

first of these is on Margot's method of coating glass with aluminium and of soldering aluminium, or even glass, by means of its aluminium coat! Prof. Threlfall vouches for the practical ease and success of these processes. He gives full details of the very simple process.

The second is on Boettger's process of depositing bright gold upon glass, just as silver is deposited. This also the author has proved to be satisfactory. The question arises whether it might not be worth while, where colour is not important, to use gold in the place of silver in reflecting telescopes for the sake of the permanence that should in this way be attainable.

The third is on slitting with a disc and diamond dust and making rock sections generally. This, however, does not require particular notice except, perhaps, the curious statement that the author was surprised how difficult it was to learn anything about this art. Vol. iii. of Holtzapffel surely cannot have been in his mind when he wrote this.

A large amount of space is given to the fullest details of the different methods of making and mounting quartz fibres and of their properties. No one with this before him need have any doubt about embarking upon this laboratory art. The writer of this notice had produced the first of some articles on the subject in the *Electrician*, but on seeing Prof. Threlfall's book, felt that the ground was so well and accurately covered that it would be a mistake to go over it again. The curious property of the quartz fibre discovered by Prof. Threlfall, of becoming at ordinary temperatures very slightly more rigid as the temperature rises, is referred to; and the suggestion which the writer of this notice also put forward tentatively years ago is made, that chronometer balance-springs made of fused quartz might have some advantage. This curious rise in rigidity with temperature is also noticed by Mr. S. J. Barnett in a valuable paper in the *Physical Review* for February last. Another point referred to by both these writers is the extraordinarily small coefficient of expansion of melted quartz. Benoit gives the extreme coefficients for crystalline quartz as $\cdot 072$ and $\cdot 04133$. Barnett found for three quartz fibres $\cdot 063$, and for a rod of fused quartz $\cdot 062$. There is one part of the description of the manipulation with quartz fibres where the writer would add to Prof. Threlfall's description. On p. 220 the method of handling the fibre, cutting it off, and mounting it so as to be of the right length is described. Instead of a board to work on, however black it may be, a piece of looking-glass lying flat on the table is infinitely superior. This was suggested years ago by some kind friend, but who it was the writer is ungrateful enough not to remember.

The writer prefers when blowing quartz fibres of extreme tenuity for suspension purposes, not to blow a maze on to some screen, but, using a finer flame, to blow out a single fibre which may often be found joining the two rods, and either thick enough to show colour or generally far too fine to do so, corresponding in fact to the black of the soap-bubble.

Soldering, brazing, silver soldering, all essential everyday arts, are next described well and fully; but whether these descriptions will make these actually easy arts ever seem so to beginners is a question. Perhaps enough is not made of the sweating process carried out

without any bit, or any preliminary cleaning or preparation of any kind. On the other hand, under brazing and silver soldering, the great use of a bit made of clean iron wire in showing the melted metal where to go when it does not flash at once, might be added in a future edition.

Insulators and conductors used in the construction of apparatus are next considered. Prof. Threlfall is probably the only person who has turned to useful account the writer's discovery of the superlative insulating properties of rods of melted quartz, even in an atmosphere saturated with water. Their application to a number of electrical appliances is described and figured.

Glass, ebonite, mica, micanite, celluloid, paper, paraffin, wood, slate, and marble are all discussed from the point of view of a constructional material with insulating properties. The electrical and mechanical properties of a large number of alloys, such as platinoid, manganin, &c., close this long and most valuable chapter.

The last chapter is upon electro-plating, chiefly gold, silver, copper and nickel, and upon allied arts. The writer has often heard that the best nickel plating is really cobalt. He hoped to, but did not, find any enlightenment upon this point.

An appendix upon platinising glass concludes the book.

This notice, already too prolonged, and yet insufficient, is enough to show that the experimentalist has now a most useful guide in a large number of processes. It is not possible to describe every process. The personal certificate is what gives value to those that are chosen. It is to be hoped that with Prof. Threlfall's valuable guide, instead of despising them, some of our growing physicists may be encouraged to make themselves familiar with some, at any rate, of those arts which Newton and Faraday cultivated with such astonishing skill and success.

