

(aus ein rosenroth gefarbten punkt), and carbonic acid (aus dem Harnorganen) will be long remembered, and even at the present day the satire has not lost its applicability. Then again in a letter purporting to be written from Paris and signed S. C. H. Windler, though doubtless written by Liebig, he laughs to scorn the idea that the theory of substitution, which he himself upheld, could be so far extended as was by some chemists believed possible. In this letter he states, as the last great discovery of the French capital, that it had been found possible to replace in acetate of manganese, first the atoms of hydrogen by chlorine, then the atoms of oxygen, then those of manganese, and lastly that even the atoms of carbon had been replaced by this gas. So that a body was in the end obtained, which, although it contained nothing but chlorine, still possessed the essential properties of the original acetate of manganese. He adds in a note: "Je viens d'apprendre qu'il y a déjà dans les magasins à Londres des étoffes en chlor filé, très recherchés, dans les hôpitaux, et préférés à tout autres pour bonnets de nuits, caleçons, etc.!"

Those who wish to read an unsparing critique, may turn to Liebig's remarks on Gerhardt (1846), to those on Mulder as regards his protein theory, or again on Gruber and Sprengel respecting a review of his own book on Organic Chemistry (1841). It was not in Liebig's nature to spare either private persons or Governments when he thought that science would be advanced by plain speaking. In his two papers on "Der Zustand der Chemie in Oestreich" (1838), and in "Preussen" (1840), whilst he points out the shortcomings of both countries, bravely asserts, in the strongest terms, the dependence of national prosperity upon original research, a subject concerning which in England, *most people, thirty years later (to our shame be it said) are altogether in the dark!*

Other and wider questions, to the solution of which Liebig in later life turned his energies, were those respecting the establishment of a Scientific Agriculture, and the foundation of a new science of Physiological Chemistry. It is in this direction that his labours are best known to the general public in England; and there is no doubt, although in many details his views have since proved erroneous, that he was correct in the main issues, and that the stimulus given to British agriculture through Liebig's writing and investigations, has been of the most important kind. Agriculturists have thus been made aware that a scientific basis for their practice exists which, if not as yet complete, can still explain much in their art of what had previously depended on mere empiricism. Then, again, the interest and attention which were thus brought to bear on these subjects, has led to the establishment of Agricultural Colleges and "Versuchs-Stationen," and to the carrying out of researches like those magnificent ones of Lawes and Gilbert, from which we are receiving information concerning the various questions relating to plant life such as long-continued investigation and observation alone can yield.

In the year 1852, having lectured for sixty semesters in Giessen, he left the university to which he had given a world-wide fame, to become the centre of a galaxy of men of science whom Maximilian II. of Bavaria had called to Munich. There, having built himself a good laboratory and a spacious house adjoining, he spent the remainder of his days in quiet labour and well-earned and honoured repose. The active period of his life having passed, he entirely withdrew from discussions on purely theoretical questions, and occupied himself with investigations chiefly of a practical character, such as those on the extract of meat, and on infants' food. He continued to re-edit his various books, indulging occasionally in his old habit of a sharp hit at the views of some scientific brother. His last investigation and critical discussion of the labours of other chemists was published in 1870, "On Fermentation and the Origin of Muscular Force." In this he strenuously

upholds his old theory of fermentation against Pasteur's explanation of the phenomena, and his views and arguments are as forcibly and clearly expressed as we find them in his early publications. The last of his hundreds of communications to the *Annalen* is a notice on the discovery of chloroform, published in March of last year, in which he calls attention to the fact that the discovery of this important substance is due to himself in 1831, and not to Soubeiran, as is generally supposed, although Liebig overlooked the small quantity of hydrogen (0.8 per cent.) which chloroform contains, and termed it a chloride of carbon.

