The local star

J.C. Brown

Astrophysics of the Sun. By Harold Zirin. *Cambridge University Press:1988. Pp.433. Hbk £37.50, $49.50; pbk £12.95, $22.95.*

The Atmosphere of the Sun. By C.J. Durrant. *Adam Hilger: 1988. Pp.168. £23.50. Distributed in the United States by Taylor & Francis, $64.*

BECAUSE of its proximity, the Sun inundates us with data and with theoretical problems. Few possess the diverse knowledge of physics required to understand and lucidly explain these problems; in consequence, most recent books on general solar physics have been collections of chapters by specialist authors, with all of the well-known drawbacks of such volumes. As the testbed of almost all of astrophysics, the physics of the Sun warrants more accessible, single-author treatment. Fortunately, there seems to be a resurgence in the publishing of such monographs; those by Zirin and by Durrant, although complementary in approach and content and contrasting in style, constitute admirable examples.

Zirin's *Astrophysics of the Sun* was spawned as a revision of his earlier *The Solar Atmosphere*, published by Gail & Blaisdell in 1966, but in its growth has gone far beyond that. Although the book still bears the hallmark of an observer and spectroscopist, the new volume embraces most of the prevailing ideas of topical interest in the physics of the entire Sun. Throughout, it also reveals the colourful personality of the author, in enthusing over results from his own team, and in the frequent philosophical and scientific asides which range from the profound to the flippant. The overall effect is to make for most enjoyable reading, although serious-minded readers may find the individualistic style irritating.

In particular, theorists may react against the familiar Zirin tirade against their cavalier use of data by pointing to his and his fellow observers' use of confusing terminology — such as 'faculae', 'plagettes' and 'network elements', all of which refer to a single phenomenon — and to mistakes in the theoretical parts of the text. Glaring examples are the conceptual, numerical and referential errors in the treatment of non-thermal *bremsstrahlung*.

Nonetheless — and despite Zirin's early disclaimer to theoretical expertise — all of the important general ideas in theoretical solar physics come across clearly and some, such as the prediction of the solar wind, are presented as succinctly and lucidly as I have seen anywhere. I was disappointed only in the chapter entitled "Questions", which is an anticlimactic end to an otherwise fascinating book.

The Atmosphere of the Sun is much shorter and more restricted in scope than Zirin's book. Durrant concentrates largely on the formulation and explanation of the plasma and radiation theory needed to understand both the gross and the detailed structure of the outer layers of the Sun, complementing this with clear accounts of the relevant observations. By adopting such a didactic theory-based approach, however, he has succeeded in producing a highly coherent account of the *physics* of solar physics, although the final chapter on solar activity falls below the general standard. Few writers have managed to present so well a mathematically rigorous development of complex physical problems, together with clear verbal explanations of the significance of the mathematics, as well as of the physics and the problems themselves.

Anyone venturing to read either of these books, whether as a research primer or for general scientific interest, will close it much better informed about the Sun. For those wishing to pursue a deeper interest in solar physics, I strongly recommend reading both. □

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Unearthly ideas

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Astrophysical Concepts, 2nd edn. By Martin Harwit. *Springer-Verlag:1988. Pp.626. DM98, £32, $54.*

Physics of the Galaxy and Interstellar Matter. By H. Scheffler and H. Elsässer. *Springer-Verlag:1988. Pp.492. Hbk DM118, £38.50, $69.50; pbk DM88, £29, $49.50.*

Cauldrons in the Cosmos: Nuclear Astrophysics. By Claus E. Rolfs and William S. Rodney. *University of Chicago Press: 1988. Pp.561. Hbk £59.95, $74.95; pbk £27.95, $34.95.*

THESE days there is such a copious production of proceedings of conferences and advanced study institutes in astrophysics and cosmology that it is difficult to keep up. The supply of textbooks that either introduce the subject from first principles, or provide an in-depth survey of a particular field, is very much smaller. So the appearance (or in two cases reincarnation) of three major texts is a welcome event.

Astrophysical Concepts is the second edition of a book that I have been recommending (with reservations) to students for some time. First published in 1973 and based on courses for seniors and beginning graduate students at Cornell, it develops many physical ideas required in astrophysics from first principles. The author uses specific astronomical situations for illustration, rather than systematically running through astrophysics as such, although essential astronomical facts and terminology are summarized in an opening chapter and an appendix.

The great strength of the book lies in the lucidity and elegance with which chosen topics are quantitatively developed using elementary and clever arguments, instructive problems being distributed throughout, and in the sceptical spirit of enquiry that pervades the writing. The weakness lies in unevenness of treatment, accentuated by absence of much serious revision in the main body of the text. A fresh chapter on cosmology has been added, and this gives a good description of recent research with some useful comments on the formation of galaxies, stars and the Solar System. But it is simply superposed on a lengthy treatment of issues current before 1973 that would have benefited from shortening in favour of newer results (for example the discovery of gravitational lenses, Hawking's work on the thermodynamics of black holes and re-evaluation of Dirac's 'large numbers' hypothesis in the light of the anthropic principle).

Too much attention is paid to the cranky concept of (potentially observable) tachyons. Here the author uses or belittles consequences of 'traditional' special relativity as it suits him, gets into a muddle as to whether the momentum of tachyons is real or imaginary, and claims that "the existence of tachyons would have important consequences in cosmology and in rapid communication across large distances" — much as one might claim that the existence of a perpetual motion machine would have important consequences in cosmology and in helping to solve the world's energy problems. This quirk can perhaps be excused on the grounds that it is bound to provoke the reader into thinking; there is rather less excuse for a few straightforward technical errors, such as treating the diffusion of Lyman-α photons in a nebula as an example of a random walk in space. A flawed masterpiece.

Galactic research is one of the oldest parts of astronomy, but one that never stays quiet for long. Successive advances in observational technique — optical, radio, cosmic ray, ultraviolet, near infrared, X-ray, gamma-ray, sub-millimetre and now (with the IRAS satellite) far infrared — have brought new insights and complications, and have stimulated theoretical developments in stellar dynamics and in the physics and chemistry of the interstellar medium. A remarkably complete and balanced survey of all these topics is provided by *Physics of the Galaxy*