The Transition in Cartography

การเปลี่ยนแปลงในศาสตร์แห่งการทำแผนที่

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การทำแผนที่ (Cartography) เป็นสาขาวิชาหนึ่งที่ถูกบรรจุอยู่ในหลักสูตรการเรียนการสอนของภาควิชาภูมิศาสตร์มาเป็นระยะเวลานาน เนื่องจากแผนที่ถือเป็นเครื่องมือที่สำคัญอันหนึ่งของนักภูมิศาสตร์สำหรับใช้ในการสื่อสารข้อมูลทางพื้นที่ไปยังผู้ใช้แผนที่ บทความฉบับนี้ต้องการนำเสนอการเปลี่ยนแปลงที่เกิดขึ้นกับศาสตร์การทำแผนที่ในหลายแง่มุม โดยในช่วงแรกเป็นการนำเสนอผ่านการศึกษาผลงานของ Arthur H. Robinson (1915-2004) ผู้ซึ่งถูกยกย่องให้เป็นบิดาแห่งการทำ

แผนที่ของอเมริกา โดยในปี 1950 เขาได้คาดการณ์ในอนาคตถึงการเปลี่ยนแปลงที่จะเกิดขึ้นกับการทำแผนที่สำหรับช่วงปี 1975-2000 ทั้งทางด้านแนวคิด เทคนิค และการเรียนการสอน ได้อย่างน่าสนใจ ส่วนช่วงที่สองเป็นการวิเคราะห์การทำนายของ Robinson กับสภาวการณ์ที่เกิดขึ้นภายหลังการทำนายของเขาจนถึงปัจจุบัน โดยเฉพาะการรับเอาระบบสารสนเทศภูมิศาสตร์ (Geographic Information Systems) มาใช้ในสาขาวิชา ซึ่งได้ทำให้ภาควิชาภูมิศาสตร์ได้รับความสนใจจากบุคคลภายนอกเป็นอย่างมาก จนทำให้สาขาวิชาการทำแผนที่แบบดั้งเดิมได้ลดบทบาทความสำคัญลงไป และต่อมาก็ได้เกิดเป็นข้อถกเถียงระหว่างบทความทางวิชาการต่างๆ ถึงการมีอยู่ของสาขาวิชา

คำสำคัญ: การทำแผนที่ ภูมิศาสตร์ ระบบสารสนเทศภูมิศาสตร์ การเปลี่ยนแปลง

Abstract

Geography departments have been offering courses in cartography for decades. Geographers use maps as a tool to communicate spatial data to multiple users. This article aims to present the transition in cartography from a variety of perspectives. The first part of the paper will review the work of Arthur H. Robinson (1951-2004), the dean of American cartography, who anticipated the conceptual, technological and institutional developments in cartography between 1975 and 2000. The second section will introduce developments beyond those predicted by Robinson, including new technology such as Geographic Information Systems (GIS), something which has drawn a great amount of attention from both geographers and those outside geography alike. This technology has recently become a much debated issue in articles in terms of its impact on traditional cartography as a discipline.

Keywords: Cartography, Geography, Geographic Information Systems, transition

Introduction

Mapping is sometimes claimed to be the 'language' of geography (Sauer, 1956). Cartography, in its traditional definition, refers to "the art, science and technology of making maps". Since the computer revolution emerged during the 1980s; however, computer-assisted mapping has played an increasingly important role in cartography, and so the discipline has more recently been defined as "the art, science and technology of spatial data handling" (Wheate, 1996). This paper will study the transition that has taken place in cartography across two major sections. The first section will review the work of Robinson (1977), who is often honored as being the dean of American cartography, as well as the interesting curriculum developments made by Nyerges (1989). The second part of the paper will investigate the predictions of Robinson and the position of cartography at the present time.

The 'Dean' of American Cartography

Arthur H. Robinson was born in 1915 in Montreal, Quebec in Canada, to parents from the US. He earned an undergraduate degree from Miami University of Ohio in 1936, then gained an MA degree from the University of Wisconsin-Madison (1938) and a Ph.D. from Ohio State University in 1947 (Morrison, 2007).

During the Second World War, Richard Hartshorne, who, in 1941, and in response to a call from President Roosevelt to provide geographical information regarding foreign areas, asked Robinson, a geographer with experience in cartography, to work as chief of the Map Division within the Office of Strategic Services (OSS) (Crampton, 2006). The war had given Robinson experience of the difficulties that can be encountered as a result of the technical, mechanical and organization problems within mapping. However, conceptual problems were the major issues he was concerned with. Most map producing staff at that time were engineers and draftsmen, and the people who prepared the reports at the OSS had little understanding of geographical concepts and interrelationships. As a result, a large number of the maps they produced could not "convey quickly and accurately the essential geographical character of some set of phenomena, sometimes combined with a reference function as well" (Robinson 1979, p. 98). Later, his work achieved its key goal: to improve the efficiency and functionality of maps as communication devices to map users (Crampton, 2006).

