

sufficient to account for the properties of emulsions prepared in different ways. The author treats of the character of the developed image, and distinguishes between the graininess due to the individual particles of silver, the aggregations of these particles, and the agglomeration of these primary aggregations. The sharpness of the image is discussed, curves showing the quantitative values of these properties are given, and the methods by which these properties have been investigated are described.

YEAR BOOK No. 19 of the Carnegie Institution of Washington contains the nineteenth annual administrative report of the president, together with the reports on investigations and projects submitted by the various departments of the institution. Two sections of the presidential address, the financial records and the list of the institution's publications for the year, disclose some interesting facts. The total income available for the year ending October 31, 1920, was roughly 388,000*l.*, and of this sum about 278,000*l.* was allotted to the various departments. The Department of Terrestrial Magnetism received the biggest

grant, some 51,000*l.*, while Mount Wilson Observatory received 45,000*l.*, and the Geophysical Laboratory the notable sum of 31,000*l.* Another large item in the expenditure was the production of the well-known publications of the Carnegie Institution, of which twenty-two were issued and a further eight authorised for publication during the course of the year; this work absorbed some 17,000*l.* The bulk of the Year Book is devoted to reports showing the progress of investigations carried on during the year; reports of directors of departments are given first, followed by reports of recipients of grants for other investigations, the latter being arranged according to subject.

THE latest catalogue (No. 415) of second-hand books offered for sale by Mr. F. Edwards, 83 High Street, Marylebone, W.1, deals with works relating to British and foreign birds, and natural history voyages and travels. It contains nearly 400 items, many formerly the property of the late Dr. F. du Cane Godman, and several choice and scarce works. It will appeal to ornithologists. The catalogue is to be obtained upon application.

Our Astronomical Column.

DR. HILL'S CUSPED ORBIT.—Dr. Hill in his "Researches on the Lunar Theory" described a certain case of satellite motion in which the orbit of the satellite relatively to the primary was cusped at first and last quarter. The period of such a satellite in the earth's case would be 205 days. Dr. Hill supposed that this was the orbit of maximum lunation, but M. Henri Poincaré later showed that still larger orbits were possible, with loops replacing the cusps.

Astr. Nach. No. 5101 contains a paper by Prof. T. J. J. See quoting results of the late Dr. John N. Stockwell, in which the latter claimed to have shown that Dr. Hill's cusped orbit was erroneous and should be replaced by a flattened oval with a period of lunation of 247½ days. He further asserted that Jacobi's integral (used by Dr. Hill) was based on incorrect mechanical principles. Both Prof. See and Dr. Stockwell appear to have overlooked a paper by R. Moritz in *Mon. Not. R.A.S.* for November, 1917, in which the latter re-investigated the cusped orbit of Dr. Hill by the method of mechanical quadratures used by Dr. P. H. Cowell for the eighth satellite of Jupiter and for Halley's comet. Needless to say, this method is independent of Jacobi's integral, and involves nothing beyond the elementary principles of accelerated motion. The result has led to the detection of a few unimportant numerical errors in Dr. Hill's work, but the accuracy of the cusped orbit is substantially verified. If Dr. Hill's figures had been rigorously exact, the minimum distance of the satellite from the earth would have been attained when the angle of motion relatively to the sun was exactly 90° from the cusp. The actual figures given by the quadrature method are 90° 6' 51". The error is mainly due to the small errata in Dr. Hill's work, though a little may be ascribed to the inevitable cumulative error of mechanical quadratures. It would therefore appear that Dr. Stockwell's method must involve some fallacy, since the orbit that he gives for a period of 208½ days is of quite a different shape from the cusped orbit, and differs little from an ellipse.

NO. 2694, VOL. 107]

STONYHURST COLLEGE OBSERVATORY.—We have received the annual report of this observatory from the director, the Rev. A. L. Cortie, S.J. The regular observation of the sun has been continued, and the results show a steady decline in spot-activity, the disc being without spots on four days in September last for the first time since 1916. The director communicated a paper to the British Association at Cardiff on the connection between faculæ and calcium flocculi, showing that the correlation of the two is so close that the faculæ are probably the bases of the flocculi.

It will be remembered that on a former occasion Father Cortie dwelt on the importance of the latitude of sun-spots as an index of their magnetic effect on the earth. This was borne out by the spot of last month, which, although not at all abnormal in its extent, passed very near the centre of the disc, producing great magnetic disturbance and extremely bright auroræ.

The report contains an obituary notice of Bro. W. McKeon, S.J., who died on May 18, 1920. He was on the observatory staff for forty-two years, the majority of the drawings of spots made at the observatory being his work.

"L'ASTRONOMIE ET LES ASTRONOMES."—M. Auguste Collard, librarian of the Royal Observatory of Belgium, has published a useful bibliography under this title, which forms a brochure of 119 pages. It is divided under the headings: (1) Dictionaries and Encyclopædias of Astronomy; (2) Biographies of Astronomers; (3) Treatises on Astronomy, subdivided into many sections; (4) Histories; (5) Bibliographies; (6) Atlases; (7) Reviews; and (8) Tables.

The works under the various headings are not arranged in alphabetical order, but there are alphabetical indices at the end. There are also in many cases brief notes summarising the scope of the work, which are a useful supplement to the mere statement of the author's name and the title. The book promises to be useful; it is one of a series of similar works of reference published by G. Van Oest et Cie, National Library of Art and History, Brussels.