ON KEEPING MEDUSAE AND OTHER FREE-SWIMMING MARINE ANIMALS ALIVE IN SMALL AQUARIA.

ALTHOUGH many marine animals, more especially those which live between tide-marks, or in shallow water near the shore, can without great difficulty be kept in a healthy state in confinement, this is by no means the case with those invertebrates whose natural habit is to swim freely in the sea, and previous attempts to rear pelagic larvae to the adult stage have only rarely been attended with much success. A method of overcoming some of these difficulties, which should prove of considerable use to marine naturalists, has recently been in use at the Plymouth Laboratory, and is described by Mr. E. T. Browne in the *Journal* of the Marine Biological Association (vol. v. No. 2).

Mr. Browne arrived at the idea of the apparatus as the result of repeated attempts to keep medusae alive in confinement. It was noticed that when recently captured medusae were put into clean sea-water, though they at first swam vigorously about, they invariably became sluggish in the course of a few hours, even if the water were constantly changed, settled to the bottom and finally died. When watching medusae in the sea it was observed that they simply float along with the tide without often pulsating the umbrella. It was therefore thought that if a movement in the water of an aquarium could be obtained, which would keep the medusae constantly floating about independently of their own pulsation, better results might be obtained; and this has proved to be the case. A suitable movement of the water can be conveniently brought about by means of a glass plate made to rise and fall slowly through the water.

A motion of this kind can be arranged in many different ways, the apparatus, illustrated in Fig. 1, being the form originally designed by Mr. Browne in conjunction with the Director of the Plymouth Laboratory, which has now been continuously working for a year. The sea-water, obtained from the open sea at some distance from shore, is contained in a glass bell-jar of about 10 gallons capacity, provided with a wooden cover made in two halves. A glass plate is suspended in the water by means of a glass rod passing through a hole in its centre, the other end of the rod being attached to one end of a light wooden beam. This beam works on a hinge at the centre, and from its other end a small tin bucket is hung. The bucket is fitted with a self-emptying siphon, and is supplied with a slight stream of water by means of a rubber tube attached to the fresh-water supply. The weights of the bucket and glass plate are so adjusted that the plate moves up and down in the sea-water as the bucket alternately fills and empties. Extra weight is added when required by placing shot in a small bottle hung at one end of the beam. In this way a delicate adjustment can be made, and the plate caused to travel as slowly as is desired. The length of the stroke is regulated by two stops, and a slit in the cover of the bell-jar, through which the glass rod passes, prevents the plate from striking the sides of the jar.

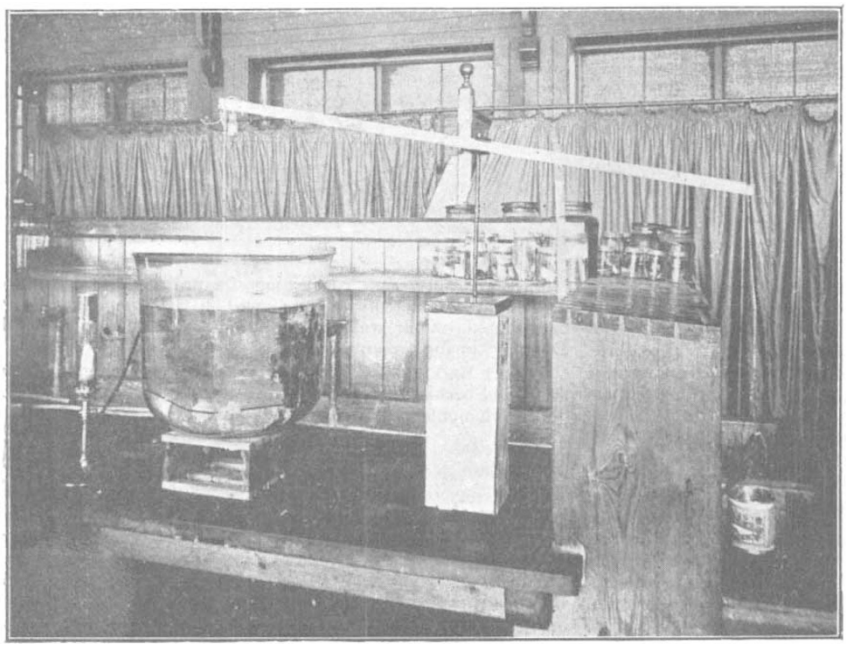

FIG. 1.—Bell-jar with glass plunger.

Arrangements have since been made in the laboratory, by which a large number of glass plates, or "plungers" as they have been named, can be worked in a similar way. A modified form of the apparatus, in which the glass plate is replaced by a glass funnel with a small hole in its top, has also been used with advantage. The funnel is fixed so that it is brought out of the water by the upward stroke of the plunger. At each downward stroke it carries with it a funnel-full of air, which escapes by way of the hole, and bubbles through the water.