Robinson is best known for the map projection he developed. *The Robinson Projection* was designed in 1963 to minimize

distortion, particularly near the equator, and to give the world a realistic appearance. In addition, in 1953, after he joined the Wisconsin faculty, he published a textbook entitled *Element of Cartography,* a publication still regarded as the key introductory text in cartography, and as taught in university geography departments worldwide (Morrison, 2007).

Robinson's Investigation

The Second World War created a huge demand for maps. "Increased planning and controls called for maps; restoring devastated cities and areas required maps; rebuilding the economies of nations demanded maps; [the] expansion of transportation facilities delayed by the war needed maps; [the] analysis of the consequences of development called for maps; integrating water use in drainage basin organization necessitated maps; and so on almost without end" (Robinson, 1979, p. 101).

In *Cartography 1950-2000 (1977)* Robinson and his co-authors reviewed the changes that had taken place in cartography since 1950 and guessed at future developments after 1975. This paper focused on three aspects of the transformations in cartography: conceptual change, technological change and institutional change, and stressed that these changes occurred based on technological innovations; often the results of war.

Conceptual Development

Robinson suggested that the triggers for the development of cartography as a scientific field were a recognized need plus a

useable technology. The need for maps from hundreds of newly formed agencies after the war increased the demand for education in this field from thousands of people who wanted to become 'instant' cartographers (Robinson et al. 1977). Consequently, there was a need to develop a more formal curriculum, as well as ensure that the basic theoretical structures and theories of the field could be tested in an educational setting.

During the first half of this period of investigation (1950-1975), the essential characteristics of this field, that is whether it should be referred to as an art, a science or a technology, had not been fully explored, and there were still arguments taking place as to whether cartography is a science, an art or a technology, when the paper was written in 1976. This debate regarding the status of cartography would receive significant attention in future years.

Thematic cartography attracted a lot of interest during the first 25 years of this review. The geographical subjects discussed at this time ranged from oceanography to social phenomena. The paper predicted that geographers would produce maps by considering the demands and desires of map users. Moreover, concern for the map as storage medium for spatial data and as a medium of communication, would also increase.

Technological Development

Technology developed significantly after 1950. Innovations in computing, electronics and spacecraft technology led to it becoming easier to produce maps, saving of time and money.

New technology improved ground survey precision and provided the means for more effective monitoring. Meanwhile, the use of satellites and special electronic and photographic scanning devices provided and broadened data acquisition capability from remote regions, as known through the term remote sensing. Robinson noted that the use of remote sensing applications in cartography would expand, and that cartographers would have to deal with huge amounts of data from previously unmapped areas by the year 2000, and that satellites images would themselves come to be treated as maps in their own right, requiring cartographers to develop image reading, analysis and interpretation skills.

The development of computer technology provided new opportunities for cartography in terms of tools and applications, with new production materials called digitizing devices taking the place of traditional maps made with ink and a pen.

The data handling and processing capabilities of large computers, plus the development of quantitative techniques, benefited environmental studies by making it possible to hold and process huge numbers of environmental variables; therefore, environmental issues become a new research trend in the field. By 1976, as cartography found itself requiring knowledge in terms of modern data acquisition, the subject of data structures became a major cartographic concern, such that "…the problem would remain of how cartographically to handle the vast amount of available data" (Robinson et al. 1977, p. 9).

The photomap was to become the standard general map of the future, because the major and primary source of data would

be acquired from the high altitude aircraft and satellites, which would be able to generate large amounts of imagery.

Because computer technology allows mapped data to be stored electronically, the number of maps produced on paper has declined. Maps can now be displayed for a long time on computer screens, and can simply be turned off when a presentation ends or a printed map is no longer required. Robinson called the nature of these electronic maps 'temporary maps'.

According to this more advanced technology, made-to-order maps have become practical and their use widespread; however, their design, based in turn upon their purpose, has been taken out of the cartographer's hands. The map user has to a certain extent become the map maker, as he or she wishes to create alternative maps for testing purposes, especially among environmental sciences.

Institutional Development

By 1950, there had been an increase of at least 80 percent in the number of cartographic societies developed since the war, while the number of cartographic journals had increased by 75 percent. As Robinson noted, "A major aim of scholarly societies is to support a journal for the dissemination of research findings and the exchange of philosophical views" (Robinson et al. 1977. p. 13). As a result of cartographers within individual countries grouping together at the national level, the International Cartographic Association (ICA) was founded in 1961.

After 1950 in the United States, the number of institutions offering courses in cartography and related subjects, the number of students enrolled, and the number of higher degrees granted in cartography, all increased significantly. Robinson noted that the role of cartographic education had shifted “as distinct from its subsidiary role as simply part of a geography degree program”. Master’s degrees in cartography were approved, certificate programs developed and cartography-remote sensing options in geography degree programs expanded. Besides this, bachelor and master degrees in cartography began to be offered at the Department of Geography, University of Wisconsin-Madison. By the year 2000, he predicted that the rate of growth in enrollments would not decrease and that education in cartography would continue to expand due to the demand for all kinds of maps, a demand led by the heightened concerns for the environment. Thus, the ‘training course’ of the past, aimed at people from a variety of backgrounds, would not be available in the future, because cartography was likely to become more specialized and more complex. A graduate degree in cartography would become a requirement for a position in the job market. Furthermore, existing or traditional cartographers would need to be retrained in the ways of modern cartography, otherwise they might not be able to deal with the new technological advances.

