THE PATH OF LIGHT QUANTA IN AN INTERFERENCE FIELD

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In recent papers[1] I have proposed a theory of light according to which radiant energy consists of discrete corpuscles governed by the laws of conservation of energy and momentum, while the probable path of each corpuscle is completely determined by the classical laws of optics. I further proposed a crucial experiment which would decide sharply between the new theory and all previous theories of light.

Now Tolman and Smith[2] suggest that my theory might still be maintained even though the experiment should fail. They take the view that in an interference field where there are bright and dark bands produced upon a photographic plate the corpuscles of light still reach the regions of the dark bands but simply do not mainfest themselves there.

I am afraid, however, that this view is untenable. While a number of physicists have proposed to abandon the law of conservation of energy in detail, I think that no one would propose to give it up as a statistical principle. Yet there seems to be such an implication in the paper by Tolman and Smith. If a beam of light of given intensity falls for a certain time upon a photographic plate we may estimate the amount of energy received by the amount of darkening of the plate. Or if the plate be replaced by an opaque screen we may determine the energy calorimetrically. If we interpose in the path of the beam of light some optical apparatus which will still allow all the light to fall upon the screen, but now in some sort of interference pattern, the total energy received in the same time, judged either by the total amount of blackening or by the rise of temperature, will undoubtedly be the same as before. But according to the view of Tolman and Smith many light corpuscles reach the dark regions of the interference pattern and go through without producing any chemical or thermal effect. In other words, the total amount of energy arriving at the plate is largely increased merely by the interposition of the optical apparatus which produces interference.

I have assumed for simplicity that the light falls upon a nonreflecting screen of high opacity so that all of the light is absorbed in a very thin layer of the screen. If there is some reflection, or if the light is absorbed by the screen after penetrating to a great depth, the whole problem is different, and it would be necessary to know many details before the result of the experiment could be predicted. But no new principle would be involved, and it is far simpler to employ an opaque non-reflecting screen.

I must, therefore, maintain that the proposed experiment is crucial, and if it should give a negative result it must mean, as I have shown in my previous analysis, that the corpuscles of light, even at a considerable distance from material objects, sometimes travel in curved paths. The extreme improbability of this makes me confident that the experiment will give a positive result.

[1] These PROCEEDINGS, **12,** 22 (1926); *Nature,* **117,** 236 (1926).

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

EFFECTS OF AN ELECTRIC FIELD UPON THE RADIATING HYDROGEN ATOM

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It has been observed by Stark and Luneland[1] that the light emitted by the particles in the canal rays, moving through hydrogen at several thousandths of a millimeter pressure, is partially polarized. If these rays are allowed to pass into a high-vacuum chamber, the radiation from the luminous excited atoms dies out with the distance from the entrance. This rate of dying out has been studied by Wien[2] and Dempster.[3] Recently Rupp[4] has observed that the bundle in the high vacuum chamber is partially polarized, the observations giving only qualitative results. The work discussed here is a study of the polarization of the light emitted by the hydrogen canal rays in a low-pressure chamber in which the dying out observed by Wien and Dempster occurred. Under these conditions the particles are disturbed very little by collisions with other particles so that we can observe the behavior of the radiating hydrogen atoms under various external influences; and, since they have a high velocity, a history of the particles can be obtained from observations along the bundle.

A special discharge tube was used in which the cathode rested on a ground joint and separated the discharge chamber from the observation chamber. By means of a Gaede all-steel mercury diffusion pump the pressure in the observation chamber could be kept much lower (0.0003 mm. of mercury) than in the discharge chamber. The canal rays passed through a small hole 0.48 mm. in diameter into the low-pressure chamber and at a distance of 3 mm. entered the space between two condenser plates 23 mm. long and 5.5 mm. apart. The electric field on the condenser was varied from 0 to 8000 volts per cm. and the effect upon the polarization was observed, the direction of observation being normal to the field.

The polarization was observed by photographing the bundle through a