Amongst the medusae which were successfully kept in the bell-jar were *Phialidium buskianum*, which grew and developed fresh tentacles, *Phialidium cymbaloideum*, which in twenty-five days added five new tentacles and five marginal bulbs, and a species of *Margelis*, which in seventeen days added two new tentacles in each of the four marginal groups, and the oral tentacles twice dichotomously divided. Two medusae of *Cladonema radiatum* were placed in the same bell-jar in the summer of 1897, and in the following spring several colonies of the hydroid of this species appeared. During the present summer (1898) these colonies have freely budded off medusae, several hundreds being seen in the bell-jar at one time.

Crustacean, annelid and molluscan larvae were put into the bell-jar from time to time (together with Copepods), as food for the medusae. Many of the larvae, which escaped capture by the medusae, continued to develop and attained the adult form. Amongst these were *Chaetopterus variopedatus* (the tube of an adult worm from an 1897 larva being about four inches long in June 1898), *Capitella capitata*, *Polynoe* sp., *Nika edulis*, *Portunus* sp., as well as small Gasteropods, Hermit-crabs, and Barnacles. Colonies of hydroids were also found to flourish well when kept in similar aquaria and plentifully supplied with Copepods, which they capture and devour in large numbers. E. J. A.

PHYSICS AT THE AMERICAN ASSOCIATION.

THE Physics Section (Section B) of the American Association was organised with Vice-President Prof. F. P. Whitman in the chair. His vice-presidential address, on colour vision, printed in the issue of *Science* for September 9, was well received, and constitutes a valuable *résumé* of the subject.

The programme of the Section included titles of fifty papers, of which forty were read. Many of these papers were of a very high order, and almost every one of them was creditable and interesting. Brief abstracts of some of them are subjoined.

"A redetermination of the ampere," undertaken, under a grant from the Association, by Prof. G. W. Patterson and Mr. Karl E. Guthe, of Ann Arbor. This work, for which an accuracy of about one part in 8000 is claimed, gives 0·0011192 grammes for the electro-chemical equivalent of silver, and reconciles almost exactly the mechanical equivalent of heat as obtained by electrical methods with Prof. Rowland's corrected

value. An electro-dynamometer of the Weber type was used for measuring current, and the torque due to the current was balanced by the torsion of a phosphor-bronze wire. This wire was standardised by studying its torsional vibrations in a vacuum when carrying a mass of known moment of inertia, and precautions were taken to eliminate the effects of elastic lag.

Experiments bearing upon the "velocity of light in a magnetic field," which were undertaken under a grant from the Association, were reported by Profs. E. V. Morby, H. T. Eddy and D. C. Miller. Their conclusion is that the velocity of light in carbon bisulphide is not altered by one part in a hundred million by a magnetic field of such an intensity as to turn the plane of polarisation through 180° in a path of 65 cm.

"A new gas" was described by Mr. Charles F. Brush. While searching for evidence of the absorption of hydrogen by glass, Mr. Brush discovered that pulverised glass gives off, when heated at a low pressure, a gas whose thermal conductivity at a pressure of a few millionths of an atmosphere is about a hundred times that of hydrogen. This gas was obtained from many other substances, and also by diffusing air through a porous porcelain plug. The kinetic theory indicates that the heat conductivity of a gas is proportional to the reciprocal of the square root of its density. Assuming this relation to hold, this new gas must have a molecular weight of only 0·0002, and a molecular velocity 100 times that of hydrogen.

"On the relative brightness of pigments by oblique vision," by Prof. F. P. Whitman. Prof. Whitman used the flicker photometer, and found that the brightness at the red end of the spectrum decreases as the vision becomes more oblique, while the opposite is true (but to a less extent) at the violet end. The brightness of yellow-green is nearly independent of the angle.

"A geometrical method for investigating diffraction by a circular aperture," by Prof. A. G. Webster. Prof. Webster plots the definite integral involved in this case, and obtains a curve similar to Cornu's spiral, but having cusps like a ratchet.

N. ERNEST DORSEY.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The one hundred and ninety-second meeting of the Oxford University Junior Scientific Club was held on Wednesday, October 26. After private business, Prof. Sollas read a paper on "Funafuti; a study of a Coral Reef." Mr. E. Gurney (New College) then read a paper on "The Birds of the Westman Islands"; in this he also touched upon the characteristic beliefs of the Icelanders, who make their living by catching the birds.

The one hundred and ninety-third meeting of the Club was held on Friday, November 4. After private business, which included the election of twenty-three new members, Dr. Gustav Mann read his paper on "The Origin of Life." Mr. E. S. Goodrich (Merton) briefly explained a model, devised by an American painter, to illustrate the theory of protective coloration in birds, after which the meeting ended. The officers for this term are :—President, Mr. F. P. Nunneley (B.N.C.); Biological Secretary, Mr. E. Gurney (New College); Chemical Secretary, Mr. H. B. Hartley (Balliol); Treasurer, Mr. W. E. Blackall; Editor, Mr. H. E. Stapleton (St. John's); Committee, Mr. F. Soddy (Merton), Mr. A. Angel (Christ Church), Rev. G. D. Allen.

