a depth of 250 fathoms; and in a short time the boat was seen to be carried along by it in a direction (W.N.W.) *almost exactly opposite* to that of the middle *in*-current of the Strait. The rate of outward movement of the boat was 0·400 mile per hour; but from the considerations formerly stated, it is clear that the actual rate of the under-current must have exceeded that of the boat on the surface. The "current-drag" was then lowered down to a depth of 400 fathoms; and again the boat was carried along in nearly the same direction as in the previous experiments, namely N.W. ½ N.; but more slowly, its rate of movement being 0·300 mile per hour.

Thus, then, our previous deductions were now justified by a *conclusive proof* that there was at this time a return-current in the mid-channel of this *narrowest* part of the Strait, from the Mediterranean towards the Atlantic, flowing beneath the constant surface-stream from the Atlantic into the Mediterranean; and it will be shown hereafter, by a comparison of all the results of our observations, that a strong presumption may be fairly raised for the *constant* existence of such a return-current, though its force and amount are liable to variation.

As the determination of the boundaries of this return-current, and of the amount and conditions of its variation, could

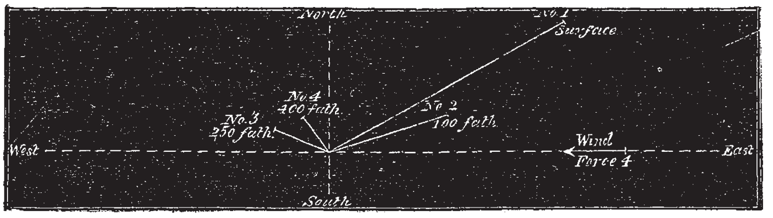

FIG. 1—Rate (per hour) and Direction of Movement of Surface-Float, and of Current-Drag at different Depths; with Force and Direction of Wind.

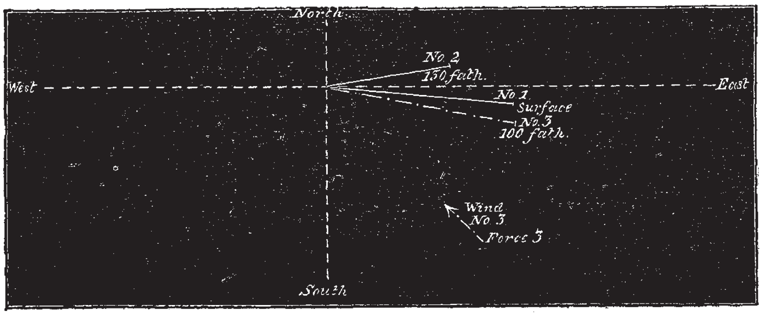

FIG. 2—Rate (per hour) and Direction of Movement of Surface-Float, and of Current-Drag at different Depths; with Force and Direction of Wind in No. 3. (No Wind in Nos. 1, 2.)

only be effected by multiplied simultaneous observations a different points, with ample license as to time, neither of whicht fell within the scope of the present expedition, we were obliged to content ourselves, as regards this locality, with what we had found ourselves able to accomplish; and at the conclusion of this day's work we proceeded westwards under easy steam, so as to be able to resume our experiments the next morning in the *shallowest* part of the Strait.

The average surface-temperature of the mid-stream during our outward passage through the Strait proved to be 66°; thus corresponding exactly with what we had found it to be on our inward passage seven weeks previously. This depression, as compared with the surface-temperature of the Strait itself nearer the shore, both north and south, and with the temperature of the Mediterranean to the eastward and that of the Atlantic to the westward, is extremely remarkable. We shall hereafter inquire how it is to be explained.

The breadth of the Channel between Capes Spartel and Trafalgar is about twenty-three nautical or twenty-six and a half statute miles. Its northern half is much shallower than the southern, the 100-fathom line off the Spanish coast running at about twelve miles' distance from Cape Trafalgar; whilst along the African coast it keeps much nearer the hore, being at only two miles' distance from Cape Spartel. Between these two lines, the greatest depth marked in the chart is 194 fathoms; and this occurs off Cape Spartel, at less than a mile from the 100-fathom line. Between this and the opposite border of the deeper channel, the depths vary from 130 to 180 fathoms; the abruptness of the differences at neighbouring points indicating a rocky bottom, of which we soon had unpleasant experience.

SCIENTIFIC SERIALS

IN the *Journal of Botany* for March we find a continuation of the useful catalogue of new species of Phanerogamous plants published in Great Britain during the year 1870, and of Mr. Hiern's paper on the forms and distribution over the world of the *Batrachian* section of *Ranunculus*. Dr. Dickie contributes a paper on the distribution of Algæ, and Mr. A. G. More the commencement of a Supplement to Bromfield's "Flora Vectensis." Short notes, reviews, and reports of Societies fill up the number.

