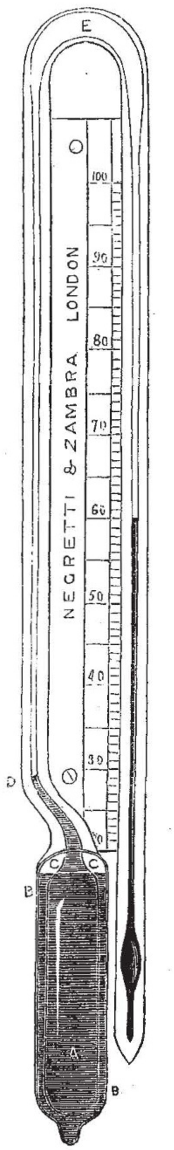
A NEW THERMOMETER

OUR readers will doubtless recollect a recent discussion in our pages relative to the priority of the invention of protected bulbs for deep-sea thermometers. The discussion has done something more than establish priority of invention, it has been the means of producing what, we believe, will prove to be a new and valuable meteorological instrument, for we have before us a paper by Messrs. Negretti and Zambra, communicated to the Royal Society by Dr. Carpenter at their last meeting, describing a new thermometer of such novel construction that it cannot fail to interest all scientific persons, meteorologists especially. We regret our inability, owing to want of space, to reproduce the paper in its entirety. The following are the main points of this communication.

In Prof. Wyville Thomson's "Depths of the Sea," p. 299, occurs the following passage :—"I ought to mention that in taking the bottom temperature with the Six's thermometer the instrument simply indicates the lowest temperature to which it has been subjected; so that if the bottom water were warmer than any other stratum through which the thermometer had passed, the observations would be erroneous."

Undoubtedly no other result could be obtained with the thermometers now in use, for unfortunately the only thermometer available for the purpose of registering temperature and bringing those indications to the surface, is that which is commonly known as the Six's thermometer—an instrument acting by means of alcohol and mercury, and having movable indices with delicate springs of human hair tied to them. This form of instrument registers both maximum and minimum temperatures, and as an ordinary out-door thermometer it is very useful; but it is unsatisfactory for scientific purposes, and for the object for which it is now used (viz. the determination of deep-sea temperatures) it leaves much to be desired. Thus the alcohol and mercury are liable to get mixed in travelling, or even by merely holding the instrument in a horizontal position ; the indices also are liable either to slip if too free, or to stick if too tight. A sudden jerk or concussion will also cause the instrument to give erroneous readings by lowering the indices if the blow be downwards, or by raising them if the blow be upwards. It was on reading the passage in the book above referred to that it became a matter of serious consideration with Messrs. Negretti and Zambra, whether a thermometer could be constructed which could not possibly be put out of order in travelling, or by incautious handling, and which should be above suspicion and perfectly trustworthy in its indications. This was no very easy task. But the instrument submitted to the Fellows of the Royal Society seems to fulfil the above onerous conditions, being constructed on a plan different from that of any other self-registering thermometer ; and containing, as it does, nothing but mercury, neither alcohol, air, nor indices. Its construction is most novel, and may be said to overthrow our previous ideas of handling delicate instruments, inasmuch as its indications are only given by upsetting the instrument. Having said this much, it will not be very difficult to guess the action of the thermometer ; for it is by upsetting or throwing out the mercury from the indicating column into a reservoir at a particular moment and in a particular spot, that we obtain a correct reading of the temperature at that moment and in that spot.

