

As this is the first occasion on which such a peculiarity has been recorded or figured, I prefer to leave all speculation as to the cause out of the question. We need a good deal more research before we can deal satisfactorily with the biological problems involved in such appearances. As a help towards this, I bring together here a list of all those works which have come under my own and Prof. Andrews's notice, in which abnormalities in annelids are recorded:—

1. Andrews: "Proc. U.S. Nat. Mus.," vol. xiv., p. 283, 1891.
2. Andrews: "Amer. Nat.," vol. xxvi., p. 725, 1892.
3. Bell: "Ann. Mag. Nat. Hist.," vol. xvi., p. 475, 1885.
4. Bell: "Proc. Zool. Soc., Lond.," 1887, p. 3.
5. Bonnet: "Œuvres d'Hist. Nat. et de Phil.," vol. i., p. 167 seq. 1779.
6. Breese: West Kent Nat. Hist. Soc., 1871.
7. Broome: "Trans. Nat. Hist. Soc." Glasgow, 1888, p. 203.
8. Bülow: "Archiv. f. Naturg.," vol. xlix., 1883.
9. Brunette: "Travaux de la Sta. Zool. de Cette," p. 8, Nancy, 1888.
10. Claparède: "Les Chaet. du Golfe de Naples," p. 436, 1868.
11. Fitch: "Eighth Report on Insects of State of New York," appendix, p. 204 seq. Albany, 1865.
12. Foster: Hull Scientific Club, February, 1891. Reported in weekly sup. *Leeds Mercury*.
13. Friend: "Science Gossip," 1892, pp. 108, 161.
14. Grube: "Archiv. f. Naturg.," vol. x., p. 200, 1844.
15. Horst: "Tydsch. ned. Dierk. Veren.," 2nd ser., D.I., Af. i., p. xxxii, 1882.
16. Laugerhaus: "Nov. Act., K.L.C.D. Acad.," vol. xiii., p. 102, 1879.
17. Marsh: "Amer. Nat.," vol. xxiv., p. 373, 1890.
18. Macintosh: "Challenger Reports," vol. xii., 1885.
19. Robertson: "Quart. J. Mic. Soc.," vol. xv., p. 157, 1867.
20. Zeppelin: "Zeit. f. Wiss. Zool.," vol. xxxix., p. 615 seq. 1883.
21. Catalogue Terat. Spec. in Mus. Roy. Coll. Surgeons, London, 1872.

HILDERIC FRIEND.

The Zero Point of Dr. Joule's Thermometer.

IN the course of a discussion on "Exact Thermometry" I described (NATURE, vol. xli. p. 488) the results obtained by heating thermometers for a considerable time to 280° and 356°; and pointed out by means of a diagram that at 356°, after about ten hours, the rise of the zero point became—at any rate approximately—a rectilinear function of the logarithm of the time; though at 280°, even after more than 300 hours' heating, the rise appeared to be rather more rapid than would correspond to such a simple relation.

Dr. Joule observed the rise of the zero point of a thermometer at the ordinary temperature during a course of no less than thirty-eight years ("Scientific Papers," vol. i. p. 558), and it occurred to me that it would be of interest to ascertain the relation to the logarithm of the time in this case also.

The following table contains the dates of Dr. Joule's observations; the total number of months from the date when the first reading was taken; the corresponding logarithms; the total rise of the zero point in scale divisions (13 divisions to 1° F.); the total rise calculated from the formula $R = 6.5 \log. t - 4.12$, where t is the time in months; and lastly the differences between the observed and calculated zero points.

Date.	Time in Months.	Log. t .	Total rise of zero point in scale divisions.		
			Observed.	Calculated.	Δ
April 1844	0	—	0	—	—
Feb. 1846	22	1.342	5.5	4.6	-0.9
Jan. 1848	45	1.653	6.6	6.6	0
April 1848	48	1.681	6.9	6.8	-0.1
Feb. 1853	106	2.025	8.8	9.0	+0.2
April 1856	144	2.158	9.5	9.9	+0.4
Dec. 1860	200	2.301	11.1	10.8	-0.3
March 1867	275	2.439	11.8	11.7	-0.1
Feb. 1870	310	2.491	12.1	12.1	0
Feb. 1873	346	2.539	12.5	12.4	-0.1
Jan. 1877	393	2.594	12.71	12.74	+0.03
Nov. 1879	427	2.630	12.92	12.98	+0.06
Dec. 1882	464	2.667	13.26	13.22	-0.04

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The agreement between the observed and calculated values is certainly remarkable, and the + and - differences are evenly distributed.