As an author, Liebig is remarkable for the lucidity and grace of his style. The best examples of this are to be found in his "Familiar Letters on Chemistry." His mode of popular treatment of a somewhat obscure subject is seen in the well-known chapter (xxiv.) in his "Familiar Letters," on "Spontaneous Combustion of the Human Body." He there goes step by step through all the better authenticated cases, shows the want of sufficient evidence in each case, points out the fallacies of the theories proposed to explain them, and concludes with proving, by the application of known physical and chemical laws, that the supposed phenomena cannot possibly occur.

Looking once more back upon the labours of Liebig, we again come to the conclusion that the chief and characteristic glory of his life is the impulse which he gave to the study of our science and the personal influence which he exerted among his numerous and distinguished pupils.

The present short and imperfect sketch of the scientific bearings of a great life is not one in which personal qualities can be discussed; suffice it to say that though Liebig was an awkward adversary, he was a faithful friend, and always ready and anxious to assist deserving merit.

H. E. ROSCOE

NOTES FROM THE "CHALLENGER"

WE left Santa Cruz on the evening of Friday, the 14th of February. The weather was bright and pleasant with a light breeze—force equal to about 5—from the north-east. Our course during the night lay nearly westward, and on the morning of the 17th we sounded, about 75 miles from Teneriffe, and 2,620 miles from Sombrero Island, the nearest point in the Virgin group, in 1,891 fathoms, with a bottom of grey globigerina ooze, mixed with a little volcanic detritus. The average of two Miller-Casella thermometers gave a bottom temperature of 2° C.

The slip water-bottle which was used by Dr. Meyer and Dr. Jacobsen in the German North-Sea Expedition of last summer was sent down to the bottom, and Mr. Buchanan determined the specific gravity of the bottom water to be 1.02584 at a temperature of 17° 9 C., the specific gravity of surface water being 1.02648 at a temperature of 18° 5 C.

All Sunday, the 16th, we spent sailing with a light air from the northward, and by Monday morning we had made about 130 miles from our previous sounding. The dredge was put over at 5.15 A.M. with 2,700 fathoms rope, and a weight of 2 cwt. 300 fathoms before the dredge.

After steaming up to the dredge once or twice, hauling-in was commenced at 1.30 P.M., and the dredge came up at 3.30 half full of compact yellowish ooze. The ooze was carefully sifted, but nothing was found in it with the exception of foraminifera, some otolites of fishes, some dead shells of pteropods, and one mutilated specimen of what appears to be a new Gephyrean. This animal has been examined by Dr. von Willems-Suhm, who finds that it shows a combination of the character of the Sipunculacea and the Priapulacea. As in the former group, the excretory orifice is near the mouth, in the anterior part of

the body, while, as in the latter, there is no proboscis and there are no tentacles. The pharynx is very short, and is attached to the walls of the body by four retractor muscles. The pharynx shows six to seven folds ending in a chitinous border. The mouth is a round aperture, beset with small cuticular papillæ. The perisom is divided into four muscular bands, the surface large, showing a tissue of square meshes, in each of which there are four to five sense-bodies. For the reception of this singular species Dr. von Willemoes-Suhm proposes to establish the genus *Leioderma*, which will represent a family intermediate between the Sipunculids and the Priapulids.

