new court) was covered with water to the depth, at 1 p.m., when it was greatest, of four to five feet. The level of the paddock is much lower than that of the ground surrounding it. . . . Therefore, on Wednesday, August 6, I cut a trench from the north-west angle of the paddock across the raised path. . . . The water had drained off by Saturday evening, August 9. The rush of water from the west across the Fellows' garden had carried with it into the paddock a great quantity of worms, which, when the water had subsided, were observed, some very large, lying dead under the water. As the water drained off, these lay on the paddock and on the slopes of grass surrounding it, and the smell of them infected the air till Friday, August 15."

Mr. Russell's observations go to show that the worms found dead were not all worms that had lived in the paddock, but those which had got washed out with the earth from the Fellows' gardens, and so they perhaps perished sooner being in the water. It is probable that worms buried deep in the earth under submerged meadows may, if they remain underground, hold out through much longer floods. However I gather that a large number perished in the adjoining parts of the Backs, and were seen on the paths and slopes as soon as the flood began to subside. Many of them were of exceptionally large size. I have heard of land injured by floods where the injury was supposed to be principally due to the destruction of all the earthworms. It is probable that the growth of peat-mosses may be in great part referred to the fact that the conditions were unfavourable to earthworms, for had they been there they would have worked up the vegetable matter into mould.

But there must be something besides floods that makes earthworms migrate.

If we drive a stick into the earth and move it about so as to shake the ground, the earthworms will come out to the surface and scuttle away in all directions. This was a common way of getting worms for fishing, and we used to be told, as Darwin notices, that the worms came out because they thought a mole was digging after them.

There must be however some other reason why worms will often come out to the surface in the daytime, and hurry away across a gravel path or on to a road, and why they then seem so much less sensitive to tremor of the ground about them than do the worms that come out to feed on the lawn.

From the analogy of other more highly organised animals I could not help thinking that there must be some creature that hunted the common earthworm, some worm ferret that drove them out. Many who have passed their lives in the country know well when they see a large field-mouse cantering down a road and showing little fear of man that a fiercer enemy than man is following the poor little animal with untiring certainty. If you draw aside and watch, you will soon see a weasel following by scent. Even a hare or rabbit will at length lie down paralysed with terror, and give itself up to the stoat that has followed it with deadly pertinacity. The sudden appearance of one or two strange birds in a neighbourhood has often been a source of wonderment, and it has sometimes been suggested in explanation that they had been chased by birds of prey and got up into strong currents of air. Those who have seen a peregrine drive a flight of rooks up into the sky can easily see how this might happen. In the cases to which I am referring the earthworm comes out like a hunted thing. I have also noticed that many of the worms that I found dead or torpid were maimed; generally they had their tail cut off, and this when there had been no digging in my garden for a long time, and although there are few birds that would touch them. I have frequently observed that the earthworms were apparently unwilling to go to ground again though I have tried to make them in order to watch the rate and manner in which they buried themselves. A few days ago, however, I saw, I believe, the explanation of most of the cases I had been observing. A large earthworm about nine inches long, bright, clean, and healthy-looking, was moving somewhat irregularly on the earth of a flower-bed. On stooping to examine it, I found a small yellow animal with a brown head holding on within about half an inch of the tail end of the worm. I sent it to Prof. Westwood, who writes: "Your worm-eating larva is evidently one of the Carabidæ, probably *Steropus madidus*" (see *Gardener's Chronicle*, 1854, p. 613). It was not disturbed by my taking up the worm, but went on biting its way round the worm, holding on like a bulldog, and bettering its hold every now and then. It had nearly got round the worm, leaving a lacerated ring. The wounded part seemed somewhat swollen, but on this point I am not clear, as the unequal power of extension of the wounded part may have produced the effect of swelling. Mr. Edwin Laurence has recorded (NATURE, vol. xxvi. p. 549) a similar circumstance observed by him in France, where, however, the larva seems to have attacked the worm differently, and with a view to killing it rather than cutting off a portion, and from his description, moreover, it would not appear to be the larva of the same species. He suggests that the numerous birds in England may have destroyed such an enemy of the earthworm. A sparrow would probably take the larva, and not touch the earthworm. One would have thought that the earthworm would have a better chance of rubbing off his deadly enemy in the earth than above ground, as a salmon is said to clean himself in a gravelly river, but we want further observations on this curious question, as well as on several others raised by the inquiry, How are worms transported to out-of-the-way places? and How long can they live in soils of various degrees of permeability when the surface is flooded?

