciplines and universities today suggests that there are probably three "almost certainties" for the immediate future: first, the fluidity in discipline thinking and program development will continue, second, environment and the impacts of ICT have yet to be felt in many traditionally defined disciplines, and third, that spatial thinking and analysis will become a hallmark of more than on the agenda of geographers. There is much we do not know about most subjects, and the fusing or merging or subject matter will bring respect for others' views and paradigms and a steady stream of intellectual progress for all concerned. The years and decades ahead are exciting times to be geographers, because we will witness new and creative ways to write about, describe, map, and analyze our hometowns, our earth, and planetary systems.

The future geographer might hold a special "stylus" memory pen that will permit one to rub it across the text and receive instant translation into multiple languages or "scan" a map with special glasses or "telepens" and send that image electronically anywhere in the world or use special "translation" pens that will permit someone to write a sentence in one language and have it sent electronically to another location and translated into another language instantly. While we do not know what the visual, manipulative, and other technologies will be in the next twenty or fifty years, we do know that the acquisition, storage, transfer, and depiction of geo-information will be in demand by individuals, organizations, and states.

Dedication

**I dedicate this paper to the families and friends of the 74 Spanish peacekeepers who had just completed road building projects in Afghanistan and were killed in a tragic plane crash in eastern Turkey on 25 May as they were en route home.*

Abstract. Disciplines and scholarly organizations, and their professionals and practitioners, are affected by the introduction of new technologies in the classroom, workplace, public and private sectors. Geography has always been a discipline that introduces and utilizes technologies in writing about, describing, analyzing, and forecasting spatial patterns and processes. The map is but one of those technologies we have utilized in our geographical inquiries. Others are the camera, remote sensing images, and today, GIS systems. Technologies have been used to map landscapes, activities, human/environment interactions, regions and systems at local and global scales. What is emerging in the academic world and real worlds of economies, culture, public policy, and geopolitics is the emergence of three "turns," spatial, environmental, and information/communication. Geography is assuming a new and major role in these transdisciplinary inquiries, in part because it is a "fluid" discipline whose concepts, theories, and methodologies resonate with new and old fields in the humanities, social and natural sciences. Many of these emerging interfaces are associated with "electronic geographies," that is, the impacts of ICT (information and communications technologies) on the locus of pioneering research, professional communication and career advancement, available resource materials, training and certification, and professional ethics. These advances also present some challenges to present and future generations of "electronic world" geographers; these include moves to greater inclusiveness, expanding disciplinary and organizational memberships, acquiring new technical and technological skills, emphasizing the importance of visual learning, and expanding applications to the scientific, policy, and corporate sector communities. The challenge for geography and geographers is to explore ways to show the importance of spatial, place and human/environmental knowledge at all scales, knowledge that is a part of the common ground we share with colleagues in the humanities and sciences.

Key words: transdisciplinary inquiries - fluid boundaries - electronic worlds - 21st century scholarship - disciplinary challenges.

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