SOLAR AND TERRESTRIAL RELATIONSHIPS

Sunspots in Action

By Dr. Harlan True Stetson. Pp. xiv+252. (New York: Ronald Press Co., 1947.) 3.50 dollars.

THE time is surely ripe for the appearance of an authoritative popular work dealing with the fascinating topic of sun-earth relationships. If Dr. Stetson's book fails to qualify for acceptance in this category, it may well be because he devotes too much space to what is uncertain and speculative, while giving too little attention to those relationships which are clear and unassailable.

The amplitude of the 'daily variations' in the terrestrial magnetic elements has shown a close correspondence with the Zurich sunspot numbers over more than a century. Both variables are capable of precise measurement, and an examination of Fig. 13 in Dr. Stetson's book will show that the correlation between them is of the closest kind. At rare intervals also there occur very violent fluctuations of the magnetic elements, known as 'magnetic storms'. Maunder, of Greenwich, showed, more than forty years ago, that each 'great' magnetic storm coincided in time with the passage of a large sunspot across the sun's central meridian. More precisely, the storm began about thirty hours, on the average, after the central meridian passage of the sunspot. The converse, however, was not true, that the central meridian passage of every large sunspot was followed by a magnetic storm. It remained uncertain whether the corpuscular stream responsible for the storm was emitted continuously from the sunspot region, confined, perhaps, to a narrow radial beam which sometimes missed the earth altogether, or was emitted only intermittently, some of the larger spots being relatively inactive in this respect.

Atmospheric ionization must be attributed in a general way to the action of solar ultra-violet light, with perhaps a small contribution from meteors, and it will therefore reflect in its changes the progression of the spot-cycle. However, with the development of the spectrohelioscope by Hale (1926), chromospheric flares came to be recognized as sudden, short-lived emissions of monochromatic radiation (including enhanced ultra-violet) and having their origin in the vicinity of active sunspot regions. Spectrohelioscope observers, co-operating under the aegis of the International Astronomical Union, rapidly accumulated a large body of facts. These results were discussed by H. W. Newton in an important series of papers, in which he established that each intense (3+) flare was followed by a remarkable train of events. The radiation emitted by the flare is both wave and corpuscular. Simultaneously, with the visual observation of the flare by light of the hydrogen α line, a burst of ultra-violet light reaches the ionosphere, giving rise to: (a) the magnetic 'crochet' effect, (b) the low-level (D-layer) ionization which causes the fade-out for short-wave radio transmissions (Dellinger effect) along sunlit channels of communication. Some twenty-six hours later, with the arrival of the charged corpuscular stream (emitted at the time and place of the flare), the 'sudden commencement' marks the onset of the magnetic storm, with its accompanying radio and visible (auroral) effects. The discussion of the locations on the sun's disk of intense flares preceding magnetic storms makes it clear that the

corpuscular stream is confined to a radial beam of semi-vertical angle about 40° .

Thus Maunder's statistical relationship between magnetic storms and the central meridian passages of large sunspots is found to be, in reality, a one-to-one correspondence between storms and intense flares associated with the sunspots near the times of their meridian passages. None of this is made at all clear by Dr. Stetson. Indeed, we find no reference, either in the text or in the bibliography, to the work of Newton, Waldmeier and others on flares, and Maunder is referred to, but in quite a different connexion, as Professor (*sic*) Maunder and in the index as A. S. D. Maunder (which was Mrs. Maunder). The author seems to regard sunspots as the primary phenomenon in all his relationships, whereas most solar physicists would now consider the spots as no more than the visible accompaniments of the much more extensive 'active regions' which are manifest through the occurrence of flares, active prominences, coronal excitations, bursts of radio-noise and in other ways. In Fig. 30 we find an unusual version of Maunder's 'butterfly' diagram, intended to illustrate Spoerer's law of the progression in latitude of sunspots with the eleven-year cycle. In the absence of a description of how the diagram was plotted, the reader will naturally conclude that there are *three* distinct belts of spots, instead of only one, on each side of the solar equator, and that each progresses independently towards lower latitudes as the cycle proceeds.

In the first six chapters the reader will enjoy very entertaining and lucid accounts of such subjects as the origin of solar energy, the measurement of the solar 'constant', the conditions in the ionosphere and the means by which radio-waves are propagated round the globe. There is also an admirable description of ionospheric sounding by the method of 'critical frequencies'. It is clear that Dr. Stetson is much more at home on the radio side.

In later sections the author summarizes much that has been written in an endeavour to relate the sunspot cycle to such matters as the growth of trees, world weather, economic cycles and human health, and he makes a plea for the further study of what he calls 'cosmecology', that is, the relationship of the earth to its cosmic environment. It is in these spheres, where we are no longer dealing with variables capable of accurate measurement, that knowledge becomes vague and a prey to opinion.

M. A. ELLISON

FISHERMAN AND NATURE LOVER

A River Never Sleeps

By Roderick Haig-Brown. Pp. 320. (London and Glasgow: Wm. Collins, Sons and Co., Ltd., 1948.) 12s. 6d. net.

NO writer has written so vividly of fishing since Lord Grey of Fallodon. Roderick Haig-Brown's book has the rare combination of good prose written by a man who is a master of the subject on which he writes.

The book is divided into twelve chapters, under the twelve months of the year, and the author describes fishing experiences, both in Great Britain and in British Columbia, where he now lives. He is a skilled