

The greatest disturbance appeared at the third pendulum (S.W. to N.E.), with oscillations 6 cm. large; the maximum, with two well-defined periods, was from 8h. 23m. 52s. until 9h. 8m. 43s. a.m. Tremors followed until 11h. 30m. a.m.; the preliminary tremors of this pendulum, commencing 7h. 45m. 25s. a.m., showed three well-marked maxima. Other very small tremors preceded, the pendulum being troubled all the preceding night, perhaps by the winds.

On February 11, there was a small disturbance on the second and third pendulum 11h. 39m. 48s.; February 13, a very great one on all three pendulums from 2h. 31m. 54s. until 3h. 8m. a.m., with oscillations up to as much as 2.1 cm., and preceded on pendulum three by a preliminary motion, on February 12, from 11h. 2m. 2s. p.m. until 11h. 34m. 38s. p.m.

A very great perturbation was observed on February 19, on the third pendulum, from 10h. 11m. until 10h. 39m. p.m.; and on February 20, from 0h. 11m. 15s. until 1h. 20m. 10s. a.m. The first pendulum (E. to W.) had a very great motion from 0h. 11m. 16s. until 1h. 49m. a.m., February 20, followed by a long series of tremors. The second pendulum was not in activity.

Dr. Ehlert (Strassburg) has put the box with the three pendulums on a short, stout, isolated sandstone pillar, to avoid the earth-waves being concealed or wholly annihilated by the frictions and elastic motions taking place in a large pillar of masonry; and the pendulums, set up in such a manner, give very accurate records of vibrations, change of level, &c. They can be made extremely sensitive. The whole instrument may be purchased for 51*l.*, with recording apparatus and lamp (Strassburg, I. and A. Bosch); and I should like to recommend it, for the seismic survey of the world, for each station of this international survey. The distinct directions and movements of the three pendulums are showing (1) each motion of the earth-crust coming from whatever an azimuth; (2) the chief direction of the seismic wave; (3) the temporary figure of the wave; (4) their splitting-up in different trains of waves. They are disturbed also by vertical shocks.

G. GERLAND.

Strassburg, March 31.

Relationship between the Masses and Distances of the Four Outer Planets.

LET the mean distance of Jupiter be the unit of measurement for the four outer planets. The distances are then as follows.

Jupiter.	Saturn.	Uranus.	Neptune.
I	1.8338	3.6869	5.7765

Now take the following numbers as the masses—

Jupiter.	Saturn.	Uranus.	Neptune.
312	92.513	13.604	15.969

and multiply the masses into the distances. We then obtain

Jupiter.	Saturn.	Uranus.	Neptune.
312	169.65	50.157	92.245
J	S	U	N

Let the last series of numbers be J, S, U, N, respectively. Then

$$\begin{aligned} U S &= N^2 \dots\dots (1) \\ U J &= N S \dots\dots (2) \\ U + N + S &= J \dots\dots (3) \end{aligned}$$

In fact, the numbers are in geometrical progression, having a common ratio R = 1.8391. So that

$$\begin{aligned} U R &= N \dots\dots (4) \\ U R^2 &= S \dots\dots (5) \\ U R^3 &= J \dots\dots (6) \end{aligned}$$

The common ratio 1.8391 is nearly the mean distance of Saturn 1.8338, and is one of the solutions of a biquadratic equation

$$x^4 - 2x^3 + 1 = 0.$$

G. E. SUTCLIFFE.

The Hermitage, Coorla, Bombay, March 19.

X-Ray Photography.

It may interest the readers of NATURE, that it is possible to take shadowgraphs (so-called) instantaneously without any special arrangement of induction coil or deviation in the form of Jackson tube.

The apparatus used consists of 10-inch Apps' induction coil, a Jackson focus tube supplied by Messrs. Newton (one of a set of twenty-five I have in my possession), and a set of small secondary batteries, about 30 ampère hour capacity, six cells in the set. The induction coil is of the ordinary type with ordinary commutator.

