the following as bearing, perhaps, the greatest resemblance to the above case as regards atmospheric conditions :—

"À la suite d'un violent orage observé près de Wakefield, le 1[er] mars 1774, lorsqu'il ne restait plus dans tout le ciel que deux nuages peu élevés au-dessus de l'horizon, M. Nicholson voyait à chaque instant des météores semblables à des étoiles filantes descendre du nuage supérieur au nuage inférieur."

October 28. GEORGE M. MINCHIN.

The Dispersal of Acorns by Rooks.

IN peat-mosses, on open chalk downs, and in ploughed fields, often a mile or more from the nearest mature tree, one constantly finds acorn-husks and also seedling oaks, which last a few months or, perhaps, a couple of years, and then die, the conditions being unfavourable. It has always seemed to me, while studying the origin of the existing fauna and flora of Britain, that this dispersal of acorns ought to give an important clue to the means by which this country was again clothed when the climate became more genial after the Glacial Epoch. The oak has the largest seed of any British plant, and if it can be carried distances of a mile or more, it is evident that the whole of our present flora may have spread more rapidly than is usually imagined, and may have crossed straits and wide rivers.

I have for several years noted the position of these seedling oaks, finding them in places where no mammal would take the acorns. For instance, they are common in any of the New Forest peat-bogs that are within a mile of an oak-tree. They are common also in some places on the top of the escarpment of the South Downs, half a mile from oaks, and 300 or 400 feet above them. They are always associated with empty acorn-husks, stabbed and torn in a peculiar way.

In October and November rooks feed in the oak-trees, and I have long felt convinced that they were mainly responsible for the dispersal of acorns, though it is not easy to catch them actually doing it. On October 29 of this year I was successful. In the middle of an extensive field, bordered by an oak-copse and scattered trees, a flock of rooks was feeding and passing singly backwards and forwards to the oaks. On driving the birds away, and walking to the middle of the field, I found hundreds of empty acorn-husks, and a number of half-eaten pecked acorns, which had not had time to change their colour—a cut acorn changes colour on exposure to the air like a cut apple, though not quite so fast. This showed that the birds had been disturbed in the middle of their feast, for the marks on the acorns were quite unlike those made by a rodent or any mammal. They were stabbed and pecked, and the husks were torn off in strips, usually starting from a puncture. It was also noticeable that many of them were not shed acorns, but were accompanied by acorn-cups, the stalks of which had been bitten to tear them off the trees. This was singular, for the ground beneath the trees was covered with shed acorns. The rooks, however, were in the trees, not under them, and the reason for the selection of acorns in cups is probably that they are easier to carry—a shed acorn must be an awkwardly large and slippery thing for a rook's beak, one with a stalk will be more convenient. Several uninjured acorns were found, and most of the remains occurred on smooth spots of short turf—places where a slippery acorn might conveniently be pecked without being lost. One almost uninjured acorn had been driven by a single peck deep into the soft soil of a mole-hill.

It might be thought that it would be much simpler for the rooks to feed on the ground beneath the trees. Some of them apparently do so; but the majority seem always to carry the acorns into the open. The rook is a suspicious bird, quarrelsome, and a born thief. He seems particularly to object to a comrade watching him from any post of vantage, and the rooks when among the oaks, for some reason or other are always quarrelling, notwithstanding the abundance of food. An acorn dropped on rough ground or in a peat-moss would stand a great chance of being lost in some crevice or soft place; but the oak seeds so freely, that the bird need not waste time trying to recover the lost acorn—there are plenty more on the tree.

In this way oak-woods must spread rapidly. But we still want observations as to the distance to which acorns can be carried. I have seen seedling oaks at a distance of a mile from the nearest mature tree (not necessarily the tree from which the acorn came), and have found the characteristically torn husks somewhat further away. Do rooks roosting in elm-trees ever carry home acorns for supper? There used to be a number of rooks which roosted in elms near Brighton in the autumn and winter, but crossed the Downs to feed in the Weald. I have often watched them returning at dusk. Do they ever bring acorns from that distance? This flock may have been responsible for the seedling oaks near the edge of the Downs; and if it could occasionally bring an acorn still further, to Brighton, it is evident that the oak may have crossed the Strait of Dover, when it was somewhat narrower, and that Britain, as far as the oak shows, may have been continuously an island since the Glacial Epoch. CLEMENT REID.

On the Audibility of Fog Signals at Sea.

IN NATURE of August 8, attention was called to some recent investigations, published in *Hansa*, on the inaudibility of fog-horns at sea within certain zones surrounding the signal, although the horn is distinctly heard outside of such regions. It seems strange to me that I can find nowhere suggested that this may be a phenomenon of interference similar to that suggested in light by Dr. Lloyd of Dublin (*Trans. Roy. Irish Acad.*, vol. xvii.).

If we let x equal the distance of the observer from the signal, h and y the heights of the signal and the observer, respectively, above the level of the sea, and δ the linear difference between the paths of the reflected and the direct rays of sound, then

$$x = \frac{1}{2\delta}\left\{\delta^4 - 4\delta^2\ (y^2 + h^2) + 16\,h^2 y^2\right\}^{\frac{1}{2}} = \frac{2\,hy}{\delta}$$

approximately. An attempt to apply this formula to the observations recorded in the Report of the American Light-House Board, published in 1894, was foiled by the lack of sufficient data for substitution in the above formula. However, if $h = 100$ ft., $y = 30$ ft., and δ be taken for a wave-length of 2 ft. (which are probable values for the variables), then we would expect minima of sound at 1·1 and 1/3 miles, the maximum between these being at a distance of half a mile from the source of sound, which quantities are of the right order of magnitude. These distances might be modified considerably by refraction, the wind, and to some extent by the tide. When there are two minima, as in the *Hansa* experiments, this seems a much more probable explanation than that by refraction alone generally offered, and it explains the phenomenal loudness outside the silent area. The above equation shows that the boundaries of the silent regions in vertical planes are hyperbolas, which is essentially different from what the refraction theory gives. F. E. FOWLE.

Washington D.C., U.S.A., October 21.

To Friends and Fellow Workers in Quaternions.

IN NATURE for October 3, 1895, there is a letter, signed by P. Molenbroek and Shunkichi Kimura, on promoting the study of quaternions and allied systems of mathematics. I notice that this has not, as yet, been responded to in NATURE. I do not think that the subject should be allowed to drop; but that some permanent good should be done to science by making this branch of mathematics part of the compulsory course of study for students for the highest honours in mathematics in our universities and uuniversity colleges, in the hope that more workers may follow the subject up afterwards.

Unquestionably the calculus is of very great value in the higher natural philosophy, and in every sense will repay the trouble bestowed upon it, though I speak in all meekness and not as an eminent authority on the subject. May we hope for some information as to what form the literature of the International Association will take? G. H. J. HURST.

Eton College, Windsor.

The Colours of Mother-o'-Pearl.

HAD Mr. C. E. Benham given his address when writing to you on this subject (NATURE, vol. lii. p. 619), I should merely have taken the liberty of sending to him direct a copy of a paper entitled, "Prof. Blake and Shell-growth in Cephalopoda" (*Ann. and Mag. Nat. Hist.*, ser. 6, vol. i. pp. 421-427, June 1888), in which similar arguments to those of Mr. Benham were adduced. Now, however, perhaps you will permit me to refer Mr. Benham to Dr. W. B. Carpenter's report on shell-structure (*Brit. Assoc. Rep.*, 1844, p. 11). As for the text-book writers, who usually support their explanation of the iridescence of mother-o'-pearl by reference to the theory of