

obituary

Keith Bullen came to Cambridge from New Zealand, and entered St. John's College in 1931. It was his great good fortune there to meet Harold Jeffreys, who was just embarking on a task which was to be momentous for the development of seismology. This was the construction of new travel-time tables for earthquake pulses, using sophisticated statistical techniques and taking full advantage of the data collected over several years in the International Seismological Summary. Jeffreys asked Bullen to assist him. In spite of the very irregular distribution of seismological stations over the Earth's surface and the inaccuracies of instruments at that time, the Jeffreys-Bullen Tables (1935 and 1940) have endured astonishingly, and are still in common use.

In 1936, using the distributions of seismic velocities with depth which were derived by inverting the travel times, Bullen obtained his first model of the distribution of density throughout the Earth—and for the rest of his life he was deeply involved in successive efforts to improve density models. He told the story of his work with skill and enthusiasm in his book *The Earth's Density*, which was published in 1975.

Bullen explored the density distribution in two ways. The seismic velocities alone are not sufficient to determine the two elastic constants and the density. One further physical assumption is

needed. In the series of models called *Bullen A* he used a relationship between pressure, density and compressibility following the method of Adams and Williamson, whereas in the series *Bullen B* he assumed that compressibility and the rate of change of compressibility with regard to pressure varied smoothly throughout most of the Earth's interior. The results of the two different methods were largely reconciled when satellite observations produced a significant correction in the accepted value of the Earth's moment of inertia.

After 1960, when observations of the periods of the free oscillations of the Earth became available, Earth models could be revised so as to fit these also. Bullen and Hadden produced a new series of models designed to do that, but Bullen noted that they had not been able to allow for the effect of anelasticity, which, as Jeffreys had pointed out, tended to lengthen the periods of free oscillations.

His experiences in trying to compare Earth models put forward by different workers convinced Bullen of the need for a single reference model with which all variants could be compared. He became Chairman of the Committee for a Standard Earth Model, sponsored by the I.U.G.G., and worked hard for it until ill health intervened.

Bullen wrote an *Introduction to Seismology* which is uneven in its demands on the reader, but has run

into three editions and is still found very valuable. He also wrote an excellent *Introduction to Dynamics*, now in its eighth edition. A great asset of the book is Bullen's effort to give the reader insight into the reasons which determine the next step to be taken, and to explain why certain methods succeed and others fail. Throughout the book one finds, under the heading S.P.I.C.E. (special point(s) in choosing examples) the type of helpful suggestions that a good tutor would make to a pupil.

Bullen was a brilliantly clear expositor, whether writing or lecturing. He was also a very effective and strong (sometimes obstinate) committee man, so that he was called to many positions of responsibility, especially on Australian scientific bodies and in the I.U.G.G. and the International Association of Seismology and Physics of the Earth's Interior. His outstanding contributions to seismology were widely appreciated, and many honours fell to him, including Fellowship of the Royal Society in 1949. He was awarded the Gold Medal of the Royal Astronomical Society, and medals of several Australian and American scientific societies.

Bullen was a man of great energy and resource, in spite of partial deafness throughout much of his working life he travelled very widely. He died on September 23, 1976, aged 70, leaving colleagues and friends in every continent.

E. R. Lapwood

announcements

Meetings

November 19, **Magnetospheric Dynamics**, London (Royal Astronomical Society, Scientific Societies Lecture Theatre, 23 Savile Row, London W1, UK).

November 23–26, **Future of Aircraft All-Weather Forecasting**, London (The Manager, Conference Department, Institution of Electrical Engineers, Savoy Place, London WC2R 0BL, UK).

December 6–10, **Fall Meeting of the American Geophysical Union**, San Francisco (Meetings Registration, American Geophysical Union, 1909 K Street, N.W., Washington, D.C. 20006).

December 9–10, **Technologies for Rural Health**, London (The Executive Secretary, The Royal Society, 6 Carlton House Terrace, London SW1Y 5AG, UK).

March 30–April 1, **Mixing**, Cambridge (The Organising Secretary, 2nd Mixing Conference, BHRA Fluid Engineering, Cranfield, Bedford MK43 0AJ, UK).

September 13–15, **Particle Size Analysis**, Salford (Dr D. Dollimore, Department of Physical Chemistry, University of Salford, Salford M5 4WT, UK).

October 25–28, **Radar**, London (Deadline for abstracts: January 10) (IEE Conference Department, Savoy Place, London WC2R 0BL, UK).

November 22–24, 1977, **Design and Applications of EHV Substations**, London (Deadline for abstracts: November 29) (IEE Conference Department, Savoy Place, London WC2R 0BL, UK).

April 16–20, 1978, **Luminescence**, Salford (D. Irish, Pye Unicam Ltd., York Street, Cambridge CB1 2PX, UK).

September 4–7, 1978, **Medicinal Chemistry**, Brighton, Sussex (Symposium Secretariat, VIth International Symposium on Medicinal Chemistry, 31 Plane Tree Way, Woodstock, Oxford OX7 1PE, UK).

September 18–22, 1978, **Fat Research**, Brighton, Sussex (The Assistant Secretary, S.C.I., 14 Belgrave Square, London SW1X 8PS, UK).