For the purpose of obtaining these results in such short exposures, a special choice of tube is necessary, working the tube for a considerable period before desired condition is arrived at, and that condition judged by experience, for no ampère measurement will give the information. The tube must be strongly heated by a spirit lamp, and when the desired condition (tube being of course connected with coil) is arrived at, the exposure must take place.

(1) By instantaneously turning current on and off.

(2) By interposing a 1/2-inch iron plate between tube and object to be shadowed, removing plate for the exposure.

Having carefully timed the exposures, I have been able to repeat the experiment with assured success. For some time past I knew that hands and arms of children could be taken in from twenty to thirty seconds, but have now succeeded in taking children's hands in half a second (showing all bones and cell tissue of bones), and adults' hands, bones of wrist, and even arms, with exposure of only one second, again showing cell tissue of bones.

It is interesting to note that everything connected with the production of these results was made in England.

WILLIAM WEBSTER.

Art Club, Blackheath, March 30.

A New Scientific Club.

My attention has been drawn to a circular in favour of a new Club, in which my name appears as one having consented to become a member. I know nothing of the Club, nor have I in any way authorised the use of my name.

12 Arundel Gardens, W., April 9.

W. RAMSAY.

DEEP-SEA FISHES OF THE NORTHERN ATLANTIC.

THE examination of the deep-sea fishes which have been collected by means of the dredge or trawl during the last twenty-five years, has now been almost completed; at least the results of this examination, as far as it has gone, are now before us, and form the most interesting and attractive portion of the ichthyological literature of our time. The harvest reaped by the various expeditions, surveys, and private enterprises, which have been fitted out to explore the mysteries of the sea, has far exceeded the most sanguine expectations, and it is satisfactory to find that the six or seven volumes devoted to ichthyology have been placed before the public in a style and with a wealth of illustration worthy of the interest attached to the subject. The first to appear was the volume descriptive of the deep-sea fishes collected during the Norwegian Expedition to the North Atlantic from 1876 to 1878, by R. Collett (Christiania, 1880, 4to, pp. 166, with five double plates); this was followed, in 1887 by the Report on the Deep-sea Fishes collected during the Challenger Expedition (1873-76), in which were incorporated the proceeds of the Faerøe Channel Exploration (1880 and 1882) (London, 1887, 4to, pp. lxx. + 335, with 73 plates); the collections made by the French expeditions of the *Travailleur* and *Talisman* (1880-83) were described by L. Vaillant (Paris, 1888, 4to, pp. 406, with 28 plates); in the Indian Ocean, H.M. Indian Marine Survey steamer *Investigator* has added largely to our knowledge of the bathybial fauna from year to year since 1885, the collections being described by A. Alcock in a series of papers which appeared in periodicals, and were supplemented afterwards by "Illustrations," of which three parts, with fifteen plates in quarto, have been issued under the authority of the Director of the Royal Indian Marine in Calcutta, 1892-95; finally, the collections made in the North Pacific by the U.S. Fish

Commission steamer *Albatross* (1890-93) have been reported upon by C. H. Gilbert in the annual reports of that Commission.

The past year has been signalised by the almost simultaneous appearance of three works, by which our knowledge of the deep-sea fishes of the Atlantic north of the equator has been vastly increased, and which we propose to notice more particularly in the present article.

By far the most important of those three publications is "Oceanic Ichthyology,"¹ a work devoted to the discussion of the material that has been brought together since the year 1877, by the naturalists on board of the steamers of the United States Fish Commission and Coast Survey. It is almost superfluous to remind our readers that the merit of having organised the systematic investigation of the North-Western Atlantic, and of having continued it for so many years, is mainly due to the late Prof. Baird, his successor Colonel McDonald, the late Dr. Brown Goode, and Prof. Alex. Agassiz.

