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Book Reviews

GEOMORPHOLOGY. CRITICAL CONCEPTS IN GEOGRAPHY. Series editor: David J. A. Evans VOLUME V: PERIGLACIAL GEOMORPHOLOGY. Edited by Hugh M. French. Routledge, Taylor and Francis Group, London and New York, 2004, 641 pp. Volume V (ISBN 0-415-27613-6): $260.00; seven-volume set (ISBN 0-415-27608-X): $1740.00.

This volume reproduces 20 articles published in a number of internationally recognized journals and chosen by H. M. French as being basic to periglacial geomorphology. The other six volumes in this series, all edited by senior geomorphologists from either the UK or Canada, concern fluvial geomorphology (Volume I, edited by Olav Slaymaker), slope geomorphology (Volume II, edited by Mike Kirkby), coastal geomorphology (Volume III, edited by Jon French), glacial geomorphology (Volume IV, edited by David Evans), arid lands geomorphology (Volume VI, edited by Andrew Goudie), and landscape evolution (Volume VII, edited by Paul Bishop). In order to avoid translation costs, the editors were instructed to consider only papers that had been published in English. The volumes are expensive and the publisher is clearly aiming at the library, rather than undergraduate, market.

The selection of articles for inclusion in volumes of this nature is often difficult and, inevitably, always open to criticism. This is especially the case for this particular volume dedicated to periglacial geomorphology. The reason is that periglacial geomorphology includes both regional studies of relief and structure and process studies that include not only those associated with cold-climates *senso-stricto* but also those associated with the operation of azonal processes, such as the action of wind and running water. In addition, laboratory experimentation, the study of permafrost and ground ice, and the recognition and interpretation of relict Pleistocene frost-action phenomena in present-day temperate regions are all within the domain of periglacial geomorphology.

In order to understand the approach adopted by H. M. French in his choice of articles it is also necessary to remember that the initial beginnings of periglacial geomorphology relied upon the assumed efficacy of intense Pleistocene frost action in fashioning the landscape of now-temperate regions. The theoretical concepts that constitute the basic underpinnings of periglacial geomorphology were then followed by direct observations undertaken in cold-climate environments. It quickly became apparent that the effectiveness of frost-related processes had been greatly exaggerated and the speed of cold-climate landscape evolution overestimated. As a consequence, the heart of modern periglacial geomorphology now focuses upon the study of permafrost-related processes. H. M. French explicitly mentions this operational definition in his introduction. Thus, the volume includes only those studies that concern processes related to frost and ground ice, 90% of which have been undertaken in North America. Moreover, he has chosen to include only the more recent works, since 90% of the articles selected have been published since 1980.

Modern periglacial geomorphology is reduced, therefore, to geocryology. In the opinion of this reviewer, this is much too restrictive a definition. For example, one cannot exclude the action of running water and wind, both of which assume distinctive characteristics in cold region as witnessed by snowmelt runoff and aeolian deflation. The study of these processes, either in combination or separately, is as much a part of modern periglacial geomorphology as the study of the phenomena that occur when soil and rock freezes and thaws. H. M. French explains that these aspects have been excluded from this volume because the other volumes in the series consider these azonal processes. However, this is unsatisfactory. First, the volumes devoted to 'fluvial geomorphology' and to 'arid lands geomorphology' do not contain any papers that specifically treat the distinctive nature of either wind action or running water in the cold environments of the world. Second, H. M. French is inconsistent in his omission of azonal processes from the volume because, although Volume II in the series is devoted to 'slope geomorphology', he does include several articles that describe the mass wasting and solifluction processes that operate on slopes in cold

environments. These topics certainly justify inclusion in the volume and, at the same time, highlight the omissions that I mention in the above.

