

published jointly with Kimball in 1884, should be singled out in the above passage, while Rayleigh is patronised as a "competent investigator."

In the history of the earlier times Prof. Cajori has followed good guides, such as Whewell and Mach; and though here also the space is entirely inadequate to give a sufficient account of the subject, we like this portion better than his treatment of contemporary science.

That there should be omissions was inevitable, but it might have been thought that the kinetic theory of gases was of sufficient importance to justify a short paragraph, while the only reference to that theory is to be found in the statement that a mathematical investigation of the radiometer action was given by Clerk Maxwell. Here again, as a matter of history, it was the discussion between Osborne Reynolds and Johnstone Stoney, not alluded to in the book, which brought about the correct explanation of the radiometer, and however important Maxwell's paper may be, it only appeared when the matter was cleared up. In a detailed historical account it is often necessary to allude to scientific squabbles and unpleasant discussions, but the author of this book might well have pleaded want of space, and omitted, for instance, such a passage as this: "William Thomson and Tait, placing a much lower estimate on Mayer's researches, brought the charge that Tyndall was belittling the work of Joule." I have marked several passages which are open to criticism, but it is not my intention to find fault with the details of a book which, as a whole, is perhaps as well done as could possibly be. It is the whole attempt to collect isolated facts in the belief that these constitute a history that seems to me to be mischievous. This does not, however, exclude the fact that most readers will probably find in the book some things they did not know before, and some useful references. ARTHUR SCHUSTER.

#### OUR SEA FISHERIES.

*The Resources of the Sea, as shown in the Scientific Experiments to test the Effects of Trawling and of the Closure of certain Areas off the Scottish Shores.* By W. C. McIntosh, M.D., LL.D., F.R.S., &c. Pp. xvi + 248, and Tables. (London: Clay and Sons, 1899.)

IT is well known that at the time of the late Lord Dalhousie's Royal Commission on Sea-Fisheries (1883-85) Prof. McIntosh conducted, for the Commission, a series of most important trawling investigations off the coast of Scotland which formed the starting-point of a good deal of the experimental and observational work of the Fishery Board for Scotland—work which has been noticed from time to time in the columns of NATURE during the last ten or twelve years. The book before us is practically devoted to the summing up of that work and the discussion of its results, and there is no one probably who has a better right to do that than Prof. McIntosh, who, by his trawling investigations in 1884, suggested the experiments of the Board, and who himself may be said to have superintended and controlled the work while acting as scientific member of the Board from 1892 to 1895—when he was succeeded by Sir John Murray. All this gives additional importance to the fact that Prof. McIntosh now declares against the policy of the Fishery

Board, criticises their methods and their conclusions as published in recent annual reports, and is apparently in favour of removing all restrictions upon fishing, and of throwing the territorial waters open to trawlers and liners alike.

It is clear, then, that the book deals with debatable matters, and probably few fisheries experts will agree with the author in all his points. The work is happily named the "Resources of the Sea," as the central idea running all through it is that marine animals and plants have such extraordinary powers of reproduction as to be practically unaffected by the influence of man; while the secondary title shows that it is the trawling experiments and the results of closure of sea-areas off the coast of Scotland that are specially discussed and criticised.

There is an "Introductory" chapter, giving a general review of marine life, with most of the statements in which every biologist will agree. It may be remarked, however, that the vast possibilities of increase which may be true of diatoms and many groups of lower animals, and even of some fish, are not necessarily true of all kinds of food fishes in the inshore waters. The plaice and the sole are probably in this respect in very different case from the herring, the cod, and the oft-quoted haddock.

Prof. McIntosh next gives us a chapter dealing with the effects of trawling, and of the hooks of liners, upon the food, the eggs and the young of our fishes; the present state of the fishery steamers and their apparatus, and upon the method in which the Fishery Board for Scotland have carried out the recommendations of the Trawling Commission. In all of this there is naturally a good deal of evidence to show that the trawlers do not do the harm to the sea-bottom that has been from time to time ascribed to them; and we readily agree with the conclusion on p. 50:

"A calm survey of the situation, therefore, does not lend support to the notion that the trawl, as ordinarily employed in sea-fishing, is the only destroyer of the invertebrate animals of the bottom; and, further, experience does not demonstrate that the sea-bottom in any known region has been, by the use of such line or trawl, so seriously impoverished as to be unable to support fish-life."