In "Oceanic Ichthyology" all the species from the Atlantic are fully described, or at least diagnosed, unless they are long- and well-known forms. Incorporated with them are the Bathybial and Pelagic forms inhabiting other oceanic areas, and hitherto not found in the Atlantic; but the authors treat of them only in a more or less general fashion, the species being usually mentioned by name only. The illustrations—417 in number on 123 plates—are very well drawn, though of no particular artistic merit, many being reduced copies in outline from other works. But the work, as it is, is a most valuable contribution to the literature of oceanic zoology, not merely for the scientific student, who will find in it a mine of information, but for all "who go down to the sea in ships, and occupy their business in great waters." If in its production attention has been paid to economy, the great object has been attained thereby of bringing the work within reach of a number of persons to whom the corresponding parts of the *Challenger* Reports will be inaccessible. As the edition seems to be as large as the publications of the U.S. National Museum usually are, and as the work seems to have been distributed with the same lavish liberality, there will be no vessel in the U.S. navy—we hope no vessel in the navy of any nation—engaged in the exploration of the ocean which has not a copy on board.

The American work covers the same ground as the two Reports of the *Challenger* series, which were respectively devoted to the Deep-sea and Pelagic fishes, and even a part of the *Challenger* Shore-fishes, as quite a number of species living above the 100 fathoms line, for instance certain flat-fishes, have been admitted into the work. The authors combine both those kinds of fishes under one term, viz. *Oceanic fishes*, which are defined as "those deep-sea and pelagic species which dwell in the open ocean far from the shore, either at the surface, at the bottom, beyond a depth of 500 feet, or, if such fishes there be,² the intermediate zones." By the term deep-sea fishes are understood only "those which are found at a depth of 1000 feet or more, without reference to the question whether or not they also occur in shallower

water. The limit of 500 feet is taken for convenience in the study of the origin of local deep-sea-faunas." *Pelagic* fishes are termed "those which live far from land and at a distance from the bottom, rarely approaching the shore except when driven by wind or current. It is those which are most closely associated with the plankton. . . . Some of them, which occur at considerable depths, we call bathypelagic."

We doubt very much whether any appreciable advantage is to be gained by this modification of our more simple method of classifying the marine fish-fauna. The littoral passes into the pelagic and deep-sea-faunas, the pelagic into the deep-sea so gradually, that any line of division that may be proposed, must appear more or less artificial; and this obstacle to classification is not overcome by increasing the number of zones. I believe no malacologist of the present day maintains the eight zones, proposed by E. Forbes; with the increase of our knowledge his boundary-lines were wiped out, although they seemed fully justified at the time when that great genius generalised from the wealth of his own original observations. In the *Challenger* and other Reports, the 100 fathoms line has been selected as the upper limit for the deep-sea-fauna, because we have the positive knowledge, that at that line some of the abyssal conditions obtain, viz. absence of light, absence of surface-disturbance, absence of plant-life. It is obvious that these conditions must operate upon organisms permanently living under them, although many surface forms descend below that line, without any part of their organisation being affected by their temporary sojourn. One of the principal factors which will have to be taken into consideration in determining zones of distribution will be, as is generally admitted, temperature; and since we have been placed in possession of a great number of data of the temperatures of certain depths in definite localities, perhaps the attempt would not be premature to ascertain the zones for that portion of the bathybial fauna which is known to live at the bottom. As to the so-called mid-water fishes, the study of their distribution cannot be attempted until some means of capture is devised, by which the question of their existence, and of the limits of their vertical range is definitely settled.

As far as fishes are concerned, a distinction between pelagic forms and fishes of the plankton cannot be maintained with any advantage. But whether such a distinction be made or not, it is difficult to understand on what grounds the authors have omitted every mention of the important group of flying fishes (*Exocoetus*), whilst the dolphins (*Coryphæna*) and other similar pelagic fishes find a place in their list.

An idea of the great labour expended in the preparation of this work may be gathered from the number of species treated therein. We have not counted the species described or referred to, but the authors state in their introduction that "more than 600 (?) different kinds of fish have been obtained from the depth of 1000 feet and more"; further, in the list of "new species" they enumerate 153 species, chiefly from the Western Atlantic¹: a number which, taken without critical examination of the species, is but little less than that of the species described as new in the corresponding *Challenger* Reports.