It is also difficult to accept that studies concerning the action of frost during the Pleistocene are not part of modern periglacial geomorphology. This is because the interpretation of relief in temperate regions has been the motivation for numerous scientists who have worked in the arctic while the recognition of the former existence of permafrost is an important line of evidence in palaeoclimatic reconstruction. In the case of the latter, the utility of periglacial information relies upon the inferences that can be made as to mean annual temperature. These augment the information that palynology provides because the latter usually (only) supplies information concerning summer temperatures. To remain silent on relict Pleistocene periglacial study, and to only mention that this constitutes part of Quaternary study, appears far too dismissive of this important field.

It is also surprising that, in a series devoted to 'critical concepts in geography', there is little or no attention given to the problems of periglacial regionalization. Yet recognition of the diversity of periglacial environments that exist today is essential if one is to correctly interpret the periglacial environments that existed during the Quaternary. A further criticism of the volume is that no articles are included that deal with alpine periglacial conditions.

In summary, to retain only the study of actual Arctic processes as the crux of modern periglacial geomorphology is not an approach that will be accepted by the majority of workers in the field. Even if one accepts that the choice of articles was restricted by the series editor to those written in English, it is nevertheless difficult to accept that periglacial geomorphology has been reduced to geocryology and the study of permafrost. This reviewer believes that the knowledge obtained from the various branches of periglacial geomorphology is mutually beneficial to the discipline and collectively contributes to our understanding of periglacial environments. It is difficult to agree with the operational definition adopted by H. M. French, namely, that modern periglacial geomorphology is limited to studies of permafrost-related processes and to ground ice. However, one must also admit that such topics lie at the heart of the discipline and supply the solid scientific base upon which periglacial geomorphology rests. Undoubtedly, it is this message that H. M. French wishes to promote because one cannot accuse him of not being aware of the different components of periglacial geomorphology, given his extensive experience in the discipline and his widely-accepted textbook entitled *The Periglacial Environment* (Second Edition, 1996, Addison Wesley Longman, U.K.).

Having considered the context and background to the articles chosen by H. M. French, let me briefly summarize them. I must stress that, in his introduction to the volume, H. M. French presents an excellent review of each article, summarizes the evolution of ideas concerning the subject in question, and stresses some of the important questions that are examined and how they relate to present studies.

The first two articles concern 'cold-climate weathering'. In the first, B. Hallet, J. S. Walder and C. W. Stubbs (1991) describe their laboratory experiments on the disintegration of permeable and porous rocks. These are relatively fragile and prone to mechanical disintegration by the formation of segregated ice. Fracturing is inferred by acoustic measurements and the authors detect, in this original approach, the phenomena responsible for the rapid breakdown by frost of less resistant rocks and emphasize the importance of water migration in frost shattering. The second article, by V. N. Konischchev and V. V. Rogov (1993), summarizes Russian research published from 1975 to 1991 on cold-climate weathering. It considers not only frost shattering in general but also what results when unconsolidated sediments are subject to frost action, through the transformation of clay minerals and the disintegration of quartz grains. This article throws light upon earlier Russian work not well represented elsewhere in the volume. It also demonstrates that mechanical disintegration is but one component of cold-climate rock weathering.

Five articles deal with ground freezing. These are of great interest. The first, by L. Dyke (1984), concerns the frost-jacking of bedrock blocks in areas underlain by permafrost. This poorly understood phenomenon is explained in the context of frost thrusting (expulsion) and by the pressures generated by the growth of ice lenses beneath the blocks. Next, an article by M. W. Smith (1985) uses precise field measurements upon soil temperature, moisture migration and frost heave, to describe how segregated ice forms in silty sand. Measurements establish the fact that water migration occurs up until $-2.4^{\circ}C$ and that desiccation of soil occurs at depth. While this paper does not present fundamentally new ideas, it nicely demonstrates the results of frost action in soils. A third paper, by J. R. Mackay (1998), describes one of the largest field experiments ever undertaken in the periglacial environment. It concerns the drainage of a lake in the Mackenzie Delta region of Canada and follows the progressive refreezing of the exposed lake-bottom sediments from 1978 until 1995. A fourth article, also by J. R. Mackay, presents observations conducted

