Antarctic Science 2 (2): 175–177(1990)

Book reviews

Antarctic Paleobiology — its role in the reconstruction of Gondwana
Edited by *T.N. Taylor and E. L. Taylor*
Springer-Verlag, New York (1990).
261 pages, 74 illustrations, DM 198.00. ISBN 0 389 970061.

This volume consists of fifteen papers arising from a workshop on 'Antarctic Paleobotany and its relationship to reconstructions of Gondwana' at Ohio State University in June 1988, plus an extensive bibliography of Antarctic palaeobotany and palynology. The successful nature of the workshop is reflected in the quality and scope of the resulting chapters in this book which evaluate our current knowledge of Antarctic floras, from the Silurian to the Tertiary, within the wider context of Gondwana. Somewhere between the workshop and publication the overall title of the work has broadened considerably. There is only one palaeozoological paper included, by Hammer, and it is sadly out of place here. It is mainly a descriptive work on Triassic vertebrates and contributes very little to the overall palaeobotanical assessments of the other chapters. This is a book on Antarctic palaeobotany and it should have the confidence to advertise the fact, as there is much of importance to divulge on this subject.

The first two papers, by Collinson and Parrish, are also non-botanical, but they provide an excellent introduction to the depositional setting of Antarctica and the likely climatic scenarios for a supercontinent such as Gondwana. Both these works are highly relevant to interpretations of the floras discussed later. Spicer then widens the theme with a comparison of the Cretaceous Antarctic vegetation and climate with those of the Arctic, notably the Cretaceous record from northern Alaska. As Spicer indicates, one of the striking features of these polar floras is the presence of large trees at very high latitudes. These forest ecosystems of the Permian to early Tertiary are discussed further by Creber.

The palynological record of Antarctica is reviewed by Playford and Truswell, and is followed by chapters on the macroscopic floras from the Silurian to the Cretaceous by Edwards, Archangelsky, Bose, Taylor and Taylor. Particularly important plant groups, notably the genera *Glossoptera* and *Dicroidium*, the cycadophytes and the conifers, are given more extensive coverage by Pigg, Taylor, Delevoryas and Stockey. The final chapter, by Drinnan and Crane, provides a consideration of the biogeography of Cretaceous angiosperms in the southern hemisphere.

There are two over-riding messages which recur throughout this book. The first is that although there are severe problems with Antarctic palaeobotany, such as the difficulty of collecting in harsh conditions, lack of suitable rock exposures, insufficient stratigraphic cross-correlation and poor preservation of palynomorphs and cuticles due to volcanic activity, there is a real need for continued and thorough collecting. The second is the urgent need to improve the Antarctic database because of the important position of Antarctica at the heart of Gondwana and at high latitude throughout much of land plant evolution. Antarctica holds the key to the biogeography of Gondwana, the evolutionary relationships and dispersal of present southern hemisphere floras, and the high latitude palaeobotanical record for climate assessment.

J. L. CHAPMAN

Origin and evolution of the Antarctic biota
Edited by *J.A. Crame.*
Geological Society of London Special Publication 47, (1989).
322 pages. £58.00. ISBN 0 903 317443

This symposium volume contains many of the papers presented at a meeting with the same title held in London in May 1988. It should be read by anybody with an interest in biogeography whether they have, or like this reviewer have not, experience of work in the Antarctic. The editor, Alistair Crame, provides an introduction summarizing the main contributions of the 21 papers included. The volume is wide-ranging but not comprehensive; notable absentees are penguins and siliceous microplankton. Rather than repeating Crame's summaries, I shall use the papers to illustrate what seem to me some of the major issues raised by research on the Antarctic biota.

Antarctica is unique among the present continents in being relatively small, isolated by deep water and its enveloping current system, polar, and largely ice-covered. At no time prior to the late Neogene do all these conditions seem to have applied simultaneously. In the Palaeozoic it was part of the mega-continent of Gondwana and in the early Palaeozoic tropical. Its evolution towards its present condition has not been straightforward or unidirectional, as Gondwana pursued a somewhat erratic path towards and across the south pole. In the Mesozoic Gondwana broke up, and Antarctica became more or less progressively isolated, although at first only by shallow water, and its climate was mainly temperate. The Cenozoic saw the completion of the process of isolation with the initiation of the circum-polar current and consequent refrigeration, but again the trend was an oscillatory one. An essential precondition for nearly all the contributions to the present symposium is our greatly improved knowledge of the geological evolution of Antarctica, (of which the above is a very inadequate summary), derived largely from geophysical evidence and independent of palaeobiogeography. Nevertheless, differences in detail persist, and different

authors use different reconstructions. The reconstructions make it clear that it is pointless to consider the earlier evolution of the biota of Antarctica in isolation; contiguous parts of Gondwana, at least, must be considered, and many papers range even more widely. In the Cenozoic part of the story another invaluable source of independent evidence is the now well-known oxygen isotope curve for oceanic sediments of the subantarctic region. Although controversy continues as to the relative importance of ice-volume and temperature effects, this near-continuous record dramatically illustrates the climatic deterioration.