CAMBRIDGE.—At St. John's College, on November 7, the following graduates of the College were elected to fellowships: R. C. Maclaurin, twelfth wrangler 1895, first division of first class Mathematical Tripos, Part II. 1896, bracketed second Smith's Prizeman 1897, Macmahon Law Student 1898; V. H. Blackman, first class Natural Sciences Tripos 1894-95, Hutchinson Research Student 1897, botanical assistant in the British Museum.

At the biennial election of eight members of the Council of the Senate held on November 7, the following were the successful candidates: The Master of Christ's and the Master of Emmanuel, as heads of Colleges; Prof. Ewing, F.R.S., and Prof. Forsyth, F.R.S., as professors; and Dr. Donald MacAlister, Mr. R. T. Wright, Mr. F. Whitting, and Mr. A. W. W. Dale as members of the Senate.

MR. THOMAS REID, of Dundee, has been appointed to the post of Head Teacher of the Engineering Department of the Birmingham Municipal Technical School.

MR. SWALE VINCENT has been elected to the Sharpey Physiological Scholarship (150*l.* per annum) at University College, London. This scholarship carries with it the post of chief assistant in the Physiological Laboratory.—Mr. D. J. Armour has been appointed to the vacant demonstratorship in Anatomy.

AT a meeting of the Council of University College, Liverpool, last week, donations to the amount of 13,000*l.* for the Medical School Building fund from the Right Hon. the Earl of Derby, Mrs. George Holt and Miss Emma Holt, Mr. R. Brocklebank, and Mr. J. Rankine were announced, and a Committee was appointed to prepare plans. The Council hope for further contributions to enable them to put the work in hand without delay.

THE Technical Instruction Committee of the County Borough of Plymouth have passed the following resolution with reference to the Secondary Education Bill introduced into the House of Commons by Colonel Lockwood in June last:—"That this Committee, while generally approving of the introduction of a Bill dealing with this most important subject, is of opinion (1) that it would be prejudicial to the best interests of higher education if secondary were separated from technical education. (2) Also that the multiplication of local authorities for educational purposes is undesirable. (3) That the funds at the disposal of Technical Education Committees are already inadequate for the purposes to which they are assigned, and that it would be impossible to devote any part of the present income to aid secondary education. (4) That the funds which Parliament at present votes for the special encouragement of science and art ought not to be diverted to cover the whole field of secondary education.

THE Calendar for the eighteenth session (1898-9) of the University College, Nottingham, has been received. The College appears to offer every inducement to students to follow systematic courses of study. Day courses of instruction are specially arranged for boys who have just left school and intend to follow the engineering profession in one of its branches. The course of instruction in architecture has been arranged in conjunction with the Nottingham Architectural Society and the School of Art; and the commercial course has been arranged in conjunction with the Nottingham Chamber of Commerce. The associate course in chemistry requires work in the College practically the whole time for three sessions. All chemistry students are strongly advised to continue their studies during a fourth year, so that they may undertake some original investigation and work at the higher branches of the subject. The courses in technical and practical physics, engineering, natural sciences, and agriculture provide for thorough work in these subjects.

IN general (says the *New York Nation*) the Prussian Government, in deciding the salary of a teacher, makes the sum depend to a great extent on the personality and reputation of the individual. A special law regulates the inequality resulting from the difference in the lecture fees received by the various professors—these lecture fees in all the German universities being an income in addition to the regular salary—by decreeing that in Berlin the full professor can receive annually only one-half of these in case they exceed the sum of 4500 marks, and in the provinces 3000; the other half being taken by the State for the benefit of other teachers not blessed with large salaries or fees. In the Würtemberg University of Tübingen, a three-class system of normal salaries is in vogue for the full professors, based on the years of service. The minimum salary is 4030 marks. The assistant professor begins with 2020. A special fund of nearly 150,000 marks is at the disposal of the Government for special salaries in special cases. In the two universities of Baden, Heidelberg and Freiburg, the average salary of the ordinarius is 6955 marks, with additional sums in special cases. The assistant professors draw salaries varying from 1820 to 5220 marks. The Imperial University at Strassburg and the Saxon at Leipzig pay good salaries, but the sums are not mentioned; while the Hessian Institution at Giessen pays its full professors 4300, and its assistants or associates 3250, with an increase until after twenty-five years of service the maximum sums of 6300 and 5250 are reached. In Rostock, the smallest of the German universities, the salaries of the full professors run from 4500 to 5850 marks; the assistant professor begins with 2400. In Jena the lowest sums are paid, the full professors receiving 300 less than is paid even at Rostock.