An Oviparous Species of Peripatus.

MR. DENDY'S observation of the extrusion of incompletely developed eggs in Peripatus is not, as he appears to think, entirely new. Captain Hutton was the first to observe it, in *P. novæ-zealandiæ*, and I confirmed his observation for the same species in my monograph of the genus. No one knows whether the eggs so extruded undergo complete development. I am inclined to think that the process, which has only been observed in animals in captivity, is an abnormal one, and is caused by the alteration in the conditions of the animal's life. We know that the New Zealand species does bring forth fully-developed young.

I hope that Mr. Dendy will carry out his intention of fully investigating the development of the Australian species.

A. SEDGWICK.

Trinity College, Cambridge, September 18.

A Rare Phenomenon.

ON a visit to Dunecht, I was just leaving the Observatory about 11.18 G.M.T. on the 10th inst., when I saw a sharply-defined straight streak of light arching the sky from east to west. It was about 1° in width, and of uniform brightness from side to side, but more intense towards the western horizon, where it disappeared behind the trees at an altitude of some 4°. Eastward it extended across the constellation of Andromeda, near the girdle, quite beyond the convergence point of auroral rays, or fully 120° from the western horizon. This much I saw, but cannot say if the streak passed north or south of the Great Nebula.

Endeavouring to lay down its course, I perceived that it was rapidly fading, and at the same time drifting southwards at a rate of, perhaps, 1° in five minutes. At 11h. 21·0m. G.M.T. the western portion was considered to cross the celestial equator in R.A. 262½°, passing through a point in R.A. 310° and Decl. + 23° (1840·0). In the meantime the eastern portion had faded away. Although there was a bright aurora in the north-north-west, I did not think that the streak was auroral in character, but rather that it had been caused by the passage of a large meteorite. Next day, however, I stumbled on an account of a similar appearance seen, together with an aurora, by the Rev. Edmund Barrel, at Sutton at-Hone, in Kent, on March 30, 1717 (O.S.). In the Philosophical Transactions, vol. xxx., after describing an ordinary aurora, the account runs:—

"Near Eleven a Clock, there was (besides the *Northern* Brightness) a long Streak, not very broad, extended *East* and *West:* Which beginning in the *Serpent's-Head,* near *Hercules'-Club,* and covering *Arcturus,* proceeded near *Berinices Hair,* and so went over *Cor Leonis,* and thence to *Canicula,* [Procyon, for Sirius had already set] and ended a little beyond that Star. It shone very bright at first, but faded away in about Eight or Nine Minutes. If it had Motion (which I am not sure of) it was Southward. I waited for the next Fit of Brightness of the *Aurora;* and in about Seven Minutes, the *Eastern* Part of the Streak, viz. from the *Serpent's-Head* to near *Berinices Hair,* became visible again tho' dim, and was quite effaced in Four or Five Minutes more: And I did not yet perceive any Change of its Place."

The course described agrees fairly with the arc of a great circle 120° in length, joining Procyon and the head of Serpens.

Assuming the Dunecht arch to have been also part of a great circle, its highest point must have been 8° 50′ east of the meridian, at an altitude of 62° 24′ above the southern horizon. The Magnetic Survey of Profs. Rücker and Thorpe gives the point to which the dipping-needle is directed as 19° 49′ E.; altitude 71° 3′, for 1891·69.

A letter signed "Wigtownshire" in the *Scotsman* of September 14, dated September 12, says:—"There appeared here last night, between nine and ten, a very bright, luminous arch, reaching from south-west to north-east. It extended directly over the zenith from horizon to horizon, and formed a very interesting spectacle while it lasted, which was only about half an hour. It seemed to be of electric origin from its wavy motion, and was slightly tinged pink at the eastern point just above the horizon. . . ."

Assuming the correctness of the dates on which the arch was observed—and of the Dunecht date I am quite certain—it seems that this rare phenomenon was visible on two successive nights.

RALPH COPELAND.