C. V. BOYS.

A NEW TEXT-BOOK OF ZOOLOGY.

A Student's Text-Book of Zoology. By Adam Sedgwick, M.A., F.R.S. Vol. i. Pp. 600. (London: Swan Sonnenschein and Co., Ltd., 1898.)

MR. SEDGWICK has produced the first part of what must prove to be a very useful treatise for University students, if the remaining portions of the work are as well carried out as is the present.

In this volume Mr. Sedgwick gives an account of the Protozoa, Porifera, Cœlentera, Platyhelminthes, Nemertea, Nematelminthes, Rotifera, Mollusca, Annelida, Sipunculoidea, Priapulioidea, Phoronidea, Polyzoa, Brachiopoda, and Chætognatha. The method adopted is strictly systematic: the larger groups are described and characterised in turn, the enumeration extending as far as families, which are also briefly characterised, important illustrative genera being cited. The work is, in fact, written on the lines of the translation of the "Zoology" of Prof. Claus, which Mr. Sedgwick gave us some years ago; but instead of merely producing a new edition of that work, he has written a new book introducing his own views and his own conception as to what are important facts and useful schemes of classification.

A distinctive feature of the work is the number of excellent woodcuts which Mr. Sedgwick has culled from

a very large variety of sources. The text-books of Korschelt and Heider, Perrier, Lang, Claus, Wasielewski and Bronn's *Thierreich* have been laid under contribution for *clichés*, and the author is to be congratulated on the admirable collection he has brought together. The book is intended to be and is as brief as is consistent with an intelligible exposition. Yet it seems hardly possible that Mr. Sedgwick will be able to complete it in another volume of the same size. He has still to treat of the Echinoderma, the entire series of Arthropoda and the Vertebrata (which he would probably call the Chordata).

There are in the book one or two noticeable and original statements and classificatory innovations which it will be interesting to mention here. Mr. Sedgwick holds, as is well known, special views on the subject of cell-structure. He accordingly defines the Protozoa as "Animals in which there is one nucleus, or, if more than one nucleus, in which the nuclei are disposed apparently irregularly and without relation to the functional tissues of the animal. Conjugating cells of the form of ova and spermatozoa are never formed." In contrast with these the Metazoa are defined as "Animals in which the ordinary (so-called adult) form of the species has more than one nucleus, and in which the nuclei are for the most part arranged regularly and with a definite relation to the functional tissues of the animal (so-called cellular arrangement). Special conjugating individuals of the form of ova and spermatozoa are always formed."

With reference to this it may be remarked that the nuclei of, say, muscular tissue in Metazoa cannot be shown to have any more definite relation to the functional contractile substance than has the nucleus of a gregarine to its functional contractile substance, and the same kind of remark is true in reference to many other active structures in the two groups compared.

It surely is not possible to maintain that conjugating cells of the form of ova and spermatozoa are never formed in the Protozoa when we include (as Mr. Sedgwick does) the Volvocinean Flagellata in that group.

The account of the Protozoa is more complete than is usual in text-books of this size and scope, and the figures of *Hæmosporidia* and *Myxosporidia*, borrowed from Wasielewski, are particularly good, though the account on p. 63 of *Hæmamœba Laverani* is not quite satisfactory.

Mr. Sedgwick, as might be expected from his own important share in elucidating the subject, is very clear and precise in defining the "cœlom," and in explaining its real nature. He does not, however, as one could have wished, give the actual history of the word "cœlom," and the steps by which the erroneous views of Haeckel, the Hertwigs and other German authorities have been set aside. He says, "formerly the word cœlom was used as synonymous with body-cavity or peri-visceral cavity, and no distinction was recognised between the body-cavity of the Arthropoda and the same structure in such forms as Vertebrata." I think it is worth noting that, as a matter of fact, the word cœlom was introduced by Haeckel in the year 1872, in the first volume of his "*Kalkschwämme*," p. 468, in the following words:

"Die wahre Liebhöhle" (contrasted by Haeckel with the digestive cœlenteron of Cœlentera, to which the

term "body-cavity" or "Leibeshöhle" was undesirably applied) "welche bei Vertebraten gewöhnlich Pleuro-peritonealhöhle genannt wird, und für welche wir, statt dieses neunsylbigen Wortes die bequemere zweisylbige Bezeichnung Cœlom (κοιλωμα, τὸ, die Höhlung) vorschlagen, findet sich nur bei den höheren Thierstämmen bei den Würmern, Mollusken, Echinodermen, Arthropoden und Vertebraten."

