Evaporation of Meteors

The publication of radar photographs in *The Times* of October 11, 1946, and also in *Nature* on December 28, has brought the question of ionic clouds again to the fore. There is no evidence that the photographs are of visible meteors. They are probably of clouds of electrons at or near the *E*-layer, usually known as 'scatter clouds'. Visible meteors move. These do not, as was pointed out in the note in *The Times*. (By visible meteors, I mean large meteors which would be visible to the naked eye if there were no ordinary cloud obstruction.) The second photograph in *Nature* of December 28 is, I think, a secondary effect of a meteor shower. We have, in fact, a photographic record taken on November 15, 1937, showing occasions on which visible meteors have produced no scatter cloud for longish wave-lengths between 32·35 and 16·13 metres. The picture in *The Times* may be of scatter clouds produced by invisible meteors evaporating; but it should be noted that meteors are by no means the only cause of scatter clouds, which may equally well be produced before Dellinger 'fades'. We have considerable evidence of this.

The second *Times* photograph may be considered as evidence of an invisible meteor shower. But with regard to the increase in this photograph, taken at 3.40–3.50 a.m., in comparison with the first photograph, taken at 9.15–9.25 p.m. on the previous day, it has been shown that there is always a peak of about three to six to one at about this time, whether there is a meteor shower in progress or not.

A theory which will account for all the effects is as follows: it is supposed that scatter clouds can be produced by small meteors evaporating. (If they are small enough, they do evaporate at great heights. The larger they are, the lower the height at which they will evaporate.) The amount of energy supplied is proportional to the area swept out by the meteor. The amount of energy required to evaporate it completely is proportional to its volume. Thus there must be a size at and below which the energy supplied is greater than that required, and small enough meteors will evaporate, producing scatter clouds. It is probably these scatter clouds which *The Times* photograph shows, and not visible meteors.

The fundamental idea which makes a complete understanding possible is published in "Studies in Radio Transmission"[1]. It is this: that there is a very close analogy between the scattering of radio waves from scatter clouds and the scattering of alpha particles from heavy molecules. This leads to the Rutherford fourth-power law. The ratio of the scattered to the primary signal E/E_0 for a constant number of particles is proportional to $(\lambda/a)^4$, where a is the radius of the cloud. It is thus only the small clouds which scatter effectively, and not the big clouds. The big clouds are visible meteor trails. The small clouds are the evaporating invisible meteors, and it is these that we see in the radar photograph. The fourth-power law for λ has been checked experimentally and theoretically, and I think there is no doubt about this. According to this explanation, the whole of the results are intelligible.

T. L. ECKERSLEY

Weatheroak,
Danbury,
Essex.

[1] *J. Inst. Elect. Eng.*, **71**, 405 (1932).

Chromatic Correction of Wide-Aperture Catadioptric Systems

IN the Schmidt camera system, where the spherical aberration of a mirror for a selected wave-length of light may be completely corrected by a suitably figured plate at the centre of curvature, there remains a chromatic variation of spherical aberration which sets a limit to the performance on the axis and for small angles of field, and which, for large relative apertures, becomes undesirably large. The effect is commonly reduced by introducing first-order axial chromatic aberration by using a corrector plate in the form of a figured lens of finite power instead of a figured plane parallel plate, the form in which the axial and marginal thicknesses are equal being not far removed from the optimum. Fig. 1 shows the departures (measured in *d* wave-lengths per 25 mm. of focal length) of the *C* and *g* emergent wave-fronts from the spherical *d* wave-front for a Schmidt system of relative aperture $f/0{\cdot}7$, using for the corrector plate a borosilicate crown glass, $n_d = 1{\cdot}516$, $V = 64{\cdot}1$, the maximum aberration for *g* being 1·5 wave-lengths when the marginal and intermediate zonal errors are equalized. The chromatic difference of spherical aberration is, of course, of the sign corresponding to an increase of glass-path with increasing aperture.

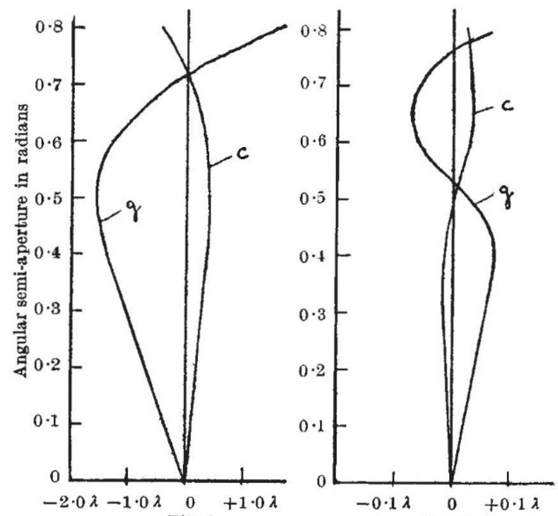

Fig. 1 Fig. 2

ABERRATION OF THE EMERGENT WAVE-FRONTS FOR *C* AND *g* PER INCH OF FOCAL LENGTH WITH RESPECT TO THE SPHERICAL WAVE-FRONT FOR $f/0{\cdot}7$ SYSTEMS

In the systems in which one or more spherical-surfaced meniscus lenses are used to correct the mirror aberration[1,2], the chromatic difference of spherical aberration is of similar magnitude to that of Schmidt systems, but of opposite sign, since the paraxially achromatic meniscus has an effective glass-thickness decreasing with aperture; this is normally minimized by introducing first-order axial colour of opposite sign to that used in Schmidt systems, resulting in curves practically identical with those in Fig. 1 but in the reverse sense. This fact, which does not appear to have been noted hitherto, obviously offers the possibility of a very considerable reduction of the residual chromatic aberrations by a combination of the two forms of corrector.

Preliminary calculation of an $f/0{\cdot}7$ system consisting of two menisci concave to, and on each side of,