Royal Observatory, Edinburgh, September 21.

LAST Friday, the 11th, my attention was called at 9 p.m. to a most remarkable appearance in the sky. It consisted of a luminous band stretching from the eastern horizon to the west, and passing a little to the south of the zenith. It was first seen here at 8.20, and began as a luminous ray coming up from the west, but when I first saw it, it had extended as described from west to east. It was like a straight tail of a large comet with its head below the horizon, or the track of the beam from a powerful electric search light. Its eastern end lay a little to the south of the Pleiades, which were just rising; and in the west it passed through Corona Borealis. The night was a brilliant starlight one, and small stars could be seen through the luminous band. It was seen in the Co. Kildare, 50 miles from here, and there it passed through the zenith also, which would show that it was at a great altitude. It gradually faded away, and was gone at 9.30. It would be of interest to know if it was observed in other parts of the country.

W. E. WILSON.

Daramona, Streete, Co. Westmeath, September 16.

SOME NOTES ON THE FRANKFORT INTERNATIONAL ELECTRICAL EXHIBITION.

I.

ON arriving in Frankfort one finds oneself in a lofty, palatial railway station, compared with which King's Cross looks mean and Victoria Station is a shanty. This new terminus at Frankfort is not, as with us, an hotel with trains whistling and shunting in the back premises; it is essentially a railway station, standing proudly alone at the western extremity of the town. And the practical Englishman is as much impressed by the completeness of its internal arrangements as by the anti-Ruskin lesson it teaches, that architectural skill when fitly applied to a railway station can produce as noble an edifice as when bestowed on a temple.

Leaving the railway station all is changed. We are on the outskirts of the town, amid unfinished houses, heaps of bricks, vacant plots strewn with rubbish, and the restless hammering of the house contractor. The Exhibition is close at hand, composed at first sight mainly of wooden hoardings, temporary structures, "restaurations," and *bier hallen:* it is the Chalk Farm fair again of our early youth, or Chicago in 1873, a month after the great fire. Presenting at the entrance a letter bearing the magic pass-words "Prüfungs Commission der Internationalen Electrotechnischen Ausstellung," we are ushered past the barrier with bows, and find ourselves surrounded on all sides by shows—Siemens and Halske's Miniature Theatre, admission 2½*d.*; Electrical Ballet, admission 1*s.*, 2*s.*, and 3*s.*; Diving Pavilion, seats 5*d.*, standing room 2½*d.*; Electrical Race Course, 2½*d.*; Siemens and Halske's Dancing Flames, 2½*d.*; and so on, all over the Exhibition grounds. Have we come all these miles, at an invitation conveyed to us through the English Foreign Office, merely to visit a collection of what are literally twopenny-halfpenny shows?

We try one of them, the Miniature Theatre, passing in by the stage door, through the courtesy of Messrs. Siemens' representative, and thus avoiding the crowd of people that flocks in at every one of the many afternoon and evening performances. In view of the audience are 48 handles, which work a large puppet show, but a puppet show without puppets, without music, without acting, without even a joke. Turning any one of 36 of these handles towards the left turns on a group of little white or red or blue incandescent lamps placed at the sides, at the top, and at the bottom of the little stage, but hidden by the scenery from the audience. Turning any one of these handles to the right also turns on the respective set of lamps, but now their brightness can be gradually diminished by revolving one of the remaining 12 handles, which gradually introduces resistance into the particular circuit. For example, either the red, or the white, or the

blue lamps behind any side wing, top drop, or set piece, can be separately turned on, or all can be turned on and the brightness of the lamps of any one colour varied independently of the brightness of the remainder.

A bell tinkles, and the curtain rises, showing a pretty set scene of a Swiss village with mountains in the background. It is late in the afternoon. The attendant slowly revolves one of the resistance handles—the daylight wanes, the shadows grow long, the sun sets, and the snowy peaks of the mountains are ruddy with the Alpine glow. The effect is so lifelike and so beautiful that a spontaneous gasp of admiration is forced from the audience.

