The three closing chapters dealing with Copernicus, Tycho, and Kepler are naturally those which command our special interest. They contain far more than mere statements of the works of these great heroes of astronomical science. They define clearly the specific *rôle* played by each of these actors in the revolution of scientific thought. In following the author through his analysis of "De revolutionibus," we realise not only the great mental power but also the heroism of the "quiet student at the shore of the Baltic," and we feel the importance of the moment when his work is ushered into the world with Osiander's apologetic introduction. We must agree with the author's endeavour to show how little Copernicus could have been influenced by Philolaus and the vague ideas of Aristarchus, whose anticipations detract nothing from the originality of his own thoughts. On the other hand, the exposition of the defects of the system is so lucid that it requires no intimate technical knowledge of astronomy to recognise the necessity of modification, which so immediately urged Tycho to the invention of his ingenious compromise between the geocentric and heliocentric conception.

How far Tycho's all-important work as an observer has paved the way for the final recognition of the true system by Kepler is admirably shown in the last chapter, where the author opens before us the successive paths along which, through a labyrinth of errors and failures, the never tiring genius of Kepler was finally led to the "golden portal of truth." The long and weary road he had to go before he finally broke away from the time-sacred idea of circular motion and the Ptolemaic *punctum aequans*, and proved conclusively the elliptic character of the Martian orbit, is brought before us by an exhaustive analysis of his works, the study of which is so highly instructive, not only from the scientific, but also from the psychological point of view. The reproach, often levelled against the author of the "Mysterium Cosmographicum," of having filled his books with all sorts of mystic fancies, is, in Dr. Dreyer's opinion, founded on a misconception of Kepler's object in making his investigations. "There is the most intimate connection between his speculations and his great achievements; without the former we should never have had the latter."

We cannot attempt to enter upon the author's review of the opinions of science and church on the Copernican system during the time between Kepler and Newton, with which, on the whole, the student of history is familiar, though it is particularly interesting to hear on this matter the verdict of an historian who has derived his knowledge so directly and completely from an exhaustive study of the original prints and manuscripts.

It is difficult to emphasise sufficiently the specific merits of a work of this kind in a brief review. Doubtless not the least of its many meritorious features is the lucidity and conciseness of exposition. In its endeavour to grasp the essence of the cosmogonic ideas the mind is nowhere impeded by an unnecessary accumulation of cumbersome detail. At the same time the non-mathematical reader is supplied with sufficient technical information to secure his acquaintance with the principal geometry of the cosmic systems under discussion. This latter advantage is important in the case of a work which is clearly not written for a limited circulation among the small section of astronomical experts, but may justly claim to appeal to all who are interested in the history of the general development of scientific culture.

PROF. EHLERS'S "FESTSCHRIFT."

Zeitschrift für wissenschaftliche Zoologie. Vols. lxxxii. and lxxxiii. *Festschrift zur Feier seines siebzigsten Geburtstages am* 11 *Nov.* 1905, *Herrn Geheimen Regierungsrat Prof. Ernst Ehlers.* Band i., pp. iv+692; Band ii., pp. 741; and plates. (Leipzig: Engelmann, 1905.) 2 vols., price 5*l.*

THE distinguished zoologist in whose honour these volumes are issued is widely known as an indefatigable worker and one of the most genial of men. Together with the late von Kölliker, Prof. Ehlers has for many years edited the journal which now celebrates his seventieth birthday. As a testimony of the inspiring character of his teaching and of the regard in which he is held this "Festschrift" gives abundant witness. With no less clearness it indicates the diverse activities of modern zoologists and the particular problems upon which they are engaged.

With such a varied content, the volumes are difficult to review. The systematic work, admirable as it is, and coordinating or expanding as it does our knowledge of annelids, starfish, and flat-worms, can only be mentioned; nor can we do more than indicate the purport of a few of the many anatomical and physiological papers.

The place of honour is appropriately given to von Kölliker's paper on the histogenesis of the vertebrate nervous system, the last contribution of the master of histology, whose amazing vitality at eighty-seven years enabled him to conduct research and to discuss difficulties of fact and interpretation with unabated zeal. The month in which this latest defence of the neuron-theory was published brought the tidings that von Kölliker had ceased from work.

A long and exquisitely illustrated memoir by Vejdowsky gives a minute account of the structure and mode of origin of the annelidan vascular system. The nature of this system in the lower animals has been of late the goal of much research. Under the influence of the trophocœl theory, as stated by Lang on the basis of Bergh's work upon annelids, the vascular system has come to be regarded generally as a mesodermic structure, its cavities as a schizocœl, and not, as had often been suggested, a blastocœlic structure. The results of Vejdowsky's work have led him to a very different conclusion. First he proves, what had often been denied, that annelids possess a vascular endothelium. He finds that this "vasothelium" arises in the following way. Blood-vessels are intimately associated with the gut. Their cavities are at first simply a space between the outer ends of the gut-cells and their basal membrane. Into this space cells are budded off from the endo-

derm. Some of these become differentiated into epithelio-muscle elements that constitute the vaso-thelium, and others into blood-cells. Thus the study of annelids leads Vejdowsky to conclude that their hæmocœl is a hypoblastic structure *sui generis*, not comparable to that of arthropods or of molluscs, but rather to the cardiac vasothelium in vertebrates. Such a result emphasises that relation of vascular system to the alimentary tract which topography has insisted upon.

