

identity with that of the earth's rotation, solar tidal friction will further reduce the earth's angular velocity, the tidal reaction on the moon will be reversed, and the moon's orbital velocity will increase, and her distance from the earth will diminish. But since the moon's mass is very large, the moon must recede to an enormous distance from the earth, before this reversal will take place. Now the satellites of Mars are very small, and therefore they need only to recede a short distance from the planet before the reversal of tidal friction."

No one can have any datum for saying that the Martian satellite must have fallen into the planet "long ere this," but Mr. Nolan shows that the satellite is now near the end of its history.

I do not think that Sir William Thomson made any allowance for solar tidal friction in estimating the ultimate distance of the moon. Both he and I only cared to obtain the result in round numbers.

I should be very much obliged to Mr. Nolan if he would give a reference to the proof of the theorem, that two heavenly bodies cannot revolve about their centre of inertia, as parts of a rigid body with their surfaces nearly in contact, unless one is smaller and denser than the other by a certain amount.

July 15

G. H. DARWIN

Peripatus in Demerara

CONSIDERING the great antiquity and importance of *Peripatus* it seems desirable to make a public notification of the fact that I have found a species, apparently *Peripatus Edwardsi*, in the Demerara division of British Guiana. Four specimens were obtained by me, but three of them, owing to some unknown cause, became considerably damaged and practically useless. The fourth specimen, which was found by me nearly a month ago, is still alive and evidently in good health. It is, when in progression, about $3\frac{1}{2}$ inches in length, but it often elongates itself considerably more and at other times becomes nearly coiled into a thick lump. It possesses thirty-one pairs of feet, the last three of which it rarely puts to the ground except when it goes backwards for short distances. Several other pairs at intervals along the body are carried off the ground in the same manner. It seems distinctly restless under the influence of light, appearing comfortable only when it retreats into some moist and darkened corner. When handled, it frequently discharges its viscid secretion, but as frequently neglects to do it when handled for the first time after a long interval, but more especially when touched or taken up for three or four times in rapid succession. It has been kept in an old sardine tin with small pieces of decayed wood, which were taken from the stump in which it was found, and the wood is kept in a moist condition. The locality from which it was obtained was the Hoorubea Creek, about twenty miles from Georgetown, on the east coast of the Demerara River, close to the meeting-point of an extensive forest and a water savannah. The four specimens were obtained in the same locality; and, though I have sought for them continually in other places, up to the present I have been unable to find others. From the long period of time during which this specimen has survived in confinement, I think there will be no difficulty, when I have obtained a large number of specimens, in sending them alive to England to Prof. Moseley and others. Unfortunately I have no possible access here to any literature on the group. I do not think it is generally known, but Mr. Im Thurn has once previously found specimens of *Peripatus* in the Essequibo division of British Guiana. His specimens were, however, very small ones.

British Guiana Museum

JOHN J. QUELCH

Upper Wind-Currents over the Bay of Bengal in March, and Malaysia in April and May

IN my last letter to NATURE, vol. xxxiii. p. 460, on the subject of upper winds, I described the circulation of the Indian Ocean from the equator, where the north-west wind changes into the north-east monsoon, as far north as Ceylon, in the month of February. From there, about the beginning of March, I took a section of the weather, as nearly straight as practicable, from Colombo, through Calcutta, and 400 miles due north to Darjeeling.

The general weather system at that season is very simple. A belt of high pressure lies across the Bay of Bengal, from about Madras, to the southern limits of Burmah. The north-east monsoon blows to the south of this, towards the low pressure

below the equator; the belt, of course, covers a calm area; while to the north a south-west wind blows towards a low pressure somewhere beyond the Himalayas.

The upper currents over the north-east monsoon always blew from some more easterly point than the surface-wind; the cloudless sky over Madras prevented any observations; north of this the higher clouds always came from some point more northerly than the south-west wind below. The lofty range of the Himalayas seemed to make no difference; at Sendukphu I succeeded in getting a photograph of a cumulo-form cloud trailing from the summit of Kanching Junga (29,000 feet) well from the west-north-west, while a south-west wind was driving up mist from the plains. The existence of cumulus at so high a level has, I think, been denied by some meteorologists.

All these observations are in complete accordance with the normal circulation of the northern hemisphere; but the character of south-west monsoons deserves notice. The term south-west monsoon is unfortunately used for two different stages of the same weather sequence, and much confusion comes thereby. Maury and others think only of the direction of the wind; common parlance all over the East talks of the monsoon as of a rainy season which sets in suddenly, long after south-west winds have been blowing for weeks or months previously.