For Haeckel the typical cœlom was the pleuroperitoneal cavity of the Vertebrate. At the time when he wrote, that cavity was supposed to have arisen phylogenetically by a splitting of the mesoblast; hence the failure of Haeckel to distinguish other cavities, such as the hæmocœl of Arthropoda and of Mollusca from the true cœlom. I gather from Hertwig's text-book of Embryology that I was the first to point out that the "schizocœl" (as Huxley called it) of higher Vertebrates could be and should be interpreted (in consequence of Balfour's discoveries in Selachian development) as an enterocœl—a pouch, in this case without lumen—which arises as a solid outgrowth from the enteron, the opening out of its cavity being delayed. Thus the cœlom is now characterised by Sedgwick as "a part of the enteric cavity which has lost its connection with that portion which constitutes the alimentary canal in the adult." The enteric pouches of the Actinozoa are "an incipient cœlom." Further, it is recognised by Sedgwick that "the cœlom, in addition to its mechanical relations, has two most important functions: the one of these is to bud out the reproductive cells, and the other to secrete the nitrogenous waste." The essential cells of the gonads and of the nephridia are parts of the cœlom. Mr. Sedgwick's own researches on the development of *Peripatus* served more than anything else to establish that the cavity of Arthropods, which I had termed "hæmocœl," is distinct from cœlom, and that there is—quite apart from hæmocœl—a true cœlom in Arthropoda reduced in the adult to nephridial and perigonadial rudiments. My own observations on the pericardium of Mollusca, and on the vascular system of both Molluscs and Arthropods, as well as the work of my pupil Gulland on the coxal glands of *Limulus*, had tended, before this, to show the existence of "cœlom" distinct from "hæmocœl" in both those groups. Thus the erroneous notions promulgated in the "*Cœlomtheorie*" of the Hertwigs were superseded. I am distinctly of the opinion that this step forward—viz. the recognition, definition and characterisation of the true "cœlom" as distinct from "hæmocœl"—has been due to English observations and English doctrine, and I think that a full account of the history would be valuable to students.

Mr. Sedgwick necessarily has something to say in this connection concerning the supposed communication of vascular system and cœlom in the Leeches. In his excellent account of those animals (in which he not only discusses *Acanthobdella*, but introduces Kowalewsky's recent figure of its anterior segments) Mr. Sedgwick lays great stress on Oka's recent observations upon *Clepsine*, and concludes that "we are bound to hold, provisionally at any rate, that in Leeches, as in other animals, the blood system and cœlom are separate from one another." I quite agree that there are probabilities in favour of Mr. Sedgwick's conclusion. Twenty years ago, and at intervals since then, I have endeavoured to put the matter

out of the region of probabilities, but in spite of the careful researches made in my laboratory by A. G. Bourne and others, I have not yet succeeded in so doing. After all, it should be possible, by modern improved methods, to test this question of continuity in *Hirudo* by means of actual injection. There are "other animals," it must be remembered, in which there is free communication between the coelom and the vascular system, to wit, the not unimportant animals known as Vertebrata.

In his classification of the Mollusca, Mr. Sedgwick has taken his own line, and refused to follow Pelseneer in the separation of the Chitons from the Gastropoda, though he places *Neomenia* and *Chætoderma* in a separate class, the Solenogastres, for very good reasons which he sets forth.

The creation of a separate phylum for each of the small groups of Sipunculoidea, Priapuloides, and Phoronidea is perhaps legitimate in the present state of knowledge, though the questions involved are of a very difficult nature, and the facts known insufficient to give one great confidence in any of the proposed classifications affecting those animals.