Some of us are unable, however, from what we know on other coasts, to endorse the further opinion that trawling does no great damage to the young food-fishes on the bottom. Our experience in Lancashire is that grave destruction of immature flat-fish is caused by trawling in the "nurseries" along the shallow sandy shores; and that in protected areas, such as the closed ground off Blackpool, a rapid increase of the more sedentary flat-fish takes place. We fail to understand the statement<sup>1</sup> on p. 234, that closure is powerless to prevent such destruction.

Prof. McIntosh then takes up, one by one, the sea-areas which have been closed against trawling by the Fishery Board, and in which experimental hauls have been made from time to time by the Board's small steamer, the *Garland*. Unfortunately that vessel is too small for the work; we labour under a similar dis-

<sup>1</sup> "The capture of great numbers of small fishes by either trawlers or liners is a misfortune for the country, but the closure is powerless to prevent it." This requires further explanation.

advantage in Lancashire. A Fishery Board or Committee carrying on scientific and experimental work ought to have a vessel that can go to sea and stay at sea in all ordinary weathers, and that can follow the fishing fleets and work with them on equal terms. That is not possible for either the *Garland* or the *John Fell*.

Chapters are devoted to the trawling experiments in St. Andrews Bay, in the Firth of Forth, in the Moray Firth, and in the Firth of Clyde; and in each case it is argued that the closure has effected no change, that there has been no great increase in the fish population, and that, on the other hand, there has not been that decrease which the Board have recently made a reason for wishing to obtain control of the fishing on the offshore spawning grounds. But it seems pretty clear, from the detailed analysis given of the statistics, that the observations are not really sufficiently numerous and sufficiently trustworthy to justify any general conclusions. We are constantly reminded of the smallness of the steamer and the inefficiency of her trawl.<sup>1</sup> Prof. McIntosh himself evidently distrusts the results, and speaks more than once of the "uncertainty." The observations, moreover, were not always taken in the same months, and so certain series of the statistics cannot fairly be compared. It is curious that the results obtained from the "closed" and the "open" areas have not been treated quite separately in the tables. Surely in a discussion of the effects of closure it would have been safer to have rigidly excluded the statistics not obtained wholly from closed grounds.

Nor is it quite clear to us that Prof. McIntosh is convinced by the evidence he brings as to the abundance of fish in our seas. Here again one ought to clearly distinguish between the more oceanic and active fishes, such as the herring and haddock, which come and go and are largely beyond man's control, and the more local and sedentary forms, such as most of the valuable flat-fish. In regard to the latter, much evidence has been given from time to time in regard to different parts of our coast, showing the depletion of certain areas. It is curious, in this connection, that Prof. McIntosh, while quoting freely from the work of the Trawling Commission of 1883 and of the earlier Commission of 1878,<sup>2</sup> makes no allusion to the evidence given before the much more recent Select Committee of the House of Commons in 1893, the statements in Mr. Calderwood's paper on "British Sea-Fisheries, &c." (1894), and other recent works. It is doubtful whether the older opinions are of much value now under the new conditions. The fishing methods have been so entirely changed with the introduction of powerful steamers and otter-trawls, and the area fished has been so enormously extended during the last few years, that no argument can safely be drawn as to the fish population of our own coastal waters from the supply landed for the markets.

In the discussion of statistics like these so much depends upon the grouping of the figures, and upon the comparisons made, that I for one should not be at all surprised if Dr. Wemyss Fulton, the scientific secretary

<sup>1</sup> This must not be regarded as any reflection upon the scientific work of the Scottish Fishery Board, or upon much other useful work accomplished by Dr. Fulton and the staff on board the *Garland*.