Then the stage grows gradually dark, lights are seen at the cottage windows, but the night is stormy, for the attendant now works the handles rapidly, as does the organist the stops when performing one of Bach's fugues: lightning plays on the hills, now a blinding flash lights up the road, the houses, and the waterfall; but the flashes grow less vivid, and one sees, or thinks one sees, the storm blowing away over the mountain tops. Presently the moon rises, the audience feel the quiet of the bright moonlight night, then the dawn, and finally the sunshine bathes the scene with light.

Since the opening of the Exhibition many theatrical managers, we were told, had ordered complete sets of this electric apparatus; and no wonder, for on it can be played a symphony in the music of colour.

We next went to see Messrs. Siemens and Halske's "dancing flames," the seats at this show being also well filled with a twopence-halfpenny paying audience. First, Koenig's manometric flames were described and shown in action; then Dr. Froelich's method of working them from a distance, the elastic membrane of the little gas-bag being pushed in and out, not directly by the air puffs, but by the motion of the ferrotyped iron disc of a telephone, the current through which was varied by speaking to a microphone. Next were shown some experiments, extremely interesting to the electrician, for illustrating graphically how self-induction, mutual induction, capacity, &c., affected the current produced by an alternate current dynamo.

We presume that the considerable number of people who, having paid for their entrance to the Electrical Exhibition, are willing to form group after group and pay an extra fivepence at the many performances that are given daily of these two shows by Messrs. Siemens and Halske, are not wholly ignorant of what they are paying to see. Probably, therefore, the continued attraction which such shows have for audiences drawn from the people is only another proof of the fact that science, and a love of science, have permeated to a much lower stratum of the nation in Germany than in England.

Numerous must be the Germans not much above the level of the sightseers at a village fair who have already listened to the explanation of Dr. Froelich's method for exhibiting these alternate current phenomena, and yet the method is novel to the majority of the English scientific visitors. For it was only some three months ago, when Prof. Perry showed his new steam-engine indicator to the Physical Society of London, that the President suggested how he thought it possible that that instrument might be converted into an oscillating telephone with a mirror on its iron disc, and used for projecting on a screen the current curve of an alternate current dynamo. But nobody at the meeting was apparently aware that Dr. Froelich had been employing a telephone with a mirror on its disc for this very object—such is the resistance to the spread of ideas introduced by difference of language.

The apparatus employed by Dr. Froelich is as follows:—A large telephone iron disc has a small piece of looking-glass stuck on it eccentrically, and at the back is a horse-shoe permanent magnet, the soft iron pole-pieces of which are wound with a coil carrying the current produced by an alternate current dynamo. The iron disc is therefore pulled more or less by the magnet, depending on the strength and direction of the current passing round its poles. A beam of light from an electric lamp is reflected from this mirror on to a screen, and as the alternating current flows round the magnet a vertical line of light is formed on the screen, the position of the spot of light on this line being at any moment a measure of the strength and direction of the current produced by the machine. At least, this will be the case if the natural period of vibration of the telephone plate be very small or very large compared with the periodic time of the current—a condition we presume Dr. Froelich has attended to.

To produce a motion of the spot of light at right angles to the former line, Dr. Froelich does not cause the telephone to be moved backwards and forwards with an oscillatory motion, by the rotation of the dynamo armature, as suggested at the Physical Society of London; but before the beam of light reaches the screen, he causes it to suffer a second reflection from one of a series of small plane vertical mirrors, arranged around the surface of a cylinder parallel to its axis. By suitable worm-gearing, the quick rotation of the dynamo causes a somewhat slow rotation of this cylinder, but quick enough to produce an apparently continuous horizontal beam of light along the screen if there be no current flowing—that is, if the mirror on the telephone plate be at rest. Hence, the combination of the vertical and horizontal motions of the beam produces a curve which shows the shape of the current-wave extending over some four or five periods.

