

the unclear and irrelevant ideas of "cell distance", "refractive index" and "electrostatic explosion of ions".

Throughout the book Professor Hora seems to be forcing his own conceptions on the reader rather than trying to properly survey the field. As a consequence the book gives a very unbalanced view. For example, only one paragraph is devoted to the production of high energy electrons, which continues to be such a major difficulty in laser fusion. Consistent with this neglect, the major problem of electron transport is totally ignored.

More than one-third of the book is spent on calculating the ponderomotive force and its effects on hydrodynamics, which leads, in the conclusion of Chapter 13, to the claim that all the problems of hot electrons in experiments can be removed by utilizing "the nonlinear force". As an alternative to the usual ablative

compression approach which suffers from electron preheat, Professor Hora suggests . . . the very fast nonlinear force pusher will accelerate the plasma before the hot electrons can be generated. This has been confirmed by extensive numerical studies and can be the way out of the present difficulties of laser fusion.

Apparently, Professor Hora genuinely believes that a short pulse intense laser at the upper limit of already achieved intensities will not produce energetic electrons. It is remarkable that, although this simple target approach is at least five years old, no major experimental programme has sought to make use of it. Evidently, of the many proposals to reduce the preheat problem, Professor Hora's has been judged to be the least likely to succeed. □

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## Seismologists look at arms control

Peter D. Marshall

*Identification of Seismic Sources — Earthquake or Underground Explosion.* Edited by Eystein S. Husebye and Svein Mykkeltveit. Pp. 876. ISBN 90-277-1320-0. (Reidel: 1981.) Dfl. 195, \$98.

IN 1958 a Committee of Experts met in Geneva to study the possibility of verifying a treaty to ban the testing of nuclear devices. Under the treaty, eventually signed in 1963, the USA, USSR and UK stopped all but underground testing — although underground explosions could be detected by their seismic effects, uncertainty in discriminating between explosions and the many earthquakes of equivalent magnitude meant that a treaty to ban them was politically unacceptable. This uncertainty in discrimination has occupied forensic seismologists for over 20 years. Their latest views are aired in these proceedings of a NATO-sponsored Study Institute, convened to assess progress since systematic research began with the Vela Uniform programme in the USA and Tabor Pluto in the UK.

These programmes led to instrumental improvements and to the use of digital computers to increase the accuracy of detection and hypocentre location. Many more earthquakes could then be distinguished from explosions because of their greater depth; in addition, the spectral differences between earthquake and explosion signals led to identification by their body to surface-wave ratios. These improvements opened up the possibility of teleseismic rather than the short-range monitoring available in 1958, thereby allowing a potential reduction in the number of stations required to verify a treaty. However problems continued to arise: the increasing number of explosions in both seismic and aseismic regions brought differences in transmission paths to the attention of seismologists and provided much of the impetus for modelling seismograms. This in turn highlighted the loss of information suffered by the narrow recording bands in common use, and thought and effort was successfully brought to bear on digital recording and processing in much wider bands.

By 1976 many countries had initiated seismological discrimination studies and the UN Committee for Disarmament took advantage of this wider interest to set up a multinational Ad Hoc Group of Scientific Experts to make recommendations on how a Comprehensive Test Ban Treaty (CTBT) might be monitored. Soon afterwards, CTBT negotiations were re-opened between the USA, USSR and UK; these demonstrated a need to supplement teleseismic stations with regionally sited stations in order to achieve the verification levels required.

At this point, groups in the USA and

Norway proposed a discussion of recent developments in discrimination studies under NATO sponsorship. The resulting proceedings of the Study Institute provide seismologists with a reference book of 45 papers, 20 by invited key lecturers.

The scene is set by Douglas's objective review which includes a comprehensive account of diagnostic criteria. Effective and stable diagnostic criteria depend on a knowledge of earthquake and explosive sources. Not surprisingly little is known about the earthquake source but strangely, as Rodean shows, much the same applies to nuclear explosions even after 20 years of underground testing. Any technique which defines their parameters thus becomes a significant diagnostic aid. One in which the seismic moment tensor is used to represent the source is discussed, among others, by Doornbos, clarifying what was becoming a rather confused topic and one turning out to be well worth further exploitation even though the method is bedevilled by transmission path effects. Waveform synthesis, discussed by both Harkrider and Kennett, may however one day lead to a solution of the problem of path effects. Of the seven papers on the influences of attenuation and scattering (both path effects) on the waveforms, that by Aki demonstrates the dramatic effects of even small velocity fluctuations within the lithosphere beneath a recording station.

In spite of the uncertainties, a seismologist must ultimately make a decision: earthquake or explosion? Much may depend on his decision, so the more independent observations available to him the better and Tjostheim reports on how multidimensional discrimination techniques may be applied to teleseismic data. The technique can also be applied to regional diagnostic data of the type described by Blandford. Finally, an indication is given of the kind of network which would need to be established with the appropriate instrumentation, automatic processing, data transmission facilities and data centres capable of promptly handling enormous quantities of data.

In 1958 Sir William (later Lord) Penney described seismology as a "stone-age science". The contents of this book demonstrate that this is no longer true, and the organizers of the meeting are to be congratulated on their initiative. Nonetheless problems remain. Seismic decoupling of explosions, explosion-like earthquakes, the detection of small explosions among earthquake signals and, above all, inadequate knowledge of the structure of the Earth all contribute to the difficulties of concluding a CTBT. Seismologists and physicists anxious not to rediscover the wheel will find in this volume the sources on which to build their new research programmes. □

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● A revised, paperback edition of *The Question of Animal Awareness* by Donald R. Griffin has been published by William Kaufmann Inc., price £6.20, and is available through W.H. Freeman. The original edition was reviewed in *Nature* 266, 792; 1977.

● A.I. Sabra's *Theories of Light, from Descartes to Newton*, first published by the Oldbourne Book Co. in 1967, has been re-issued by Cambridge University Press in both hardback and paperback. The book is essentially a reprint of the original edition, but some minor corrections and a new bibliography have been included. Price is hbk £20, pbk £6.95.