RECALCULATIONS OF CLOUD ELECTRIFICATION BASED ON A GENERAL CHARGE-SEPARATION MECHANISM

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Professor B. J. Mason, Imperial College, London, in private correspondence, has made several important comments and corrections concerning the paper "Calculations of Cloud Electrification Based on a General Charge-Separation Mechanism" by J. D. Sartor.[1] Since the outcome is favorable to the author's hypothesis he hastens to bring the adjusted results to the attention of the reader. The items requiring correction are:

1. The factor q_o of Table 1 is dimensionless and refers to values of the electric field, E, in volts per centimeter not esu as indicated.

2. The E should not appear in the right hand term of equation (6) and the numerical factor should be $2\pi^2$, not $4\pi^2$.

3. The values of q_o in Table 1 should be multiplied by 300 when entering equation (6) or more precisely, equation (6) should contain an extra factor of 300 in the exponent and q_o entered as given in Table 1.

Professor Mason points out that if the field is allowed to vary in computing the volume charge density, equation (2), the field growth, equation (6), takes on a different form in which the exponent contains t in place of t^2 and the double summation is replaced by its square root. This suggested generalization and a clarification of the summation notation have been incorporated into a rederivation of the field growth

[1] Sartor, J. D., Calculations of Cloud Electrification Based on a General Charge-Separation Mechanism, J. Geophys. Res., Vol. 66, No. 3, March 1961.

equation along the same general lines given in the paper, but considering the field E to vary with time in the computation of the volume charge density.

The revised growth equation becomes

$$\frac{E}{E_o} = \exp\left\{\left[1200\,\pi^2\,\mathcal{E}q_o \sum_{j=2}^{k}\sum_{i=1}^{j-1} n_j r_j^2 (V_j - V_i)^2 n_i r_i^2 + \frac{\lambda^2}{4}\right]^{1/2} t + \frac{\lambda}{2}t\right\}$$

where the notation is as before. The summation notation applies to the drop-size distribution divided into k intervals in which each interval is characterized by a mean radius r and drop concentration n and the k intervals are ranked by increasing radius from j = i = 1 through h = i = k.

The computations of the field growth based on the revised equation are shown in Figure 1. The charge-exchange coefficient is taken as $1/3 \times 10^{-2}$, a value slightly less than the minimum expected value. The previous value was 10^{-2} corresponding closely to the maximum expected value of 1.08×10^{-2}. The results are shown parametrically according to the value of $\mathcal{E}$, the particle interaction efficiency.

As before, it appears that, assuming reasonable or even low particle-interaction efficiencies, the proposed general charge-separation mechanism is capable of building fields of thunderstorm magnitude in the required time providing an appropriate cloud and rain drop distribution is present.

The corrections pointed out by Professor B. J. Mason are profoundly appreciated and his suggestions for improvement of the field enhancement equation gratefully acknowledged.

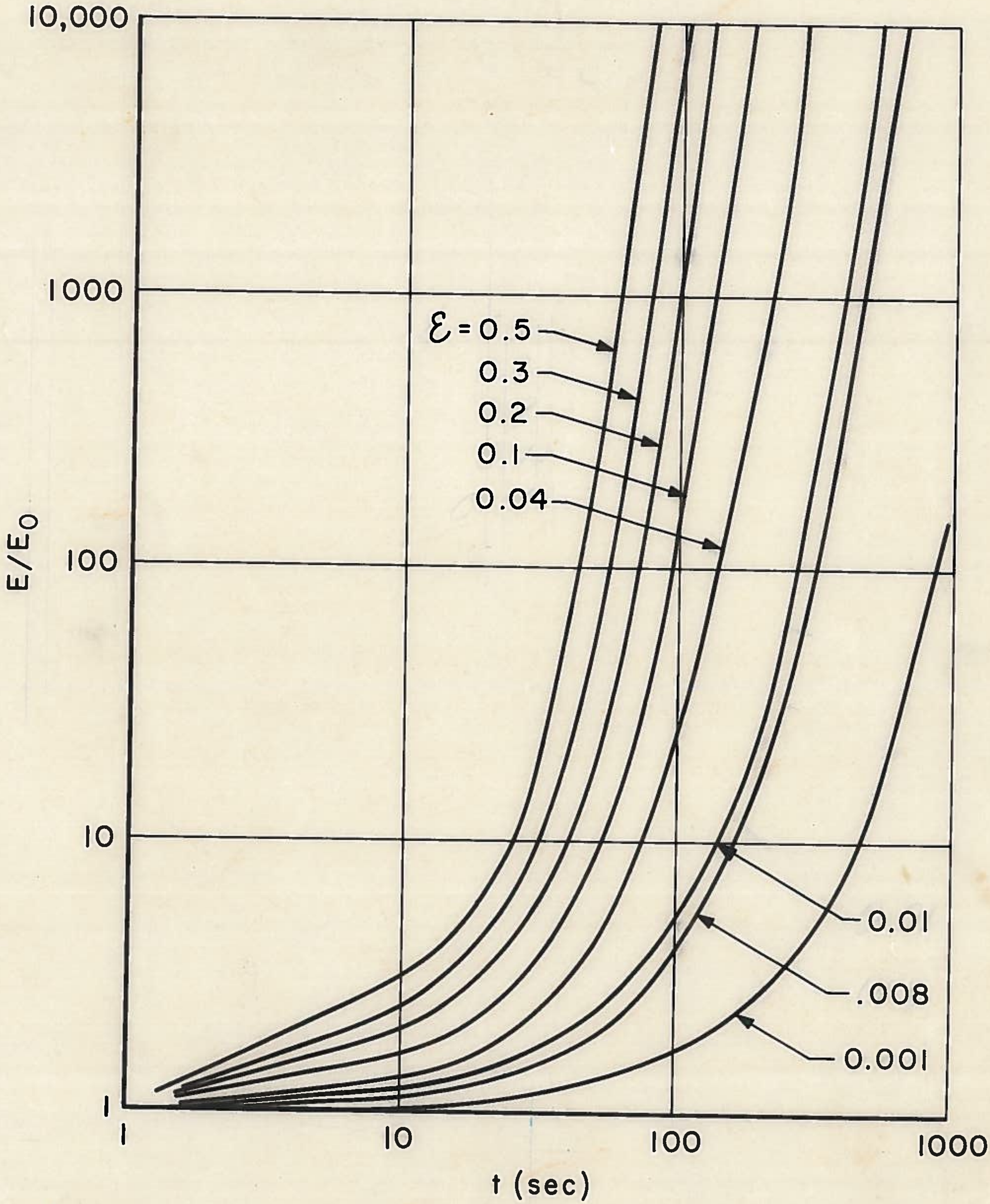

Fig. 1—Field enhancement versus time for values of ℰ shown beside curve

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