over a 40-year period upon 26 pingos in the Mackenzie Delta region. This exceptional synthesis summarizes all that is known about closed-system pingos and demonstrates the value of long-term observations. It certainly warrants inclusion in the volume. The fifth article, co-authored by J. R. Mackay and C. R. Burn (1992), documents ice-wedge growth and evolution over a 20-year period in the bottom of the drained lake previously described. These observations are clearly unique and the results obtained are informative, numerous and diverse. The most surprising conclusion is that thermal-contraction cracking ceased after several years due primarily to the growth of vegetation which allowed snow to accumulate on the drained lake bottom thereby insulating the ground from further cracking.

Three articles deal with cryolithology. The first, by J. B. Murton and H. M. French (1994), treats the very important problems associated with the classification, description and origin of ice types within soil. The second, by C. R. Burn (1997), describes the regional thaw unconformity that exists in the Mackenzie Delta region of Canada and is the result of climate warming approximately 8000 years ago. The author seeks to explain the causes of the climatic variation and concludes that the proximity of the sea played a large role. It is a good example of the sort of information that can be obtained from permafrost. J. R. Mackay and S. R. Dallimore (1992) are the authors of the third article chosen. The introduction to this article by H. M. French is excellent and highlights the two possible origins for the massive icy bodies that can be observed in parts of the Mackenzie Delta, Alaska and Siberia. The ten arguments presented by the authors in their conclusions appear to support, at least in the Mackenzie Delta region, an ice-segregation origin. This remarkable study analysed 634 boreholes drilled within this type of ice within Canada and Siberia.

Three articles concern thermokarst. The first, by C. R. Burn and M. W. Smith (1990), describes the actual development of thermokarst lakes in the central Yukon. Here, the commentary by H. M. French is especially interesting. However, this article is not fundamental and does not discuss in length the mechanisms of enlargement of the lakes. Undoubtedly, the editor wished to present a relatively recent article upon one of the most common landscape features of permafrost regions. The second, by J. B. Murton and H. M. French (1993), describes examples of structures that are similar to cryoturbations but result from thermokarst activity. They propose the term 'thermokarst involutions' to distinguish these structures from those that result from traditionally-understood frost-induced movements. This article is undoubtedly of great interest to researches working in temperate regions. The oldest article chosen for inclusion in the volume dates from 1970. This is another article by J. R. Mackay (1970). It illustrates the fragility of permafrost terrain and describes examples of the permafrost degradation that followed upon forest fire, the tethering of an Inuit dog, and the cutting of seismic lines in the forest-tundra of the Mackenzie Delta region.

Three articles concern patterned ground. The first, a further contribution by J. R. Mackay (2000), describes the previously unrecorded outward lateral movement during summer of the active layer from above and adjacent to the ice wedge towards the centre of the wedge. These movements were identified only following a series of long-term experiments in various localities. This mechanism has implications for the interpretation of ice-wedge pseudomorphs and is a most interesting recent discovery. An older article, also by J. R. Mackay (1980) examines the origin of the ubiquitous tundra hummocks or non-sorted circles. Although H. M. French considers the explanation as only partial, it is also plausible and finds some support from laboratory experiments. The third article, by B. Hallet, S. P. Anderson, C. W. Stubbs and E. C. Gregory (1988), describes observations made in Svalbard upon well developed sorted circles. The authors clearly demonstrate the movements which produce the surface features and deduce a convection-like movement. However, the movements that occur at depth are not obvious and there are other possibilities; nevertheless, these observations are of great interest.

