

## Preface

WE LIVE IN UNUSUAL TIMES. Greenhouse gas concentrations are increasing rapidly and are now much higher than they have been for at least 420,000 years. Global average temperatures exceed anything seen in the last thousand years. The evidence is now overwhelming that such changes are a consequence of human activities, but these are superimposed on underlying natural variations. Climate on Earth naturally undergoes changes driven by external factors such as variations in solar output and internal factors like volcanic eruptions. How can we distinguish the human from the natural impacts? And what might the changes herald for the future of human societies as population pressure grows, as fossil fuel consumption increases and as land cover is altered?

Such questions are compelling, and the need for answers urgent. But the search for answers will only be successful when we have developed insight into the full range of natural variability of the climate system. That range is illustrated by the events of the past, and it is only by unravelling those events that we will be able to predict the future, and our place in it, with confidence.

This book stands as a progress report in the search for the past. It highlights a number of the extraordinary discoveries about the operation of the Earth System through time that have been made by natural scientists around the world over the last few decades. The great gains described in these pages have been wrought through exploration across the face of the planet and beyond: on land, sea, lakes, ice caps, via satellite observations and through simulations run on silicon chips. But that is only one dimension of the search, for critical to the future of human society is an improved understanding of the sensitivity of civilizations to climate change. Increasingly, paleoclimatologists are working with social scientists to disentangle the impacts of evolving social pressures and cultural practices from those induced by past climate change.

The scientific findings in these pages give cause for both exhilaration and concern. The exhilaration lies in appreciating the remarkable increase in our understanding of the complexity and elegance of the Earth System. The concern is rooted in recognizing that we are now pushing the planet beyond anything experienced naturally for many thousands of years. The records of the past show that climate shifts can appear abruptly and be global in extent, while archaeological and other data emphasize that such shifts have had devastating consequences for human societies. In the past, therefore, lies a lesson. And as this book illustrates, we should heed it.

Keith Alverson, Ray Bradley, Tom Pedersen, September 2002.