<sup>2</sup> By the way, why is "the late Mr. Spencer Walpole" (*sic*) not referred to under his present title of Sir Spencer Walpole, K.C.B.?

of the Fishery Board, succeeded from the same series of figures in establishing what we may take to be his main contention that, as a result of the closure there has been a diminution of plaice and lemon soles, and a marked increase of common and long rough dabs, *in the closed areas*. We are afraid, however, that the statistics collected so far are insufficient, and that it is premature as yet to draw any conclusions. And that is the reason why some of us think it important that the Fishery Board's experimental work should not be stopped at this stage. Although ten or even fifteen years may have been spent—and much money—still if reasonable doubt remains, if it seems that more extended experiments might give other and more definite results, surely this is not the time to reverse the policy and stop the accumulation of statistics.

We have reason to think, moreover, from information obtained outside the official reports, that in the Clyde at least the closure is resulting in an increase of the flat-fish on the ground. In the spring of 1887, as the result of their trawling experiments, the Board stated that "the flat-fish in the Clyde are only about half as numerous as in the Forth at the same period of the year," and they considered this as evidence of depletion. In the spring of 1898, after the decade of protection, the Lancashire Fisheries' steamer *John Fell*, trawling during three days for scientific purposes, by special permission of the Board, found what the experienced fishermen on the ship, accustomed to the fishing grounds of the Irish Sea, considered to be rich accumulations of flat-fish, including many true soles (*Solea vulgaris*). The very fact that poaching goes on is sufficient to show that the fishermen regard the closed areas as desirable trawling ground with an abundant fish population.

Well, there are the two policies: the one to preserve these fish sanctuaries by means of restrictions which cause constant friction, and which we would all prefer to see removed; and the other to add more or less artificially to the population of the sea by hatching, or by returning fertilised spawn to the water. The Board is at present pursuing both policies, and it may be that both are necessary.

As the book before us is mainly directed against restrictive measures, we are glad to see at the end of it, in the "Summary," some words as to the natural alternative, "productive" measures; and we can cordially agree with the remarks on p. 231, in regard to hatching. Some years ago (December 1894), Prof. McIntosh wrote an interesting article on the subject in *Science Progress*; a few months ago, in a letter to the present writer, he said, in regard to sea-fish hatcheries:

"Of course such institutions are strictly experimental, and it may be some time before a decisive result is evident. Meanwhile, work them thoroughly and support them liberally."

This is what the Fishery Board are doing at Dunbar and at Aberdeen, and what we in Lancashire are now doing at the Piel hatchery. At the conclusion of the present book Prof. McIntosh repeats his former statements, and urges that support should be given to such experiments "till the issue is clear."



I cannot refrain from drawing attention to the fine ideal of the scientific man's action in regard to the fisheries which our author holds up to us. I quote from p. 223 :

"A close observer of nature, he weaves no theories, and is not incautious in deduction. The welfare of the fisheries as a whole is his aim, and the influences which act on those engaged financially in them, or have political or other connections with them, are unknown to him."

Prof. McIntosh's friends may be permitted to add that he himself realises that ideal more nearly than any one else we know in the field.

The book is charmingly illustrated with views of the marine laboratory, the harbour, the boats, and some characteristic features of fishing life in the celebrated old Scottish university town of St. Andrews, which the fame and long-continued labours of McIntosh have done so much to render a "Mecca" to the young marine zoologist.

W. A. HERDMAN.

#### OUR BOOK SHELF.

*The Lepidoptera of the British Islands. A Descriptive Account of the Families, Genera, and Species Indigenous to Great Britain and Ireland, their Preparatory States, Habits, and Localities.* By Charles G. Barrett, F.E.S., one of the Editors of the *Entomologist's Monthly Magazine*. Vol. V. Heterocera : Noctuæ. Pp. 381. (London : Lovell Reeve and Co., Ltd.)

