adapted to give to the young student a clear idea of the leading structural features distinctive of the different groups of animals. The figures are well selected, well drawn, and well coloured, and are of a size sufficiently large to display the structure of each type of animal. The letter-press is written in exact and yet such popular language as to be easily understood by the most unscientific.

Although the author has seen fit to conceal his identity, certain peculiarities in spelling (*e.g.* "armored" and "centipeds") suggest that he is an American. It would have been better if a little more attention had been given to proof-reading, and we should not then have met with "chitin" on one sheet, and "chitine" on the next, while certain errors in punctuation would have been avoided. It seems a pity to allude to the argonaut as the nautilus, and a figure of the pearly nautilus ought certainly to have been introduced. We fancy, too, that the common gaper (*Mya*) will be somewhat unfamiliar to English students under its American title of "clam." R. L.

A Guide to the Fossil Invertebrates and Plants in the Department of Geology and Palæontology in the British Museum (Natural History). Pp. xvi + 158. (Printed by order of the Trustees, 1897.)

THE guide-books prepared by officials of the Natural History Museum at South Kensington, to interest visitors in the collections under their charge, are models of what guide-books should be; they are concise in text, often well illustrated, and marvellously cheap; and the persons who digest them obtain a liberal education on the subjects with which they deal. In this new Guide, prepared under the direction of Dr. Henry Woodward, the fossil invertebrates and plants represented by specimens and drawings in the Natural History Museum are described; the characteristics of the living organism, as well as of the parts found in a fossil state, being placed before the reader. With this Guide in his hand, the student of geology and palæontology will be able to derive the fullest advantage from the admirably-arranged geological record at South Kensington.

Report on the Causes and Prevention of Smoke from Manufacturing Chimneys. By Dr. Harvey Littlejohn, M.A., M.B., B.Sc., Medical Officer of Health. Pp. 51. (Sheffield: Wm. Townsend and Son, 1897.)

DR. LITTLEJOHN drew up this report, upon the subject of the smoke nuisance in Sheffield, at the request of the Health Committee. He gives a short account of the past history of the subject, which occupied the attention of a Select Committee of the House of Commons so far back as 1819. Sheffield has an unenviable notoriety for smoke, owing, of course, to the fact that a large number of its manufactures depend almost wholly upon the combustion of coal. Dr. Littlejohn suggests that further restrictions be imposed on the amount of smoke emitted by steam-boiler furnaces, but no special form of apparatus for preventing excessive smoke is recommended, the opinion being that greater care and attention in firing would considerably lessen the nuisance.

Birds of Our Islands. By F. A. Fulcher. Pp. 368. (London: Andrew Melrose.)

WITH the multitude of readable books which now exist on British birds, it is almost a reproach to be without a knowledge of bird-life. In this dainty volume the characteristics and habits of birds, and the curiosities of bird-land, are pleasingly described. The book is not an exhaustive treatise, but a collection of word-pictures drawn by the author in various parts of the British Isles. It is simple-worded; nevertheless, it is instructive, and it will lead its readers to look about them so as to see for themselves how interesting are the works of nature. The book would be a very acceptable present for a boy with a taste for natural history.

LETTERS TO THE EDITOR.

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The Theory of Dissociation into Ions.

I AM glad that Mr. Dampier Whetham has noticed the two experiments which I adduced against the present theories of osmotic action and dissociation respectively. The force of the first of these experiments he admits, but, as regards the second, I fear that he can hardly have realised the true results of the experiment, or else I do not realise the meaning of the explanation which he offers of it.

The experiment was: That when a mixture, represented by $100H_2O + H_2SO_4$, is put into excess of acetic acid, the lowering of the freezing-point of the latter shows that the mixture contains less than 101 acting units, instead of more, as would be the case if the H_2SO_4 molecule was dissociated into ions. The actual number of acting units indicated was about 70. (I have only an abstract of the paper by me: it will be found in the *Berichte*, 24, p. 1579.) Mr. Whetham's explanation is that the acetic acid takes the water away from the sulphuric acid, and this latter goes into solution as such in the acetic acid, and in this solvent it is undissociated. But even if this were so—and a determination of the conductivity of the complex solution should tell us at once whether it is, or not—we should still have our 101 acting units ($100H_2O$ and H_2SO_4) in the acetic acid, or, even if the sulphuric acid molecules combined with each other to form complexes, we should have, at any rate, something more than 100 units; whereas, as a matter of fact, we find only 70. Complete recombination of ions, and complete polymerisation of the sulphuric acid is quite incapable of explaining the reduction of the number of acting units present.

To quote some actual values: 16·8 molecules of water lower the freezing-point of 100 molecules of acetic acid 7·32°; 0·097 of a molecule of sulphuric acid lowers the freezing-point of 100 molecules of acetic acid 0·038°; the two together should lower the freezing-point of acetic acid 7·358° if they acted on it independently of each other, but the actual lowering which they produce is only 7·03°; therefore, they do *not* act independently of each other. The two together have even less action than the water only.

As an alternative explanation, Mr. Whetham suggests that "dissociation of the ions from *each other* does not forbid the assumption that the ions are linked with one or more solvent molecules." Quite true: but when a theory can only explain observed facts by driving us to assumption of the existence of such compounds as H_xH_2O and $SO_4\,yH_2O$, I venture to think that that theory must be somewhat shaky.

Harpenden, May 1. SPENCER PICKERING.

I AM very glad that Mr. Pickering has given further details of his experiment. From his former letter I did not gather that the number of acting units indicated by the freezing-point of the solution of $100H_2O + H_2SO_4$ in acetic acid was as low as now appears. The result is most interesting, and seems to me to furnish strong evidence for the modification of the dissociation theory for which I am contending, under the belief that, in spite of the last paragraph of Mr. Pickering's present letter, it furnishes the best explanation of *all* the facts. Had the number of acting units indicated been nearer 100—say 90, or more—it would have been possible to explain the experiment in the first way which I suggested, for the freezing-point of a solution of water in acetic acid shows that some of the solute molecules are polymers of H_2O (Raoult's value for the molecular depression is 33·0, as compared with 38·8 found from Van 't Hoff's formula, which agrees well with Raoult's values for other substances). This would reduce the number of acting units in the case of the mixed solution also, and even complete dissociation of the sulphuric acid would be insufficient to bring that number up again to 100.

This explanation, however, seems to me to be entirely upset by the result that the lowering of freezing-point produced by a mixture of water and sulphuric acid is actually less than that produced by the water alone. Certainly, as Mr. Pickering says, the water and sulphuric acid "do not act independently of each other"—at least, when dissolved in acetic acid. I do not think it quite logically follows that they are combined when