WEDDELL SEA TECTONICS AND GONDWANA BREAK-UP. B.C. Storey, E.C. King, and R.A. Livermore (Editors). 1996. London: The Geological Society (Special Publication 108). 284 p, illustrated, hard cover. ISBN 1-897799-59-4. £56.00; $US93.00.

This volume is the result of a conference organized jointly by the British Antarctic Survey and the Tectonic Studies Group of the Geological Society of London in Cambridge during June 1994. It comprises an introduction that forms a summary of the current state of knowledge and 18 papers that address different aspects of the subject, investigated by various techniques.

The first paper, by M.L. Curtis and B.C. Storey, reviews the tectonic constraints on the early position of the Ellsworth Mountains and their implication for Weddell Sea evolution. It is interesting here to see that, after almost 30 years of moving the Ellsworth Mountains hither and yon in a welter of reconstructions by innumerable authors, the present authors are currently in broad agreement with the scenario first described by Jim Schopf in 1969. V. Divinere, D.V. Kent, and I.W.D. Dalziel summarize palaeomagnetic results from West Antarctica to interpret the tectonic evolution of the Pacific margin of Gondwana during the Mesozoic. New Zealand is intimately involved in this study, and the implications for Weddell Sea evolution are discussed. T.S. Brewer, D. Rex, P.G. Guise, and C.J. Hawkesworth present new Ar-Ar radiometric data to refine the chronology of tholeiitic Mesozoic magmatism in Dronning Maud and Coats lands and the Pensacola Mountains. Their data are interpreted as indicative of a failed rift system in the Weddell Sea. The conclusions of G.H. Grantham in his paper on Jurassic magmatism in Dronning Maud Land support the postulated transpressional first stage of Gondwana break-up between Africa and Dronning Maud Land.

W. Reimer, H. Miller, and H. Mehl describe the Mesozoic and Cenozoic palaeo-stress field of the South Patagonian Massif from structural and remote-sensing data. This is an interesting paper, in terms of both the techniques involved and the implications of Andean tectonics in relation to the opening of the South Atlantic Ocean, but it does not appear to bear directly on the tectonics of the Weddell Sea region. However, it is perhaps useful background to the following paper by B.C. Storey, A.P.M. Vaughan, and I.L. Millar, which relates specific episodes in the Mesozoic geodynamic evolution of the Antarctic Peninsula to known spreading events in Weddell Sea history. P.C. Richards, R.W. Gatliff, M.F. Quinn, J.P. Williamson, and N.G.T. Fannin interpret the geological evolution of the Falkland Islands continental shelf from marine seismic and gravity magnetic data. They find that their data do not support the hypothesis that the Falkland Islands have been rotated during the opening of the South Atlantic Ocean. This paper is also marginal to the main focus of the volume. Multi-channel seismic and gravity data and ERS-1 altimeter data are used by W. Jokat and his colleagues to interpret the off-shore continental margin of East Antarctica (10–30°W) as a line of seamounts between the submarine Andenes and Explora escarpments. R.J. Hunter, A.C. Johnson, and N.D. Aleshkova synthesize aeromagnetic data from the southern Weddell Sea, Filchner–Ronne Ice Shelf, and adjacent areas to interpret rifting, crustal thinning, and extension in this region, related to evolution of the Weddell Sea. D.C. McAdoo and S.W. Laxon have used marine gravity from Geosat and ERS-1 altimetry to construct a gravity field for almost the entire Weddell Sea, including the ice-covered areas normally denied to shipborne studies. Land/sea seismic refraction studies across the continental margin in the eastern Weddell Sea have enabled C. Hübscher, W. Jokat, and H. Miller to interpret their data as indicating a passive continental margin in this area. The next paper, by G.L. Leitchenkov, H. Miller, and E.N. Zatzepin, considers the structure and Mesozoic evolution of a much longer stretch of this margin in relation to early Gondwana break-up resulting from the mantle plume identified between Africa and Dronning Maud Land about 179–162 Ma ago.

J. Jacobs, N. Kaul, and K. Weber studied denudation and re-sedimentation at the margin of western Dronning Maud Land. They have used apatite fission-track dating to determine the uplift history and conclude that the sediment was deposited in the Weddell Sea basin. C. Hübscher, W. Jokat, and H. Miller have also used seismic refraction data in the southern Weddell Sea. They conclude that there are up to 13 km of sediment of continental origin in the eastern part that pinches out to the west. E.C. King and A.C. Bell present new seismic data from the western Ronne Ice Shelf and find no evidence for major dextral strike-slip motion between the Antarctic Peninsula and the Weddell Sea, as proposed in existing models of tectonic development of the region. A re-evaluation of Weddell Sea magnetic anomaly data by R.A. Livermore and R.J. Hunter, in conjunction with other data, has been used to develop a spreading history for the southern Weddell Sea. Geophysical investigations in the Riiser-Larsen Sea have been used by H.A. Roeser, J. Fritsch, and K. Hinz to determine crustal development of Dronning Maud Land. They have identified detailed strike-slip motions between the African, Madagascan, Indian, and Antarctic plates to model the break-up of Gondwana in this region. Finally, the paper by Y. Nogi, N. Seama, N. Isezaki, and Y. Fukuda describes magnetic anomaly lineations and fractures zones deduced from vector magnetic anomalies in the West Enderby Basin, around 40°E, rather remote from the Weddell Sea but nonetheless valuable.