On the 18th we sounded at 9 A.M. in 1,525 fathoms, lat. 25° 45' N., long. 20° 12' W., 160 miles S.W. of the Island of Ferro, and 50 miles to the west of the station of the day before, in 1,525 fathoms. The "Hydra" tube brought up no bottom, and we sounded again with a depth of 1,520 fathoms, and again no bottom. It thus seemed that we had got upon hard ground, and as the sounding of the following day gave 2,220 at a distance of only 19 miles, we had evidently struck the top of a steep rise. The dredge was lowered at 10 A.M. with 2,220 fathoms of line and 2 cwt. leads 300 fathoms before the dredge. At 5.30 P.M. the dredge was hauled up, and contained a few small pieces of stone resembling the volcanic rocks of the Canary Islands, and some large bases of attachment and some branches of the calcareous axis of an Alcyonarian polyp allied to *Corallium*. Some of the larger stumps were nearly an inch in diameter; the central portion very compact, and of a pure white colour: the surface longitudinally grooved, and of a glossy black. The pieces of the base of the coral which had been torn off by the dredge were in one or two cases several inches across and upwards of an inch thick, forming a thick crust from which the branches of the coral sprang. The crust was of a glossy black on the surface, showing a fine regular granulation, and a fracture through the crust was of a uniform dark brown colour and semi-crystallised. The whole of the coral was dead, and appeared to have been so for a long time. It was so fresh in its texture, however, that it was scarcely possible to suppose that it was sub-fossil, although from the comparatively great depth at which it was found, and the many evidences of volcanic action over the whole of this region, one could scarcely avoid speculating whether it might not have lived at a higher level and been carried into its present position by a subsidence of the sea-bottom. I hope we may have an opportunity of determining this question in returning over the same ground later in the season.

Attached to the branches of the coral there were several specimens of a magnificent sponge belonging to the Hexactinellidæ. One specimen, consisting of two individuals united together by their bases, is about 60 centimetres across, and has very much the appearance of the large example of the tinder-fungus attached to the trunk of a tree (Fig. 1). Both surfaces of the sponge are covered with a delicate network of square meshes closely resembling that of *Hyalonema*, and formed by spicules of almost the same patterns. The sponge is bordered by a fringe of fine spicules, and from the base a large brush of strong, glassy, anchoring spicules project, fixing it to its place of attachment. The form of the barbed end of the anchoring spicules is as yet unique among sponges. Two wide, compressed flukes form an anchor very much like that of one of the skin-spicules of *Synapta*. The sponge when brought up was of a delicate cream colour. It was necessary to steep it in fresh water to free it from salt, and the colour changed to a leaden grey. A number of small examples of the sponge, some of them not much beyond the condition of gemmules, were found attached to the larger specimens and to branches of the coral, so that we have an opportunity of studying the earlier stages of its development.

For this sponge, which forms the type of a new genus, I propose the name *Poliopogon*¹ *amadou*.

Attached to the sponge were two examples of a fine Annelid which Dr. v. Willemoes-Suhm refers to the family Amphinomideæ, sub-family Euphrosyninæ, with many of the characters of the genus *Euphrosyne*. The body is 12 mm. long and 5 mm. broad, and consists of fifteen segments. The surface of the head is covered with a caruncle extending over the anterior segments, and the whole surface is clothed with milk-white two-branched setæ, which radiate over each segment like a fan.

On the following day a series of temperatures were taken from the surface to 1,500 fathoms at intervals of 100 fathoms.

Depth.	Temp.	Depth.	Temp.
Surface	19° 5 C.	800 fathoms	5° 6 C.
100 fathoms	17° 2	900 "	4° 7
200 "	13° 7	1000 "	4° 6
300 "	11° 0	1100 "	3° 8
400 "	9° 5	1200 "	3° 5
500 "	7° 6	1300 "	3° 1
600 "	6° 5	1400 "	2° 8
700 "	6° 2	1500 "	2° 6

The dredge was not used, but, as is our custom whenever the rate of the ship is such as to make it practicable, a large towing-net was put out astern.

In hot, calm weather the towing-net is usually unsuccessful. It seems that the greater number of pelagic forms retire during the heat of the day to the depths of a few fathoms, and come up in the cool of the evening and in the morning, and in some cases in the night. The larger phosphorescent animals are frequently abundant during the night round the ship and in its wake, while none are taken in the net during the day. Mr. Moseley has been specially engaged in working up the developmental stages of *Pyrosoma*, and the intricate structure of the tissues and organs of some of the surface groups, whose extreme transparency renders them particularly suitable for such researches.

Feb. 21.—Up to 2.15 P.M. sailing under all plain sail at the rate of six knots an hour before the N.E. trades, force 3 to 4.

