

the sea or of volcanoes, is preserved among the rocks; their record, indeed, is one of singular uniformity, despite the catastrophes of Krakatoa in Sunda Strait and of Bandai-san in Japan, to which attention is directed. Much has also been learnt about fissure-eruptions. Here we are in touch with the author's special subject, and he devotes a considerable space to the volcanic history of the British Isles. To petrography, which no doubt is dealt with in a special article, but brief reference is made.

A glance at the article on geography shows how intimately it has become linked with geology during the past quarter of a century, thanks to the labours of Suess, Penck, Lapworth and W. M. Davis. The fact that the surface of the sea preserves no uniformity, and that it may locally rise and fall to a considerable extent without change in the lithosphere, would seem to revolutionise our ideas about raised beaches and submerged forests; but the author points to certain regions where there is definite evidence of slow upheaval or depression of land. The indications of changes of level derived from a study of coral-reefs are also discussed.

Structural geology naturally occupies some space, and special reference is made to the great flexures and overthrusts that have been determined in many regions. Palæontological zones receive attention, for on this subject great progress has been made, and although we miss reference to the brilliant researches of Dr. A. W. Rowe, the importance of the subject is fully admitted. We agree with the author that there is much yet to be solved in the problem of life-zones. Special mention might have been made of observations on radiolarian chert, but in so complex and many-sided a subject as geology we feel that the author has done all that could well be done to illustrate its progress in a limited space.

Prof. Greenhill's two contributions on ballistics and the gyroscope and gyrostat are full of material of interest to students of dynamics. In a short essay Sir W. T. Thiselton-Dyer summarises the chief points of Huxley's life and work, and contrives to express the essential characters of each in a few pages. Dr. Günther has brought the article on fishes up to date. In 1870 the number of known species of living fishes was stated as 8525, but since then it has been nearly doubled. Knowledge of the distribution, organisation and development of fishes has also made substantial progress, and Dr. Günther gives a survey of the most important advances.

The article on insects is by Dr. David Sharp, whose general knowledge of the subject is probably more extensive than that of any other living entomologist. Nevertheless, it is obvious that the space at his disposal was utterly inadequate to permit of his attempting more than a mere glance at a few of the more interesting matters connected with entomology that have been discussed in recent years. Among these are the number of species of insects; antiquity; duration of life (inadequately discussed; but the fact of a water-beetle living five and a half years in captivity was new to us, though some of Lord Avebury's Queen ants have attained a much greater age); economic entomology (with special reference to Coccidæ, and to insects and malaria); luminosity (concerning which Dr. Sharp remarks, "The light given by insects has been shown to be highly economical, and if a similar illuminating agent can be produced artificially it will be a great boon.")

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Granted; but then there is the immense initial difficulty of producing or imitating organic chemical substances artificially; galls; anatomy and morphology (with special reference to the structure of the segments of the head); metamorphosis; classification (twenty-two orders are now recognised, the sequence of which differs considerably from that followed in the author's "Cambridge Natural History," published in 1899) and ethology (referring to intelligence and to social insects). The article concludes with a paragraph of "authorities," including references to a few recently published books and papers on insects; but the list is necessarily so short and incomplete that we think it might almost as well have been omitted altogether.

Though limitations of space have prevented some of the writers from doing full justice to their subjects, the volumes are rich in matter of interest to the student of science, and furnish substantial evidence of progress in many branches of natural knowledge.

THE STUDY OF THE PROTISTA.

Archiv für Protistenkunde. Herausgegeben von Dr. Fritz Schaudinn. Band i. Heft 1. Pp. 192; 5 plates. (Jena: Gustav Fischer, 1902.) Price Mk. 24.

OF late years very rapid progress has been made in our knowledge of that vast assemblage of organisms for which Haeckel set up a special "kingdom" or *Reich* with the name Protista, comprising the simplest living creatures amongst which the distinction of plant and animal is of quite secondary importance. In no branch of biology do works become so quickly out of date as in that which deals with the lowest forms of life. The attention which the Protista have received has been stimulated from two sources. From a purely scientific and theoretical point of view, it is evident that many elementary problems, or fundamental phenomena, of life can be studied in their simplest form, divested of unessential complications, in these lowly organisms. This is especially true of the facts of cytology relating to the structure and activities of cells. The discoveries of the last decade of the nineteenth century have revealed a remarkable uniformity, underlying the greatest variety in form and detail, in the cell-processes of the higher animals and plants, which cannot be considered as satisfactorily understood until the steps are made clear by which they have been evolved from the usually simpler, but in any case far more diversified, types of structure or development which are found to occur in unicellular organisms. It is only necessary to refer to the problems of cell-division and fertilisation in support of this proposition. Quite apart, however, from their claims on the attention of scientific biologists, the Protista are becoming continually more important as objects of study from the practical point of view. Some, as, for instance, the organisms of fermentation, are indispensable for human arts and manufactures; others have a claim to consideration which, if more melancholy, is not less great, on account of the injuries or disease which they inflict as parasites or pathogenic agents upon man, beast, or plant. The importance of the lower organisms from the practical standpoint has already been the cause of specialisation in their study. An instance of this is seen in the rise

and rapid growth of the science of bacteriology, and the special study of yeasts and fermentation has been dignified by the name of zymotechnology. By "Protistenkunde" or protistology is denoted a wider field of study, embracing all Protista as its objects, and of which bacteriology and kindred sciences are but subordinate branches.