Studies of the reconstruction of Gondwana have steadily gathered pace through the years and refined the details of Alexander du Toit's reconstruction of the 1930s that was broadly correct in the re-assembly of the major continental plates. Work in the Weddell Sea region has been piecemeal, due largely to the difficulty of surface access, the paucity of rock outcrop over vast areas of the hinterland, and the consequent need for investigation by remote-sensing techniques. Major advances were made around

the margins of the region, notably the marine seismic work in the Scotia Sea and Drake Passage, and along the Pacific margin of the Antarctic Peninsula, but each of these advances introduced new problems and raised new questions when extrapolation towards the key area of the Weddell Sea was attempted. I had assumed from the title of the volume that the tectonics of the Weddell Sea region in relation to Gondwana break-up was the focus of interest. Therefore, I was surprised to find that some of the papers are geographically remote from this focus and do not mention the Weddell Sea at all, although they do address the problem of Gondwana break-up.

The introduction to this volume by the editors, E.C. King, R.A. Livermore, and B.C. Storey, is actually an excellent summary of the current state of knowledge, incorporating and balancing the ideas and results presented in this volume. What emerges is a picture of an incomplete jigsaw with a space of uncertain size to be filled by an unknown number of pieces. The number of microplates that constitutes the region, their geologies and movement histories, vary between authors, but eventually we can expect to see a growing consensus and an agreement on the plate-tectonic evolution of this most enigmatic of regions.

The book is very well-produced, in common with many recent publications of the Geological Society, and there are some excellent false-colour images showing the regional structure of the sea-floor derived from ERS-1 and Geosat data. There are many maps and diagrams, but the variety of styles and orientations does not make for easy comparisons in many cases. Sadly, some unfortunate errors have slipped through the editors' net: the name of the Queen Alexandra Mountains appears to have undergone a sex-change to Alexander; and a basin in one running head becomes a formation by the end of the paper; but these are relatively minor. In these days of bureaucracy invading the ivory towers, such slips will continue to pass unnoticed while too many scientists are required to be more concerned with the minutiae of the arithmetic in travel claims than the correctness of their published work.

This will be a valuable reference volume for anyone working in the region. However, the reader who is expecting to find the answers to the last major key in the reconstruction of Gondwana will be seriously disappointed; there is still too much to learn. On the other hand, the reader who is looking for a research project will find a wealth of ideas with the potential to provide major advances in understanding the plate tectonic evolution of this region. Personally, I look forward to a sequel in a few years' time when geologists and geophysicists will be that much nearer to the solution, even if they have still not reached it. (Peter Clarkson, Scientific Committee on Antarctic Research, Scott Polar Research Institute, Lensfield Road, Cambridge CB2 1ER.)

BRIEF REVIEW

THE OCEANS AND CLIMATE. Grant R. Bigg. 1996. Cambridge: Cambridge University Press. xii + 266 p, illustrated, hard cover. ISBN 0-521-45212-0. £55.00; $US69.95.

This book is intended as a textbook for undergraduates studying Earth and environmental sciences, oceanography, meteorology, and climatology. Its intention is to review the processes by which the ocean plays a role in the global climate system. This is a vitally important field, and the author bravely covers a very wide range of topics, including the physical, chemical, and biological interactions between ocean and atmosphere; large-scale interactions such as ENSO (El Niño – Southern Oscillation); the ocean's role in past climatic variability; and present interactions by which the ocean modulates climate change. The treatment is largely qualitative and non-mathematical, and is intended to provide a broad introduction to the field.

Because a book is intended as an introductory textbook does not mean that it is excused from the need for scientific rigour and accuracy. Some fundamental ocean processes are explained in such tortured prose as to seriously mislead the reader. High-latitude processes are especially badly treated; the formation of Antarctic bottom water, for example, is ascribed entirely to sea-ice formation without the cabelling process being mentioned (page 77). Grammatical infelicities abound, at such a density as to seriously impair one's enjoyment of the book. It appears not to have been touched by an editor. I counted at least one error per page, ranging from the use of *spectra* as a singular noun to complete howlers, such as the statement that 'The oceans are 96.5%, by volume, water.' We know what the author is getting at, but it is hard work for the reader.

Another problem with the book is that this is a subject that is advancing at a ferocious rate. Any attempt at a review of the ocean's role in climate becomes obsolete within a year or two. Although this book contains a few recent references and has a 1996 publication date, the main content appears to deal with results obtained prior to 1993. Therefore, many new ideas about ocean processes that strongly interact with climate are missing, including new findings about convection and the thermohaline circulation, and the latest results of climate-prediction models. Ideally the book should have been revised in the light of the four-volume *Climate change 1995*, the latest consensus view of the Intergovernmental Panel on Climate Change, but it appears that the chapters dealing with the greenhouse effect and its impact are based mainly on the 1992 version.

Having said this, it is still a book to be recommended to anyone who wishes to find out about the whole scope of the role that the oceans play in the global climate system. No other textbook at this level exists at present.