The effect of adding self-induction or mutual induction or capacity to the circuit is instantly seen by the change in the shape of the current-curve on the screen, and the change of phase is also evident from the shifting of the whole series of waves sideways. The comparison between the current waves in the primary and secondary circuits of a transformer is also very prettily illustrated.

This lecture concluded with an exhibition of an apparatus that has been constructed for Dr. Froelich for the examination of compound sounds. On a shaft, turning at a uniform velocity, are eight little alternate current dynamos, and by pressing down a piano key, which closes the circuit of the particular dynamo, a current is sent round the soft iron pole-pieces of the horse-shoe permanent magnet at the back of a telephone disc. The number of pole-pieces and armature-coils on the respective dynamos are such that, on pressing down the keys in succession, the telephone emits the notes of an ordinary musical octave, and by pressing down two or more the compound sound is heard.

An Englishman finds it somewhat exasperating, if he desires to see the whole Exhibition, to have to be constantly taking out his purse to make small payments for entrance here and entrance there; but, as half the receipts for the shows go to the Exhibition authorities, they will be saved from the financial *fiasco* that attended the Edinburgh Exhibition of last year, for that Exhibition had to be finally declared bankrupt, even after all the money guaranteed by the promoters had been called up. Further, the shows are themselves illustrations of the application of electricity to industry and art: the mere bazaar element, that has been so prominent a feature at some of the Exhibitions held at Earl's Court, is practically non-existent at the Frankfort International Electrical Exhibition.

International, however, the Exhibition is but in name, the comparatively small exhibits of one or two English and American firms only serving as a reminder of the magnificent collections of electrical machinery and apparatus England and America could have contributed. As a display, however, of the part Germany is playing in the development of electrical industry, the Frankfort Exhibition is most interesting.

Two separate buildings are devoted respectively to electrical railway signalling and to telegraphic and telephonic exhibits. The Government have contributed an interesting collection of historical telegraphic apparatus, from which it may be seen that the signalling instruments have been going through the same sort of evolutionary changes in Germany as in England, with this difference, however, that our apparatus has reached a much later stage of development than theirs. The German telegraph wires have been well erected, although less attention than would satisfy an English telegraph engineer has been paid in obtaining that perfect symmetry in the hanging of the wires which is necessary to avoid contacts being produced between them as they are swayed backwards and forwards by the wind. The underground wiring is especially good, but the methods of testing and signalling are antiquated, and the routine of the Telegraph Department generally is fettered with red tape.

There is one detail, however, in connection with the German Post Office, that forces itself on the admiration of the foreigner. If you desire to send money, you hand in the sum at the post-office, with a postcard costing $2\frac{1}{2}d$, which you address to your correspondent with details of the sum sent, and receive a receipt in exchange. But you need write no letter, send no postal order nor receipt, nor trouble your correspondent to go to the post-office; the postman delivers to your correspondent at his house or office your postcard, and in return for half of it hands him at once in cash the sum of money sent.

The display of telephonic apparatus at the Exhibition is large and complete, but owing to the activity of the commercial traveller of the day in keeping English engineers acquainted with practically all that is being done abroad, there is little that strikes the English telephone engineer as new. A new telephone exchange switch-board, constructed by Messrs. Mix and Genest, contains, however, a point of novelty, and a switch-board of this description has just been adopted at the Berlin Telephone Exchange.

The general arrangement of an exchange switch-board is as follows :—The wires from all the subscribers are brought to all the clerks at the exchange, so that it is possible for any clerk to connect any subscriber with any other, to enable the two subscribers to talk to one another. The calls, however, from certain subscribers only are received by any particular clerk; for example, of all the wires coming to clerk A, only those from, say, 1 to 100 are provided with drop shutters, so that if any subscriber from 1 to 100 rings up the exchange, one of the drop shutters in front of clerk A will fall, whereas if a subscriber from 200 to 300 rings up the exchange, it will be a drop shutter in front of clerk C that will fall. Each clerk, therefore, deals with the calls from a certain set of subscribers only, but this clerk may have to connect any one of this set of subscribers with any other of the same set or with any subscriber of any of the other sets; since, of course, any subscriber to the exchange has the right to be put in communication with any other.

