

following pages will have been accomplished if they are the means of inspiring somebody to further unfold the subject."

The volume is certainly a very welcome addition to the literature, and can be warmly recommended to those interested in insect life, as well as to proprietors, foresters and all others interested in the growth of the British oak.

PRACTICAL ASTRONOMY.

Cours d'Astronomie. By H. Andoyer. Second part. *Astronomie Pratique.* Pp. 304. (Paris: A. Herman and Sons, 1909.) Price 10 francs.

TO provide anything like a complete account of the methods of instrumental astronomy, whilst keeping the work within limits suitable for a course of university lectures, is not a practicable task. The second part of Prof. Andoyer's "*Cours d'Astronomie*" is much more bulky than the first part (which was devoted to theoretical astronomy), yet there is everywhere evidence that the author has been harassed by want of space, and is obliged to omit details which are often of the highest practical importance. He himself is keenly sensible of this limitation; again and again throughout the work he repeats that his treatment must be confined to a general indication of the methods, without entering into details.

The point of view of the work is thus necessarily academic, and differs somewhat from that of the practical observer; nevertheless, in the descriptions of instruments and accessories much interesting practical detail is given, which is not usually found in astronomical text-books. It is clear that great care has been taken that all such information should be trustworthy; in fact, the precision and accuracy which distinguished the first part of the course are again noticeable in this part. We may, however, point out one or two questionable passages; it is stated that the chronographic method is only used for meridian observations made at observatories (p. 63). It is difficult to understand why the author should have supposed that the method is thus limited; it is not so in practice. Again, we read that in determining differences of longitude of the great observatories, in spite of all precautions, and in spite of the skill of observers, "on est loin de pouvoir répondre du dixième de seconde de temps." Prof. Andoyer must have been misled into this generalisation through some exceptional discordances in one or two of the classical determinations of longitude. In recent determinations a much greater accuracy is normally attained.

The first part of the book deals with such subjects as interpolation, the theory of errors, and the method of least squares. Common accessory apparatus, including the graduated circle, micrometer and spirit-level, is next thoroughly discussed. Three instruments are selected for specially detailed treatment; these are the theodolite, the equatorial, and the transit circle. The theodolite is probably chosen because it is likely to be more familiar to the student than a more strictly astronomical instrument. It is doubtful, however, whether the theodolite serves as a good introduction

to instrumental astronomy or well exemplifies its principles; and the same may be said of the equatorial when used for making absolute (as opposed to differential) measures. The fundamental principles of practical astronomy are not to be found in the development of the formulæ for a general type of instrument; its main problem is the design and use of specialised instruments, in which the mechanical errors are few, and can be as far as possible determined and eliminated. We feel that the treatment of the transit circle has suffered somewhat from the devotion of so much space and the priority accorded to the theodolite and equatorial, though it must be admitted that in his account of it the author has compressed a wonderful amount of matter into a concise form. Besides the three chief instruments, numerous others are briefly described; these include the zenith telescope, coudé equatorial, heliometer, siderostat, and celostat.

In most cases this short treatment appears to be sufficient (though we doubt if any reader will be able to picture to himself the coudé equatorial from the description given); but when the whole subject of astrophotography is likewise dismissed in half a page, some protest seems to be required. Surely this branch of astronomy has now attained a development and importance sufficient to secure for it a place in the text-books. It cannot be urged that the subject is unsuitable for inclusion in the university course; the theory of transformation of coordinates and the formulæ involved should surely appeal more to the mathematical student than the study of the small errors of a transit instrument.

Among the other subjects considered may be noticed an excellent chapter on the fundamental constants of astronomy. Although limitations of space preclude a detailed discussion of the methods of avoiding error, a very fair idea is given of the difficulties and uncertainties involved in the determinations. We are glad to see that in a complementary chapter an explanation of Gauss's method of determining an orbit from three observations has been included in the course.

A. S. E.

OUR BOOK SHELF.

Water Hammer in Hydraulic Pipe Lines. By A. H. Gibson. Pp. iv+60. (London: A. Constable and Co., Ltd., 1908.) Price 5s. net.

THE phenomenon of water hammer in pipe mains is one familiar to all who have had any practical experience in matters of water supply, either for domestic consumption or for power purposes. Indeed, it is safe to say that it comes within the observation of most people. There can scarcely be a householder who is not aware that the abrupt closing of a tap, or valve, produces a violent and perfectly audible concussion in a water pipe, though perhaps he may not realise that the shock, if repeated with sufficient frequency, is capable, in process of time, of producing rupture, unless the pipe possess a very large margin of strength to resist so considerable an excess over the normal pressure, or unless a relief valve be provided. This latter expedient is most generally adopted in all important installations, where the consequences of a sudden outburst would be serious, if not disastrous.

In the case of a phenomenon of such common occurrence, it is somewhat remarkable that there is