Ten years have now elapsed since the last reading was taken, and if the thermometer is still in existence it would be of great interest to know what further rise has taken place in its zero point. According to the equation the reading should now be 13.86.

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University College, Bristol, January 20.

THE APPROACHING SOLAR ECLIPSE, APRIL 15-16, 1893.

THE total solar eclipse of April 15-16, 1893, is not only one of the longest of the century, but is the last of the century from which we are likely to get any addition to our knowledge of Solar Physics. The longest duration of totality of this eclipse is 4 minutes 46 seconds, and as the path of the moon's shadow lies to a great extent on land, there is a considerable choice of possible stations with long durations of totality. Commencing in the Southern Pacific the line of totality passes in a north-easterly direction and enters Chili at Charañah in 29° southern latitude, crosses the South American continent, and issues at Para Cura, a village near Ceara, at the north-east corner of Brazil, in latitude 3° 40' south. It crosses the Atlantic at its narrowest part and enters Africa at Point Palmerin, near Joal, almost midway between Bathurst and Dakar, and in latitude 14° north; the shadow finally leaving the earth in the interior of Northern Africa. The eclipse will be observed by several parties of astronomers in Chili, Brazil, and Africa, there being almost absolute certainty of fine weather in Chili and Africa, and a reasonable probability in Brazil.

The English arrangements to observe the eclipse have been made by a joint committee of the Royal Society, the Royal Astronomical Society, and the Solar Physics Committee of the Science and Art Department, South Kensington; Dr. A. A. Common, LL.D., F.R.S., undertaking the duties of Secretary. Two expeditions will be sent from England, one to Africa and the other to Brazil, the expenses being defrayed by a grant of £600 from the Royal Society.

The African expedition will be in charge of Prof. T. E. Thorpe, and will consist of Prof. Thorpe, Mr. A. Fowler, Mr. Gray, and Sergeant J. Kearney, R.E. The Brazilian expedition will be in charge of Mr. A. Taylor, who will have with him Mr. W. Shackleton.

Prof. Thorpe and his party will leave Liverpool by the British and African mail steamer on March 18th, arriving at Bathurst on April 2nd. They will be met at Bathurst by a gunboat kindly placed at the disposal of the expedition by the Admiralty, and will be conveyed at once to Fundium, a station on the Salum River, about sixty miles from Bathurst; this being the station selected by the Committee from the three which were offered by the French Government. The gunboat will remain with the expedition, and the officers and crew will assist in the preparations for and in the actual observations of the eclipse. After the eclipse the party will be taken to Bathurst on the gunboat, and will return to England by a British and African mail steamer, if one is available. From the time-tables of the steamers now published it appears, however, that there will not be any mail steamer available until the end of April, and in this case a cruiser will meet the party at Bathurst and bring them to the Canary Islands or to Gibraltar, from either of which places they will be able to return by mail steamer, arriving in England early in May.

The members of the expedition to Brazil will leave Southampton by the Royal Mail steamer on February 23 for Pernambuco, arriving at the latter place on March 12. They will take passage by the local mail steamers to Ceara, at which place they will arrive about March 20.

The Brazilian Government are willing to place a war vessel at the disposal of the foreign expeditions to observe the eclipse, and it is hoped the English observers will be able to avail themselves of the privilege thus gracefully offered. The station selected is at Para Cura, on the coast about forty miles west of Ceara, and the party will rely upon obtaining any necessary help from the Brazilian authorities and from local assistants. The observers will return from Pernambuco by the Royal Mail steamer due to leave there on April 22, and expect to be in England on May 5.

