

LETTERS TO THE EDITOR

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.]

[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.

JOHN LE CONTE

Berkeley, California

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 the 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