NOTE ON THE COMPLETE STOCHASTIC TREATMENT OF ELECTRON CASCADES

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1. INTRODUCTION

IT is well known that the cascade theory correctly describes the behaviour of a cascade of electrons and photons in their passage through matter. Denoting* the number of particles (electrons *plus* positrons) whose energies lie between E and E′ by N (E, E′), one has so far calculated to varying degrees of accuracy the mean $\overline{N(E, E')}$ of this number after a thickness t of material in a shower started by a primary electron or photon of some given energy E_0. The process is, however, a stochastic one, and this information is therefore far from complete. If one wishes to know something about the probable deviation of the actual number from the mean, one has to calculate $\overline{N(E, E')^2}$. If one wishes to know next whether this deviation is more likely to be in the direction of larger or smaller showers, one has to calculate $\overline{N(E, E')^3}$. Complete information about the stochastic process is only obtained if one knows $\overline{N(E, E')^k}$ where k is any positive integer. It has been shown in a recent paper (Bhabha, 1950, Theorem 2) that for a stochastic assembly of continuous parametric systems of a very general nature, which includes in particular the type of physical system with which one is concerned here,

$$\overline{N(E, E')^k} = \sum_{l=1}^{k} a_{kl}\, N^{(l)}(E, E') \tag{1}$$

where

$$N^{(l)}(E, E') = \int_E^{E'} dE_1 \int_E^{E'} dE_2 \ldots\ldots \int_E^{E'} dE_l \cdot n_l(E_1, E_2, \ldots . E_l). \tag{2}$$

$n_l(E_1, \ldots . E_l)$ is a symmetric function of the l variables $E_1, \ldots . E_l$, which we call the lth order correlation function. The coefficients a_{kl} are numbers which do not depend on the particulars of the physical system.

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* Use is made of the same notation as in a recent paper (Bhabha, 1950, referred to here as B). It will be assumed that the contents of that paper are known to the reader.