The objects of the expeditions are—

(1) To obtain visual photometric measures of the light of the corona.

(2) To obtain photographs of the corona with the four-inch lenses of a little over sixty inches focus belonging to Captain Abney, which were successfully used in Egypt (1882), Caroline Island (1883), Granada (1836), and Salut Isles (1889), in order to continue the series.

(3) To obtain enlarged photographs of the corona with small photographic action, so as to show details of the structure of the brightest parts, *i.e.* those nearest the sun.

(4) To measure the photographic intensity of the light of the corona, by direct comparison with standard intensity scales placed on the margins of the plates used for the negatives to be obtained under sections 2 and 3.

(5) To obtain photographs of the spectrum of the corona. These spectra will be obtained on three different plans:—

(a) With integrating spectroscopes, where no collimator is used and the prism or prisms are placed directly in front of the object glass of the photographic camera.

(b) With ordinary slit spectroscopes, the slit being arranged as a radius of the sun.

(c) With ordinary slit spectroscopes, the slit being arranged as a tangent to the sun's limb.

The first of these objects will be attempted only at the African station; Prof. Thorpe and his assistant, Mr. Gray, making the observations. Their equipment will consist of a six-inch Simms equatorial of seventy-eight inches focus (lent from Greenwich) fitted with special photometric apparatus lent by Captain Abney. The observations will be made on essentially the same plan as that pursued by Prof. Thorpe at Hog Island, near Granada, in 1886, separate portions of the corona being compared with a standard glow lamp by means of a Bunsen photometer. An integrating box for measuring the total coronal light with as little light from the sky as possible, and an ordinary Bunsen's bar photometer will also be used, these being entrusted to officers of the gunboat.

As regards objects 2, 3, and 4, duplicate apparatus has been arranged for use at the two stations.

A photoheliograph mounting from Greenwich has been lent for Brazil, and an exactly similar instrument from South Kensington for Africa. On each of these mountings a specially designed new double tube will be fixed. An Abney lens will be mounted in one compartment of each of these tubes, and this, with a focal length of sixty inches, will give pictures on the scale of rather more than half an inch to the moon's diameter. In the other compartment a four-inch Dallmeyer photoheliograph lens will be mounted in combination with a specially-constructed two-and-a-half-inch Dallmeyer negative lens of eight inches negative focus; this arrangement giving, with a total length of sixty-eight inches, pictures on the scale of over one-and-a-half inches to the moon's diameter. This latter arrangement is essentially the same as that of Dallmeyer's new telephotographic lens. It will be so arranged that the ratio between the photographic effect of the Abney lens and the new combination will be as 10 : 1.

Special plate holders have been made to fit the double tubes, each of these plate holders carrying two plates,

which will be exposed simultaneously to the images formed by the Abney lens and the enlarging combination. The six separate exposures, giving twelve photographs, will be so arranged that the longest exposed pictures with the enlarging combination will have received the same photographic action as the shortest exposed pictures with the Abney lens. The whole of the pictures will thus form a continuous series, all the short exposures in the series having a direct enlargement of three diameters.

In Brazil Mr. Taylor will take charge of this double instrument, and in Africa the similar instrument will be entrusted to Sergeant Kearney. On the night before the eclipse intensity scales for object 4 will be impressed by the use of standard lights and specially-constructed scales kindly supplied by Captain Abney on all the plates to be exposed to the corona. The plates will be developed at the stations as soon as convenient after the eclipse, experience on previous occasions, both by English and American observers, having shown that it is impossible to repack undeveloped plates after exposure in the tropics, and bring them home without serious deterioration.

Similar spectroscopic work is to be carried out at the two stations. For the integrating spectroscope in Africa Mr. Fowler will use a six-inch objective prism with a six-inch photographic lens of about nine-foot focus, mounted on an equatorial stand, belonging to Prof. J. Norman Lockyer, and kindly lent for the expedition. At the Brazilian station Mr. Shackleton will use two three-inch prisms in front of a three-inch photographic lens of about two-foot focus; the spectroscope, which belongs to South Kensington, being arranged horizontally and used with a ten-inch heliostat, also lent by the Science and Art Department. Very short exposures will be given at each station at the commencement and end of totality, so as to obtain, if possible, the very numerous bright lines which have been observed in the chromosphere; and exposures of from 5 to 45 seconds will be given during totality.

