

data are adequately summarized throughout. This makes the book a more or less self-contained thesis which could be studied independently without frequent recourse to a bibliography. A useful bibliography is, however, provided for those who need it. On the whole the authors seem to address their writing to an audience of physicists rather than one of specialist astronomers. This makes the book an invaluable text for both the specialist research worker and beginner.

My only criticism is that in a few instances the book is already out of date by five years. Omission of recent developments in the identification of interstellar molecules and certain components of cosmic dust are notable examples. This is inevitable in such rapidly evolving fields. But it seems unfortunate that the time lag between the last Russian edition and the present translation should be as long as five years. A few of the shortcomings caused by this delay are remedied in a short addendum at the end of the volume. N. C. WICKRAMASINGHE

RIFT RESEARCH

Graben Problems

Proceedings of an International Rift Symposium held in Karlsruhe, October 10–12, 1968. By J. H. Illies and St. Mueller. Pp. 316+7 plates. (International Upper Mantle Project Scientific Report, No. 27.) (Schweizerbart'sche Verlagsbuchhandlung: Stuttgart, 1970.) \$23.10; DM 82.

THIS book contains the scientific contributions presented at the third symposium of the international Rhine graben research group held at the University of Karlsruhe on October 10–12, 1968. There are four papers of a general nature on the world rift system, thirty four papers on the Rhine graben and six papers on the East African rift system.

The proceedings are introduced by Leon Knopoff giving a clear discussion of the concept and importance of rigid plate tectonics. This is followed by two excellent review articles on graben tectonics, the first of a geological nature by J. H. Illies and the second geophysical by St. Mueller. These are followed by an interesting article by J. P. Rothé on the seismicity of oceanic and continental rifts. It is often forgotten that it was Professor Rothé who paved the way to the recognition of the world rift system by his observation in 1954 that the seismic zone of the African, Carlsberg and mid-Indian Ocean rifts continues around Africa to join with the mid-Atlantic rift. Rothé here gives many more interesting pieces of information including the fact that for the period 1953–1965, only 1.5 per cent of the world's total seismic energy is liberated along oceanic rifts. This is in contrast to island arcs and deep trenches where most seismic energy is liberated, this being caused by the plunging of cold, rigid plate into the upper mantle.

These four opening chapters are followed by five papers on stratigraphic evidence pertaining to the development of the Rhine graben. These are noteworthy for their dependence on data from oil companies which have enabled the production of excellent isopach maps of the region. These are followed by five more geological papers on basement and structure.

Five geothermal papers show that the Rhine graben, like other rifts, has high heat flow. These are followed by two papers on volcanism emphasizing its basaltic nature. Next come four papers on seismotectonics; two of these are on seismicity studies and two on geodetic levelling and also plans for laser distance experiments (Kuntz *et al.*). Ahorner has collected data from 1600 to 1967 in a very comprehensive survey of the seismicity of the Rhine graben. This indicates that in the neighbourhood of Mainz, the active rift zone of the upper Rhine turns north-west towards Amsterdam rather than con-

tinuing north-north-east through the Hessian depression. For the period 1600 to 1967 the most seismically active region was between Köln and Aachen. It must be remembered, however, that the seismic activity is relatively very small, the seismicity of the whole of the Rhine area being about 1 per cent of that of southern California!

German scientists have been especially active in pursuing seismic studies including application of refraction and reflexion techniques, the use of spectral transfer ratios of long period body waves and the dispersion of Rayleigh waves. This has led to a very complicated structure for the crust beneath the Rhine graben. Emphasis is placed on a "cushion" (7.6 to 7.7 km s⁻¹) above the "Moho" beneath the rift. Above the cushion, evidence is claimed for two low velocity channels in the crust of 5.5 and 6.2 km s⁻¹ respectively.

Papers on gravity, magnetic surveys and palaeomagnetism are followed by a final Rhine graben section entitled "Magneto-Telluric Deep Soundings". These reports confirm the existence of a high conducting zone beneath the rift, but there remain some uncertainties concerning its depth and temperature.

The book concludes with six articles on the East African rift system. These include three papers (by Knetsch, Tazieff and Schaeffer) giving preliminary results of recent reconnaissance expeditions to the inhospitable Afar triangle of Ethiopia. The book ends with a very useful article by Wohlenberg on the seismicity of the rift system in East Africa.

These conference proceedings show the thoroughness and intensity of the work on the Rhine graben; the German scientists are to be congratulated on the way in which they have assembled so much material and conducted new geophysical experiments, many of them at small or moderate costs. It is disappointing to see how few geologists (with the notable exception of Laubscher) interpret their observations in the light of Knopoff's opening lecture on plate tectonics. Otherwise, criticisms are minor. Many of the papers are in German; in these days when there is so much literature to be read it is regrettable that the editors did not insist on at least abstracts in English for the German papers and abstracts in German and French for the English papers. There are no lists of references at the ends of each paper; they are collected together at the end of the book. I found this irritating, especially on discovering several omissions and inaccuracies. The book is well produced, has clear illustrations and some beautiful photographs. It is somewhat expensive but is well worth it. R. W. GIRDLER

MODERN VOLCANOLOGY

Volcanoes

By Cliff Ollier. (An Introduction to Systematic Geomorphology, Vol. 6.) Pp. xiv+177. (MIT: Cambridge, Massachusetts and London, June 1970.) 68s.

CLIFF OLLIER has contrived to write an interesting and readable text, in which, although the subject matter is never profoundly treated, he nevertheless conveys a sense of appreciation beyond the evident limitations of length.

There are, however, some sections, for example chapters one and eight, which, although they are no doubt necessary for the sake of completeness, are unduly elementary and contribute little to a publication of restricted length. Nevertheless, the book is both useful and justified, for there is no modern text on volcanology. The only comparable publications are reprinted or revised older works, but the considerable interest and advances in the study of volcanology justify an entirely new publication.

The list of references is wide, representative and useful. B. C. KING