As regards interpreting the history of the biota, we are dependent on the living fauna and the fossil record, and the situation is in some ways frustrating. Present Antarctica has practically no terrestrial biota, and little shallow continental shelf that is not ice-covered, while the record of land floras and shelf macro-invertebrates of pre-icecap Antarctica is, although sparsely distributed, in places such as Seymour Island remarkably well-preserved. Conversely, we currently have an astonishing pelagic and deep-water biota, but its fossil record is poor to non-existent.

Looking at the fossil record in another way, there are Antarctic fossils that are interesting in their own right, for instance in reconstructing major evolutionary events such as the origin of the cephalopods (Webers and Yochelson), but which have no special bearing on the continent's polar journeyings or climatic history. This applies to most pre-Permian fossils as described in the first four contributions and to some later ones such as Chatterjee and Small's plesiosaurs. Then there are faunas which are necessarily discussed as part of the larger Gondwana story, notably Defauw's Permian and Triassic dicynodonts. From the later Mesozoic onwards we embark on what I see as the main story, of isolation and eventual cooling. Several papers deal with the stages prior to major refrigeration, and the few remaining ones mainly with the living fauna, which has little fossil record. Some of the earlier papers also suffer from lack of evidence from Antarctica itself, notably Molnar (one specimen!). The Rich *et al* (Australia) and Stevens (New Zealand) articles are well illustrated and more comprehensible to the non-expert than most of the others.

What general themes emerge? One long-standing debate now seems to be settled: according to Chaloner and Creber there was no insuperable problem imposed by the Antarctic polar nightfor plants growing at high latitude, . The flourishing forests could plausibly have been the Cretaceous source of the distinctive vegetation of southern humid forests (Dettman, Askin). By the same token, however, other taxa could have migrated *into* high latitudes.

Modesty perhaps forbade Crame from putting the Clarke & Crame paper earlier in the volume, but it is perhaps the clearest statement in the book of the fundamental questions concerning physiological adaptations to life at low temperatures and, more importantly according to these authors, of extreme seasonality of food supply. They also envisage a southern origin for various marine taxa (prior to major refrigeration) and discuss the puzzling differences in response of different groups or organisms to the steepening ecological gradients of the Cenozoic. In a way, the 'normality' of austral high latitudes prior to the early mid-Cenozoic makes them less critical for theories of 'ecological evolution' than they may once have seemed!

As part of their review, Clarke and Crame mention the now well-established evidence from the Ocean Drilling Program for earlier glaciation of Antarctica than the Miocene date often quoted: certainly Oligocene, perhaps mid-Eocene. Birkenmajer & Zastawniak review glacial-interglacial cycles on land, and claim an *early* Eocene glaciation based on K-Ar dating of lavas. This seems at odds with much evidence from isotopic and palaeo-botanical studies of a worldwide temperature maximum at that time, and the dating clearly invites discussion. Nevertheless, the rich floras intercalated with glacial deposits are in themselves highly significant.

Case discusses the classic problem of the marsupial radiations of South America and Australia, and claims that the latter was delayed until the northward travel of Australia ameliorated the climate. The argument is reasonable, but the fossil evidence weak: none in Antarctica, and only post mid-Miocene in Australia. The fish fauna (Eastman & Grande) is an extreme and interesting case: 'normal' up to the early Cenozoic with no fossils after that and the present fauna totally endemic.

Thomas's review of the benthic foraminiferal faunas does not suffer from lack of data. Faunal changes correrate well with isotopic shifts and probably with major re-organizations of water-masses (which presumably also affected the fish!). Thomas favours the 'warm salty bottom water' scenario for the early Eocene, a topic much discussed recently by palaeoceanographers.

As remarked above, one of the most intriguing yet frustrating questions concerns the origin – by immigration, *in situ* evolution or both, – of the modern marine fauna (the endemic fish, penguins, whales and seals), once Antarctica had attained its ice-bound, current-encircled isolation. The fossil record here largely fails us. That of the marine mammals (Fordyce) is the least unsatisfactory, but most questions can be addressed only by cladistic or molecular analyses of the living fauna.

