PREFACE

Glaciers and the glaciated landscape was the theme of the International Glaciological Society symposium held in Kiruna, Sweden in August 1998: a meeting sponsored by the Department of Physical Geography of Stockholm University, the Climate Impacts Research Centre of the Environmental and Space Research Institute, and the City of Kiruna. It brought together scientists who use a variety of methods and data types, all aimed at improving our understanding of how glaciers and ice sheets affect their substratum and surrounding environment, and how the extent, dynamics and temporal evolution of former ice masses can be deduced from the evidence provided by the glaciated landscape.

This volume of the *Annals of Glaciology* is therefore multidisciplinary. Contributions range from detailed studies of ice–substratum interactions, at the scale of days and metres, to those aimed at improving our ability to reconstruct the evolution of entire ice sheets, on the temporal scale of a full glacial cycle.

Presentations during the meeting, reported as articles in this volume, showed that significant progress has been made in several key areas:

(a) There has been a scarcity of reliable and generally applicable dating techniques which can reach further back in time than radiocarbon dating. Recent advances in cosmogenic-dating techniques now go a long way towards improving this situation. Important, but previously elusive parameters, such as long-term erosion rates on rock surfaces, can now be determined through the use of isotopes with different half-lives. Eventually, these advances will considerably improve our understanding of the long-debated "trimline" landscapes, characterizing many mountainous areas around the North Atlantic.

(b) Successful and reliable attempts to derive precise palaeoclimatic information from glacial-geological data were reported. The use of these data for palaeoclimate estimation is developing continually. Glaciological models now serve as the link whereby landscape traces can be used to derive climatic parameters, most often palaeo-equilibrium-line altitudes.

(c) Recent studies show that some time-honoured methods and ways of working simply do not stand up to scrutiny. For example, it no longer appears to be acceptable to decipher glacial history from flow-traces (till lineations), without specifying under which ice-dynamic conditions particular systems were created, or without considering intra-system age gradients. This is an area where substantial progress has been made in recent years, through development of glaciologically based classification systems for glacial-landform assemblages.

(d) It is becoming increasingly clear that "pure" glacial landscapes are rare and that an evolutionary approach has to be adopted in many cases. This aims at deciphering the sequence of events that created a particular landscape, and recognizes that landforms inherited from non-glacial conditions are an important and integral part of many "glacial" landscapes.

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We see much scope for development in several areas:

(1) Major collaborative efforts involving experts from several relevant fields are still few. It ought to be normal that a research team includes experts on the process system, the spatial dimensions, and the time dimension, i.e. glaciologists, geomorphologists and glacial geologists, especially at the "large and long" end of the scale spectrum.

(2) The lack of contact between numerical ice-sheet modellers and glacial geologists and geomorphologists is still apparent. The strength of numerical modelling lies in its realistic mass-fluxes, whereas glacial geology has the potential to show what actually happened, provided the direct record is properly interpreted. Both approaches are necessary. Conceivably communication could be facilitated by simple means, such as glacial geologists reporting their data in calendar years, instead of radiocarbon years, and glaciologists testing their results more explicitly against glacial-geological data.

(3) Improved understanding of basal processes, involving both the ice- and water systems, are imperative because they deal with the environment where glaciers reshape their substratum, i.e. create glacial landforms and landscapes. Inversion of the glacial-geological record requires understanding of genetic conditions for specific types of deposits and landforms.

(4) Not only do we need to bring glaciologists and glacial geologists closer together, but there is also considerable scope for improved communications between the subfields surrounding pure glaciology. The relatively poor fit between numerical ice-sheet models of, for example, Northern Hemisphere ice-sheet evolution and glacial-geological data, has often been observed. At face value, this situation seems to involve only the two sub-disciplines of glaciology and glacial geology. However, the solution may lie rather in improved communication between glaciologists and climatologists, because most such models are driven by assumed or modelled mass-balance evolutions. Improvements in the schemes driving the models are very likely to reduce the discrepancies between predicted and observed glacial geology and geomorphology.

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