[1] Hodge, *Physic. Rev.*, **26**, 540 (1908); **28**, 25 (1909).

[2] Goldmann, *Ann. Physik*, **27**, 449 (1908).

[3] Grumbach, *Comptes Rendus*, **176**, 88; **177**, 395 (1923); **179**, 623 (1924); and **180**, 1102 (1925).

[4] *Physic. Rev.*, **18**, 402 (1921).

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# REMARKS ON PROFESSOR LEWIS'S NOTE ON THE PATH OF LIGHT QUANTA IN AN INTERFERENCE FIELD

By Richard C. Tolman and Sinclair Smith

Norman Bridge Laboratory of Physics and Mount Wilson Observatory

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In an earlier number of these Proceedings,[1] Professor G. N. Lewis adopted an extreme form of the light quantum theory, in which the light quanta are assumed to travel in straight lines except when deflected by matter, the facts of interference being explained by the assumption that the quanta do not go to those places where the wave theory forbids the action of radiation. As a crucial test between this and other theories of light, Professor Lewis proposed an experiment in which the absence of light quanta, traveling over a particular path which leads to the center of of an interference band on a screen, would produce an unbalanced torque on a reflecting mirror.

In criticizing this proposed test,[2] the present authors called attention to the fact that the absence of action at a given point certainly could not always be interpreted as due to the absence of quanta passing through that point, since it would then be impossible to account for the well known phenomena of standing light waves. For this reason we suggested that even if light quanta should travel in straight lines, Professor Lewis's experiment might give no effect, since quanta might still be traveling through the point on the screen where interference exists, and then continue by transmission or reflection to places where the action of light is permitted.

Professor Lewis now replies[3] that our suggestion would contradict the principle of the conservation of energy. He argues that, if the interference pattern falls on a screen of highly absorptive material, all the energy available from the light source will produce its effect in a very thin layer of the screen at those places where the light bands are produced by reinforcement, and hence there can be no additional quanta traveling through the position of the dark bands.

We are, however, unable to agree with this argument. In discussing the case of an absorptive screen we called attention to the possibility that quanta arriving on the screen at a position where interference occurs could be deflected, if necessary, to regions where the action of light is permitted by the wave theory; and in the case of a *highly* absorptive material it would seem reasonable to expect a very sharp deflection of the quanta, that arrive at points where interference occurs, to neighboring regions where they are needed to produce the experimentally verified reinforcement. Hence we do not agree that our suggestion involves any contradiction to the principle of the conservation of energy.

In conclusion we wish again to emphasize our belief that hybrid theories containing disparate elements taken both from the wave theory and corpuscular theories of light are probably temporary expedients which will later give place to an integrated view.

[1] G. N. Lewis, these Proceedings, **12,** 22 (1926).

[2] Tolman and Smith, *Ibid.*, **12,** 343 (1926).

[3] G. N. Lewis, *Ibid.*, **12,** 439 (1926).

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# *THE MEAN FREE PATH OF ELECTRONS IN MERCURY VAPOR*

By L. R. Maxwell

Department of Physics, University of Minnesota

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Numerous investigators[1] have determined the nature of the scattering of electrons in many of the common gases and have interpreted their results in terms of the mean free path of the electron. The present article describes a method for measuring the mean free path of electrons and presents the results for mercury vapor for velocities ranging from a fraction of a volt to 3000.

We know from kinetic theory that for a beam of electrons moving through a gas

$$I = I_0 e^{-x/\lambda} \qquad (1)$$

where $I_0$ is the initial number of electrons in the beam, $I$ the number which go a distance $x$ without suffering a collision with a molecule of the gas and where $\lambda$ is the mean free path. In order to apply this equation experimentally it is sufficient to insert a movable Faraday cage which can measure the current $I_0$ and then the succeeding values of $I$. In doing this the natural spreading of the beam must be considered. When there is no gas in the presence of the electrons, let $K$ be the fractional part of the total number of electrons initially present in the beam which enter the cage opening for a certain position $x$. With this definition of $K$ our above equation becomes

$$I = KI_0 e^{-x/\lambda} \qquad (2)$$

which presents a working formula. Having obtained $K$ for a value of $x$