garding the mean distances, mean paths, &c., of molecules on rarefying gases. For the relations computed depend on known mathematical principles. The only possible ground for question would be the particular data of mean distance, &c., taken as a basis for the calculations. But it should be noticed that these rest on an experimental basis : having been deduced from observed facts by investigators of admitted competence, and by means of several *diverse* lines of argument which are found to accord in a remarkable manner as to the results,—which is therefore strong confirming evidence of their substantial accuracy. Also the above inferences regarding a mechanism for the fundamental purposes of carrying energy, storing energy in equilibrium, and producing effects of approach (such as gravity, &c.), cannot as mechanical facts admit of any question. For mechanical principles (like mathematical truths) hold independently of any inquiry as to whether they actually find practical *application* in nature or not. The best argument for their practical application in nature is the incomprehensibility of observed facts without them. We can at least say with certainty that under such conditions, effects (phenomena of approach,[1] transferences of motion, &c.) of the character observed would be produced,—and which effects have not hitherto found any explanation that appeals to our reason. The certainty of simple and automatic mechanical conditions being conceivable which are capable of producing such important effects, should lend a legitimate interest to these inquiries, and the mechanical beauty of the "radiant" adjustment of moving particles of matter which adapts them to so many noteworthy purposes at once, should surely itself be an argument in favour of the practical application of the scheme in nature,—as a simple means to great and important ends.

S. Tolver Preston

DEEP-SEA OPHIURANS

In the anniversary *Memoirs* of the Boston Society of Natural History, Prof. Theodore Lyman gives an account of a structural feature hitherto unknown among Echinodermata which he has discovered in deep-sea Ophiurans. The remarkable structures described appear under the microscope as little tufts resembling bunches of simple Hydroids on the sides of the arms of certain Ophiurans. On careful examination these tufts are found to be bunches of minute spines, each inclosed in a thick skin-bag, and in form resembling agarics, or parasols with small shades. They are arranged in two or even three parallel vertical rows, and in this respect the animals on which they occur differ from all other Ophiuridæ known, for all others possess a single row only of articulated spines. The peculiar tufts, which are apparently homologous with pedicellariæ, are attached to the outer joints of the arms, near the margins of the side arm-plates. Two new genera, Ophiotholia and Ophiohelus, closely allied to Ophiomyces, are described in which these curious appendages occur. The species of the genera are soft with imperfect calcification. Examples of Ophiotholia were dredged off Juan Fernandez, in 1825 fathoms, and of Ophiohelus off Barbadoes in 82 fathoms, and off Fiji in 1350 fathoms.

Prof. Lyman states that among the Ophiuridæ and Astrophytidæ of the *Challenger* Expedition the entire number of new genera brought home is 20; that of species 167.

[1] It would not be difficult substantially to imitate what occurs in gravitation (according to the dynamical theory), by cooling down the opposed faces of two metal disks freely suspended in a moderately large vessel of rarefied gas, at a less distance apart than the mean length of path of the gaseous particles,—when from known principles (already experimented on by Mr. Crookes) the two disks would approach. Here the diminished velocity of rebound of the gaseous particles from the cooled inner surfaces of the disks (which entails the approach), is imitated in gravitation by a similar diminished velocity of rebound of the gravific particles from gross matter, owing to their translatory motion being partly shivered into vibration (and rotation) at the shock of impact against gross matter (in a manner elucidated by Sir W. Thomson, *Phil. Mag.*, May, 1873). On a large scale, a similar diminution of translatory motion at impact is universally illustrated by the known retarded rebound of elastic masses at collision,—when part of the translatory motion is (in a somewhat analogous way) converted into a vibratory or rotatory motion of the colliding body at the encounter. It becomes interesting in a dynamical phenomenon of the nature of graviration to contemplate the possibility of doing something toward's illustrating it experimentally, and to acquire the certainty of the existence of the streams of particles which produce the effect,—by almost visualising them, through the means employed in the recent researches by Mr. Crookes.

AN ELECTRICAL THERMOMETER FOR DETERMINING TEMPERATURES AT A DISTANCE

The success of many industrial operations depends upon the steady maintenance or proper variation of certain temperatures, and it is often of the highest importance that the person in charge of these operations should be able readily to ascertain by means of the thermometer if the workmen are performing their duties correctly. It sometimes happens that thermometers have to be placed in positions which are difficult of access, or removed some distance from the centre of the manufactory, and that considerable time has to be expended in visiting the different stations. It was in order to meet the requirements of such a case as this that the electro-thermometric apparatus here described was constructed.

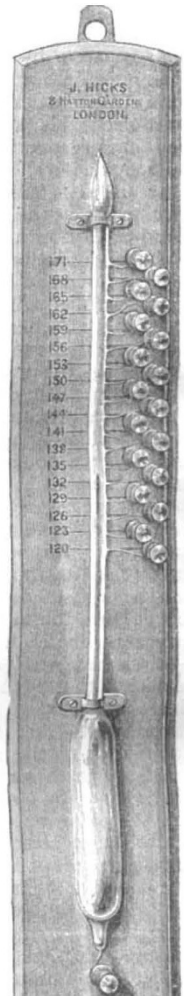

Fig. 1.

I had for some time been much in need of an instrument which would admit of the temperature of a series of malt-drying kilns being determined at a considerable distance from the kilns themselves, and, not being able to meet with a description of a suitable instrument, I was led, after several trials, to contrive this apparatus, which, although it does not embody any new principle, and is not perhaps adapted to accurate meteorological work, is nevertheless very suitable for the technical purpose for which it was originally designed, and is doubtless capable of extended application in many industries.

The apparatus consists essentially of two parts, a mercurial electro-thermometer, and a combination of apparatus which constitutes an automatic receiver and transmitter of signals from the thermometer.

The thermometer, which is shown in Fig. 1, was constructed for me by Mr. J. Hicks of Hatton Garden. It is an ordinary thermometer about nine inches in height, with a large bulb and a stem of wide bore. Through the side of the stem, and fused into the glass, are inserted a series of short platinum wires, the free end of each being connected with a binding screw. These wires, which project slightly into the bore of the thermometer, are, in my instrument, inserted at intervals of 3° F. between 120° and 171°, the range of temperature required in this case. The constructor of this part of the apparatus informs me that, if necessary, there is no practical difficulty in inserting wires at intervals of a single degree, or even less, without interfering with the calibration of the tube. The upper part of the bore of the tube is expanded