a pushing stroke must have been developed by the Romans, who understood the importance of setting the teeth. They also experimented with an extension of the handle along the top of the blade, thus anticipating modern backed saws, and developed several types of framed saw in various sizes which continued in use through the Middle Ages until the present day in some backward areas.

Boring tools include the bow-drill depicted on early Egyptian reliefs, the auger used by the Romans, and the brace, known as a fully developed tool in northern Europe in the fifteenth century and probably originating farther east. Chisels and gouges, which date back to prehistoric times, have a section to themselves. Other essential items of the carpenter's equipment are also discussed and include his bench, also probably a Roman innovation connected with the invention of the plane, devices for measuring and setting out, such as rulers and dividers, squares and levels, and even his bag.

The book is attractively produced and well illustrated, with 200 photographs or line drawings of both actual tools, and tools shown in pictures, illustrated books, sculpture or wood-carvings from all over Europe. Many of the objects depicted, such as the seventeenth- and eighteenth-century planes, show much decoration, so that Mr. Goodman has not only produced a useful work of reference for craftsmen, but also an important book for all who are interested in the ordinary every-day life of people at all periods.

JOAN LIVERSIDGE

INTERNATIONAL SPACE RESEARCH

Space Research IV

Proceedings of the International Space Science Symposium, Warsaw, June 4–10, 1963. Edited by P. Muller. (Organized by the Committee on Space Research—Cospar—and the Polish Academy of Sciences.) Pp. xvi + 997. (Amsterdam: North-Holland Publishing Company, 1964.) 220*s*.

THE fourth International Space Science Symposium arranged by the Committee on Space Research (COSPAR) was held at Warsaw in June 1963, and, as in previous years, the proceedings have been published in a handsome 1,000-page volume by the North-Holland Publishing Company. The papers are mainly concerned with geophysics and interplanetary physics—with Earth, Air, Sun and Space. There is little on the tracking or dynamics of satellites, while the biological papers are being published in a separate volume.

Since the subject-matter of space physics extends without interruption from cloud-level to the outermost limits of the universe, any attempt to classify the papers is liable to be as fallacious as librarians' attempts to classify books. But in both spheres the attempt must be made, and in the present volume the division into, basically, six sections is surprisingly successful. There are 90 specialized papers in the six sections, and it is worth mentioning a few individually, even though others equally worthy must be omitted.

The first section deals with the upper atmosphere, which in practice means the study of the main neutral constituents of the atmosphere from the stratosphere to about 2,000 km height. L. G. Jacchia and J. Slowey report the most detailed analysis yet made of the variations in upper-atmosphere density and temperature at heights near 600 km, from the orbit of the *Explorer* 9 satellite. K. Y. Kondratyev discusses how to interpret the measurements of the Earth's outgoing radiation made by meteorological satellites.

The next section is on the ionosphere, which is to be interpreted as the charged particles with ordinary thermal energies at heights from 100 to 2,000 km, and sometimes higher. R. C. Sagalyn and M. Smiddy report on the electrical microstructure of the *D* and *E* ionospheric regions. The measurements of electron density made (by different methods) from the *Alouette* and *Ariel* 1 satellites are described by G. L. Nelms and P. Rothwell respectively.

The third section, entitled "Magnetosphere", is primarily concerned with the high-energy trapped particles of the radiation zones at heights ranging from 400 km (near the Brazilian magnetic anomaly) up to the outer limits of the Earth's atmosphere, 50,000 km or more. There are three papers, by Yu. I. Galperin, V. I. Krassovsky and others, on the results from the *Cosmos* 3 and 5 satellites, while L. A. Frank, J. W. Freeman, jun., and J. A. Van Allen describe their mapping of the outer boundary of the magnetosphere with the aid of *Explorers* 12 and 14.

The fourth section describes investigations of solar radiation, chiefly ultra-violet and X-ray, and includes many new measurements from the *Oso* 1 and *Ariel* 1 satellites, and from high-altitude rockets. The fifth section is devoted to the interplanetary medium (the plasma streams and meteoric material). There are useful papers by T. Obayashi and E. I. Mogilevsky on the interaction of the solar wind with the Earth's magnetosphere, and by T. R. Kaiser and C. T. D'Aiutolo on meteoric particles. Finally, there is a group of papers on cosmic rays, X-rays and nuclear reactions in space.

The specialized papers are preceded by a valuable series of review papers. The first, a frankly critical review of the ionospheric *F*-region by J. A. Ratcliffe, offers a new method of presenting a scientific paper, as the bare bones without the all-too-solid flesh of verbiage which normally hides them. Though some readers may yearn for more complete sentences, this vivid staccato style may well be more conducive to progress than the stodgy tone of the average scientific paper, because it brings out the main points at issue so clearly. The dozens of unanswered quickfire questions inevitably give the impression, however, that little has been discovered in thirty years of ionospheric investigations.

There are two important review papers on the aurora and airglow by B. J. O'Brien and V. I. Krassovsky. O'Brien notes that the energy required to run the world-wide aurora is on average 4×10^{17} ergs/sec, while the tube of particles streaming out from the Sun, as intercepted by the outermost atmosphere, brings about 3×10^{19} ergs/sec. So 1 per cent of the solar-wind energy could sustain the aurora. But the detailed process—the life-history of the particles—is still unknown.

P. V. Vakulov and others contribute a thorough review of cosmic rays, their energy spectra and their time variations, utilizing measurements both in space probes and on the ground. W. N. Hess discusses the life-times and life-histories of high-energy particles trapped in the radiation zones, and there is a useful review by E. R. Mustel of the Sun and the interplanetary plasma. C. W. Snyder and M. Neugebauer contribute an interesting report on the measurements of the solar wind made by *Mariner* 2, which showed that the velocity of the plasma varied between 300 and 800 km/sec, with a 27-day recurrence tendency and a mean of about 500 km/sec.

The book, like its predecessors, is well printed and produced, with good type and paper, though misprints are more frequent than in previous volumes. Each of the papers is intended to have abstracts in English and Russian, but many of the Russian ones are unfortunately missing. Several of the Russian papers are rather difficult to read because the English is far from fluent: most specialists will be prepared to accept this slight inconvenience as a small price to pay for the advantage of having so many Russian papers available in English within a year of the conference. Recording as it does the main advances in space research, reported by the leading space scientists of all countries, this volume should be in every library covering the subject, and many space scientists will wish to obtain a personal copy for reference.

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