TABLE I.

Pb $\lambda=4.7$ X.U.

Z	A_{Chao}	A_{Tarrant}	σ_{KN}	τ_K
82	14.1×10^{-24}	13.4×10^{-24}	10.2×10^{-24}	1.1×10^{-24}

A = total absorption observed

σ_{KN} = Klein-Nishina scattering

to be in excellent agreement. The surplus, $A-\sigma_{KN}-\tau_K$, agrees qualitatively with the theoretical absorption for the formation of positron-electron pairs.[3]

Details of the calculation, and more complete results will soon be submitted for publication.

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[3] J. R. Oppenheimer and M. S. Plesset, Phys. Rev. **44**, 53 (1933).

On Collisions Between Photons

In the November, 1933 issue of the *Journal of the Optical Society*, Dr. F. L. Mohler describes an experiment in which two conical beams of light were made to intersect each other in such a way that the axes of the cones made an angle of 180° with each other. This experiment is similar to one described three years previously by us.[1] In our experiment the axes of the conical beams made an angle of 120° with each other. In both experiments evidence for the scattering of light by light was sought in a direction bisecting the re-entrant angle between the axes of the two cones. A superficial difference between the two experiments seems to be that Dr. Mohler looked for scattering without, while we looked for scattering with, change of wave-length. However, according to the theory given in our paper the wave-length of the light scattered in the direction of the bisector of the re-entrant angle is

$$\lambda_1=\lambda/(1+\cos\theta),$$

where λ is the wave-length of the light in the original beams and 2θ is the angle between the beams. In Dr. Mohler's experiment $\cos\theta=0$ while in our experiment $\cos\theta=0.5$. Thus on our theory no change of wave-length was to be expected in Dr. Mohler's experiment and his experiment is just a repetition of ours, the only difference being the value of the angle between the two beams of light.

Further, Dr. Mohler's remark that:

"The effect looked for by Hughes and Jauncey can also be ruled out on the evidence that the converse process, the spontaneous creation of two photons from one, is not observed. The radiation from distant stars maintains its spectral characteristics (apart from red shift) for periods of more than 10^8 years"

has no point. If the theory underlying Eqs. (1) and (2) of our paper is examined, it will be seen that we certainly did *not* contemplate the possibility of *two* photons coalescing to form *one* photon. We considered the case where *two* colliding photons gave rise to *two* other photons. Hence the question as to the creation of *two* photons from *one* and *vice versa* has no relation to our work. Conservation of both momentum and energy can be satisfied in the process we contemplated, but not in the process incorrectly ascribed to us by Dr. Mohler. It is believed that, in order to conserve both momentum and energy in photon-photon collisions, the number of photons must be conserved; certainly a process resulting in one photon will not do.

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[1] A. L. Hughes and G. E. M. Jauncey, Phys. Rev. **36**, 773 (1930).

Radiation from the Mutual Annihilation of Protons and Electrons

Sir Arthur Eddington on pages 78 and 79 of *The Expanding Universe* (Macmillan, 1933) says

"So long as they (i.e., free protons and free electrons) are not combined in complex nuclei, protons and electrons are immune from annihilation. The reason for this security is that the photon or quantum of radiation, which results from the annihilation of a proton and electron has to be provided with momentum, which must be balanced by a recoil momentum. But in hydrogen there is nothing left to recoil. Annihilation of a proton and electron (if it ever occurs) can happen only when they form part of a complex system which will leave a residuum to carry the recoil."

Eddington ascribes this argument as to why protons and electrons cannot annihilate each other to Sir Alfred Ewing. The matter was first discussed, however, by Hughes and Jauncey in a letter dated January 4, 1926. This letter appeared in the February 6, 1926 issue of *Nature* and was in criticism of the annihilation hypothesis put forward by J. H. Jeans in a letter in the December 12, 1925 issue of *Nature*. Jeans had calculated the energy of the photon