In his article on the morphology of the cestode body, Prof. Spengel stoutly supports the monozoic theory. He regards the Bothriocephalidæ as the most primitive tapeworms, and considers that in the highly modified Tæniidæ we have simply a coincidence of somatic and gonidial segmentation areas. Incidentally he suggests the comparison of the scolex with the hinder end of segmented worm, and emphasises the singular nature of the cestodes by pointing out their entire lack of true regenerative power.

The remaining anatomical papers deal with the modifications of clasping organs in arboreal mammals, with the head of collembolous and culicid insects, the nervous system of leeches, and certain abnormal gasteropods.

Of the embryological memoirs, the accurate and laborious research of Wierzejski on the cell-lineage of Physa will be welcomed as a topographical paper of the first rank. Prof. McIntosh contributes a well illustrated account of the life-history of the shanny, and then follow memoirs on the early development of the blind-worm, on the breeding habits of Rhinoderma and of the salamanders.

The physiological papers are of more general interest. Prof. Häcker continues his illuminating work on the skeleton of the Radiolaria by treating the Tripylaria from the same ecological standpoint which he adopted in his paper of last year. Häcker is the most active of a band of workers who are putting new life and new significance into the merely geometric descriptions of earlier students of these skeletal products. Dr. Rhumbler gives a further instalment of his work on the mechanics of streaming movement in Amœbæ, and shows some interesting stream figures produced by dropping chloroform water upon shellac. He fully recognises the inward and autogenous control that dominates those displays in organisms that we cannot parallel in not-living matter, but he holds that in Amœba the phenomena of movement and feeding are capable of mechanical explanation in terms of the aggregation theory which he has formulated elsewhere.

Dr. Jordan contributes an essay on the origin of species in Lepidoptera. His main thesis is to the effect that geographical subspecies, and no other variations, are the material out of which new species have been evolved. Much of the paper is summarised from his earlier work, and represents a line of research to which several naturalists are applying themselves. The work of Petersen on the Fritillaries in particular pursues the method employed by Dr. Jordan, but in a more comprehensive manner, and it is to be hoped that these important results may be rendered more available to the student of evolution than they now are by a new mode of presentation, graphic, tabular, or other than textual description.

Lastly, the memoir of the Baroness von Linden on the influence of heat, cold, and gases upon the coloration of Vanessid butterflies constitutes a further instalment of the author's prolonged investigation. The general conclusion drawn from these experiments is that whatever lowers the rate of pupal metabolism increases amount of black imaginal pigment and diminishes the extent of red colour in the butterfly.

F. W. GAMBLE.

THE BIRDS OF TUNISIA.

The Birds of Tunisia. Being a history of the birds found in the Regency of Tunis. By J. I. S. Whitaker. 2 vols. Royal 8vo. Pp. xxxii+294 and xviii+410. Plates and maps. (London: R. H. Porter, 1905.) Price £3 3s. net.

THE two handsome and beautifully illustrated volumes containing the history of the birds of the Regency of Tunis form a fitting crown to the years of work in the field, the museum, and the library which their author has devoted to the ornithology of this until recently little known country. They form too a valuable contribution to the avifauna of the western Mediterranean region; for although the present work purports to be merely a history of the birds noticed in Tunisia, and of their lives as observed in that country, the author has thought it advisable, when possible, to allude to the occurrence of the various species also in Algeria and Morocco, as likewise, in some cases, in Tripoli, and in the Mediterranean basin generally.

The articles on various warblers (especially the interesting remarks on their life-history), and other birds which are met with most commonly in that region, will be most welcome, even to those whose interests are restricted to the birds which figure on the British list. Tunisia, a long and somewhat narrow country, stretching from the Mediterranean back in the vagueness of the great desert, presents a great variety of natural features and climate; and the contrast between the well-watered, wooded and mountainous region north of the Atlas Mountains and the rainless, sandy and rocky desert country is very great. To these circumstances, and to the fact, pointed out by the author, that few countries are geographically so favourably situated as the Regency for the observation of the migration of birds, the wealth of the Tunisian avifauna is due. No less than 365 species and subspecies of birds are included in this work; and only about thirty-five of these have to be relegated to the roll of occasional and accidental visitors. Two beautiful photogravures give an excellent and most truthful idea of the character of the scenery and the traveller's mode of life in the south of the country; while other plates introduce the reader to some of those wonderful Roman ruins, so marvellously preserved in that dry, clear air, which so startle the inexperienced wanderer in the central parts of Tunisia.