

Dawson, Alastair, G. (1992) : *Ice Age Earth : Late Quaternary Geology and Climate*, Routledge, London and New York, xx + 293 p., 81 fig., 16 pl., index, 15,5 x 23,5 cm, 25\$ US.

John J. Clague

Volume 46, numéro 3, 1992

Le 150<sup>e</sup> anniversaire de la Commission géologique du Canada  
The 150<sup>th</sup> Anniversary of the Geological Survey of Canada

URI : <https://id.erudit.org/iderudit/032922ar>

DOI : <https://doi.org/10.7202/032922ar>

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Éditeur(s)

Les Presses de l'Université de Montréal

ISSN

0705-7199 (imprimé)

1492-143X (numérique)

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Citer ce compte rendu

Clague, J. J. (1992). Compte rendu de [Dawson, Alastair, G. (1992) : *Ice Age Earth : Late Quaternary Geology and Climate*, Routledge, London and New York, xx + 293 p., 81 fig., 16 pl., index, 15,5 x 23,5 cm, 25\$ US.] *Géographie physique et Quaternaire*, 46(3), 389–390. <https://doi.org/10.7202/032922ar>

# Comptes rendus

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It is almost a truism that Quaternary paleoclimatic research is interdisciplinary, involving a wide range of specialist disciplines. *Ice Age Earth* is an attempt to summarize and synthesize this research. It

focuses on important geological and geomorphological changes that occurred between the last interglaciation and the final melting of the great Northern Hemisphere ice sheets. As the author states in the preface, this is a daunting challenge, for the literature on this subject is vast and anyone attempting the task must have a catholic knowledge of fields as diverse as Quaternary geology, climatology, and geophysics. Furthermore, research advances are being made at a feverish pace, with the result that many new textbooks are out-of-date soon after publication.

*Ice Age Earth* is divided into 13 chapters which deal with various aspects of Late Quaternary climate and history. Chapter 1, the introduction, provides an organizational overview and a short discussion of timescales and terminology. Chapter 2 is concerned with the climatic record of ocean sediments and ice cores. This information has provided the basis for numerical reconstructions of Quaternary climate using global circulation models (the subject of chapter 3). The next two chapters summarize the history of late Quaternary glaciation, with emphasis on the chronology and extent of specific ice sheets: the history from the last interglaciation to the last glacial maximum is covered in chapter 4, and deglaciation is considered in chapter 5. The discussion stresses the rapidity of past climate changes and the complexity of environmental responses to the melting of the last great ice sheets. Chapters 6 through 10 focus on research in unglaciated areas; topics include periglacial environments, lakes and bogs, rivers, and eolian and volcanic activity. Crustal responses to periodic redistributions of water and ice on the earth's surface, and late Quaternary sea level change are the subjects of chapters 11 and 12, respectively. In the final chapter, the Milankovitch insolation theory is summarized, and possible relationships between late Quaternary climatic change and variations in insolation are considered.

Each chapter could be the subject of a monograph in its own right. Consequently, the coverage is necessarily selective, uneven, and, one might argue, superficial. In many instances, conflicting points of view and potentially helpful detail have been sacrificed for brevity. Some illustrations are not well explained or related to the text, and thus fail to communicate effectively. As a result, parts of the book are likely to be poorly understood by those not already familiar with the subject matter, including most undergraduate students (part of the author's intended audience). This is particularly true of the chapters on ocean sediments and paleoclimatic models. Specialists, in contrast, may be critical of what they perceive to

be superficiality and, in some cases, a lack of critical analysis. Furthermore, some relevant research disciplines (notably paleoecology) are scarcely mentioned.

The chapters on glaciation and deglaciation provide a good summary of current thinking on the history of late Quaternary ice sheets in different areas. There is a refreshingly balanced treatment of Eurasian and North American ice sheets, and glaciation in many other areas, including Antarctica, is also discussed. An attempt is made to relate glacial advances to the marine oxygen-isotope record, but I sense that many of the suggested correlations are tenuous and will have to be revised in the future. In fact, our understanding of the timing of glaciation prior to the Late Wisconsinan is still extremely poor. Much better dating of critical stratigraphic units is required if we ever are to determine accurately the history of the great Northern Hemisphere ice sheets following the last interglaciation (substage 5e).

The strongest sections of the book are those on crustal deformation and sea level change. There is a particularly good discussion of the factors (geoidal, tectonic, hydro-isostatic, and glacio-isostatic) responsible for sea level change.

The final chapter on Milankovitch cycles and climatic change is intended to serve as a summary and synthesis. The author points out that there is generally good agreement between marine oxygen-isotope and global sea level records on one hand, and variations in insolation on the other. There are, however, apparent differences between the histories of specific ice sheets and the Milankovitch insolation pattern, showing that other factors are also important. A notable example is the Younger Dryas cooling event which occurred about 11 000-10 000 yr BP at a time of high summer insolation in the Northern Hemisphere and perhaps was triggered by the sudden influx of an enormous volume of cold water from Lake Agassiz into the North Atlantic Ocean.

In conclusion, Dr. Dawson has made a heroic effort at synthesizing a vast body of knowledge on an important subject-climate change during the late Quaternary. The book's shortcomings stem largely from its brevity and from the fact that the subject is a minefield of controversy and uncertainty. In spite of voluminous research that has been done in recent decades, we still have only a rudimentary understanding of Quaternary events and environments and an even poorer appreciation of the interplay of factors that controlled the waxing and waning of Pleistocene ice sheets.

John J. CLAGUE  
Geological Survey of Canada