The dredge was put over at 5 P.M. with 3,400 fathoms of line, and was kept down till one o'clock A.M. on the following morning, the ship drifting slowly. Our position at noon on the 21st was about 500 miles S.W. of Teneriffe, lat. 24° 22' N., long. 24° 11' W., Sombbrero Island S. 58° W. 2,220 miles. Work began early on the 22nd, and the dredge, which had begun its ascent at 1.15 A.M., came up at 5.45 half full of a yellowish ooze, which was not so tenacious as usual, and on the whole singularly poor in higher living things. A careful and laborious sifting of the whole mass gave us three small living mollusca, referred to the genera *Arca*, *Limopsis*, and *Leda*; and two Bryozoa apparently undescribed. Foraminifera were abundant, many examples of miliolines being of unusually large size. Some beautiful radiolarians were sifted out of the mud. These may have been taken into the dredge on its way up, or more probably they may have lived on the surface or in intermediate water and have sunk to the bottom after death, since they consist of continuous fenestrated shells of silica.

On Tuesday the 25th a small dredge was lowered at 6.30 A.M. with 3,500 fathoms of line (2,500 fathoms of 2½ in. rope and 1,000 of 2-in.), and 2 cwt. leads attached 300 fathoms in advance. At 7.30 we sounded in 2,800 fathoms, with a bottom of the same reddish ooze, and a temperature of 2° C. A series of temperatures were taken at intervals of 100 fathoms down to 1,000, the result agreeing closely with those of the previous series. At 5.15 P.M. the dredge came up clean and empty. It had either never reached the bottom, owing to some local current or the drift of the ship, or else everything had

¹ Πολιός, white, and πώγων, a beard.

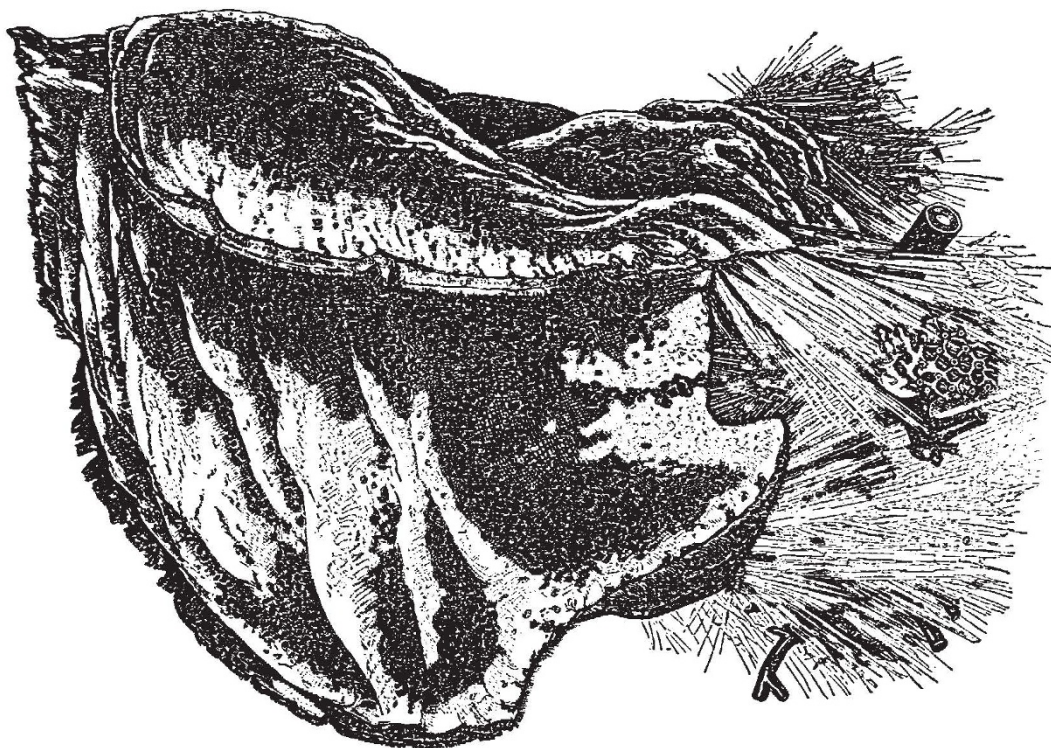
been completely washed out of it on its way to the surface. The bottom water gave a specific gravity of 1.02504 at 19°6 C., that of the surface being 1.02617 at 21°3 C. While sounding, the current-drag was tried, and indicated a slight north-westerly current.

