

Things are looking up and up

Stephen P. Maran

Pathways to the Universe. By Francis Graham-Smith and Bernard Lovell. Cambridge University Press: 1988. Pp. 239. £15, \$24.95.

IN *Pathways to the Universe*, two leaders of the post-war revolution in radioastronomy have joined forces to produce a comprehensive survey of astronomy for the educated general reader. Sir Bernard and Sir Francis explain that "having enjoyed the privilege of pursuing research in a new

photographs of the Moon's surface were rushed to a 1964 meeting of lunar experts. There are many such elements in the book, in which the authors also employ the clever device of beginning each chapter by describing an experience or observation that readers can try for themselves. Each chapter ends with information drawn from the most recent investigations; that on comets, for example, contains an excellent summary of the visit of the International Cometary Explorer to the Comet Giacobini-Zinner and of the subsequent space missions to Halley's Comet.

On occasion, the narrative lapses into a dry recitation of facts, but the reader is encouraged to resume the journey upon encountering such rewarding chapters as the lucid discussion of cosmology or the skilful interweaving of facts, history and graphical information on meteors and micrometeorites. *Pathways* does leave us spinning when it comes to the rotation of

the Earth, however; to profit from that section, one really needs to be a trained physicist or even a Cambridge graduate. A few usages can be debated, too: for example, "Galactic centre", treated (as in "Roman orgy") as a capitalized adjective followed by a noun with its initial letter in lower case, seems like an international convention that should not be ratified.

I found only one certain oversight: Alvan Clark (p.152) did not photograph the white dwarf star Sirius B in 1862; rather, it was then that his son Alvan G. Clark spotted the tiny star visually while testing a new telescope on the brilliant Sirius A, and exclaimed excitedly, "Why father, the star has a companion". With this new book the reader, too, has found a trustworthy companion. □

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Oculomotoring

I. M. L. Donaldson

Movements of the Eyes, 2nd edn. By R.H.S. Carpenter. Pion, 207 Brondebury Park, London NW2 5JN: 1988. Pp. 593. £59.50, \$115.

OUR eyes are mobile and our perception of the visual world is built up as a series of snapshots, each taken with the eyes pointing in a slightly different direction. Eye movement is a pre-condition of seeing, and the relation between ocular displacement and visual perception presents problems which have occupied philosophers and natural scientists for centuries.

The movements themselves are simple compared to those of the limbs, in that they involve a system of constant inertia and are confined to rotations without translation. They are also exquisitely controlled. Thus, the oculomotor system is one that should be relatively easy to understand, and so should be a good testing ground for our understanding of the general problems of motor control.

The first edition of *Movements of the Eyes*, published in 1977, has become a standard work; what then of its successor? Although it is more than 40 per cent longer, with all of the sections rewritten to reflect the work of the past decade, the arrangement and overall scope remain much the same as before. Of the three sections, the first describes the types of eye-movement (there are six in human beings), and the second provides an excellent account of the static and dynamic properties of the globe and its muscles, and of the anatomy of the neural pathways which lead to and from the eye-muscles.

The third section deals with the whole system, and presents, explains and illustrates the mathematical models which may be used to describe and predict the system's behaviour; this section also confronts squarely the formidable problems of trying to identify the neural circuits which may be the black boxes of the mathematical models. There is an excellent new chapter on oculomotor adjustments; here Carpenter deals with the necessity for continual re-calibration of the oculomotor system to take account both of imperfections in its performance and of changing circumstances (for example, growth at one time of life and ageing at another).

One of the features of the first edition was an appendix on linear systems analysis for the non-mathematician. This has been expanded and is now a first-class introduction to the subject, requiring no technical mathematical knowledge — it is a remarkable achievement, and a necessary one, because the revised text relies upon a much more formalized use of systems analysis than before. The last section, in which models of the oculomotor system are described, includes perceptive discussions of the value of such schemes and of the usefulness of a strictly quantitative approach to the complexities of the nervous system. The author delivers a timely warning against being seduced by the elegance of such models into according them independent existence.

This new edition is a worthy successor to Carpenter's previous book. All those interested in the control of movement or in vision are once again in his debt. □

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REASONS

Sir Bernard Lovell in the operations room of the 250-foot radiotelescope named after him. The sight, during wartime, of short-lived echoes on a radar screen inspired Lovell to employ radar to search for echoes caused by showers of cosmic rays, using borrowed equipment and a field at Jodrell Bank lent by the Botanical Department of the University of Manchester. Since then, radioastronomy has grown into a big science, not least at Jodrell Bank.

field, we are now impelled to tell the story to the best of our abilities". Their abilities are more than equal to the task, and the authors are particularly successful at portraying the areas in which they themselves have had especially strong interests — meteors, space missions and the search for extraterrestrial intelligence (Lovell), and pulsars and radio galaxies (Graham-Smith).

The book is enlivened by their personal reminiscences of historic moments in modern astronomy, for example the sensation caused when the first close-up