In Africa the radial and tangential slit spectroscopes will be mounted together on the Corbett equatorial stand lent from Greenwich, the spectroscopes used belonging to the Royal Society. Mr. Fowler and Sergeant Kearney will erect and adjust these instruments, but the actual exposure, which will extend through the whole of totality, will be made by an officer of the gunboat who will be placed in charge of the instrument. In Brazil the radial and tangential slit spectroscopes will be mounted horizontally and used with a second ten-inch heliostat lent by the Science and Art Department. The erection and adjustment will be made by the observers, but the actual exposure during totality will be entrusted to a local assistant. Orthochromatic plates will be used for all the spectroscopic work, the spectra obtained extending from above D into the ultra-violet.

Briefly summarised, the English programme is as follows:—

In Africa:—Prof. T. E. Thorpe, assisted by Mr. Gray and local assistance—Photometric measures of the visual intensity of the corona with the equatorial photometer, the integrating photometer, and the bar photometer; Mr. Fowler—The six-inch integrating spectroscope; Sergeant Kearney—the Abney and Dallmeyer coronographs; local assistance—the radial and tangential slit spectroscopes.

In Brazil:—Mr. Taylor, the Abney and Dallmeyer coronographs; Mr. Shackleton, the three-inch two-prism integrating spectroscope; local assistance, the radial and tangential slit spectroscopes.

It is not yet decided whether one of the 20-inch mirrors of 45-inches focus specially constructed to photograph the faint extensions of the corona during the eclipse of 1889 (December 21-22) will be taken to Africa. If so it will be entrusted to a local assistant. It was originally intended to use one of these in Africa, and it was hoped that one would be used by the Harvard College

Observatory party, which is to occupy a station in Chili, but Prof. W. H. Pickering writes that difficulties of transport will prevent him from taking the 20-inch mirror he has at Arequipa to the Harvard station; and owing to this and to the already large programme of the English party in Africa there is some doubt whether they will take one of the mirrors. April being the middle of the rainy season in Brazil, it is not deemed advisable to send one of the mirrors to that station.

The duration of totality at Para Cura is four minutes forty-four seconds, the altitude of the sun being between 70° and 80° . At Fundium the totality lasts four minutes eight seconds, the altitude of the sun being about 54° .

The Joint Eclipse Committee having arranged the expeditions and the general scheme of work, final details as to the actual operations have been left to a sub-committee consisting of the Astronomer Royal, Captain Abney, Mr. H. H. Turner, Prof. Thorpe, Mr. A. Taylor, and the secretary, Dr. Common. Prof. Lockyer, previous to leaving England for Egypt, determined the exposures to be given by Messrs. Fowler and Shackleton with the integrating spectroscopes. These, with the final instructions to observers drafted by the sub-committee, will be published in due course.

At present very few details are available as to the actual work to be undertaken by foreign observers. The Harvard College Observatory expedition to Chili has already been mentioned. Prof. Schaeberle, of the Lick Observatory, has already started for Chili, and will use a six-and-a-half-inch equatorial, a five-inch horizontal photoheliograph of forty-feet focus, and a Dallmeyer portrait lens. He will be assisted by Mr. Gale, an amateur, from Paddington, N.S.W. A Chilean party will also observe the eclipse in Chili.

At Para Cura there will probably be two or three American parties, one being announced as probably under Prof. H. S. Pritchett, from Washington University, St. Louis, and another will probably be brought to that station by Prof. David P. Todd. A Brazilian party will also observe. The Bureau des Longitudes, Paris, are sending a complete expedition to Joal, in Africa, under MM. Deslandres and Bigourdan, the latter observer having already started for his station. The work undertaken will be to obtain photographs of the corona and of its spectrum. M. de la Baume Pluvinel will also go to Joal to photograph the corona. At present we have not heard of any Italian expedition, but it is hoped that Prof. Tacchini will be able to arrange to observe the eclipse.

