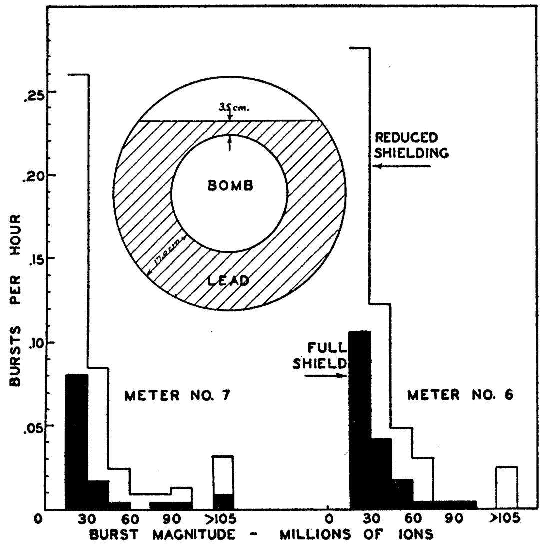

FIG. 1.

writer decided to remove about 250 lbs. of lead shot from Meter No. 7, leaving a minimum thickness of from 3 to 4 cm above the top of the bomb (see Fig. 1). The burst frequency at once jumped from the lowest in the group to approximately twice that of the highest in the group. After a few days an equal amount of shot was removed from Meter No. 6 as a check and a similar large increase of burst frequency was noted. The results for a period of approximately 250 hours before reducing the shielding and an equal period afterwards are shown in Fig. 1.

The observed increase of burst frequency with reduced shielding indicates that the burst-producing radiation is absorbed rather strongly in the lead. With the reduced shield it seems likely that some of the bursts are due to tertiaries produced by air secondaries whereas with the full shield the air secondaries can hardly be effective and all of the bursts are presumably due to tertiaries produced by lead secondaries.

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Direct Detection of the Angular Momentum of Light

It has been known for some time that, on the basis of either the wave theory[1] or the quantum theory (by assigning an angular momentum of $\pm h/2\pi$ to a photon), a beam of circularly polarized light should exert a torque on a doubly refracting plate which changes the state of polarization of the light beam. The result can be extended to elliptically polarized light and it is quantitatively the same on the basis of both theories.

The purpose of this note is to announce the direct mechanical detection of this effect.

The apparatus used involves a torsional pendulum with about a ten-minute period consisting of a round quartz half-wave plate (for a wavelength of 1.2 mu) one inch in diameter suspended with its plane horizontal from a quartz fiber about 25 centimeters long. About 4 millimeters above this is mounted a fixed quartz quarter-wave plate (for the same wavelength) with its axes turned 90 degrees from those of the hanging plate. The *top* side of the upper plate was coated by evaporation with a reflecting layer of aluminum. This whole system is mounted in a heavy copper vacuum chamber with a fused quartz window at the bottom for the light beam. The rotation of the pendulum is observed by a telescope and scale.

Just below the bottom window is mounted a second quarter-wave plate for 1.2 mu in a ring which may be rotated in a horizontal plane from a position in which its axes are at 90 degrees to those of the hanging half-wave plate (i.e., the same direction as the top plate) to a position in which its axes are parallel to those of the hanging plate and back again.

Light from a 3-millimeter tungsten ribbon filament lamp passes up through a fused quartz condensing lens and a large Nicol prism and enters this plate system from the bottom. With the plane of polarization of the Nicol at 45 degrees to the plate axes, the change in light torque caused by rotating the lower plate through 90 degrees was measured by a resonance method, the plate being turned at the end points of the pendulum swing first so as to decrease the amplitude for two full cycles and then so as to increase the amplitude for two full cycles. Preliminary values for the torques obtained at various filament temperatures are as follows:

Filament temperature, degrees absolute		
2400	2600	2800
Torque change, dyne-cm		
2×10^{-9}	3×10^{-9}	4×10^{-9}

Blank runs made by removing the lower plate from the ring holding it, but otherwise turning the ring in the same way with the light on showed no trace of the effect.

At present the largest uncertainty in predicting the exact magnitude of the effect on the basis of the theory is the lack of knowledge of the spectral transmission characteristic of the optical train. With this uncertainty all that can be said at present is that the order of magnitude of the effect found is correct.

More exact measurements of the effect are now being made and will be considered in connection with a more detailed theoretical treatment of the effect in a complete paper to be submitted later.

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[1] A. Sadowsky, Acta et Commentationes Imp. Universitatis Jurievensis **7**, No. 1–3 (1899); **8**, No. 1–2 (1900). P. S. Epstein, Ann. d. Physik **44**, 593 (1914).

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