T. McKENNY HUGHES

THE LOW BAROMETER OF JANUARY 26, 1884

IN the end of January we gave a brief notice (see NATURE, vol. xxix. p. 316) of the unprecedentedly low barometric readings which were observed on the evening of January 26 in the middle districts of Scotland over which the centre of that great storm passed. The lowest reading, reduced to 32° and sea-level, then given was 27·332 inches, and was observed by Mr. George Croucher at Ochtertyre, near Crieff. This still remains the lowest reading observed during the storm, and as it is absolutely the lowest known to have been observed in Europe, if not indeed the lowest on any land surface of the globe since the invention of the barometer, it is desirable to give an accurate record of it in NATURE.

On that occasion, Mr. Croucher's observations included the barometer, its attached thermometer, and a thermometer hung outside the window, it being too stormy to venture out. The observations near the time of greatest depression, corrected for instrumental errors and reduced to 32° and sea-level, were, in inches, 27·631 at 7 p.m., 27·527 at 7.45 p.m., 27·420 at 8.30 p.m., 27·390 at 9 p.m., 27·332 at 9.45 p.m., and 27·365 at 10.15 p.m. The correctness of these readings is amply attested by the hourly barometric readings made at a considerable number of the Scottish meteorological stations that evening.

At the meeting of the Royal Meteorological Society on February 20, a paper was read on the storm of January 26, in which it is remarked that "the lowest readings of the barometer (reduced to 32° and sea-level) yet reported were 27·32 inches at Kilcreggan, and 27·332 inches at Ochtertyre." The observations at Kilcreggan were made with an aneroid, whose errors were unknown. From the hourly observations made at the different stations in Scotland, the isobars for each hour have been drawn, and, from a comparison of the Kilcreggan observations with these

isobars, the following approximate errors of the aneroid have been determined for the lowest recorded readings:—

p.m.		Aneroid, inches						inch
7	...	27·300	...	Approximate error				−0·230
8	...	27·200	...	...	...	...	...	−0·240
8.30	...	27·155	...	...	...	...	...	—
9	...	27·200	...	...	...	...	...	−0·230
10	...	27·300	...	...	...	...	...	−0·220
				Mean error ...			...	−0·230

If the correction + 0·230 inch for instrumental error and height be applied to 27·155 inches, the lowest observed sea-level reading at Kilcreggan was only 27·385 inches—a reading, it may be remarked, agreeing closely with the lowest readings noted at several stations on the mainland and islands of Argyllshire earlier in the evening. The Ochtertyre reading, 27·332, was thus, so far as known, absolutely the lowest recorded during the great storm of January 26, 1884.

THE THEORY OF SUNSPOTS[1]

THE literature of heliography, by no means inconsiderable in extent, has received an addition by the publication of the work before us which, if it makes no attempt to enlarge our knowledge of solar phenomena from personal observation, is deserving of notice as a specimen of one of the modes in which those phenomena are attempted to be explained.

