Letters to the Editor.

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Broadcasting Transmitter.

I EXPECT that broadcasters would find that a definite generator of E.M.F. would give cleaner articulation than is probable with a transmitter depending on random variation of resistance. In other words that one of those telegraphic devices which I described long ago (Proc. Inst. E.E., vol. 27, p. 838, Dec. 1898), consisting of a light stiff coil of fine wire suspended elastically in an annular magnetic field, would reproduce speech and music better than a microphone. The fluctuations of the induced current in such an instrument are not capricious, and apart from stimulation it is silent; always provided that the exciting magnetic field is kept steady—a condition likely to be assisted by saturation of the iron magnet core, or by use of a sufficiently strong permanent magnet.

If an electromagnet is used, some contrivance is advisable whereby the coil circuit is automatically opened whenever the rousing current is put on or off. Otherwise, the response may be too violent for the valve and rest of the apparatus, not to mention a receiving ear.

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The Green Flash at Sunset.

SIR ARTHUR SCHUSTER in his review of Dr. Mulder's book on this subject states that "there seems no reason to doubt that dispersion combined with absorption of light completely accounts for the effect" (NATURE, September 16, p. 370). Yet Dr. Mulder's own view is that a complete explanation is still wanting.

My apology for again raising this question is that I believe I can supply from some recent observations what seems to be lacking in the dispersion theory, which fails to account for the remarkable variations in visibility of the green flash under apparently favourable conditions.

On the outward voyage to Australia to observe the solar eclipse of September last, I was struck with the faintness of the green flash at sunset, although the sky was clear down to the horizon. It was visible in binoculars ($\times 8$), but scarcely, if at all, to unaided vision. On the return journey, on the other hand, the phenomenon was brilliant every evening on the run between the north-west coast of Australia and Java, and I was able to observe also what happened when Venus set in the sea. On this voyage the ordinary mirage effect was conspicuous, that is, distant land appeared raised above the sea horizon by a small interval, due to the total reflection of sky and land at the surface of a thin layer of air of low density in contact with the sea. At sunset the last segment of the disappearing limb was similarly reflected and reversed, causing a lenticular shape with the cusps raised about a minute of arc above the horizon. The green flash occurred when the green-edged cusps coalesced into a single bright patch, and this on one occasion turned to violet at the last moment.

The striking thing about the setting of Venus was the sudden appearance of a reflected image moving upwards to meet the descending image, and the instantaneous and conspicuous change of colour from

dull red to green at the moment of meeting of the two images. The vertical spectrum of the planet caused by atmospheric dispersion was at no time visible in the binoculars, but the change of colour was probably due to the setting of the lower red of the spectrum.

It seems to me evident from these observations that the mirage layer greatly intensifies the ordinary dispersion effect, by adding the light from the reflected image to the direct image at the moment of setting. The normal dispersion effect at sunset under conditions when there is no mirage is scarcely visible to unaided vision, although easily seen in a telescope of low power.

J. EVERSHED.

Kodaikanal Observatory, September 26.

Thermal Opalescence in Crystals and the Colour of Ice in Glaciers.

IN a previous communication to NATURE (vol. 109, page 42) it was pointed out that the thermal agitation of the atoms in crystals causes optical heterogeneity which should give rise to a noticeable scattering when a beam of light is sent through the substance, and that this effect may actually be observed with suitable arrangements in clear quartz or rock-salt. I have recently found that the same phenomenon is conspicuously exhibited by ice. If a block of clear ice, free from air-bubbles, striae, or other obvious inclusions, and having flat sides, be held squarely and a narrow pencil of sunlight concentrated by a lens be passed through it, the track of the pencil shows a beautiful blue opalescence. It is advisable not to use a very highly-condensed cone of rays, as this would cause internal melting of the ice with formation of cavities which reflect white light and distract the eye. A dark background should be provided against which the track may be viewed. With small or irregular lumps of ice, the observation may easily be made by immersing the ice in clear distilled water contained in a glass flask which is painted black outside, windows being provided for ingress and egress of light and for observation of the opalescent track. Even with ice which at first looks unpromising owing to internal flaws or inclusions, portions in which the blue opalescence is not overpowered by disturbing effects may be picked out. A suitable orientation of the block with reference to the direction of the incident rays is often useful in avoiding reflections from cavities in the ice.

A comparison of the relative scattering powers of clear water and of ice at 0°C . is instructive. According to the measurements of Bridgeman, the compressibility of ice is 35×10^{-6} per atmosphere, and its refractive index is 1.310, while the corresponding figures for water are 52×10^{-6} per atm., and 1.334. The Einstein-Smoluchowski formula gives the scattering power of water at 0°C . as 144 times that of dust-free air, and if it could be applied in the case of solids, the scattering power of ice should be 79 times that of air. As has already been pointed out, however, the formula has to be modified in the case of crystalline solids, and a revised calculation indicates the scattering power of ice as about 30 times that of air, which is of the order actually observed in experiment.

The atomic scattering of light in block-ice demonstrated and measured in these experiments should certainly be capable of being observed on a large scale under suitable natural conditions. Indeed, it is well known that masses of ice in glaciers and icebergs often exhibit a blue colour, and it appears to the writer very significant that the circumstances in which natural ice shows a blue colour are precisely those found to be