Boletín de la Asociación de Geógrafos Españoles N.º 73 - 2017, págs. 515-518

I.S.S.N.: 0212-9426

ON THE EVOLUTION AS A SCIENCE OF DYNAMIC GEOMORPHOLOGY IN FLUVIAL ENVIRONMENTS

Jesús Horacio

Department of Geography. University of Concepcion. Chile

Laboratory of Environmental Technology. University of Santiago de Compostela. horacio.garcia@usc.es

This paper analyzes the history and development of fluvial geomorphology in dynamic environments. The goal of this study is to outline the past events that have been making up the body of what this science is nowadays. The timeline established is divided into different stages, each of which is defined by its own characteristics resulting in a particular way to conceive of and practice science; the timeline also serves to guide the reading of this text.

I. INTRODUCTION

The development of the present work has the objective of organizing the historical trajectory of dynamic geomorphology in fluvial environments, thereby contributing to a better contextualization and understanding of what this science is these days. Some studies allude to the advantages of having a global knowledge of the science practiced, which provides the researcher with better pragmatic criteria.

The general purpose of this article is underlain by two ideas that must be borne in mind. First, fluvial geomorphology is the science responsible for studying the forms and processes of rivers, both as they are now, in the present, and in their historical context, in the past. The approach of the present study has to do only with the current dynamic of fluvial geomorphology. Secondly, the use of the expression fluvial geomorphology in this text refers to current forms and processes, therefore, without the *quaternarian* or historical perspective. Even so, it is necessary to point out that currently there are a remarkable number of works that deal with pleistocenic and holocenic fluvial geomorphology, and that, moreover, this number has grown accordingly as dating methods have allowed to locate changes in fluvial dynamics.

II. METHODOLOGY

The methodological process followed is based on a wide-ranging bibliographic survey about the subject in question. With the information drawn we have established a timeline that takes the reader to the origins of fluvial geomorphology as a science, from its original inception through its manifold stages and concluding with twenty-first-century fluvial geomorphology.

There are numerous works that deal with the subject of geomorphology in its historical context. The ones chosen for analysis have been regarded to offer relevant enough information for the purposes of the present article. Also, it is necessary to add that the temporal limit assigned to each historical period must be understood in a flexible way.

III. EVOLUTION OF FLUVIAL GEOMORPHOLOGY AS A SCIENCE

III.1. Fluvial Geomorphology before the Twentieth Century

Two stages can be distinguished in the historical evolution of geomorphological science until the 18th century: (1) a phase corresponding to Greco-Roman classical antiquity (from the 6th-5th centuries b.C. to the Christian age), where we see the first contributions by naturalists and cartographers that try to find rational reasons for natural phenomena, but still with fanciful ideologies and frequently resorting to the gods to account for natural creation; (2) a phase going roughly from the early first century to the Renaissance (15th-16th centuries), still dominated by a strong fanaticism which, under the principle of divine creation, lasts until the early 19th century. The end of this period is dominated by the catastrophist theories intended to explain the geological changes occurred in the planet. The period between the 17th and 19th centuries marks the transition to modern geomorphology. During these centuries diluvian ideas begin to give way to scientifically-based works.

III.2. Fluvial Geomorphology in the Twentieth Century

Geomorphology proper is born with (3) the beginning of a third stage which corresponds to the contemporary age (late 19th – late 20th centuries), and which represents the period of greater development and importance, both for geomorphology in general and for fluvial geomorphology in particular. This third stage is divided into five phases:

(3.1) Historical phase (1890-1930): it is dominated by the ideas of the geographical cycle put forward by William Morris Davis to explain the evolution of relief. His work offers a properly morphological methodology or paradigm that contributes to the first evolutionary interpretation of relief.

(3.2) Regionalization phase (1920-1950): it is characterized by the introduction of an analytical-descriptive methodology which, encompassing the processes and forms of the earth's dynamics, makes it possible to study in detail any natural region. The regional view, focused on a concrete piece of land, begins to vanish in favor of broader analyses, many of them of a global nature.

(3.3) Quantitative phase (1940-1970): it is a period of change brought about by the dramatic introduction of methods and techniques for field work, laboratory work and office work. The phase corresponds to a period in which neo-positivism was the dominant philosophy and reductionism the dominant method. This led to a remarkable atomization in the discipline, a fact that, in its turn, meant a loss of connection among the sub-specialties and a distancing with the umbrella sciences of geography and geology. By contrast, there is a rapprochement with other disciplines such as hydraulic engineering, edaphology and biology.