The subject is confessedly full of difficulty as well as interest. Nothing can be more natural than the wish to obtain some knowledge of the constitution of that splendid orb that is the dispenser of life and enjoyment to unnumbered millions of organised beings, and that exhibits on its surface such a strange development of forces commensurate in intensity with its amazing magnitude. But these tempting inquiries are beset with difficulties scarcely to be appreciated in the absence of actual experience. When we bear in mind the amount of light and heat that has to be encountered, with all its consequences in optical, mechanical, and atmospheric impediments, we may rather wonder that man should have been permitted to accomplish so much, than that he should have failed in effecting more. The serviceable working of the telescope soon comes to an end; and what it is able to exhibit it is not able to render intelligible. In strong contrast with the exploration of the selenographer, who feels no doubt as to the general character of his object, whatever perplexities may arise out of the study of its details, the observer of the solar disk knows absolutely nothing as to what he is looking upon. He finds a blazing surface of by no means uniform texture, unlike anything else in the whole compass of his experience. He encounters strange-looking specks that disfigure, if we might venture to use such a word without presumption, the purity and perfection of that brilliant orb. In those dark patches, and their attendant fringe-like borders, what is it that meets the eye? Cavity? or cloud? or eruption? or cyclone? or scoria? Have astronomers succeeded in explaining them? Shall we listen to Wilson, or Herschel, or Kirchhoff, or Nasmyth, or Secchi, or Faye, or Zöllner, or Langley? More or less, they all disagree. Or shall we be venturous enough to attempt an independent solution of the mystery? Little encouragement could be found in such a course. After such protracted discussion we could hardly bring to our telescope an unbiased eye or an impartial judgment. What we are looking for, we should be likely to find. We shall be surrounded with phenomena that lend themselves with perplexing facility to very dissimilar and even opposite interpretations; and, where one observer is confident as to a clear vacancy leading down to unimaginable depths, another fills the same dark area with heavy clouds or floating dross. There may be, and for our own part we believe there are, as in the formerly contested theories of light, details of less equivocal character adequate to guide if not absolutely to establish our judgment; but the ambiguity of the general aspect is sufficiently shown by the support which such conflicting theories have claimed from it, each in its turn.

Perhaps we are disappointed in our telescope. It will be to no purpose to enlarge our aperture or deepen our eyepieces: we are still confronted by an insoluble mystery. We adopt a fresh mode of investigation, the means of which have been but recently placed in our hands; and we bid the spectroscope exert its analysing power and report to us what is there. And now, under the guidance of Lockyer and Janssen and Huggins, we shall be carried a long way in advance, further than the boldest imagination would have dared to anticipate but a few years back; and we find set before us, as in some strange vision, the unmistakable presence of familiar elements, ninety-three millions of miles away. Yet even this triumph of human ingenuity finds there a boundary that it cannot overpass. The evidence, to a great extent conclusive, is sometimes equivocal, sometimes perplexing: affected probably by influences the force and direction of which we can little estimate. The well-known features often wear a strange aspect, and are associated with incomprehensible surroundings. We have succeeded in interrogating the sun: he has answered us, and his answer will surely be reliable:—

"Solem quis dicere falsum
Audeat?"

That is, if we can but comprehend it; but unfortunately the message is not free from obscurity; some of it is in an unknown speech, and "Helium" and "No. 1474" and others of their companions are not only beyond our interpretation, but are likely so to remain. Very wide is the field thus opened for speculation, and very different may be the deductions from the same, or apparently the same, premises, with little possibility of demonstrating that any one combines all the elements of truth. Not one of the current theories has wanted defenders of intelligence and skill; if no one of them clears up all difficulties, no one fails in showing that there is much to be said in its favour; and therefore, as long as no patent absurdity interposes an insuperable bar, we may well exercise toleration to those who do not see through our eyes, or who question to some extent our conclusions. The best result is perhaps not very far in advance of probability, and every claimant has some right to be heard.

Remarks somewhat of this nature may be suggested by the treatise before us, which may be looked upon as an attempt to stem the prevailing current of opinion as to the cause of solar phenomena by showing that they may receive a complete explanation from Zöllner's theory of floating scoriæ, as expanded and developed by the author. The principal results which he has deduced from an extended collation, as it would appear, of the previous observations of others, may be expressed in the following way:—

The sun is to be looked upon as an intensely heated and very gradually cooling ball of monatomic gas, the visible surface of which, or photosphere, is, as Kirchhoff also maintained, composed of iron, with a small admixture of other metals, in a state of glowing fusion, and permeated in every direction by an abundance of incandescent hydrogen, this gas being poured forth abundantly from the exterior of the monatomic nucleus, where the central temperature is sufficiently reduced through decreasing density to admit of the first steps of elemental association. The presence and diffusion of this hydrogen maintains the fused condition of the iron shell, and prevents it from cooling enough to exhibit in every part the

[1] "Die Theorie den Sonnenflecken." Nach den neuesten wissenschaftlichen Forschungen dargestellt von J. E. Broszus. (Berlin, 1884.)