

Sections ii.-vi. contain tabular matter exclusively. The explanation of the tables is contained in the ten chapters of section i. This appears to be a model of clearness. Except in chronological questions and in special researches the ordinary astronomer rarely has occasion for single places of the moon outside the range of the hourly ephemeris provided in the Almanacs. The chief function of the tables therefore lies in the calculation of this ephemeris from year to year, and this fact has been kept in view in their arrangement. Advantage has been taken of Hansen's example to the extent deemed profitable, and a number of original devices have been introduced, including a new scheme of re-entrant arguments. By these means it is believed that the computation of an ephemeris will be at least as rapid as with Hansen's tables, in spite of the inclusion of about five times as many terms. An accumulation of errors in the sums of many tabular entries is unavoidable. From this source probable errors of  $0.04''$  in the longitude or latitude, and of  $0.003''$  in the parallax, are expected after these co-ordinates have been finally contracted to one decimal place less. Imperfections in the adopted constants and cumulative small defects of theory may raise these amounts to  $\pm 0.1''$  and  $\pm 0.05''$  respectively. Clear instructions are given for making such adjustments in the fundamental constants as may hereafter prove necessary. But there need be no illusion that the moon will actually follow the strict gravitational path laid down so carefully in these tables. As it is, the empirical term

$$+ 10.71'' \sin \{ 140.0^\circ (t_e - 18.5) + 170.7^\circ \},$$

with a period of 257 years, has been admitted in the longitude, with consequential changes in the arguments of some other terms. In magnitude this is comparable with the great Venus term, and the explanation of it is still to seek. Discrepancies will recur, and the advantage to be expected from the new tables is that they will no longer be entangled with the errors of a faulty ephemeris. If this hope is realised—and there is no reason to doubt that it will be—unstinted gratitude will be due to Prof. Brown and to those who have assisted him either by active collaboration or by financial aid.

The tables have been printed in England at the Cambridge University Press. The paper is of an unusually sumptuous and durable quality appropriate to a work of lasting value which will have to bear repeated handling for a long time. The type is admirably clear. Only one superficial point suggests adverse comment. The pagination is peculiar. In their present form the tables consist of six sections in three volumes. Each

section, of length varying from 39 to 223 pages, is paged independently from 1 onwards. In whatever form the work is finally bound, this will surely prove an inconvenient plan for any purpose, such as the correction of errata. A continuous sequence would have been preferable. But perhaps there will be no errata (beyond one already noted), and in any case the blemish, if it be one, is trivial.

H. C. P.

### Genesis, Evolution, and History.

*The Evolution of the Earth and Its Inhabitants.*

By Joseph Barrell and Others. A Series of Lectures delivered before the Yale Chapter of the Sigma Xi during the Academic Year 1916-1917. Pp. xiv + 208 + iv plates. (New Haven: Yale University Press; London: Humphrey Milford; Oxford University Press, 1918.) Price 10s. 6d. net.

THIS book consists of five lectures by five experts, who deal with various aspects of evolution. The range extends from the nebula to modern civilisation, and the wonder grows that one word can cover it all. We feel as if the word "evolution" were in danger of becoming like a household knife—used in so many ways that it tends to become useless. The use of the same term for so many different kinds of becoming is apt to suggest that they are all describable by the same formulæ. To avoid this fallacy, might it not be well to find differentiated terms, such as *genesis* in the domain of things, *evolution* in the realm of organisms (keeping *development* for the becoming of the individual), and *history* for the kingdom of man?

The first lecture deals with the genesis of the earth and of the parent solar system, and, the establishment of the earth having been accounted for, its subsequent changes are traced until the time of its becoming a fit home for life. Prof. Barrell adopts the theory of the origin of the earth as a secondary spiral nebula heaved off from the central sun as the result of tidal forces produced by the close approach and passage of another star. He favours the hypothesis of earth-growth by the rapid infall of planetoids (not by Chamberlin's "slow accretion of planetesimals") and the hypothesis of an earth initially molten.