Among the new species are a number of very singular forms. Although many of them represent, according to the view of the authors, types of distinct families, the majority are, at any rate, closely related to previously known genera.

The vertical and horizontal distribution is given under the head of each individual species, very often in great detail, for which the authors deserve our best thanks. But they would have added to the usefulness of their

¹ Singularly, *Psychrolutes paradoxus*, described some thirty years ago from the Pacific, is also included in this list of "new species"; on the other hand, others are omitted.

¹ "Oceanic Ichthyology, a Treatise on the Oceanic and Pelagic fishes of the world, based chiefly on the collections made by the Steamers *Blake*, *Albatross*, and *Fish Hawk* in the North-Western Atlantic," with an Atlas of 417 figures, by George Brown Goode and Tarleton H. Bean. (Washington, 1895,* 4to, pp. xxix. + 553. It forms a special volume of the Bulletin Series of the United States National Museum, and is also issued as vol. xxii. of the Memoirs of the Museum of Comparative Zoology at Harvard College, with the same title, but dated "Cambridge, U.S.A., September 1896."*

² Called mid-water fishes, *Challenger* Report, p. 33.

* Questions of priority are sure to arise hereafter, and therefore it is just as well to be certain as to the actual date of publication. In the last letter which we received from one of the authors, the late Dr. Brown Goode, and which is dated August 9, 1896, he says: "I am sending you the first copy of our 'Oceanic Ichthyology.'" The copies of the work sent out by the Smithsonian Institution reached England towards the end of the year.

work, if they had collected the information as to the bathymetrical limits of the deep-sea forms in some conspicuous form, as has been done in the *Challenger* or some of the *Blake* Reports. With the absence of such a list or table, we have also to regret that the authors have abstained from giving us an account of the general results of their observations; an account which would have been all the more valuable, as it would have proceeded from competent men who were able to form a sound judgment from their personal intimate acquaintance with the subject. They evidently laboured under great disadvantages: they (as they state) had commenced the work in 1881, revising and rewriting it thrice; it was written at odd hours snatched from administrative duties, always under the pressure of haste; whilst later, serious illness delayed its printing. Under such circumstances it is not to be wondered at, that not a few errors, of commission and omission, have crept in, which the authors would or could have avoided if they had been in a position to apply themselves with care proportionate to the magnitude of their task. Thus even the *Challenger* Report on the pelagic fishes seems to have come to their knowledge at a time when it was too late to fully utilise it, as might have been done, at least, in the Appendix at the end of the work. Under *Lycodes murena* all reference to the *Challenger* description and figure, and to its abundance in the Færøe Channel is omitted. Of other blunders of a more or less serious nature, we will mention one only, viz. the use of the same figure for two fishes of different families. Fig. 42 is a reduced outline-copy taken from the figure of *Alepocephalus niger* in the *Challenger* Report; the same figure, but with the addition of scales, is reproduced under No. 52, where it does duty for *Bathyrhissa dorsalis*!

But this is not the place to enter critically into errors which in due time will be corrected by the specialist; they may be annoying to him, but will little interfere with the usefulness of the book to every one interested in the subject, and will not weaken the impetus which this work cannot fail to give to the prosecution of oceanic ichthyology. We have to deplore the premature death of one of the authors, Dr. Brown Goode; but it is some satisfaction to know that he lived, at least, long enough to see the completion of a work which must have been to him, as it is to us, and as it will be to posterity, the lasting record of his untiring devotion to one of the great tasks of his life, viz. the exploration of the marine fauna of his country. There was no more earnest and unselfish searcher of truth; and we have no doubt that, had he been spared, he would have redeemed his promise to work out the general results of his study of the pelagic and bathybial fish-faunas.