THE *American Naturalist* for February contains several interesting papers. Among them is one on the ant-lion (*Myrmeleo immaculatus*), a Neuropterous insect, by Mr. J. H. Emerton, with drawings of its matamorphoses; one on the resources and climate of California, by Rev. A. P. Peabody; notes on some birds in the Museum of Vassar College, by Prof. Jas. Orton; a short account of the spores of Lichens, by Mr. H. Willey; the Sperm Whales, giant and pigmy, by Dr. Theodore Gill, illustrated with numerous drawings, including the skull of *Callignathus simus* and *Physetur macrocephalus*. The Natural History Miscellany comprises also several shorter papers of much interest, including one on the morphology and ancestry of the King Crab, by the editor, Dr. A. S. Packard, jun.

THE March number of the *Geological Magazine* (No. 81) commences with a long article by Mr. James Croll "On the Determination of the Mean Thickness of the Sedimentary Rocks of the Globe." The author disusses the different methods which have been adopted in order to obtain an approximate estimate of the time occupied in the fo oation of the sedimentary rocks, and remarks that in all these researches it must be borne in mind that, from the continual action of denudation, the existing sedimentary rocks only represent a fraction of the whole thickness of sediments that have been deposited. Taking the denudation of the area of the Mississippi as a guide, he estimates the wearing down of the land at one foot in 6,000 years, and the matter thus removed spread over the bottom of the ocean would produce a deposit one foot thick in 14,400 years. Taking the maximum thickness of British sedimentary strata as calculated by Prof. Ramsay, namely, 72,000 feet, to represent the mean thickness of all the sedimentary rocks which ever have been formed, the author thus gets 1,036,800,000 years as the age of the stratified rocks. Mr. Croll also notices the conditions of the deposition of the sediment carried from the land, and his remarks upon this subject are all worthy of consideration. The editor, Mr. H. Woodward, describes and figures a new Myriopod from the Scotch coal-measures, under the name of *Euphoberia Brownii*, and also some new palæozoic Phyllopod Crustacea, namely *Ceratiocaris ludensis*, a gigantic species from the Lower Ludlow of Leintwardine, *C. oretonensis* and *C. truncatus*, from the yellow carboniferous limestone of Oreton and Farlow in Worcestershire, and *Dithyrocaris Belli*, from the Middle Devonian of Gaspé. He also figures a specimen of *D. tenuistriatus*, McCoy. Mr. De Rance communicates a paper on the occurrence of two distinct glaciations in the Lake District; Mr. John Aitken notices some curious faults occurring in drift at Stockport in Cheshire; and Mr. S. C. Perceval describes the occurrence of Websterite at Brighton.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, March 16.—"Description of *Ceratodus*, a genus of Ganoid Fishes recently discovered in rivers of Queensland, Australia." By Dr. Albert Günther, F.R.S. We shall return to this communication.—"On the Formation of some of the Subaxial Arches in Man." By George W. Callender.

