

LETTERS TO THE EDITOR

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[The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to insure the appearance even of communications containing interesting and novel facts.]

Lightning-Flashes

THE brief note (NATURE, vol. xxxv, p. 85) giving the results of the observations of Herr Leyst, of the Pawlowsk Observatory, on the anomalous forms of lightning-flashes, suggests several considerations relating to this class of phenomena.

Leaving out of view the exceptional and anomalous phenomena of slow-moving (ball or globular) lightning—which are very difficult to correlate with any purely electrical manifestation—it is questionable whether it is possible for the observer to determine the direction in which the electrical current moves. In ordinary cases the velocity of the electrical discharge is so great, and the duration of the luminous flash is so brief, that it is impossible for the unassisted eye to determine the direction of motion.

According to the experiments of Prof. Rood (*American Journal of Science*, third series, vol. i. p. 15, 1871; also *idem*, vol. v. p. 163, 1873), the duration of lightning-flashes varies from 1/1600 to 1/20 of a second. Even the maximum duration of 1/20 of a second is probably too small to be recognised by the unaided human eye. Hence simple observation by means of the eye cannot determine the direction in which the electrical current moves.

It is nevertheless true that the eye seems to perceive the direction of motion of the luminous tract from one point of the cloud-covered sky to another. But this seeming recognition of direction must be an illusion of judgment based upon our interpretation of the phenomena presented to the sight. In these cases, our judgment of direction of motion seems to be dependent upon two considerations:—

(1) When the flash bifurcates or forks, we imagine (probably from the analogy of a ruptured projectile) that the electrical discharge passes in the direction of the diverging branches.

(2) But the more common cause of illusion of judgment in relation to the apparent direction of motion of the electrical discharge arises from the difference of brightness of different portions of the luminous path; this gives rise to a difference of duration of the lingering visual impression on the retina. Thus, in the case of a flash several kilometres in length, one extremity will probably be much nearer to the observer than the other; and hence the light emanating from one end will traverse a greater thickness of absorbing atmosphere than that emanating from the other end. This would necessarily render one extremity of the luminous path brighter than the other; and consequently the duration of the impression on the retina would be greater for one end than for the other: hence the flash would seem to reach the end where the visual effect lingered longer at a later period than the other extremity. In other terms, the light produced in the luminous path is really generated sensibly at the same instant of time along its entire length, and the apparent direction of discharge is an illusion of judgment arising from the varying duration of the visual impression, due to differences of brightness in different portions of the flash. It is evident that the refinements of modern methods of measuring indefinitely small intervals of time might render the actual direction of motion of the electrical discharge appreciable to our senses.

With regard to the zigzag and irregular branching forms of lightning-flashes, these are the natural results of electrical discharges through an interrupted and non-homogeneous medium. The enormous length of some flashes (eight or ten kilometres) indicates that the intervening non-homogeneous dielectric acts as an interrupted conductor. In such a medium the path of electrical discharge is along the line of least resistance, which is the line of best induction, which is likewise the line of best conduction. In the atmosphere these lines are irregular and are perpetually shifting, hence the path of discharge may be nearly rectilinear at one time, branching at another time, and even quadrilateral at another time.

Berkeley, California

JOHN LE CONTE

THE quotation from M. Hirn in your issue of January 27 (p. 303) suggests a few remarks. What may be the greatest length of a flash of lightning? In the year 1843 I attempted to answer this question by the following observations.

My Inarya hut had far-projecting eaves supported by rough posts, some black, others white, and thus easy to distinguish. On the first appearance of a storm in a brick-red cloud I took my seat near the threshold, leaning my head against the door-post, and holding to my ear a pocket-chronometer. Among several flashes I noticed one nearly horizontal. It travelled northwards, and its thunder followed 54.4 seconds later. The thermometer being then at 19° C., I took that degree of heat, from want of better information, as mean heat of the whole trajectory, and got thus 343.7 metres for the velocity of a sound per second. This gave a distance of 18.7 kilometres for the commencement of the flash. It had begun before post A and ended beyond post D. As they were near me, I took care not to move my head before measuring with a small sextant the horizontal angle between A and D. I found it = 20° 30', and obtained thus 6760 metres for the length of flash, supposing it horizontal and perpendicular to my line of sight. This result was a minimum, because the angle was evidently too small, and because moreover the flash, not quite horizontal, had travelled obliquely towards me. I drew the latter conclusion also from what appeared to me a fact on this and on other occasions, viz. my ear referred the thunder successively to different parts of the preceding flash. If an amanuensis had been at hand, I could have dictated to him at what beats of the watch the sound came from the direction of each post. It would then have been easy to get at least a rough estimate of the azimuth in which the flash travelled, and consequently its real length. In a similar way I measured on another day a flash more than ten times longer. I have not put down its particulars, because such an enormous result made me fear some mistake in time or angle. On my return to Europe, I mentioned these observations to the late F. Petit, then astronomer at Toulouse. He subsequently informed me that he had measured two flashes of lightning, one 13 and another 17 kilometres long. Should you publish the foregoing note you may induce other observers to follow this line of inquiry with improved appliances.