The thermometer in shape is like a syphon with parallel legs, all in one piece, and having a continuous communication, as in the annexed figure. The scale of the thermometer is pivoted on a centre, and being attached in a perpendicular position to a simple apparatus (which will be presently described), is lowered to any depth that may be desired. In its descent the thermometer acts as an ordinary instrument, the mercury rising or falling according to the temperature of the stratum through which it passes; but so soon as the descent ceases, and a reverse motion is given to the line, so as to pull the thermometer to the surface, the instrument turns once on its centre, first bulb uppermost, and afterwards bulb downwards. This causes the mercury, which was in the left-hand column, first to pass into the dilated siphon bend at the top, and thence into the right-hand tube, where it remains, indicating on a graduated scale the exact temperature at the time it was turned over. The woodcut shows the position of the mercury *after* the instrument has been thus turned on its centre. A is the bulb ; B the outer coating or protecting cylinder ; C is the space of rarefied air, which is reduced if the outer casing be compressed ; D is a small glass plug on the principle of Negretti and Zambra's Patent Maximum Thermometer, which cuts off, in the moment of turning, the mercury in the column from that of the bulb in the tube, thereby ensuring that none but the mercury in the tube can be transferred into the indicating column ; E is an enlargement made in the bend so as to enable the mercury to pass quickly from one tube to another in revolving ; and F is the indicating tube, or thermometer proper. In its action, as soon as the thermometer is put in motion, and immediately the tube has acquired a slightly oblique position, the mercury breaks off at the point D, runs into the curved and enlarged portion E, and eventually falls into the tube F, when this tube resumes its original perpendicular position.



The contrivance for turning the thermometer over may be described as a short length of wood or metal having attached to it a small rudder or fan ; this fan is placed on a pivot in connection with a second ; on the centre of this is fixed the thermometer. The fan or rudder points upwards in its descent through the water, and necessarily reverses its position in ascending. This simple motion or half turn of the rudder gives a whole turn to the thermometer, and has been found very effective.

Various other methods may be used for turning the thermometer, such as a simple pulley with a weight which might be released on touching the bottom, or a small vertical propeller which would revolve in passing through the water.

Messrs. Negretti and Zambra in their paper merely mention the new thermometer as being available for deep-sea temperatures ; but we believe it will prove to be of great value on land ; for with this thermometer we are at once provided with the means of making observations which will solve some of the most interesting questions connected with atmospheric temperature. At present we do not possess a *simple* instrument, in fact none at all which will automatically record *out of doors* the exact temperature at fixed periods ; we read of the temperature being so many degrees of heat or cold yesterday or last night, but we have no means of recording how cold it was (say) at midnight, or how warm at midday, except by actually watching the instrument at those hours. With the new thermometer in connection with an inexpensive time-piece, we can ascertain and record the exact temperature at any hour it may be deemed desirable, and by its means, and with experiments carried over some period of time, we may be able to determine with a degree of accuracy hitherto only approximately arrived at, which are the coldest or warmest periods of the days or nights.

ON SOME RECENT ASTRONOMICAL SPECULATIONS IN THEIR RELATION TO GEOLOGY*

I HAVE called my subject *speculations*, because in the present state of the inquiry there are so many questions that can be looked upon in no other light. At the same time it appears to me very desirable that certain facts should be examined from this new point of view, if only to lead to researches which otherwise would not have claimed attention. What I then propose is to consider the bearing on certain geological questions of the new views of Mr. Lockyer respecting the constitution of matter, as indicated by a comparison of the spectra of the various classes of stars, and the probable effects of a change in the constitution of our sun.†

Sir W. Thomson has contended that the sun cannot have continued to give out heat and light for so long a period as has been assumed by many geologists, and has concluded that it was "on the whole most probable that it has not illuminated the earth for 100 millions of years, and almost certain that it has not done so for 500 millions."‡ Prof. Huxley made this question the subject of his address to the Geological Society in 1869, but the argument on both sides was on the supposition that the constitution of matter is such that from the earliest epoch the heat and light given off had been derived mainly, if not entirely, from the simple cooling of a heated body. If, however, Mr. Lockyer's views be true, the sun at the earliest period must have consisted of matter in a more dissociated condition than at present, and, as he points out, in combining so as to give rise to other so-called elementary substances, probably a large extra amount of heat and light would be set free. The result of this appears to me to be that when the general temperature was that at which such a dissociation occurs, the sun's energy would continue nearly the same for a period which in the present state of our knowledge cannot be determined, but which would probably be of vast duration; and not only so, but the cooling would be more uniform from the first, and not subject to so great a variation as would occur in the case of an intensely-heated body cooling without any physical change in its constituents. If this be so, the length of time during which our globe may have been receiving such an amount of heat and light as would be compatible with the existence of animals and plants may well have been as great as that demanded by any of the supporters of evolutionary theories.