The facts of the case are these:—As early as January a light south-west wind commences in the north of the Bay of Bengal, first only as a sea breeze; later, when we encountered it, as a light continuous wind. Nothing can be more lovely than the weather then; bright blue sky, scarcely a light cloud, with a warm gentle wind; the monsoon, unlike March, begins like a lamb and goes out like a lion. As the season goes on an area of low pressure, which has been gradually forming over Northern Bengal, becomes more pronounced, and the south-west wind gradually works further and further to the southwards below Ceylon. Then, sometimes in June, a sudden total change comes over the weather, while the only alteration the isobars show is a slight motion of the lowest pressure towards the North-west Provinces of India. A sudden burst of rain and thunder breaks over Ceylon, and then the bad weather works slowly northwards. This is the commencement of the south-west monsoon in common talk. Everyone will tell you how many days it takes to work up to Bombay on one side and to Calcutta, by way of Burmah and Assam, on the other. Madras escapes for the present, only to be deluged in November by the north-east monsoon. So we get the curious sequence that the wind works downwards, the rain upwards; and also the fact that the greatest and most sudden change in the year is associated with no striking change in the distribution of pressure. The Indian meteorologists are of opinion that this sudden change in the character of the same wind is due to a sudden irruption of air, highly charged with vapour from the neighbourhood of the equatorial doldrums, but that the south-east trade is not linked with the south-west monsoon in a continuous current, except occasionally and temporarily. Would it not be of the highest interest and importance to discover whether this sudden change of weather is associated with any change in the relation of the upper and lower winds? In my letter to NATURE (vol. xxxiii. p. 460) I showed that over the south-west monsoon of the Gulf of Guinea the upper currents were those of the southern hemisphere, and that the south-east trade there seemed to grow gradually into a south-west wind as it crossed the line. If in Ceylon and India the higher clouds continue to come, as we found them, from west or north-west after the burst of the south-west monsoon, there must be a doldrum between it and the south-east trade; but if the upper currents turn towards south or south-east after the burst, then undoubtedly the south-east trade has invaded the northern hemisphere. The latter is of course the old theory of the monsoon; and perhaps another test may be applied to the solution of these alternatives. If the south-east trade blows into a doldrum, there must be a belt of high pressure between Ceylon and the equator to give gradients for south-west winds. Has this ever been found? I do not think that calm alone is sufficient to be called a "doldrum." During the north-west monsoon, which is unquestionably the north-east monsoon drawn across the line, the direction of the wind changes gradually, but the velocity is often less just on the equator than on either side. I made some special inquiries on this point.

In the Philippines, China, and Japan the upper winds over the south-west monsoon follow the normal course of the northern hemisphere; but there is no burst of the monsoon in those countries.

Some meteorologists have asserted that the south-west monsoon may be considered a stationary cyclone. This might be so if we define a cyclone simply as an irregularly circular area of low pressure round and into which the wind blows spirally. But when we look at the kind of rain and varieties of cloud which give distinctive character to various parts of a cyclone, our own observations and the information we have received from others entirely discountenance this idea.

In Malaysia, between Singapore and Borneo, in the early days of April the surface-winds were all from about north-east, and the clouds at various levels always from more south of east. In North Borneo, later in the month, the south-west land breeze of the morning always went round by south-east to north-east in the afternoon and evening, while the higher clouds came always from about north-east.

In Sooloo and the Philippines during the month of May the surface winds were much complicated by land and sea breezes, but the sequence of upper currents was always that proper to the hemisphere.

So far for ordinary weather. I was not fortunate enough to meet with a typhoon, but the reports of the observatories at Manilla, Hong Kong, and Tokio are all agreed that the relation of upper and lower currents is the same in a typhoon in the China Seas as in a European cyclone.

Yokohama, June 12

RALPH ABERCROMBY

Mock Sun

I INCLOSE sketch of the first mock sun I have been fortunate enough to see at Cranbrook, Kent, on July 20, 5 to 5½ p.m.

About 10m. before noticing this fine phenomenon we had noticed a fragment of it, not knowing what was to follow; and we were struck by the extraordinary position of the bow with reference to the sun, viz. about 45° from it, and at an unaccountable angle to the horizon. The latter picture I can only draw by memory. The upper drawing is from one made on the spot in presence of two intelligent adult witnesses, who were consulted on each point which I proceed to notice.

(1) The rainbow near the zenith was of the breadth and brilliancy of an ordinary rainbow (the same was the case with the fragment seen ten minutes earlier, which was lost when the rest came out). The fact of the arc seen near the zenith belonging to two circles, one small and one large, touching each other, was sufficiently certain to my eye, confirmed by another educated eye, but not admitted by the third less educated one. I draw it as I apprehended it. The colours were unusually vivid against a thin veil of fleecy clouds.

(2) The halo-circle round the sun, and the arched eyebrows, so to call them, were about half the breadth of the rainbow, and washy in colour. The shapes drawn are quite faithful, and were so sharp as to leave no room whatever for doubt or imagination.

(3) The interior area of the circle was darker than the outside.

(4) The position of the mock sun was not diametrical. The sun, seen through a handkerchief whose edge was stretched through the two mocks, was about two-thirds of its own breadth below the edge, clear.