A. TAYLOR.

MEASURE OF THE IMAGINATION.¹

THE first perceptible sensation is seldom due to a solitary stimulus. Internal causes of stimulation are in continual activity, whose effects are usually too faint to be perceived by themselves, but they may combine with minute external stimuli, and so produce a sensation which neither of them could have done singly. I desire now to draw attention to another concurring cause which has hitherto been unduly overlooked, or only partially allowed for under the titles of expectation and attention. I mean the Imagination, believing that it should be frankly recognised as a frequent factor in the production of a just perceptible sensation. Let us reflect for a moment on the frequency with which the imagination produces effects that actually overpass the threshold of consciousness, and give rise to what is indistinguishable from, and mistaken for a real sensation. Every one has observed instances of it in his own person

¹ Extract from a lecture on "The Just-Perceptible Difference," delivered before the Royal Institution, on Friday, January 27, by Francis Galton, F.R.S. We hope to give next week an extract on "Optical Continuity."

and in those of others. Illustrations are almost needless; I may, however, mention one as a reminder; it was current in my boyhood, and the incident probably took place not many yards from where I now stand. Sir Humphrey Davy had recently discovered the metal potassium, and showed specimens of it to the greedy gaze of a philosophical friend as it lay immersed in a dish of alcohol to shield it from the air, explaining its chemical claim to be considered a metal. All the known metals at that time were of such high specific gravity that weight was commonly considered to be a peculiar characteristic of metals; potassium, however, is lighter than water. The philosopher not being aware of this, but convinced as to its metallic nature by the reasoning of Sir Humphrey, fished a piece out of the alcohol, and, weighing it a while between his finger and thumb, said seriously, as in further confirmation, "How heavy it is!"

In childhood the imagination is peculiarly vivid and notoriously leads to mistakes, but the discipline of after life is steadily directed to checking its vagaries and to establishing a clear distinction between fancy and fact. Nevertheless, the force of the imagination may endure with extraordinary power and be cherished by persons of poetic temperament, on which point the experiences of our two latest Poet-Laureats, Wordsworth and Tennyson, is extremely instructive. Wordsworth's famous "Ode to Immortality" contains three lines which long puzzled his readers. They occur after his grand description of the glorious imagery of childhood, and the "perpetual benediction" of its memories, when he suddenly breaks off into--

"Not for these I raise
The song of thanks and praise,
But for those obstinate questionings
Of sense and outward things,
Fallings, from us, vanishings," &c.

Why, it was asked, should any sane person be "obstinately" disposed to question the testimony of his senses, and be peculiarly thankful that he had the power to do so? What was meant by the "fallings off and vanishings," for which he raises his "song of thanks and praise"? The explanation is now to be found in a note by Wordsworth himself, prefixed to the ode in Knight's edition. Wordsworth there writes—"I was often unable to think of external things as having external existence, and I communed with all I saw as something not apart from, but inherent in, my own immaterial nature. Many times while going to school have I grasped at a wall or tree to recal myself from this abyss of idealism to the reality. At that time I was afraid of such processes. In later times I have deplored, as we all have reason to do, a subjugation of an opposite character, and have rejoiced over the remembrances, as is expressed in the lines 'Obstinate questionings,' &c." He then gives those I have just quoted.

It is a remarkable coincidence that a closely similar idea is found in the verses of the successor of Wordsworth, namely, the great poet whose recent loss is mourned by all English-speaking nations, and that a closely similar explanation exists with respect to them. For in Lord Tennyson's "Holy Grail" the aged Sir Percivale, then a monk, recounts to a brother monk the following words of King Arthur:—

"Let visions of the night or of the day
Come, as they will; and many a time they come
Until this earth he walks on seems not earth,
This light that strikes his eyeball is not light,
The air that smites his forehead is not air,
But vision," &c.

Sir Percivale concludes just as Wordsworth's admirers formerly had done: "I knew not all he meant."

Now, in the *Nineteenth Century* of the present month

¹ Knight's edition of Wordsworth, vol. iv. p. 47.