eventually, upon the total retraction of pseudopod, they are deposited on the substance of the organism. Thus the "house" is built by purely mechanical means, without any "intelligence" or "volition" on the part of *Difflugia*. In the *Contemporary Review* for April 1873, the late Dr. Carpenter alluded to similar habits of a certain marine Protozoa, saying: "The deep-sea researches on which I have recently been engaged have not exercised my mind on any topic so much as on the following." He then describes what he regarded as a selective choice by the Protozoa of *finer* particles of sand by some species, and *coarser* particles by other species, for the purpose of building into the structures of their shells. No doubt, however, if the process were carefully observed, it would be found that this apparently selective choice is really due to the size or quality of the adhesive drops on the pseudopodia, which may very well differ slightly in these respects among the different species.

Much the larger portion of Dr. Verworn's work is, as its title conveys, occupied with an account of his experimental researches. These are thoroughly systematic and fairly exhaustive. First there are thirty pages describing the natural or spontaneous movements characteristic of well-known forms belonging to all the main divisions of the Protozoa. Next there follow a hundred pages dealing with the author's experiments in stimulation, arranged under the headings—luminous, thermal, mechanical, auditory, chemical, and electrical. Lastly, there are over fifty pages describing a number of experiments in various forms of section and artificial division of sundry unicellular organisms. The whole of this part of the research is exceedingly good, and must be studied by everyone who is engaged in practical work. From this point of view the two most interesting facts are, we think, the following. It is a general law of excitable tissues that the principal seat of excitation is the kathode on closing a galvanic circuit, and the anode on opening it. But Dr. Verworn finds that among the Protozoa the reverse of this otherwise general rule obtains. It appears that this curious observation was first made by Kühne as long ago as 1864; but Dr. Verworn has done good service in now calling attention to it, corroborating, and extending it to other unicellular organisms.

The second fact to which we allude is, that when a galvanic current is closed through a drop of water containing a number of Protozoa (*e.g. Paramecium, Coleps, Colpoda, Stentor, Halteria*), they will all begin to travel rapidly and directly to the negative pole, and, if the current be left closed for a few seconds, will all become congregated thereat. On now opening the current they will all begin to travel towards the positive pole, but then soon segregate. It was proved that this is not any merely physical phenomenon, but a truly vital one: the Protozoa of the genera named will invariably swim towards the kathode on closing, remain at the kathode so long as the current continues to pass, and swim towards the anode as soon as the current is opened. Even when the kathode is a copper wire, which causes the death of all the Protozoa that approach it, they will equally well congregate in its vicinity, there to perish; and by using a movable kathode of harmless material, the Protozoa may be led about like a flock of sheep following their shepherd. To this curious physiological property on the part of Protozoa, Dr. Verworn has assigned the name "Galvanotropism." But one would like to be informed as to the strength of the current employed, *e.g.* if it were sufficient to induce electrolysis. If the current used was a very weak one, would it not be interesting to try the effect of greatly strengthening it?

The experiments in section were all devoted to testing the value of the nucleus as a co-ordinating centre of movements, ciliary and otherwise. The results were uniformly opposed to the views of Rossbach, Engelmann, and others who have regarded the nucleus in this light—the un-nucleated portions of several Protozoa continuing to exhibit all the same spontaneous movements as the nucleated. It is to be regretted that the author did not more completely extend these researches to an investigation of the functions of the nucleus in respect of nutrition and regeneration, where so much still remains to be done. But we may hope that this is perhaps to follow.

GEORGE J. ROMANES.

OUR BOOK SHELF.

Treatise on Trigonometry. By W. E. Johnson, M.A. (London: Macmillan and Co., 1889.)

WE have here a work which should prove very serviceable to those who are commencing the subject with the hope of proceeding to more advanced mathematics, and also to those wishing to revise their study of trigonometry and to extend it beyond the limits of an ordinary elementary text-book.

The volume is divided into two parts, geometrical and analytical, the former dealing with geometrical applications, the latter with the purely theoretical and analytical side of the subject. The first part deals with the properties of points and circles connected with triangles and rectilinear figures, trigonometrical ratios and their fundamental relations; chapter ix. treats of the geometry of the triangle, including the nine-point circle, the cosine and ex-cosine circles; and in chapter x. we have formulæ for circles and rectilineal figures. In the algebraical part, logarithms, ratios of compound and multiple angles, developments of formulæ for the sums of angles, factorization and summation, are dealt with. In chapter xviii. the proof of the binomial theorem is a modification of Euler's, thereby making it depend directly on the index theorem. Chapter xxi. consists of the application to trigonometrical formulæ of imaginary and complex quantities, and chapter xxii. of a geometrical interpretation of imaginaries.

Short digressions have been made into geometry, algebra, and theory of equations in various parts of the work, thus bringing out more clearly the train of reasoning that is necessary to establish and expound the principles that lie at the foundation of mathematics, to which, in trigonometry, the student is first introduced.

At the end of each chapter is a copious supply of examples, and the book concludes with a set of miscellaneous examples and answers to the above.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Taming the Puma.

As I believe that the puma, or Rocky Mountain lion, is usually considered one of the most intractable and untamable of animals, the following brief account of what I have just seen