Though there would be such an approximate uniformity for a vast period, yet still at the earliest epoch, the physical state of the sun would not have been the same as now, and it becomes important to consider what effect this may have produced on life on the globe. According to Mr. Lockyer's views the sun at an early period had much the same physical constitution as the stars of the type of Sirius, giving off light of a whiter or bluer character, *i.e.* the rays at the blue end of the spectrum were relatively stronger than at present, whilst in future ages they would become more feeble, and the sun pass into the condition of stars of the red type. What then would be the effect of the greater intensity of the rays at the blue end of the spectrum on animals and plants at early geological epochs? This question clearly indicates the importance of future experimental inquiries, directed to this particular subject, but at the same time it may be well to consider the bearing of what is already known. In the present state of our knowledge no facts seem more likely to help towards a conclusion than those connected with the distribution in plants of the more important of the coloured substances which absorb different rays of light. I have found that there is an intimate relation between their optical and chemical characters, and that these are also related to the development of the individual plants, and to the structural development of mature plants of different classes. Taken as a whole, in advancing from a more rudimentary condition, there is in each case a farther and farther departure from such colouring-matters as can be formed artificially, and a relatively greater and greater production of those which are more and more easily decomposed by light, when not protected by the constructive energy of the living plants. This destructive action is due relatively more to the rays at the blue end of the spectrum, whilst, at all events in the case of chlorophyll, the production depends more upon the yellow rays. Hence, by relatively increasing the intensity of the blue rays the destructive force would be relatively increased, and the constructive force relatively diminished. We may, perhaps, therefore conclude that bluer light would be relatively more favourable to the higher classes of plants when in the early stage of their growth, and to the lower than to the higher classes when in the mature condition requisite to insure permanent reproduction. The former conclusion is borne out by Mr. Robert Hunt's experiments, which showed that whilst the rays at the blue end of the spectrum quicken the germination of the higher classes of plants, it is the rays at the extreme red end which facilitate their flowering and the perfecting of the reproductive organs.* The effect of differently coloured light on the growth of the cryptogamia has not, I believe, been examined; but, if the principles involved in the above arguments be correct, they would lead us to conclude that at an early epoch in the history of our globe the bluer light of the sun would be relatively more favourable to the growth of larger cryptogams than to that of phænogams. The arguments I have used do, however, involve so many new and imperfectly-tried general principles, that it would be very premature to say that the characteristic peculiarities of the vegetation of the earlier geological periods depended on this cause, and all that I contend is that the question deserves to be examined from this new point of view, since it may at all events assist in arriving at a true explanation.

* An abstract of a paper read before the Sheffield Literary and Philosophical Society, Feb. 3, 1874, by H. C. Sorby, F.R.S.
† *Comptes Rendus*, Dec. 8, 1873.
‡ Brit. Ass. Report, 1861, p. 28.

* Brit. Ass. Report, 1843, p. 35.

THE "CHALLENGER" EXPEDITION†

II.

FERNANDO NORONHA

THIS group of islands was visited by the *Challenger* on September 1 and 2, 1873. They consist of a principal island, about four miles long, and three-and-a-half broad, stretching about N.E. and S.W., and several smaller ones at the eastern extremity, known as Platform Island, Booby Island, St. Michael's Mount, Egg Island, and Rat Island. They are situated in the Atlantic, in lat. 30° 50′, about 200 miles from the nearest point of the South American coast, their entire length being about seven miles. The principal island is generally of a volcanic character, and hilly, the highest hill being about 600 feet. On its northern coast rises to a height of 1,000 feet what is known as the Peak. It is a peculiar-looking

† These Notes are founded on letters sent home by Mr. H. N. Mosely.