(5) The white rays (about half the breadth of the mock lights) were seldom seen both at the same time, but were quite decided outside the circle and traceable within it, but nowhere nearly so bright as the mock lights.

(6) The mock lights were short fragments of arcs of rainbows, more vividly coloured than the halo-circle outside of which they stood clear of it, but not so broad and not quite so vivid as the great rainbow arc.

These fragments were *not* tangential. Short as they were, their own axis was clearly determined by all three witnesses to be inclined towards the radial ray, and more inclined to the arc of the halo. But I have unconsciously given a curved shape to the short fragment. It was too short to show a curve. There was no pretence of a disk, as if really a mock sun. It was only a very vivid fragment of a rainbow. A third fainter one was at the top of the halo.

The sky was much covered with thin cirrus; a fine sunny evening; air peculiarly clear for distant views.

Collingwood, July 22

W. J. HERSHEY

P.S.—Radius of halo-circle, measured as best I could, $22\frac{3}{4}^\circ \pm 2\frac{1}{2}^\circ$. Radius, continued to the rainbow, 45° with proportionate error. The arc of the halo-circle was generally absent next to the mock lights, but could sometimes be traced.

"The Duration of Germ-Life in Water"

IN A letter bearing this title in your last issue (p. 265) Mr. Downes refers to the recent publication by Messrs. Crookes, Odling, and Tidy, of some experiments which they have made on the vitality of the *Bacillus anthracis* in water, with regard to which I should like to call attention to the fact that this subject has during the past three years been investigated by various experimenters, including Koch, Cornil, and Babes, Nicati and Rietsch. Within the past two months no less than three papers have been published on this subject, two of them in Germany by Dr. Wölfhügel and Meade Bolton respectively, whilst the third, by myself, "On the Multiplication of Micro-organisms," was communicated to the Royal Society at the meeting in June last. In this paper I have recorded a number of experiments made both with the mixtures of organisms found in various natural waters, as well as with three well-characterised forms which are associated with disease, viz. Koch's "Comma" spirillum of Asiatic cholera, Finkler-Prior's "Comma" spirillum of European cholera, and the *Bacillus pyocyaneus*, which produces the greenish-blue colouring matter frequently present in abscesses. The methods of research which have been independently selected both by Wölfhügel, Meade Bolton, and myself, are identical, and consist in the examination, by gelatine plate-cultivation, of waters purposely impregnated with the organisms in question. This method is obviously the one which most recommends itself for the purpose, as it not only enables one to ascertain the presence or absence of the organisms, but also to quantitatively follow their multiplication or reduction. I may mention that these three organisms present great differences in their behaviour under similar circumstances; thus the *Bacillus pyocyaneus* is possessed of far greater vitality in water than either of the other two, its presence being demonstrable even in distilled water after fifty-three days, in numbers exceeding manyfold those originally introduced. Koch's "Comma" spirillum, on the other hand, was in the purest forms of potable water no longer demonstrable after the ninth day, whilst in London sewage it was found in largely multiplied numbers after twenty-nine days; whilst Finkler's spirillum could in no case be detected after the first day, and frequently not even on the day of inoculation. A curious phenomenon, which my experiments, as well as those of Wölfhügel and Meade Bolton have brought to light, is that when organisms of this kind, which are not the natural inhabitants of water, are introduced into this medium, a large proportion of them are frequently at first destroyed, a greater or less multiplication in their numbers often subsequently taking place.

The *Bacillus anthracis*, as is well known to bacteriologists, appears in two very distinct forms, the *bacillus*-form and the *spore*-form, and these present very great differences in their powers of endurance, the former being destroyed with comparative ease, whilst the spores are remarkable for their vitality. Mr. Crookes and his colleagues have apparently experimented with the bacillus-form of anthrax only, which they state is rapidly destroyed when introduced into London water, but Dr. Meade Bolton, who has dealt with anthrax in both its forms, has shown that the spores of anthrax retain their vitality even in distilled water for upwards of ninety days, and that it is only the bacilli which rapidly perish in some kinds of potable water. In polluted well-water Meade Bolton has also shown that even the bacilli are persistent for upwards of ninety days, and the spores for nearly a year, whilst Wölfhügel has found that in polluted river-water (the River Panke, in Berlin), even when diluted tenfold with distilled water, the anthrax bacilli undergo extensive multiplication.

PERCY F. FRANKLAND

Normal School of Science,
South Kensington Museum, S.W., July 26

Animal Intelligence

IN NATURE for July 22, on p. 265, Mr. Frederick Lewis calls attention to a nest-building wasp who closed up her nest without filling it first with grubs or laying an egg. There is nothing uncommon in this neglect on the part of the wasp, as any one who has at all studied their habits in the tropics will know, such perfectly empty nests being frequently met with. I have often thought the empty nest might have something to do with the fact that the wasp may not have been prepared to deposit her egg; but then, if that were the case, we should occasionally find nests with the remains of the caterpillars or