Mr. Sedgwick excludes the Platyhelminthes, the Nermertea, the Nemathelminthes, and the Rotifera from the Coelomata; but he does not argue at any length the question as to whether there are or are not coelomic rudiments in each of these groups. The perigonadial sacs of Platyhelminthes and Nemertea and their nephridia may be interpreted as modified developments from coelom, though it would no doubt be difficult to show that they are so. It must, however, be remembered that in such matters the assertion that *A is not B* is as positive and definite a statement, requiring just as full a proof, as the statement that *A is B*.

The chief omission which has to be noted in Mr. Sedgwick's book is that which I have recently pointed out in other works—namely, an insufficient historical account of the discoveries, hypotheses, conceptions and terms (with immediate reference to chapter and verse), the bringing together and explanation of which is the purpose of the writer's labour. Mr. Sedgwick is not so determined to omit history and the names of contemporary workers as are some other writers of text-books. He does not make a profession or virtue of this practice, and in many cases gives an immediate reference to a special memoir, or even cites a naturalist's name, after mentioning an important fact or theory. At the same time, he cannot be said to have done what could easily have been done in this respect without materially increasing the size of his book. Of course, all such references and discussions must be in proportion to the size and scope of the text-book in which they should appear, and Mr. Sedgwick not unfrequently does give a historical reference. But why should he not tell us, for instance, who invented the name Protozoa, what he meant by that term, and how it came to have its present limitations? Why should he not tell us (p. 533) who proposed the separation of Sipunculoidea and Echiuroidea which he adopts? Why should he not give credit to Dr. Hudson for his most interesting discovery of the six-legged Rotifer *Pedalion*, instead of printing Hudson's drawing of his discovery with the label "from Perrier after Gosse?" Mr. Sedgwick very properly states in a foot-

note that the classification of the Polychæta adopted by him is that of Dr. W. B. Benham, to whose work he refers. It would, I think, have helped many of his readers if he had given some account of the source of classification and terms used by him, in all other instances. Putting aside such suggestions for improvement, I think we must recognise that Mr. Sedgwick's book is a very good one, ably put together, and likely to be extremely useful; it is, in fact, not only the last, but the best zoological text-book—so far as the first volume goes—in the language. E. RAY LANKESTER.

THE ANALYSIS OF ORES.

Methods for the Analysis of Ores, Iron and Steel, in Use at the Laboratories of Iron and Steel Works in the Region about Pittsburg, Pa. Pp. iv + 133. (Easton, Pa.: Chemical Publishing Co., 1898.)

A COLLECTION of the methods in use in the modern laboratories of steel works must be useful if only for comparison, but the present book cannot take rank with standard works such as those by Blair and Arnold. One notes a sameness in the modes of procedure, varied, however, in some instances by questionable modifications, more especially as regards phosphorus determinations.

Sufficient attention has not, on the whole, been given to the exact relative proportions of nitric acid, molybdate, &c. Most of the operators are apparently content to assume that it is sufficient to add, in all instances, measured quantities of the reagents required. This is contrary to the writer's experience: each analysis should be conducted in accordance with the conditions observed at the time; it is not enough to merely add fixed quantities of reagents, but the operator must judge for himself, more especially as regards the use of nitric acid.

In practice the best and most accurate results are obtained by the direct weighing of the molybdate precipitate, using the magnesia method only as a check.

Volumetric methods are useful where rapid determinations are required for check purposes, but are not so trustworthy as the weight method, *i.e.* when proper precautions are taken and the necessary experience gained.

Sulphur.—The evolution method cannot be dispensed with in an ordinary steel works, but is only useful for rough determination; it is little better than a qualitative method, as has been repeatedly demonstrated.

Apparently we have no better method than with aqua regia and subsequent precipitation with barium chloride. It is well known, however, that discordant results are often obtained. At present a rapid and strictly accurate mode of determining sulphur has yet to be devised; this for various reasons well-known to analytical chemists.

As regards the estimation of manganese, nickel, copper, &c., little need be said; there is not much that is novel in the methods, which are fairly good and are such as are usually practised. The same is applicable to carbon determinations, with the exception of barium hydroxide as an absorbent (A. G. McKenna), which the author recommends; as also the complete analysis of chrome iron, which appears a mode of procedure sufficiently accurate for all practical purposes.