Geological Society, March 8.—Mr. Joseph Prestwich, F.R.S., president, in the chair. Lieut. Lewis de Teissier Prevost and Mr. John Haines were elected Fellows of the Society; and Dr. C. Nilsson, was elected a foreign member of the Society. The following communication was read:—(1) "On the Red Rocks of England of older date than the Trias," by Prof. A. C. Ramsay, LL.D., F.R.S., V.P.G.S. The author stated that the red colour of the Triassic beds is due to peroxide of iron, which encrusts the sedimentary grains as a thin pellicle. This could not have been deposited in an open sea, but rather in an inland salt lake or lakes. The peroxide of iron, which stains the Permian, Old Red Sandstone and Cambrian rocks, is believed by the author to have been deposited in the same manner, in inland waters, salt or fresh. Agreeing with Mr. Godwin-Austen, the Old Red Sandstone was of Lacustrine origin. The absence of marine shells helps to this conclusion. The fish do not contradict it, for some of their nearest living congeners live in African and American rivers. The life of the Upper Silurian deposits of Wales and the adjoining districts continued in full force up to the passage-beds, which mark the change from Silurian to Old Red Sandstone. In these transition strata, genera, species, and individuals are often few, and dwarfed in form. Near Ludlow and May Hill the uppermost Silurian strata contain seeds and fragments of land plants, indicating the neighbourhood of land, and the poverty of numbers and the small size of the shells a change in the condition of the waters. The fish of the Old Red Sandstone also indicate a change of condition of a geographical kind. The circumstances which mark the passage of Silurian into Old Red Sandstone were as follows:—First, shallowing of the sea, so that the area changed into fresh and brackish lagoons, afterwards converted into great freshwater lakes. At the present day marine species are occasionally found living in fresh water, as for example in the Swedish lakes. The same may have been the case in the Old Red Sandstone period. The Old Red Sandstone waters at their beginning are comparable to the Black Sea, now steadily freshening; or the Caspian, once united to the North Sea, if by a change of amount of rainfall and evaporation it freshened by degrees, and finally became a freshwater lake. The Permian strata, to a great extent, consist of red sandstones and marls in the greater part of England; and the Magnesian Limestone of the north of England is also in less degree associated with red marls. These do not occur in the same districts of England, excepting in Lancashire, where a few beds of Magnesian Limestone are interstratified with the marls. The sandstones and marls being red, the colouring matter is considered to be due to peroxide of iron, possibly precipitated from carbonate of iron, introduced in solution into the waters. Land plants are found in some of the Permian beds, showing the neighbourhood of land. No mollusca are found in most of the red beds, except a brachiopod in Warwickshire, and a few other genera in Lancashire, in marls associated with thin bands of Magnesian Limestone. The traces of amphibians are like those found in the Keuper Sandstone, viz., *Dasyceps Bucklandi* and labyrinthodont footprints in the Vale of Eden and at Corncockle Moor, printed on damp surfaces, dried in the sun, and afterwards flooded in a way common in salt lakes. Pseudomorphus crystals of salt and gypsum help to this conclusion. The molluscous fauna of Lancashire, small in number, in this respect resembles the fauna of the Caspian Sea. The fauna of the Magnesian Limestone of the east of England is more numerous, comprising thirty-five genera and seventy-six species, but wonderfully restricted when compared with the Carboniferous fauna. The specimens are generally dwarfed in aspect, and in their poverty may be compared to the Caspian fauna of the present day. Some of the fish of the Marl-Slate have strong affinities to carboniferous genera, which may be supposed to have lived in shallow lagoons, bordered by peaty flats; and the reptiles lately described by Messrs. Howse and Hancock have terrestrial affinities. Besides the poorness of the Mollusca, the Magnesian Limestone seems to afford other hints that it was deposited in an inland salt lake subject to evaporation. Gypsum is common in the interstratified marls. In the open sea limestone is only formed by organic agency, for lime, in solution, only exists in small quantities in such a bulk of water; but in the inland salt lakes carbonates of lime and magnesia might have been deposited simultaneously by concentration of solutions due to evaporation. Some of the Magnesian Limestone strata have almost a tufaceous or stalagmitic aspect, as if deposited from solution. The Cambrian strata also show some evidence of not being true marine deposits. They are purple and red, like the other strata previously spoken of; and the surfaces of the beds sometimes exhibit sun-cracks and rain-pittings. The trilobite *Palæopyge Ramsayi* is considered by the author to be an accidental marking, simulating the form of a trilobite; and the fossils of St. David's are found in grey beds, which may mark occasional influxes of the sea, due to oscillations of level. The foregoing reasonings, in the author's opinion, lead to the conclusion that a continental area existed more or less in the northern hemisphere from the close of the Silurian to the end of the Triassic epoch, and that this geographical continuity of land implies probable continuity of continental genera. There is therefore no palæontological reason why the *Hyperodapedon*, *Telerpeton*, and *Stagonolepis* of the Elgin country should be considered of Triassic age, especially as the beds in which they occur are stratigraphically inseparable from the Old Red Sandstone. Finally, terrestrial and marine European epochs were rapidly reviewed. 1. The Cambrian epoch was probably fresh water. 2. The Old Red Sandstone, Carboniferous, Permian, and Trias were formed during one long continental epoch. This was brought to an end by partial submergence during the Jurassic epoch; and by degrees a new continental area arose, drained by the great continental rivers of the Purbeck and Wealden series, as shown in various parts of Europe. 3. This continent was almost entirely swallowed up in the Upper Cretaceous seas. 4. By subsequent elevation the Eocene lands were formed, and with this continent there came in a new terrestrial fauna. Most of the northern half of Europe since then has been continental, and its terrestrial fauna essentially of modern type. If according to ordinary methods we were to classify the old terrestrial faunas of North America, Europe, Asia, and probably of Africa, a Palæozoic epoch would extend from Old Red Sandstone to Wealden times, and a Neozoic epoch at least from the Eocene period to the present day. The Upper Cretaceous strata would at present remain unclassified. The marine epoch would also temporarily be divided into two, Palæozoic from Laurentian to the close of the Permian times, and all besides down to the present day, would form a Neozoic series. The generic gaps between the two begin already to be filled up. The terrestrial and the marine series at their edges at present overlap each other. The great life-gaps between the two terrestrial periods may some day be filled up by the discovery of the traces of old continents containing intermediate developments of structure as yet undiscovered. Prof. Huxley was pleased to find that