Curricular Development

The growth of computer technology has brought about revolutionary changes in mapping activities. Spatial data capture, storage, integration, and display and analysis, have advanced

since the early 1980s, through the development of *Geographic Information Systems (GIS)* (Johnston, 2004).

Nyerges (1989) has presented *A Framework for Model Curricula Development in Cartography and Geographic Information Systems* at the Department of Geography, University of Washington, where cartography and GIS are combined into a program titled “CAGIS”. Development of the curriculum within CAGIS is built upon the body of knowledge held within cartography and GIS.

Curriculum development requires guidelines and standards to be developed, in order to clarify who is being educated and what knowledge is being communicated. Professional skills are a primary driving force for producing uniform guidelines for cartographic and GIS programs (Carter, 1985, 1987; as cited in Nyerges, 1989). Not all institutions can offer a full, professional curriculum. Jenks (1987, as cited in Nyerges 1989) presented the essential courses required for geographic cartography education, these being: maps and map reading, visualization and planning of thematic maps, map symbolization and compilation and map composition. These four courses represent the core curriculum for a communications centered approach to cartography. However, smaller departments cannot offer the full graduate program in cartography in line with this kind of curriculum. Jenks has listed other courses important for an effective cartography curriculum, including: statistics for cartographers, GIS, cartographic databases, remote sensing, the history of cartography and map projections.

Beyond the Predictions

According to Robinson, the ability of computer technology to perform database management and analyze the vast amounts of spatial data in existence is called Geographic Information Systems, or GIS, and this has caused geography to receive much more attention from outside disciplines.

The increased incidence of employers seeking students with GIS skills rather than traditional cartography skills, and of universities dropping traditional cartography courses, has called into question the continued existence of the discipline. Consequently, the statement “cartography is dead” has become a much discussed topic among articles since the late 1990s and during the early part of the twentieth century (Unwin, 1994, Wheate, 1996, Wood, 2003, Koch, 2004).

The different ideas in existence on this issue depend on an individual’s viewpoint. Unwin (1994) thinks that cartography is just one of a number of crafts and that almost everyone can be a potential cartographer, as long as he or she knows how to use map making software. He therefore concludes that cartography is almost dead. Wheate (1996); however, thinks that GIS developments these days are simply attempts at copying what cartographers have been doing for decades. “Cartography is still king, but goes by a different name, which we might call ‘GIS mapping’…” (p. 2).

Wood (2003) encouraged people to admit the death of cartography, and was tired of people asking for a professional cartographers license, saying “no matter how badly university-

based cartographers demanded it, few noticed, and even fewer paid attention to the attempts to make mapmaking a profession" (p. 1). On the other hand, Koch (2004) has argued with Wood, saying that cartography is not dead but has just changed its name; first we call geography a science and more recently we have called GIS a science (p. 6). Moreover, all of the hard work in terms of the analytical tools and the other means of calculating spatial information are simply added into the mapping program, which is easy to use; therefore, he does not think it is important to ask for a license any more.

By 2006, mapmaking for special purposes had come much further than even Robinson expected for the year 2000. Not only had made-to-order mapping passed out of cartographers' hands and into the hands of the to the environmental science experts, but also to anyone with a home computer and an internet connection. Modern technology has brought maps directly into people's hands. People can easily practice with the open-access mapping applications, or by 'map hacking'. The popular open-access applications today include Google Earth. Google Map, MapQuest and Yahoo Map. Although these mapping sites are based on geospatial technology, they have been developed by programmers, not by those from cartography or GIS disciplines. Since mapping can be practiced everyday by anyone, cartography has found itself 'undisciplined' (Crampton, 2006).

While we allow simple kinds of maps to be made by 'intruders', members need to pay attention to specialist mapping, particularly that used for dealing with environmental problems. Skole

(2004) suggests that geographers have already championed the use of geospatial information technology, but that with the growing demand for complex environmental and global change research, it now needs someone who can deal with advanced spatial analysis techniques. Therefore, a situation might develop which is not far from the one Robinson predicted.

Conclusion

The changes in cartography have taken place in response to the revolutions in technology, as with other disciplines. The tools being used have changed in many disciplines; accountants now use computers with Microsoft Excel instead of a calculator, a secretary uses a computer with Microsoft Word instead of a typewriter, and a cartographer now uses a computer with GIS, instead of ink, pen and paper. Only the name of the discipline has changed and it does not really matter what we call it. The word “cartography” comes from the Greek, with a meaning similar to “mapmaking”. The recent name we have given the discipline, “GIS”, is simply another name for it. Computer mapping software is a tool which copies what cartographers did before, and the power of modern technology has provided opportunities to make the development of maps more analytical. Geographers who call themselves mapmakers, cartographers or GIS technicians should understand what the map they have made is actually about, and how it can help with specific issues and problems, not just as a simple mirror of its inputs.

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