two great monographs of the Rhizopods and Heliozoa, are here presented in a form more accessible to the student. About fifty species and varieties are described and figured, the majority being peculiar to deep lakes, the others characteristic of, though not confined to, deep lakes.

On looking over the diagnoses of the species, it cannot fail to be remarked that many of them are distinguished by very trivial differences from other known species. Considering the intolerable burden of synonymy in zoological nomenclature which results from the practice of describing species on insufficient grounds, it is a pity that Dr. Penard should have conferred a specific name upon a form (*Difflugia curvicaulis*, Penard) which he naïvely admits he regards as scarcely even a fixed variety. Other instances are not wanting in the volume of species which seem to be of very little value. It is obvious that he makes insufficient allowance for the recognised variability of the species of the group. He puts too much reliance on size as a specific character, and gives an exaggerated value to minute differences in the size and form of the scales which encrust many species.

Making all allowance for the slight differences on which he separates the abyssal species from the related species of shallower waters, it appears that there is really some considerable amount of peculiarity among the abyssal Sarcodina. Species tend to appear in the abyssal region under different forms or varieties from those found elsewhere. We would ask, however, whether this peculiarity is any greater than one would expect from the influence which must be exerted by the very different environment upon the individuals produced in this region?

Of interest in this country is Dr. Penard's assertion that some representatives of the abyssal fauna of the Swiss lakes have been found by him in Loch Ness. The difficulty of accounting for the passage of abyssal forms from one lake to another is just touched upon, and dismissed with the short statement that several of the species have also been found at the margins of the lakes, as well as in the depths. One is tempted to make another explanation of this fact, and say that it proves that they are not peculiarly abyssal. Dr. Penard does not say whether he regards this coming to the shore as a normal mode of migration of abyssal species.

In the special case of Loch Ness, there are facts which make it difficult to believe that the abyssal Rhizopods are peculiar species. No abyssal species of any other class has yet been found in Loch Ness. Some of the forms which are regarded as purely abyssal in the Swiss lakes are found in the shallow bays of many Scottish lochs, and even in peat bogs. This may prove an interesting fact in distribution if it can be shown that species which are superficial in Scotland have to descend to some depth in Switzerland in order to find congenial conditions of temperature. Among Dr. Penard's abyssal forms which have been found in Scottish moss may be mentioned *Heliopera petricola*, var. *amethystea*, Penard, and *Cyphoderia ampulla*, var *major*, Penard.

Making due discount for his too high appreciation of minute differences, and appraising his species at our own value, this volume is valuable to students of the Sarcodina, as there is no question of Dr. Penard's painstaking accuracy of observation. His descriptions are clear and concise, while the illustrations in the text are excellent.

STEAM TURBINES.

(1) *Steam Turbines, with an Appendix on Gas Turbines.* By Dr. A. Stodola, of Zurich. Translated from the second revised and enlarged German edition by Dr. L. C. Loewenstein. Pp. xvi+434; illustrated. (New York: D. Van Nostrand Company; London: Archibald Constable and Co., Ltd., 1905.) Price 21*s.* net.

(2) *Bau der Dampfturbinen.* By Prof. A. Musil. Pp. 6+233. (Leipzig: B. G. Teubner, 1904.) Price 8 marks.

(1) THE steam turbine has for some years now, thanks to the inventive genius of Mr. Parsons, become a formidable rival of the reciprocating steam-engine on land, and the past three years have seen a rapid increase in its use for marine purposes. On cross-channel steamers there is no doubt that in a few years it will completely oust its rival, while the adoption of this type of engine for two of the Allan line steamers, and the decision to use steam turbines for propelling the great Cunarders now being built, probably herald the approach of the day when on these big liners also the reciprocating marine engine will be entirely displaced.

It is not surprising, therefore, that there has grown up a rapid demand for good text-books on the steam turbine in which both the theory and the constructive details of the numerous types now on the market are fully dealt with. In addition to numerous papers and articles which have been printed in the Transactions of our leading engineering societies and in the technical journals, we have had two editions of Mr. Neilson's book, and now, by this English translation, the latest edition of Dr. Stodola's classic work is made available to British engineers.

In his preface to the second edition, Dr. Stodola points out that he has been able in the period which elapsed since the issue of the first edition to investigate experimentally several important problems untouched in the first edition, as, for example, the frictional resistance of turbine wheels in air. In the first section, after dealing with the elementary theory of the steam turbine, a concise and clear classification is given of the various types which have so far been practically successful. The more advanced thermodynamic problems which are met with in the theory of the steam turbine form the subject of the second section, and details are given of a series of valuable experiments on the flow of steam from orifices; these experiments are of great importance, and the results are very striking, and will undoubtedly prove of great value to those engaged in the design of diverging nozzles for turbines. In connection with this chapter, Mollier's diagrams for the properties of saturated steam are explained; these diagrams have been reproduced, and, for the English edition, similar

diagrams, expressed in English units, have been prepared by the translator. The design of the details of the more important types of turbines is then investigated, and such details as the shape, the construction, and the strength of the blades, and the design of the bearings of the shafts are fully dealt with.