IN the present volume, Mr. Barrett discusses 111 species of British Noctuæ, in the same elaborate manner as in the volumes which we have previously noticed. He has long been recognised as one of our best living authorities on the British *Lepidoptera*, and his book will remain of great and permanent value as a record of the state of this branch of our fauna as it exists at the end of the present century. Among the most interesting moths here noticed are those which are attached to the Fens, several of which are now very much scarcer than formerly in England, though some species (such as *Tapinostola concolor*, Guen.), which were supposed to have become extinct, have now been rediscovered in other localities ; while several Fen species, quite unknown during the palmy days of the Fens, have lately been discovered there. We have heard it suggested that this may be due to fresh localities in the Fens having been made accessible by drainage ; but in the case of *Calania brevitinea*, Fenn, Mr. Barrett remarks : "It seems to furnish all the evidence which it would be possible to obtain, in order to suggest the actual genesis, or introduction of a total novelty, to the world's fauna." It appears that the exact locality where the insect now occurs was well worked in 1857, without its being discovered ; but in 1864 the first specimen was taken, and no more till 1871, when a few specimens were taken, after which, it has become both commoner and more widely spread in the Fens, and a single specimen has been taken in Belgium. The remarks on the habits of various moths, especially, perhaps, their behaviour at sugar, &c. (under the notice of *Taenioctampa gothica*), will also be read with interest. The well-known cannibal habits of the larva of *Cosmia trapezina* are also remarked on. It should be observed that this work is issued in two editions—one with, and the other without, plates.

W. F. K.

*An Introduction to the Mathematical Theory of Attraction.* By Francis A. Tarleton, Sc.D., LL.D. Pp. xii + 290. (London : Longmans, Green, and Co., 1899.)

THE author tells us that his object is to make the acquisition of a competent knowledge of the theory of attraction as easy as possible for the student. With this

view he has given, in addition to the theorems on attractions and potential to be found in most of the text-books, an account of the theory of electrostatics and some outlines of the theory of magnetism. He has attended almost exclusively to the mathematical view of his subject. Possibly the students for whom he writes will have formed sound physical conceptions before they begin to read his book ; in that case they will probably find in it what they want in the way of mathematical theory.

To indicate the scope of the book, we may observe that it contains such things as the determination of the attraction of an ellipsoid by direct integration, Laplace's equation in elliptic coordinates, the distribution of electricity on a freely charged spherical bowl, and Kirchhoff's theory of the distribution on two spheres. A student for whom these things are not too difficult could appreciate many things that are omitted, such as the potential of a magnetised body of finite size, Laplace's equation in orthogonal curvilinear coordinates and the logarithmic potential in three dimensions. The author has done well in refraining from barren discussions of artificial laws of force differing from that found in nature.

The plan followed, viz. that of treating gravitational attraction and electrostatic and magnetic forces together, has the disadvantages that the standard case of attraction is repulsion and that special units have to be used in treating gravitation ; it has the advantage that it tends to break down the system of water-tight compartments in which students always store their knowledge. A number of results that might be more simply obtained by indirect methods are obtained by direct integration. The potential is introduced comparatively late, the definition even being postponed to the fourth chapter. One excellent feature of the book is that two-dimensional problems and three-dimensional problems are treated separately and side by side.

The author's mathematical methods are the traditional ones of British text-books, except that here and there he presents investigations by Mr. Purser. But surely it is time that writers of books, even on applied mathematics, took some account of modern developments of analysis. If an exhaustive discussion of the existence theorem would be out of place, it would yet seem not unreasonable to expect the banishment of such banalities as "consecutive points" and "infinitely small quantities," the avoidance of meaningless equations between divergent series and divergent integrals, the presentation of a proof that the convergent integrals which represent the components of attraction at a point within an attracting mass are the differential coefficients of the convergent integral which represents the potential at such a point, a little care in extending Gauss's theorem concerning the surface integral of normal force from a single particle to a distribution of density, some discussion of the discontinuity of the second differential coefficients of the potential at the boundary of an attracting body. Why write a new book which follows the old ones in leaving undone the things that ought to be done, and doing the things that ought not to be done ?

The book contains several interesting collections of examples. These should prove useful to teachers as well as to students.

A. E. H. L.

*Outlines of the Earth's History; a Popular Study in Physiography.* By Nathaniel Southgate Shaler.

Pp. viii + 418. (London : William Heinemann, 1898.)

IN these outlines Prof. Shaler has felt the necessity of selecting certain features of the history of the earth for comparatively full treatment in order to supply a more helpful aid to a true knowledge of the earth than is afforded by the "ordinary text-books." At first sight the selection appears inadequate and arbitrarily proportioned. The seven chapters devoted to the concrete subject (after thirty pages of introductory matter) are entitled "The Stellar Realm," "The Earth," "The