The second publication¹ to which we draw attention, treats of oceanic fishes of the Eastern Atlantic. It is part of a series of volumes published by the Prince of Monaco, and descriptive of the results of the cruises which he undertook in the yacht *Hirondelle* in the years 1885 to 1888. Profiting by the experiences of the British and American expeditions, and personally possessing an intimate knowledge of every technical detail, he adapted his vessels especially for deep-sea work, and fitted them with the most perfect apparatus. In the volume before us the fishes are described which were collected, during the period named, between the Bay of Biscay and the Azores, and between the Azores and Newfoundland; they are ninety-five in number, of which about one-half are bathybial or pelagic. Prof. Collett, to whom the examination and description of these materials were entrusted, has carried out this task with the same care which has rendered his Report on the Fishes of the Norwegian

¹ Résultats des Campagnes Scientifiques accomplies sur son Yacht par Albert 1^{er} Prince Souverain de Monaco. Fasc. x. Poissons provenant des campagnes du yacht *Hirondelle* (1885-8). Par Robert Collett. Monaco, 1896. 4to, pp. viii + 198. With six double plates.

North Atlantic Expedition so valuable a contribution to our knowledge of the distribution of deep-sea fishes, as well as of their distinctive characters and structure. Six new species have been added to the Atlantic fauna in the present report. Some of the deep-sea forms were captured by a method not employed in previous expeditions, viz. by sinking baited traps to a depth of 1000 fathoms, thus securing species which, for some reason or other, were never captured by the trawl of the *Hirondelle*. We cannot conclude this short notice without referring to the great artistic beauty of the illustrations of the work; neither can we refrain from expressing our admiration of the scientific spirit which has led the Prince to devote so much of his leisure and wealth to the advancement of knowledge.

We have included the last of the three publications on deep-sea fishes in the present notice, in order to show that even at a small expenditure of time and money excellent results may be obtained in oceanic exploration. The cruise of the French ship *Caudan* was an undertaking of very modest pretension. Being much in need of deep-sea material for purposes of instruction, R. Koehler, Professor of Zoology at the University of Lyons, organised a short cruise in the Bay of Biscay. The sums required to defray expenses for the necessary apparatus were obtained by donations from scientific institutions of Lyons, Nancy and Toulouse, whilst the Minister of the Marine placed the steamer *Caudan*, of 650-horse power, at the disposal of Prof. Koehler for a fortnight. In this short time (August 1895) M. Koehler, in company with three of his colleagues, employed the trawl thirty times, in depths varying from 60 to 1200 fathoms, and was so successful that the results just published fill a handsome octavo volume of 741 pages and 39 plates. Its title is "Résultats scientifiques de la Campagne du *Caudan* dans le Golfe de Gascogne. Par R. Koehler." (Paris, 1896.) The species of fishes obtained, thirty-five in number, are described on pages 475 to 526, and some of the more remarkable forms figured on plates 26 and 27. Five of the species are described as new, whilst the discovery, in the Bay of Biscay, of others known to exist in other most remote parts of the ocean, adds further evidence of the remarkable fact of the uniformity of the abyssal fauna all over the globe.

Prof. Koehler's experiences of the effect of formaldehyde in the preservation of deep-sea fishes, are well worthy of the notice of future collectors. It is well known that the tissues of many deep-sea fishes are of extreme softness and fragility; by immersion in spirits sufficiently strong for preservation, these tissues are much contracted, the natural shape of the fish often being distorted. This is entirely avoided by the use of the usual 40 per cent. formaldehyde, mixed with twenty times its volume of water. The specimens, however, have to be transferred into spirits after some days, because the formaldehyde has been observed to entirely destroy black pigment in a very short time.

A. G.

THE MEMORIAL STATUE OF SIR RICHARD OWEN.

SIR RICHARD OWEN'S whale has been removed from its familiar place in the Natural History Museum, and a fine bronze statue of the great naturalist, by Mr. T. Brock, R.A., now forms the most conspicuous feature on the floor of the central hall of that institution. The first view of the statue, as it is seen from the entrance to the Museum, is not prepossessing. Visitors whose business takes them to either of the departments on the ground-floor, pass by with only an uninteresting view of a skull-cap, a vertically corrugated doctor's robe, and a pair of flaps hanging from the arms, suggestive of the rigid "primaries" of a cherub's wings. The front view of the statue, however, is far more pleasing. Owen