In section iv., a full description is given of the various types of steam turbine which have so far been constructed and have been practically successful, and, in the case of several, the results of experiments by trained observers are given in detail. This portion of the book will be found of particular value to users of steam power who are anxious to have some knowledge of the relative merits of the various types of turbine now on the market. The application of the steam turbine to marine purposes is scarcely dealt with in as full and comprehensive a manner in Dr. Stodola's book as the rest of the subject, and a little more information might well have been given as to the relative merits of the steam turbine and the reciprocating engine for various purposes.

The last section of the book deals with some of the more advanced scientific problems, treated largely from a mathematical point of view, which occur in connection with the theory and construction of the turbine. We might instance such problems as that of the distribution of pressure in any cross section of an expanding gas or steam jet, the deflection, due to its own weight, of a horizontal disc of variable thickness, and the straightening out of such rotating discs under the action of centrifugal forces.

In an appendix, the possible future of the heat engine is briefly discussed; the main directions in which increased economy may be hoped for appear to be in the decrease of the passive resistances, such as friction, &c., in the supply of the heat to the motor only at the highest possible temperature and in the abstraction of the waste heat only at the lowest possible temperature, and in the avoidance, so far as possible, of all non-reversible changes of condition. Dr. Stodola is of opinion that in the future a heat motor which combines the high thermal results of the gas engine with the constructive advantages of the steam turbine will supplant all other types. Such a motor will be found in the gas turbine, a motor which at present has not reached practical constructive stages.

(2) After a brief account of the history of the steam turbine from the days of Hero, and a discussion of the lines upon which recent invention has proceeded, Prof. Musil gives a very useful bibliography; then, as is usual in books on this subject, there follows a classification of the various steam turbines now in use. The theory of the well known Laval nozzle is then dealt with mathematically, and the proportions of such nozzles are worked out in detail; the results of experimental investigation into this question are given, and the effect on the flow through such nozzles of superheating the steam is discussed. The thermodynamic problems involved in this branch of the theory of the turbine are also treated by the author with the aid of entropy diagrams.

The remainder of the book is devoted to detailed descriptions of several types of turbines, beginning with the Laval, which is described in detail with a number of illustrations. The important problems due to the use of a flexible shaft in this turbine are investigated, also the question of the governing of the turbine. The steam consumption of this type when under test is given in a series of tables, and the relation of the actual steam consumption to the theoretical is dealt with in some detail. The second type of turbine taken up is the Parsons, again illustrated with a number of well drawn plates, and here also the question of the governing of the turbine forms an important section; details of the actual steam consumption under varying loads are given, and the results have been put into the form of a series of curves, which will be of great use to the student.

It may be well to point out that Prof. Musil expressly excludes from the scope of his text-book the application of the steam turbine to marine purposes. The other types of turbines which are dealt with by Prof. Musil include the Zoelly, the Riedler-Stumpf, the Curtis, and the Rateau. For each type good descriptions of the mechanical details are given, with very clearly drawn illustrations, and in the case of the Zoelly and the Rateau results of tests are also given. Prof. Musil's book will be found of especial value by students in engineering colleges, and by draughtsmen in those engineering works where turbines are now built. T. H. B.

OUR BOOK SHELF.

An Angler's Hours. By H. T. Sherringham. Pp. xii+264. (London: Macmillan and Co., Ltd., 1905.) Price 6*s.* net.

MR. SHERRINGHAM deserves the thanks of all anglers who have an idle hour and no fishing for having re-published his essays in book form, and he who is forced by sad circumstances to enjoy his fishing vicariously will find his time well spent in our scribe's company. There is a pleasant and old-world flavour in his style; whether he rises early to catch tench while the dew is still thick, or drowses away his Sunday afternoon in the July heat of a sunny garden, he is an entertaining companion, who boldly confesses to his crimes in the first person or conceals his triumphs, like Julius Cæsar, in the third with equal art. But there is instruction in his essays too, such mild instruction as may best suit an idler, and much shrewd observation of the habits of fishes delicately imparted in pointing the moral of a failure or adorning the tale of a success.

Many important considerations are thus put forward and discussed; for instance, the possibilities of the fly as a lure for other fish than trout and their kind, and the hopes held out to the fisherman who finds himself by some sluggish southern stream if he will only not despair but go forth and tempt the Cyprinids that haunt its troutless waters with flies and tackle suited to their tastes.

Again, there is the harmless, necessary worm; Mr. Sherrington handles him gently (especially when dragging him from his burrow), and adjures us to treat him as a friend in need and no mere despicable device for luring fish to an undeserved and unedifying end. We may be cursed with the instincts of a poacher, but must confess to a leaning towards that conception of the angler's art which advocates the