Four articles concern the last topic covered in the volume, namely, the periglacial processes that fashion slopes. The first article, by N. R. Morgenstern (1985), summarizes the state of both laboratory and field knowledge concerning the flow law of ice and ice-rich permafrost at relatively warm temperatures. In a second article, E. C. McRoberts and N. R. Morgenstern (1974) consider landslides in the Mackenzie River Valley. They demonstrate that the general laws applied to explain movement do not take into account the influence of segregated ice as it melts. Field research is necessary in order to determine values to introduce in the formulas. The authors describe the different types of movement observed and stress the difficulties of predicting movements in thawing soils. The third article, by P. A. Egginton and H. M. French (1985), describes solifluction phenomena observed on slopes of 2–8° on Banks Island. The authors measure the speed of movement and identify the factors that influence the rates measured. They emphasize that long-term observations are essential because the

speed of movement can vary significantly from year to year. The final article, by C. Harris and A. G. Lewkowicz (1993), concerns the form and internal structure of active-layer detachment slides. The important role played by the melt of segregation ice at the base of the active layer is obvious. This article also contains interesting diagrams that allow comparison with structures in Pleistocene periglacial deposits.

In summary, therefore, this volume reproduces a total of 20 scientific articles all concerned with periglacial processes. The articles chosen were published initially in English and all are relatively recent in age. Most describe work undertaken in the Canadian Arctic. The majority of articles were published in the *Canadian Journal of Earth Sciences* and four come from the journal *Permafrost and Periglacial Processes*. The exceptional role of J. R. Mackay is illustrated by the fact that he is the author of seven of the 20 articles. He has truly made an outstanding contribution to periglacial geomorphology. All the articles are interesting and H. M. French has been careful in making a balanced coverage of the more important periglacial processes. One regrets, however, that the azonal processes such as running water and wind have not been considered. Likewise, the volume does not cover Pleistocene periglacial geomorphology or alpine periglacial environments. Size and page constraints are probably the explanation. Based upon the contents of this volume, a more correct title would be 'Periglacial Processes' rather than 'Periglacial Geomorphology'. Other volumes are necessary if one wishes to cover all aspects of periglacial geomorphology.

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STUDIES IN POLAR RESEARCH. WIND AS A GEOMORPHIC AGENT IN COLD CLIMATES. Matti Seppälä. Cambridge University Press, Cambridge, 2004, 358 pp. ISBN 0-521-56406-9. £80.00 (hardback).

The author is Professor at the University of Helsinki, Finland. In his acknowledgements, he informs us that the book is based on almost 40 years of research. He has visited many areas of the Arctic and Antarctic, and his main research sites are in sub-arctic Finland. The book has illustrations from all these regions. Most are black-and-white, but there is an inset of 14 colour plates. The English language is problematic throughout the book.

No textbook is yet available covering the large, important and overlapping areas of periglacial and glacial research that Arctic and Antarctic aeolian geomorphology constitutes. Therefore, expectations of this book are high.

The book is written mainly from a periglacial and geomorphological point of view, but also includes parts of glaciology on snowdrift and glacier formation controlled by wind. Only terrestrial, non-coastal areas are covered in the book, but some data from coastal sites are also presented. Upon reflection, I think it would have been logical to include coastal environments in the text because these are an integral part of the periglacial cold-climate environment. Geographically, the book covers both the Arctic and the Antarctic, while alpine areas are not included. The text also covers the former periglacial and glacial areas that existed during the Late Pleistocene. I assume this is the reason why the book is not specifically entitled 'The geomorphology of wind in polar areas'.

The introduction is used to point out, quite rightly, the largely neglected importance of wind in geomorphological climate-change studies, both past and present, and the lack of publications that specifically examine the geomorphic effects of wind in cold environments. These facts justify this new textbook. The author does not recognise any active well-specialized cold environment research group studying cold environment aeolian processes but, instead, finds that interest is split between himself, in Finland, and Augusta Niessen and Eduard Koster in the Netherlands.

Chapter 2 is entitled 'Delimitation and characterization of cold environments'. It contains a discussion of the definition of the Arctic and provides a general physical description of temperature, precipitation, humidity, seasonality, glaciers, soils, permafrost, vegetation, and basic snow ecology in polar areas.