(3.4) Systems phase (1960-1980): it is a logical consequence of the former phase, in the sense that the detailed application of mathematics and statistics, and the interpretation of the dynamics on such a detailed scale (reductionism) are fruitless when it comes to providing a general view of both geomorphological behavior and the evolution of landscape.

The systemic conception of geomorphology involved the adoption of the theoretical models from other disciplines (physics, mathematics and biology, among others), a fact that enriched the geomorphological lexicon with a great number of terms (energy and mass flow, entropy, hysteresis, stress, threshold, etc.). By contrast, there is an excessive tendency to reduce geomorphological processes to systemic behaviors, often to the detriment of research into dynamic processes. This gives rise to critical voices which maintain that systems theory amounts to an accumulation of concepts and ideas rather than to a scientific-experimental archetype.

(3.5) Modern phase (1980-end of the 20th century), consisting of three periods; the first is defined as a moment of importation and expansion linked to quantitativism; it is followed by a second period of consolidation, which can be placed between the systems phase and the modern phase, and during which the bases are laid down for present-day geomorphology; the third period is one of innovation, corresponding to the current situation.

The achievement of the current status of geomorphology as an independent science is characterized by the following elements. The most significant is the high degree of specialization that it undergoes, a tendency common to most sciences. In addition, the current phase has witnessed remarkable conceptual and technological advances with a practical and applied dimension, and, consequently, an unprecedented abundance of publications.

Independently of the historical phases into which it is divided, the 20th century, especially its second half, brought an unprecedented expansion of fluvial geomorphology. From the 1060s onwards, there begins to be a noticeable increase in the number of articles in scientific journals. However, it will not be until the 1970s-1980s that the real boom takes place thanks to the writing and publication of scientific articles in a variety of journals. In a like vein, in many countries there begin to appear national and international societies and research group. The fluvial sections in these general groups of geomorphology are a minority, because where risks related to fluvial environments compete risks with other geomorphological risks the latter remain the main concern.

III.3. Fluvial Geomorphology in the Twenty-First Century

The most relevant aspect of present-day fluvial geomorphology in comparison with previous decades is the massive use of the new technologies. This change, which amounts to the dawn of a new era, has given cause for debate and reflection within the scientific community. On the one hand there is some concern about the values that might be lost because of the new trend. On the other hand, a number of works have highlighted the advantages of technology. A noticeable change has occurred in the way of proceeding, analyzing and getting results. Thus, the forms and processes of 19th-century geomorphology have little in common with those developed in the 21st century. Even within the short span of the first sixteen years of the 21st century, the changes occurred in the methods of the earth sciences have been radical. But these changes are not only great in terms of content and form, but are characterized too for being highly mutable and dynamic; because of this, it would not be surprising if in the next few years it was necessary to speak of new advances that will continue to give shape to the geomorphological method.

The thematic areas with more intense research within fluvial geomorphological in the 21st century are the following: fluvial management, restoration and effects of vegetation on fluvial systems, soil erosion, fluvial hydraulics, sediment transport, hillslope sediment transfer, fluvial environment modeling, river regulation, watershed changes and human influence, methodological advances in fluvial geomorphology, riverbank erosion and paleoenvironmental studies.

IV. FINAL REFLECTIONS

The historical events that, for multiple reasons, have succeeded each other in the course of time are very useful to arrive at a logical understanding of what fluvial geomorphology is nowadays. The glance cast at the past and present of this science encourages thoughts of a future in which it will have an increasingly strong presence in management plans and fluvial good practice. In this sense, the following are considered to be the most promising lines of development for the next few years: (i) the application of the new technologies to obtain quantitative data; (ii) the improvements in the application of models; and (iii) fluvial restoration.

The sudden irruption and consolidation of the internet and social networks in advanced societies has led to a new approach in fluvial geomorphology. The collaborative possibilities offered by the social networks, with their focus on sharing and spreading information, has helped to free the word geomorphology from the ostracism that it had long suffered. This revolution represents a slow but steady change in the introduction to the general public of the figure of the geomorphologist. It could be said that we are now in the age of geomorphology 3.0.