In this connection it is interesting to note that $X_3$ does not appear to occur to any appreciable extent in the atmosphere. Sometimes when suffering from the difficulty of clearing out these gases I have been goaded into speculating whether they do not represent the partially abortive attempts of ordinary metals to imitate the behaviour of radio-active substance; but whereas in these substances the $\alpha$ particles and the like are emitted with such velocity that they get clear away from the atom, in ordinary metals they have not sufficient energy to get clear, but cling to the outer parts of the atom, and have to be helped by the kathode rays to escape.

I would like to direct attention to the analogy between the effects just described and an everyday experience with discharge tubes—I mean the difficulty of getting these tubes free from hydrogen when the test is made by a sensitive method like that of the positive rays. Though you may heat the glass of the tube to melting point, may dry the gases by liquid air or cooled charcoal, and free the gases you let into the tube as carefully as you will from hydrogen, you will still get the hydrogen lines by the positive-ray method, even when the bulb has been running several hours a day for nearly a year. The only exception is when oxygen is kept continuously running through the tube, and this, I think, is due, not to lack of liberation of hydrogen, but to the oxygen combining with the small quantity of hydrogen liberated, just as it combines with the mercury vapour and causes the disappearance of the mercury lines. I think this production of hydrogen in the tube is quite analogous to the production of $X_3$, of helium, and of neon. I have been greatly assisted in the experiments I have described by Mr. F. W. Aston, Trinity College, and Mr. E. Everett. J. J. THOMSON.

February 8.

### The Water-surface "Halo."

THE "halo" which a happy memory of eighty years enables the Rev. O. Fisher to recall in NATURE of February 6 was probably one to which the explanation offered by Dr. Franklin Parsons does not apply.

There is a very striking phenomenon of separate rays or shafts of light converging on the shadow of the observer's head when this shadow is thrown on water. The phenomenon requires for its production certain conditions:—(1) A bright sun, high in a clear sky. For this reason in these latitudes the appearance is best seen about midday in summer. In winter it is scarcely noticeable. (2) The water must not be quite clear; on the other hand it must not be very turbid. (3) The surface must not be smooth, but may be fairly briskly agitated, but again not too briskly. (4) The water should be deep.

If any one of these conditions is absent the phenomenon is not seen, or is only imperfectly seen, as I was able to satisfy myself about twenty-five years ago by observations made, day after day, on the lake of Ullswater, where a stream discharged the muddy water of a mine far into the lake, and thus provided one of the necessary factors of variation. The necessity of these conditions, when once discovered, makes the explanation easy. The irregular convexities of the ruffled surface acting as condensing lenses separate the light penetrating the water into converging shafts. Along certain lengths of each or many of these shafts a sufficient condensation of light takes place to render them visible by means of the additional illumination of the slight turbidity. Thus the water is filled with luminous parallel shafts of varying lengths, which, seen in perspective, have their vanishing point in the shadow of the observer's head. I remember that it was long before I realised that the rays were *below* and not *on* the surface. When the observer's head is not many feet above the water the rays may be traced to great distances—50 or 60 degrees—from the shadow of the head.

The phenomenon, though often very brilliant, is often unnoticed, even by good observers—I think because it requires a certain comprehensive glance, no doubt in the first instance accidental, to recognise that the widely separated broken radiations belong to a single convergent system. But when this system has once been realised it becomes hauntingly present, and one glimpses portions of it at every glance at the water, even though the shadow of the head is cut off from the surface. A. M. WORTHINGTON.

Exmouth, February 9.

### An X-Ray Fringe System.

BY allowing a diverging pencil of Rontgen radiation to fall at nearly grazing incidence on one of the sets of cleavage planes of a crystal of rock-salt, and observing the intensity of the reflected pencil by a photographic plate, we find a series of well-marked and equal-spaced maxima in positions corresponding to equal increments of $\cos\theta$, where $\theta$ is the angle of incidence of radiation on the cleavage planes. In the directly transmitted beam there is no indication of variation of intensity with angle of incidence We thus have what *appears* to be a series of X-ray spectra of different orders, due to agreement in phase of waves from successive layers of molecules. Calculating on this assumption we get a wave-length of the order of magnitude in agreement with that calculated from the velocity of ejection of electrons by a substance exposed to this particular radiation—that is, assuming the results of the experiments of A. L. Hughes and others on ultra-violet light are equally applicable to Röntgen radiation. While only few experiments have yet been made on which to base any interpretation, this is in agreement with what we have already observed. Of the experimental results there is no doubt, and we cannot at present suggest any probable explanation except the very obvious one of interference. Further experiments are in progress.

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G. H. MARTYN.

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February 11.

### Atmospheric Potential.

IN NATURE of December 12, 1912 (p. 411), Dr. George C. Simpson directs attention to several outstanding problems in atmospheric electricity. He says, *inter alia*: "Everywhere it has been found that the air is a conductor, and that the potential gradient is practically the same." It is not the object here to consider these statements, however questionable.

The potential gradient of the atmosphere is the difference of electric potential between two points in the same vertical one metre apart; which, for the first few kilometres above the earth's surface, is about 100 volts.

Now one problem which Dr. Simpson does not mention is the absence of current from the upper regions of the atmosphere to the lower corresponding to this difference of potential between them. It is a fundamental law of electricity that an electric current will flow in a conductor from a high potential to a lower one.

A conductor projecting vertically from the earth's