ANTOINE D'ABBADIE

Abbadia, Hendaye, February 2

Dr. Modigliani's Exploration of Nias

YOU have on two occasions given news of Dr. Elio Modigliani's recent exploration of this remarkable and interesting island. I believe it will therefore interest your readers if I endeavour to complete such information. Dr. Modigliani returned to Florence from Nias a short time ago, and at the last meeting of our Anthropological Society gave an able and graphic account of his visit to the island, and especially of his experience of the people; he illustrated his communication with an exhibition of the rich and very complete ethnological and anthropological collections he has made.

The natives of Pulo Nias are evidently Malesoid, judging from the numerous interesting photographs taken by Dr. Modigliani, and yet they have peculiarities of their own; and looking at the fine series of crania exhibited, one would say that on a Malayan face a Papuan skull had been fastened. Dr. Modigliani found also some resemblance between the Nias people and some of the hill tribes of Southern India. No traces of stone or shell implements are found in use at Nias. The natives get their iron, brass, and gold from traders, principally Chinese, but work the metals themselves with a primitive forge, making axes (hafted in wooden, club-like handles, as those of some African tribes), lance-heads, and swords: the former, usually barbed, recall the Celeban ones; the latter are very like the *parangs* of the Bornean Dyaks. Their shields are often heavy and cumbersome, coated with buffalo-hide, very Bornean in shape; they make besides curious iron helmets of a common Asiatic pattern. The swords are sheathed in wood, and have in front a globular wicker or rotang basket, the size of a big orange, which contains curious and very various amulets, with which they never part willingly; the handle is often carved so as to represent a grotesque human face. The Nias people are inveterate head-hunters, and Dr. Modigliani showed one of their ghastly trophies procured whilst he was there, and preserved in spirits. The head is buried, and when the flesh has fallen off, the skull is hung up under the council-house. Every young fellow to be considered a man must have cut off at least one head—no distinction is made of sex

or age; after that, he wears as special badge a collar made of a polished section of the cocoa-nut palm stem with ends of brass.

The women go about with a curious staff ornamented with brass; the usual ornaments are armlets of brass wire, bracelets cut out of *Tridacna*-shell, and ear-rings of the same material or of metal, and beads. The clothes used to be, and in the southern districts are still, entirely made of beaten bark.

Their idols are roughly carved wooden figures, and both they and the still more primitive carvings representing dead relations vividly recall the idols and the *Karwars* of the Western Papuans. Each village has its chief, and usually war to the knife is waging between one village and the other. This renders a thorough exploration of Nias far from easy.

Dr. Modigliani certainly lost no time, and did his very best; and although quite new to such explorations, in a very short time, with rare energy and perseverance, surmounting many difficulties and not slight dangers, he has succeeded in bringing home most interesting and ample information on the people, extensive ethnological and anthropological collections, important zoological series, and a most interesting sample of the local flora, amongst which are some new species of the singular ant-plants (*Myrmecodia*) now being illustrated by Dr. Beccari.

I must say in conclusion that I do not know of any traveller so young and inexperienced who in so short a time (Dr. Modigliani was absent from Florence altogether just eleven months) has succeeded in doing so much and so well.

HENRY H. GIGLIOLI

Royal Museum, Florence, January 22

"*Lepidosiren paradoxa*"

ZOOLOGISTS will be interested to hear of the capture of a fine specimen of this the rarest of the Dipnoi. Only a few weeks ago I received from my friend Dr. J. Barbosa Rodriguez, the learned and energetic Director of the Museu Botanico do Amazonas, at Manaós, a very fine specimen of the *Lepidosiren*, captured some time last August in that neighbourhood. This specimen is well preserved in alcohol; it measures 85 centimetres in length, with a girth behind the pectorals of 28 centimetres. On opening it I found that it is a female, the ovaries being well laden with well-developed ova; unfortunately the alcohol had not been let into the visceral cavity, and none of the internal organs were in a condition to be successfully investigated. I found the pericardium singularly large and thick. The body is cylindrical, but quite flat along the abdominal surface, where the scales are also bigger, thicker, and of a lighter colour. The short caudal region is much compressed. There are no true median fins except the irregularly rounded caudal, which extends merely as a slightly marked keel to about the middle of the back. The fin-rays on the caudal portion are close together, cartilaginous, and quite hidden by the skin; pectorals and ventrals without traces of membranous edging and rays; the former are slender and compressed, the latter conical and considerably stouter. The entire body, except the head in front of the eyes and the paired fins, is covered with moderate cycloid scales—thicker, as I observed, on the *abdominal cuirasse*, extending from the chin to the anus and composed of about ten longitudinal rows of scales. Except along this ventral stripe, which is of a whitish colour, the animal is generally of a dark brownish purple, with darker indistinct blotches. The double lateral line is dark; it reticulates on the cheeks and around the eyes. These are quite rudimentary, and show under the skin as a whitish spot; they remind me of the eyes of the two *Gymnotus* which I saw alive in the Insect House at the London Zoological Gardens last October. The branchial openings are very narrow, protected by a thick fleshy flap: there are no traces of external branchial appendages, indeed, even the internal branchiæ cannot be seen through the deep, narrow, branchial slit. The mouth is terminal, with well-developed fleshy lips; there are two small conical vomerine teeth; the maxillary and mandibular dental plates are very similar in size and shape; fleshy pads fit into the spaces between the dental ridges. The tongue is thick, smooth, and fleshy, with a rounded point. Four branchial clefts can be made out on each side in the pharynx, the fourth is much reduced; the three free branchial arches are fringed with conical papillæ. The palate and mucous membrane of the mouth is white and quite smooth; the pads along the dental plates are papillose. The anus is exactly 10 millimetres on the left of the mesial line; it