As the attempt to dredge on the previous day had been unsuccessful, it was determined to repeat the operation with every possible precaution on the 26th. The morning was bright and clear, and the swell, which had been rather heavy the day before, had gone down considerably. A sounding was taken about 10 o'clock A.M. with the "Hydra" machine and 4 cwt. The sounding was thoroughly satisfactory, a sudden change of rate in the running out of the line indicating in the most marked way when the weight had reached the bottom. During the sounding a current-drag was put down to the depth of 200 fathoms, and it was then ascertained, that, by means of management and by meeting the current by an occasional turn of the screw, the ship scarcely moved from

her position during the whole time the lead was running out. The depth was 3,150 fathoms; the bottom a perfectly smooth red clay, containing scarcely a trace of organic matter—merely a few coccoliths, and one or two minute granular masses. The thermometer indicated a bottom temperature of 1°9 C.

The small dredge was sent down at 2.15 P.M. with two hempen tangles; and, in order to ensure its reaching the bottom, attached to the iron bar below the dredge which is used for suspending the tangles, a "Hydra" instrument with detaching weight of 3 cwt. Two additional weights of 1 cwt. each were fixed to the rope 200 fathoms before the dredge. 3,600 fathoms of rope were payed out—1,000 fathoms 2 in. in circumference, and the remainder (2,600 fathoms) 2½ in. The dredge came up at 10.15 P.M. with about 1 cwt. of red clay.

This haul interested us greatly. It was the deepest by several hundred fathoms which had ever been taken, and, at all events coincidentally with this great increase in



Base
FIG. 1.—POLYPOCON AMADOU WY. T.

depth, totally different from what we had been in the habit of meeting with in the depths of the Atlantic. For a few soundings part of the ooze had been assuming a darker tint, and showed on analysis a continually lessening amount of calcareous matter, and, under the microscope, a smaller number of foraminifera. Now calcareous shells of foraminifera were entirely wanting, and the only organisms which could be detected after washing over and sifting the whole of the mud with the greatest care, were three or four foraminifera of the Cristellarian series, with their tests made up of particles of the same red mud. The shells and spines of surface animals were entirely wanting; and this is the more remarkable as the clay-mud was excessively fine, remaining for days suspended in the water, looking in colour and consistence exactly like chocolate, indicating therefore an almost total absence of movement in the water where it is being deposited. When at length it settles, it forms a perfectly smooth red-brown paste, without the least feeling of grittiness between the fingers, as if it had been levigated with extreme care

for a process in some refined art. On analysis it is almost pure clay, a silicate of alumina and the sesquioxide of iron, with a small quantity of manganese.

It is of course a most interesting question whether the peculiar nature of this deposit is connected in any way with the extreme depth. I am certainly inclined at present to believe that it is not. The depth at Station 5 was 2,740 fathoms, and on that occasion foraminifera were abundant; and several bivalve mollusca were taken living. I cannot believe there can be any difference between a depth of 2,740 fathoms and one of 3,150 so essential as to arrest the life of the organisms to the secretions of whose tests the grey Atlantic ooze is due. I am rather inclined in the meantime to attribute this peculiar deposit to the movement of water from some special locality—very possibly the mouths of the great South American rivers—the movement possibly directed in some measure by the form of the bottom. This, however, is a question for the solution of which we may hope to procure sufficient data.

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