The second lecture, by Prof. Schuchert, discusses the changes of the earth's surface and climate during geologic time, which the author is inclined to put at about 800 million years. The constant shrinkage of the earth leads to an instability of surface that brings about periodic changes, not only in the areal space-relations of water and land, but also in the shapes and heights of the

lands. As the lands are elevated, the weathering becomes more active and the high places are brought down to the sea. The waters are thus to a certain extent displaced, and periodically flood more or less of the lands. Every now and then, when the lands are largest, highest, and driest, a cold period sets in and disarranges the whole organic world. During these critical times the earth is scenically grand, and the struggle for existence unusually intense. The over-specialised types give place to smaller, less specialised, more plastic types. The unadaptive types become extinct, or are pressed into corners and refuges. Some adaptive stocks find relatively easy haunts, as in the sea, but from such there evolves no great mentality. The highest organisms, with the greatest mentality, have evolved on the land, "where the struggle for existence is fiercest, because of the constant necessity of adaptation to an environment subject to intense changes. Organic supremacy is attained only through constant vigilance."

In the third lecture Prof. L. L. Woodruff gives a clear and critical account of the various suggestions that have been made in regard to the origin of organisms, cautiously favouring the uniformitarian idea that they arose from not-living matter upon the earth.

Of great interest is the fourth lecture, in which Prof. R. S. Lull discourses on "the pulse of life," attempting to link up cause and effect; "to find those forces which are responsible for the more or less rhythmic accelerations of evolution shown by the fossil record. The main cause is found to be climatic change, which in turn has as a chief controlling factor earth-shrinkage and the consequent warping of the crust." In a very fresh and suggestive way, Prof. Lull discusses some of the crises in organic evolution and their physical correlates. Thus he deals with the establishment of the lime-secreting habit, the origin of vertebrates, the emergence of terrestrial vertebrates, the evolution of the terrestrial foot, the origin of reptiles, the establishment of warm-bloodedness, the appearance of birds and mammals, man's arboreal apprenticeship, his descent from the trees, and his subsequent ascent far above the level of climbing. He submits a very striking curve to show the correspondence between the pulse of life and the heavings of the earth's broad breast. To mention a concrete factor, he shows how *aridity* probably affected the evolution of dinosaurs.

In the fifth lecture Dr. Ellsworth Huntington deals with the influence of climate on civilisation. Human progress depends, he says, upon three resources, and constitutional energy. But climate

has a great influence on each of these, especially the last—a thesis which the lecture graphically illustrates. Some of the great steps in civilisation are discussed, and likewise some of the relatively recent climatic changes; the problem is to correlate the two. The author admits that, so far as inherent mental capacity is concerned, climate is in one sense a minor factor; that it is more important as regards material resources, but is far from being the sole factor; and that even when energy is considered, the effect of climate may readily be neutralised by several other factors, such as lack of resources or lack of ability. But the point to be emphasised is that climate is one of the great factors which must be reckoned with in any attempt to understand the history of civilisation.

The five essays are at a high level, the authors evidently giving of their best. There are a number of vivid illustrations, and Prof. Lull's "pulse of life" diagram makes a deep impression. We strongly recommend the book to serious students as a notable contribution to the study of the various modes of the great process of becoming.

J. A. T.

### Fertilisers and Parasiticides.

*Chemical Fertilisers and Parasiticides.* By S. Hoare Collins. (Industrial Chemistry, Pp. xii+273. (London: Baillière, Tindall, and Cox, 1920.) Price 10s. 6d. net.

MR. COLLINS has followed up his book on plant products by another on chemical fertilisers and parasiticides, of approximately the same size and intended for the same kind of reader. The book gives a good general account of fertilisers, and it includes numerous tables of data which will be found useful to the specialist.

Artificial fertilisers are of great interest to British chemists, as they were first used in this country and for many years the industry remained in British hands. The beginning was made in 1843, when Lawes took out his first patent for the manufacture of superphosphate; the industry developed greatly when the Chilean deposits of nitrate of soda began to be worked largely by British enterprise, and when sulphate of ammonia was recovered from coal-gas and from coke-ovens. It underwent further expansion in the 'eighties, when Wrightson showed the value of basic slag, followed in the 'nineties by the demonstrations of Dobbie, Gilchrist, Somerville, and Middleton. Only one important section has remained outside British hands—the potash fertilisers, which were formerly controlled by German interests, but now will be worked by the French companies.

Mr. Collins deals mainly with the sources and