It is not surprising, therefore, that a journal has appeared which is to be devoted entirely to protistology. The *Archiv für Protistenkunde* will be welcomed by a wide circle of naturalists, and will find a place in every biological library. Edited by Dr. Fritz Schaudinn, who has himself pursued the study of Protozoa with such remarkable success, its high standard of excellence is practically guaranteed. The contents of the first number do not disappoint our expectations, while they show at the same time that the aim of the journal is to be scientific rather than practical. With contributions headed by names so well known as Hertwig, Bütschli, Brandt and others, the new journal makes a good start.

The first article is contributed by Prof. R. Hertwig, and is a very interesting discussion on Protozoa in relation to the cell-theory. To show the scope of his dissertation, it must suffice to quote his principal conclusions. He attempts "to develop a uniform conception of the cell, applicable alike to Protozoa and Metazoa," recognising that any such attempt does not rest at present on a very firm basis, but thinking it nevertheless more useful to formulate precise conclusions, which can be criticised, than to rest content with vague indications.

"Three kinds of substances, characterised by the part they play in cell-life, must be assumed: (1) the achromatic substance; (2) the chromatin; (3) the nucleolar substance. These three substances show the following distribution in the cell of the Metazoa, and probably also in that of multicellular plants. The protoplasmic framework—leaving out of consideration the material filling the meshes or alveoli (Bütschli)—represents an intimate union of achromatic framework and chromatin, of which the latter is only separated out under special circumstances in small quantities, and then induces a heightened staining-capacity of the cell body. . . . The linin-framework of the nucleus consists only of achromatic substance, in which is deposited the chromatin, bound up with nucleolar substance and thereby organised. In this way arises the chromatic nuclear framework of authors. An excess of nucleolar substance forms the true nucleoli, which in the majority of cases are subsequently used up in the formation of chromosomes in karyokinesis, in the Metazoa just as in *Actinosphaerium*."

The first number contains five other articles besides that of Hertwig, amongst which may be noticed one by Bütschli on the structure of the Cyanophyceæ and Bacteriaceæ, a monograph of the Coccolithophoridae by Lohmann, and a discussion by Doflein of the outlines of classification of the Protozoa. The last-named author divides the Protozoa into two main divisions: first the Plasmodroma, characterised by possessing organelles for locomotion

"which can be easily recognised as protruded portions of the body-protoplasm, and which, moreover, in many cases can be extruded and withdrawn as required";

secondly the Ciliophora, in which the organs of locomotion, when present, are cilia. The Plasmodroma comprise the three classes Rhizopoda, Mastigophora and

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Sporozoa; the Ciliophora comprise the Ciliata and Suctoria.

In conclusion, it is only necessary to add that the various memoirs are illustrated, where necessary, by lithographed plates of the degree of excellence to which one is accustomed in German zoological periodicals.

E. A. M.

AN ASSAYER'S HANDBOOK.

Assaying and Metallurgical Analysis for the use of Students, Chemists and Assayers. By E. L. Rhead and Prof. A. Humboldt Sexton, F.I.C., F.C.S. Pp. x + 431. (London: Longmans, Green and Co.) Price 10s. 6d. net.

THE differences between assaying and chemical analysis in the ordinary usage of the terms are perhaps not very precise. An effort was made some years back in America to apply the word "assaying" only to the estimation of some or all of the elements in a substance by means of dry reagents and heat, and the word "analysis" to all estimations by the use of reagents in aqueous solution. These definitions, however, have not met with much favour, and have little to recommend them. It would be better to limit "assaying" to the estimation of the valuable constituent or constituents of an ore or other substance, and to use "analysis" for the estimation of the other constituents and for all qualitative determinations. According to this view, a gold ore would be assayed for gold and silver, and the sulphur, copper, iron, &c., would be determined by analysis, while a copper ore would be assayed for copper, the sulphur in iron pyrites would be determined by assay, and so on. Messrs. Rhead and Sexton have in general followed this method, but there are difficulties in its adoption, and in any case an authoritative definition is required.

There are already many books on the subject, and although some of them are out of date, the need of a new one which does not follow any strikingly original and advantageous plan does not seem pressing. It may be presumed that the authors of the book under review have found difficulties in teaching their students with the aid of the older books, and after supplying their own wants have decided to offer their system to other teachers. The result is by no means displeasing. The plan of the book is excellent. The student or assayer can find what he wants without delay, and the description of the required process is always terse, usually accurate and in many instances sufficiently complete. The accuracy, however, is unfortunately by no means without exception, but the chief fault of the book is that in the effort to reduce its size terseness has been pushed to an extreme, and the working directions are often insufficient to enable the process in course of description to be properly carried out even by an assayer of some experience unless he has been previously taught what to do.

An example of the lack of accuracy occurs in the description of the iodide method of estimating copper, in the course of which on p. 79 the student is informed that

"Cupric salts liberate iodine from potassium iodide. The liberated iodine may be estimated by means of a solution of potassium thiosulphate of known strength, sodium iodide and sodium tetrathionate being produced."