

LETTERS TO THE EDITOR.

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Experimental Study of Fulgurites.

FULGURITES, or the tubes of fused sand which are sometimes formed when heavy discharges of lightning strike on sandy soil, are not common enough to make their study very easy. It has been frequently remarked that they usually have a spiral or cork-screw form, but, so far as I know, it has not been decided whether or not this is accidental, and whether the direction of rotation of the spiral remains constant in the same fulgurite, or whether it is always the same in the case of various discharges. Through a fortunate accident I recently hit upon a way of extending our knowledge of these curious autographs of thunderbolts. The accident referred to was the circumstance that I was standing within about 50 feet of the spot on our lawn where a rather heavy discharge struck a day or two ago. I was about to walk across the lawn at the time, but was delayed a moment to reply to a question, when the bolt fell. The report was not deafening, resembling the explosion of one of the modern dynamite cannon crackers with which we have become familiar. There was a distinct flash of fire at the surface of the ground, and a column of steam or smoke 6 or 8 feet high. On examining the spot I found three patches of withered clover in a line about 18 inches apart. At the centre of one was a hole about an inch in diameter, and in the neighbouring one a smaller hole of perhaps a quarter the size. It had been raining hard for a hour or more, and we had had much rain for the past week, which made the ground an excellent conductor, and I was surprised to find that I could pass a straw down the larger hole a considerable distance.

I melted about 15 lb. of solder in an iron pot and poured



Photograph of the cast of a hole formed in ground by a lightning discharge.

it into the hole until it was full, and then carefully excavated the cast. In digging it out, I found a lateral tube several inches below the surface joining the two holes, and one or two lateral branches to the large tube, into which the solder had not penetrated. The cast obtained was nearly 4 feet in length, and the ground was soaking wet, which surprised me a good deal, for I imagined that the discharge would spread out and become dissipated long before reaching a depth of 4 feet in wet soil. The edges of the tubes were lined with small patches of white grains of sand fused together. The metal cast had an unmistakable spiral form, which could be followed for its entire length, and was especially conspicuous at the lower or smaller end. The diameter of the artificial fulgurite increased to a depth of about 2 feet, after which it diminished gradually. The spiral form can be seen in the accompanying photograph of the cast. It was clock-wise in the downward direction, that is, it was similar to that of a cork-screw. The surface was covered with small buds, which were arranged in straight lines along its length, some of the lines 7 or 8 inches long. One of these lines can be seen in the photograph immediately to the right of the label. These lines may be due to cracks in the tube, resulting from the explosive action of the steam. The localisation of a bright light at the surface of the ground is extremely interesting. Several members of my family, who were not looking at the spot at the moment the flash struck, turned round at the report, and said that they saw a bright light and a cloud of smoke. It will be interesting

to hear if others have noticed this phenomenon. It may possibly be due to the combustion of a blast of gas generated by the passage of the discharge through the soil.

On the day after the storm I found another and much larger hole on the golf links, where a very heavy discharge had struck and demolished a wooden box of sand on the top of a banked-up tee, leaving no mark, however, on an iron cylindrical can of water standing beside and in contact with the sand box. Lateral branches had spread out in all directions over the top of the tee, making furrows similar to mole tunnels. I have not yet made a cast of this hole, which is probably 6 or 8 feet deep, pending the decision of the golf committee. Similar holes must be of very frequent occurrence, and their study by this method should prove interesting.

East Hampton, Long Island.

R. W. WOOD.

Ooze and Irrigation.

THE valuable contribution to this subject contained in the letter of Mr. Horwood (July 14, p. 40) shows the importance of communicating the results of research. I am, in consequence, submitting a few further facts which have not heretofore been made public. Up till the present time it has been assumed that our British Annelids were limited to a few species of earthworms, and a few aquatic forms usually lumped together as Tubifex. So far is this from being the case that we have at least four distinct groups of indigenous worms, to say nothing of the many foreign species found at Kew, Chelsea, Oxford, and elsewhere. These are, first, the true earthworms, of which we have nearly forty species, now ranged under upwards of half a dozen genera. Secondly, certain species of semiaquatic worms, including not only the well-known *Allurus* (*Eiseniella*), but two species of *Helodrilus*. Of these, *H. oculatus*, Hoffmeister, is now known to be British, while a second species, *H. elongatus*, Friend, new to science, is at present known to occur in Cornwall in streams and lily ponds. These are of peculiar interest, both because they necessitate a revision of nomenclature and because they link on the earthworms with the aquatic forms.

Next come the ooze formers, which are exceedingly numerous, and occur in almost all our lakes and ponds, our rivers, streams, ditches, and pools, doing an immense work as scavengers and mould-makers. Lastly, we have to notice another series, which may be conveniently spoken of as white worms (*Enchytræids*). It is in relation to these that I wish especially to make one or two observations. Some

years ago I carefully examined the banks of the Eden near Carlisle. I then found, not only a large series of water worms engaged in making ooze, but, at particular seasons of the year, an equally varied assortment of *Enchytræids* (*Fridericia*, *Heulea*, *Enchytræus*, and others) at the roots of grasses. By careful observation I found that these were most abundant at the time when decaying vegetable matter was in a state of fermentation, and that they were apparently engaged in clearing off this fermenting matter.

I have recently further observed on the Malvern Hills that, if the stones are lifted which have for a time been covering the grass and causing it to decay, one finds that, when a given stage of decay is reached, certain white worms always make their appearance; and that these *Enchytræids* are, curiously enough, almost invariably associated with a species of earthworm (*Lumbricus rubellus*, Hoffm.). Other observations, such as that relating to the amphibious nature of the tiny aster-worm (*Enchytræus parvulus*, Friend), and the action of other forms on decaying seaweed and the like, will call for fuller treatment elsewhere. Enough has been said to show that a very wide field of observation is opened up, and that, while it has its interests for the geologist, it is of supreme importance for the biologist and the student of agriculture. I am at present engaged in a series of observations which are bringing many new facts to light.

HILDERIC FRIEND.

Malvern, July 18.