decreased. In view of the uncertainties still present, the author proposes as a best estimate for log τ_{op} the round value log $\tau_{op}=-19.0$. The masses of meteoroids must therefore be computed by using

$$\tau_p=1\times10^{-19}v, \tag{42}$$

with v expressed in cms^{-1} and I_p in units of zero magnitude. The error in the mass resulting from the intrinsic error of τ_{op} may be estimated to be of the order of 2 or even larger. From the preceding discussion it is clear that it is more likely that equation (42) gives overestimated values of τ_p than vice versa. The error in relative masses, caused by the uncertainty in the adopted value of n, between 10 and 70 kms^{-1} does not exceed 20 percent.

If we express the luminous efficiency τ_p in physical units as the ratio between the energy radiated in the blue-emulsion spectral range and the kinetic energy of the parent meteoroid, we have

$$\tau_p=5.25\times10^{-10}v. \tag{43}$$

Therefore τ_p turns out to be 0.002 for a velocity of 40 kms^{-1}.

It is interesting to observe that the dependence of τ_p on the velocity appears to be linear, as Öpik predicted in his earlier work (1933) for bright meteors. The linear dependence is, however, also valid for fainter meteors, and here Öpik's theory fails. The present best estimate of the coefficient of the luminous efficiency τ_{op} is about 8 times smaller than Öpik's 1933 value [10] and only 5 times smaller than the value he proposed in 1955.

On the basis of equation (42) we can evaluate the mass of a zero visual magnitude meteoroid at a given velocity. After converting visual into photographic magnitude by means of equation (4), we may use the following formula, empirically derived by Jacchia (1958) from photographic meteors with smooth light curves:

$$E_\infty=\frac{10^6 I_{pm}^{1.093}}{v\cos Z_R}, \tag{44}$$

where I_{pm} is the photographic intensity at maximum light, and Z_R is the zenith angle of the meteor path. The integrated brightness E_∞ and the meteor mass outside the atmosphere m_∞ are related [see equation (10)] by

$$m_\infty=\frac{2E_\infty}{\tau_{op}v^3}. \tag{45}$$

At $v=40$ kms^{-1} and cos $Z_R=0.6$ (mean value of cos Z_R for the Super-Schmidt meteors) m_∞ is 0.84 gram.

The ionizing efficiency.—It appears that at present the uncertainty concerning the ionizing efficiency β of meteors is an order of magnitude larger than the uncertainty affecting the luminous efficiency τ_p. It therefore seems reasonable to deduce the ionizing efficiency from the present results on τ_p and from experimental data. As a result of their program of combined radio and photographic observations of meteors, Davis and Hall (1963) were able to determine the ratio I_p/q for 7 meteors, q being the electronic line density of the meteor trail. Their result was log $I_p/q=-3.96\pm0.14$ at $v=32.2$ kms^{-1}.

The ionizing efficiency is defined by an equation analogous to equation (1):

$$I_q=-\frac{1}{2}\tau_q v^2\frac{dm}{dt}, \tag{46}$$

I_q being the power going into the production of electrons. The electronic line density is given by

$$q=-\frac{\beta}{\mu v}\frac{dm}{dt}, \tag{47}$$

β being the probability of ionization of an ablated meteor atom of mass μ. The terms β and τ_q are related by

$$\tau_q=\frac{2\Phi}{\mu v^2}\beta, \tag{48}$$

where Φ is the mean ionization potential; $\Phi\sim7$ ev (Cook and Millman, 1955).

From equations (2) and (46), we have

$$\frac{I_p}{q}=\frac{\tau_p}{\beta}v^3\frac{\mu}{2}. \tag{49}$$

[10] Harvard meteoric masses are, however, only 6.5 times smaller than the values computed on the basis of equation (42). See footnote, page 145.