I have few quibbles about this book. There are some omissions of topic, as mentioned earlier. A curious intellectual absentee is the dispersion-vicariance debate, at least as a methodological issue. Some articles have little direct Antarctic reference. The jargon level is forbidding at times; a layman could hardly be expected to know that heterochroneity is something quite different from heterochrony. But the book is a splendid tribute to the vitality of biogeographic research in Antarctica; let us hope that it stimulates so much research that it dates rapidly.

J.D. HUDSON

https://doi.org/10.1017/S0954102090240231 Published online by Cambridge University Press

Chronological list of Antarctic expeditions and related historical events

R.K. Headland
Cambridge University Press, Cambridge (1989).
730 pages. £65.00 ISBN 0521 3093 4

It used to be said that the idea of a polar institute came to Raymond Priestley and Frank Debenham when snowed up in a tent during Scott's last expedition of 1910–13. Debenham explained its origins and purpose to readers of the *Geographical Journal* more prosaically after the inauguration in May 1926 of the Scott Polar Research Institute, Cambridge of which he was appointed first Director. The 'germ of the idea' he wrote, had 'been born in 1913, when certain of the scientific members' of the Scott expedition 'sat down to prepare their reports and found considerable difficulty in obtaining the scientific reports of previous expeditions'. The Institute, from small beginnings, has continued and enlarged upon its task of collecting, disseminating and distilling material of many kinds concerning with the polar regions. It is best known for the *Polar Record*, but over the years its staff have compiled a chronology of expeditions to the Canadian Arctic, a snow and ice glossary, a manual for polar libraries, a text book on the Antarctic, Clive Holland's manuscripts in a1982 catalogue, a sea ice atlas of the seas north of the USSR, one of the Antarctic regions and one of the Canadian Arctictica, and a glaciological and geophysical folio of Antarctica. A most useful publication was the late Dr. Brian Roberts '*Chronological list of Antarctic expeditions*' which appeared in 1958, a slim handlist, first published in the Admiralty's *Antarctic Pilot* ten years before.

Now we welcome a greatly expanded version of Roberts' list, by the Institute's Archivist, Bob Headland. The chronological arrangement of the original has been kept, but there is a lengthy and carefully structured introduction, packed with facts, including information on legislation and the past and present administration of the various nations operating in the Antarctic. The Chronology ends in September 1988, as opposed to Roberts' 1957 – a further thirty years and those the busiest in the history of the 'Seventh Continent'. There are in addition a number of apposite illustrations, ranging from Captain Cook's 'Ice islands' of 1773 to tourists at Paulet Island in 1988. Clear and helpful maps and instructive statistical diagrams (concerning sealing and whaling, and numbers of wintering parties) also enhance this volume.

The fact that the last chronological entry is numbered 3342 (in a book of 730 pages) demonstrate the monumental character of this work. Anyone who has attempted a similar compilation will admire the author's determination in getting the list to press and his skill in ferreting out a whole host of elusive facts. Each expedition entry provides a succinct summary of its areas of operation, scientific work and other activities or occurrences. There is hardly a ship's captain or base leader whose full first names are not given. Ascertaining these alone must have entailed much correspondence. Similarly, a great deal of painstaking research was needed to assemble the entries included in 'related historical events' which link the Antarctic with the rest of the world. Examples of these are the first canning of food in 1812 and the establishment of the Kommandor Christian Christiansens Hvalfangst Museum in Norway in 1917. Others deal with specifically Antarctic legislation and meetings of (for instance) signatories of the Antarctic Treaty and members of the Scientific Committee on Antarctic Research.

The bibliography has had necessarily to be very selective, to keep the size of the book within bounds, but the index is full and detailed. Inevitably in a *magnum opus* such as this, errors creep in, despite the most careful scrutiny (eg. on p.617 in the reference to my own paper, for 1861 read 1831 and on p. 619, for Toissant read Toussaint). With a price of £65, many will swallow hard before buying the book. However, given the cost of a paperback nowadays, it is good value for money and a quite invaluable work of reference. As a former junior colleague of Dr. Brian Roberts. I can give no higher praise than to say he would have been well pleased with its successor.

ANN SAVOURS

Environmental Bioassay Techniques and their Applications

Edited by *M. Munawar, G.E. Dixon, C.I. Manfield, T. Reynoldson and M.H. Sadar.*
Kluwer Academic Publishers, Dordrecht (1989)
680 Pages. £157.50. ISBN 0 7923 04985

[Proceedings of the 1st International Conference held in Lancaster, England 11–14 July 1988. 67 pages covering use of microbes, plants, invertebrates and fish to measure degree of environmental contamination. Includes papers on environmental impact assessment, selection and implementation of bioassay techniques and toxicity assessments.]

D.W.H.W.