whenever the radiation absorbed by an electron in passing over a free path is greater than the increase in kinetic energy and energy radiated through acceleration during collision.

If the electron consists of a packet of radiation, as de Broglie and Schrödinger suppose, it is all the more likely to possess the above properties.

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INTERPRETATIONS OF THE CURVE OF NORMAL GROWTH

ALTHOUGH there seems to be a striking similarity between the course of growth in animals and plants and the courses followed by the autocatalytic curves as described by Robertson[1] and Crozier,[2] it seems doubtful whether such a complicated process as growth would follow so simple a chemical reaction. A growth equation embodying a general biological rather than a chemical interpretation of the growth process may be derived in the following manner. Minot[3] showed for a number of animals that the percentage increments in body weight $\frac{W_2 - W_1}{W_1}$ tend to decrease constantly from birth to maturity. Child[4] explains this decrease in the percentage increments as due to the ever-increasing mass of inactive protoplasm in the body cells accompanying growth and differentiation. As the mass of inactive protoplasm increases, the mass of active protoplasm decreases and hence the relative rate of metabolism decreases, which in turn brings about a decrease in the reproductive or growth power of the cells. These percentage increments may be looked upon as measuring the average growth power of the body cells, if growth power may be defined as the percentage rate of increase in growth. Wright[5] suggested briefly that the hypothesis that growth power falls off at a constant percentage rate leading to the curve

$$\log \log \frac{c}{W} = a - kt \tag{1}$$

might often give a good fit to growth data. This equation may also be expressed in the forms

$$\log W = A - be^{-kt} \tag{2}$$

and

$$L = Be^{-ce^{-kt}} \tag{3}$$

Dr. Wright found that equation (1) gave a very good fit to growth in weight W of rabbits. Equation (2) was found by Davidson[6] to give a good fit to growth in weight W of dairy cattle. Equation (3) was applied by Weymouth[7] with excellent success to growth in length L of the razor clam.

The derivation of equation (2) is as follows: $\frac{dW}{Wdt} = P$ where W equals body weight at any time t, and P equals the growth power of the body cells. Since growth power is assumed to fall off at a constant percentage rate, $\frac{dP}{Pdt} = -k$. By integration $\log P = -kt + C$, or $P = e^{C-kt} = \frac{dW}{Wdt}$. By integration again, $\log W = -\frac{1}{k}e^{C-kt} + A$, or $\log W = A - be^{-kt}$. In the last equation A is the logarithm of the weight of the animal at maturity; 100k is the constant percentage rate of decrease in growth power according to the above interpretation, and b locates the curve in time; W is the weight at any time t. The equation of the curve for weight W is $W = e^{A - be^{-kt}} = Be^{-be^{-kt}}$ where $e^A = B$. This equation is similar to equation (3) for length L and is S-shaped with the point of inflection at approximately 37 per cent. of the final weight. It differs from the growth curves of Robertson and Crozier in that it embodies a general biological rather than a chemical interpretation of the growth process and at the same time requires the utilization of fewer velocity constants.

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