Introduction

In the first two volumes of this book, we examined all of the steps involved in producing a thematic map and described, in lesser or greater amounts of detail, cartographic procedures that were known but little used until recent times, with computers alone having enabled them to be used and updated. Yet until present, we have not explicitly emphasized the role of computer science in cartography. Its importance was nonetheless highlighted in the brief history of this discipline, provided in the first volume, and it remained of underlying importance, as the majority of current processing and productions make use of this equipment. Yet, cartography continues to evolve and there is a complete revolution underway. This is of course linked to the digital revolution that began in the late 1950s and was announced by W. Tobler in 1959 [TOB 59], but it is above all a result of the fundamental transformations in Information and Communication Technologies (ICTs), which began in the 1980s-1990s, opening up the paradigm of geovisualization. The last volume of this book, dedicated to thematic cartography, will thus focus on these major upheavals, which are essential to the future of the discipline.

The "first" revolution, the digital revolution, was marked by the possibility of moving to and fro between visualization (thus taken to be the last step in the production of a thematic map) and digitization (including all of the steps preceding visualization), leading to what S. Rimbert already called a "map algebra" [RIM 92]. This coming and going, which was now possible, between visible maps and digital data, illustrated in Figure 2.11 (Volume 1), expressed the two major directions of the development of cartography and the disciplines linked to the appearance of computers, then micro-computing, from the 1980s onwards. One pathway developed that was oriented towards reproducing what cartographers knew how to do manually, both by automating it as efficiently as possible (rapidity, accuracy, etc.), and by improving and transforming certain procedures. A second pathway

focused more on data, their structuring, their processing and their modeling, thus leading to geographical information systems among others.

However, it is above all the factors of what we will call "the new technological revolution", or the revolution of NICTs and their consequences, that will be explored in this third volume. The reduced cost of equipment and software, the improved, generalized accessibility to spatio-temporal databases, the increasing user-friendliness and the diversity of computer-science tools, have completely modified the relationship that cartography has with its product, that the user has with maps, and institutions for the management and regulation of data, maps, etc. These transformations form part of a society that is undergoing a complete mutation, experiencing globalization, and that is expressing new needs. We are witnessing change on a worldwide scale, increasingly complex environmental problems, international security that is insufficient, and the absolute necessity for sustainable development and the good governance practices that need to accompany it. All these factors, along with the fact of enabling citizens to participate in decision-making, have triggered and reinforced the need for geographical information tools that are flexible, adaptable, dynamic and diversified (particularly for data representation) and accessible to a large number of users.

In this context, where cartographic science has reached a level of presence and importance that has never been seen before, new opportunities and new challenges are presenting themselves to this discipline. For the time being we have caught no more than a brief glimpse of the consequences of these changes, but one of the most remarkable that we have witnessed is without a doubt the transformation in maps' uses and their users. On the one hand, within the research domain, maps are used as an exploration tool, in J.W. Tukey's sense of the term [TUK 77]. Visualization makes it possible to discover and handle data, as D. DiBiase *et al*. [DIB 90] point out. On the other hand, at the other end of the "chain", maps represent a communication tool for the public, enabling them to participate in exchanges and thinking, as shown in the diagram adapted by A.M MacEachren [MAC 94, KRA 96]. Map users are no longer specialists in a particular topic; nowadays, they can be "the public", and this public has also become a producer of the maps it requires: the user and cartographer have become one.

From new tools (Chapter 1) and new data expressed as a whole (Chapter 2) to new procedures opening out into the world (Chapter 3), this last volume is dedicated to exploring these changes, which are leading cartography into the 21st Century.