is 8 millimetres in diameter, and surrounded with a border in deep folds. I had forgotten to mention the nostrils: both pairs are *inside* the mouth; the anterior ones, just within the upper lip, are ovoid, transverse, without flap or valve; the posterior pair are situated just outside the hinder ridge of the maxillary dental plate, they are ovoid and longitudinal.

I need hardly insist on the importance of the capture of this new specimen of *Lepidosiren*. As far as I am aware, this is the *fourth* known; there are, besides, Natterer's two preserved at Vienna, and Castelnau's one in the Paris Museum. More recent explorers have utterly failed to find any, although an active search was made by several. Only recently I heard from a high authority the expression of a doubt as to the existence of such a creature as the South American *Lepidosiren*!

I may finally state that, evidently prompted by his friendship for me, Dr. Barbosa Rodriguez, seeing, as he believed, distinctions in his specimen, sent a brief description to a Rio scientific periodical, naming it *Lepidosiren gigliolina*; this before forwarding the specimen to me. I have not yet seen his description, nor am I in a position to decide as to any distinction existing between this and the other three existing specimens. I can only say that I consider such a difference very unlikely. I suppose that, like *Ceratodus*, *Lepidosiren* is liable to considerable individual variation. Lastly, I believe it not unlikely that *Lepidosiren* may be on the verge of extinction; that would account for its rarity.

HENRY H. GIGLIOLI

Royal Museum, Florence, January 22

The Coal-Dust Theory

SOME of the facts elicited at the adjourned inquest on the bodies of the twenty-eight persons who lost their lives in an explosion at Elemore pit on December 2 last, appear to have a direct bearing upon the coal-dust theory, and are therefore worthy of being recorded. It will be remembered that the inquest was adjourned until January 18, when it was re-opened; it was concluded on the following day. The verdict of the jury was as follows:—

"That Ralph Fishburn and others met their deaths by an explosion in the George Low Main seam, Elemore Colliery, on the morning of December 2, 1886; that the said explosion occurred between the Daleway end and the greaser; but what caused the ignition there is not sufficient evidence to show."

One of the victims, named Luke, who afterwards died from his injuries, made a statement to the effect that a shot was fired in one of the main intake airways not far from the bottom of the down-cast shaft, at the instant the explosion took place. The person who, according to Luke's statement, ignited the shot, still survives, and denies having done so, although he admits having fired a shot near the same place a short time previously. Some of the experts, including the two inspectors of mines, came to the conclusion that Luke's statement was the more probable; others were unable to concur with them in this. The evidences of violence point to the place indicated by Luke as having been the origin of the explosion. A good deal of discussion took place between some of the examining counsel and solicitors and some of the witnesses, as to whether coal-dust alone in the absence of fire-damp could originate and carry on an explosion, but nothing new was elicited in this respect. All agreed that there could not have been any gas present at the point where the shot was said to have been fired. Mr. G. Baker Foster was "quite of opinion that there had been no gas; . . . he could not imagine that in such an intake, with such ventilation, and such a position, gas could accumulate for a minute." Mr. Bell, the Inspector of Mines for the district, said:—"The ventilation throughout the pit was good. It was a well-managed pit, and the last in which he would have expected an explosion to take place." Mr. W. M. Atkinson, the Assistant-Inspector, said:—"The explosion was confined to those parts of the pit least likely to contain gas, and where there was the most coal-dust. It was highly improbable that there was any fire-damp where the explosion originated. He once examined the place when the barometer was as low as 27.5 inches, and no trace of fire-damp could be detected." (The barometer stood at 29.55 inches at 1 a.m., two hours before the explosion.) "He believed the explosion was entirely due to the combustion of coal-dust in pure air, and that its ignition was caused by a shot fired by Johnson. A blown-out shot would not be necessary. Wherever there had been coal-dust in the mine the explosion had gone; but wherever there was an absence of coal-dust,