

## Events frozen in time

T.M.L. Wigley

**The Little Ice Age.** By Jean M. Grove. Methuen: 1988. Pp. 498p. £85, \$144.

IN THIS outstanding piece of scholarship, Jean Grove has succeeded in providing an immensely detailed, critical account of climatic changes without losing sight of the global perspective in which these changes are most usefully viewed. Don't be misled by the title. There is much more to this book than just an account of the Little Ice Age; indeed, I know of no better review of the climate of the Holocene (the past 10,000 years).

The Little Ice Age is the most important climatic fluctuation that has occurred in historical times. Although there are variations in the defined time limits, it can broadly be assumed to have begun in Mediaeval times and ended in the nineteenth century. During this period, Europe (from which the most voluminous evidence comes) was generally colder than today, Alpine glaciers were far advanced, and various tales of the woes inflicted by particularly severe years or groups of years may be found in historical sources. These details are brought out vividly in the text, in words, immaculate diagrams and pictures. But was this a world-wide event? Grove states "It is always tempting to seek universals, and they are easier to promote when the data are imprecise . . .". By carefully reviewing the evidence of glacier fluctuations throughout the world, never losing sight of the attendant uncertainties, she concludes that the event was global in scale, albeit with regionally specific variations superimposed. Grove's conclusion corresponds to that reached by other authors, but the information has not previously been considered so comprehensively.

The next leading question concerns the uniqueness of the Little Ice Age. For many years it has been known that the Holocene was punctuated by similar events in specific regions, but the perceived wisdom has been that few of these were of global scale. The general picture of the Holocene is of an early warm period followed by overall cooling with more pronounced cool episodes every 2,000–3,000 years (the Little Ice Age being the last of these). This picture has unfortunately been perpetuated in a number of authoritative reviews of climatic change. Grove is more realistic and more sceptical, correctly pointing out, for example, that there is "no certainty that there ever was . . . a single identifiable warm period in the [early] Holocene". Instead, what emerges from her analysis is a Holocene climatic history characterized by a sequence of ten or more global-scale Little Ice Ages, fairly irregularly spaced and each lasting a few centuries. As Grove notes, this was the view espoused by Matthes when he introduced the term 'Little Ice Age' in 1939.

The causes of these periods of glacial advance are difficult to ascertain. The most popular candidates are changes in volcanic activity or in solar irradiance, most probably modified by induced changes in albedo and/or ocean circulation. Grove leans slightly towards the solar explanation. I agree, and have been able to support this possibility statistically using carbon-14 data which appeared since Grove's book was written.

Why is the Little Ice Age (and the earlier similar events) so important? The future climate of the globe may well be dominated by the influences of man-made greenhouse gases such as carbon dioxide. But whatever these effects are (and there are considerable uncertainties in this regard) they must be judged against the natural climatic variability that occurs on the same time scale, decades to centuries. The Little Ice Ages documented and described in this book are this natural varia-

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bility. Grove estimates that these events correspond to global coolings of 1–2° C (in summer at least), although I would prefer slightly lower numbers. But even 1–2° C is appreciably smaller than most projections of global warming between now and the mid-twenty-first century.

I can find little of consequence to fault in this book. The author herself, however, has one regret and this is that she completed her work on it too soon to be able to make full use of the equally impressive work of Friedrich Röthlisberger (*10,000 Jahre Gletschergeschichte der Erde*; Verlag Sauerländer, Aarau, 1986). In my view, her own study is just as valuable and is certainly broader in scope. She makes a great deal of the foreign literature, including much of Röthlisberger's work, accessible to the English-speaking scientific community. In the end she reaches the same conclusions as Röthlisberger, but perhaps in a more balanced way.

As future climatic change becomes an increasingly important issue, we may tend to lose sight of the past. The literature, even on the Holocene, is extensive and diverse, spanning many disciplines. For those eager to gain an appreciation of the most relevant part of our climatic heritage, this book should be compulsory reading.

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Slippery slope — Holocene and Little Ice Age moraines in front of a glacier in western China.

A. T. Grove