Suppose, now, that clerk A receives a request from subscriber 85 to be put in communication with subscriber 560, the first thing to find out is whether the line of subscriber 560 is free, or whether it has been already connected with some other subscriber by one of the other clerks. This is usually ascertained by means of what is known as a "testing wire," which permeates all the switch-boards of all the clerks, and enables any clerk to see whether any line coming into the exchange is free or not. But in a large exchange the running of this testing wire throughout all the switch-boards necessitates the employment of many miles of wire, and it is to avoid this that Messrs. Mix and Genest have adopted the following new device :—

The ends of the plugs which the clerk presses into the various holes, or "spring jacks" as they are technically called, for the purpose of connecting one subscriber with another, are made electrically in two parts, the tip of the plug being insulated from the remainder by a piece of ebonite; a couple of cells are joined up at the exchange to each pair of plugs, in such a way that on inserting the tip of the second of a pair of plugs into a spring jack, an instantaneous current passes, deflecting the needle of a galvanoscope if the second line be free. For example, clerk A receives a call from subscriber 85 to connect him with subscriber 560: he inserts one of a pair of plugs into the spring jack 85, he then inserts the second plug into spring jack 560, and as the top of this second plug enters the spring jack there will be an instantaneous swing of clerk A's galvanoscope if line 560 be free, in which case the clerk pushes the plug home, and completes the connection between subscribers 85 and 560. If, however, the needle of the galvanoscope does not deflect, the clerk knows that line 560 is occupied, having been connected up by one of the other clerks, and instead of pushing home the plug he pulls it out, and tells subscriber 85 to wait, as line 560 is engaged.

Long-distance telephony is admirably illustrated by the opera at Munich being heard every evening with marvellous clearness at the Frankfort Exhibition, some 200 miles away.

The most striking feature of the Exhibition—indeed, the exhibit that has brought many a foreigner hundreds of miles to Frankfort—is the electrical transmission of power from Lauffen, over a distance of 109 miles. No measurements have yet been made by the jury of the exact amount of power that is received, or of the efficiency of the transmission; but as over 1000 sixteen-candle lamps are daily fed by the current, as well as an electro-motor pumping up water to form a large artificial waterfall, the actual power received must be something like 100 or 110 horse.

The plans had to be rapidly formed, for it was not until May 1 that it was definitely decided to carry out the experiment. The transformers have, on the one hand, been duplicated, from an anxious dread on the part of each firm of contractors that the other would not have finished their work in time; while, on the other hand, the insulators of the proper size are yet only partly ready, and many are defective from too hurried baking. Permission to carry the wires had to be obtained from the four Governments of Baden, Hesse, Würtemburg, and Prussia, and every step of construction had to be taken under the depressing influence of cavilling criticism. But in spite of all these difficulties, it has been conclusively proved that, by means of three overhead bare copper wires, each only 0·158 inch in thickness, supported on poles such as are used for ordinary telegraph lines, it is possible to deliver some 110 horse-power at a distance of nearly 110 miles from the water stream where the power is produced; and further, that this may be done without excessive loss by actually maintaining a potential difference of some 18,000 volts between each pair of wires.

The result is of international importance. The methods that have been employed (and which will be fully described) will probably not be copied in detail on a future occasion; there are doubtless faults which the cautious engineer can criticize; but the broad fact still stands out prominently, that, by an experiment as bold in conception as it has been successful in its realization, the Allgemeine Electricitäts Gesellschaft of Berlin, in conjunction with the Oerlikon Works of Zürich, have made the thoughtful realize that towns like Milan, which are within 30, 40, or 50 miles of vast water-power, may become the industrial centres of the future. It is, indeed, as if it had been shown that such towns stood on an inexhaustible field of smokeless, dustless coal.

(*To be continued.*)