Letters to the Editor

PROMPT publication of brief reports of important discoveries in physics may be secured by addressing them to this department. The closing date for this department is the third of the month. Because of the late closing date for the section no proof can be shown to authors. The Board of Editors does not hold itself responsible for the opinions expressed by the correspondents. Communications should not in general exceed 600 words in length.

Electron Polarization

C. G. SHULL*
New York University, University Heights, New York, New York
February 1, 1942

ACCORDING to the Mott calculations[1] based on the Dirac electron theory, under suitable conditions electron polarization should become observable in a doubly-scattered beam of fast electrons. Several previous experiments in this field have yielded contradictory results. Dymond's experiment[2] showed no definite effect within his experimental error of 1 percent. Kikuchi[3] has obtained agreement with the theory, but his results have been questioned because of his use of thick scattering foils with their consequent depolarizing action.[4]

Briefly, the present experiment consisted in studying the number of electrons scattered in the two directions, parallel and anti-parallel to the incident beam, as shown in Fig. 1. Electrons of 400-kev energy were scattered through angles of 90° by gold foils sufficiently thin to insure single scattering (four times thinner than required by Wentzel's criterion). Simultaneous counting was performed at the two positions by Geiger-Müller counters. In the design of the equipment, provision was made for the evaluation of other asymmetries which might mask the true polarization. The asymmetries considered were those caused by (1) geometrical differences, (2) counter dissimilarities, and (3) differences in the "reflection" and transmission intensities (cf. below). Electron polarization will cause a greater number of electrons to be scattered in the anti-parallel direction than in the parallel direction.

With both foils of gold and the first one set in the transmission orientation (as shown in Fig. 1), a residual asymmetry of 8 percent was found. To test the correctness of this asymmetry, an aluminum foil was substituted for the second gold scattering foil, thereby making the expected polarization asymmetry much smaller. The asymmetry then found was 1 percent in the opposite direction, confirming the reality of the above effect. A total of nearly one million and a half electrons have been counted and tabulated into the results listed here.

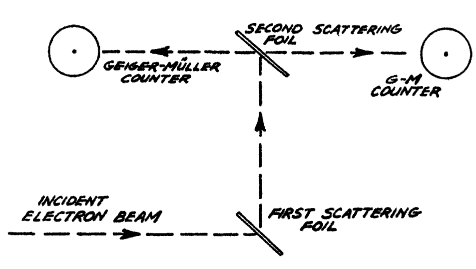

FIG. 1. Schematic diagram of experiment.

The reflection-transmission asymmetry found by Chase and Cox[5] appears to play an important role in polarization experiments. A difference in the number of electrons scattered through the "reflection" side of the foil, the one on which the beam is incident, and the number scattered at the same angle through the other side, the side of transmission, has been observed. This reflection-transmission ratio for the gold foils used amounted to 1.56. There is the possibility then that a reflection polarization asymmetry (in which only electrons "reflected from" the foils are studied) exists as distinct from a transmission polarization asymmetry (in which only electrons scattered through the foil are studied). This difference has been established from the experimental data. The transmission polarization asymmetry is about 2 percent larger than the 8 percent asymmetry given above, while the reflection polarization asymmetry is much smaller than either. Bartlett and Watson[6] have published recalculations of the equations in Mott's treatment and have found for the polarization asymmetry corresponding to 400-kev electron energy, a value of 11 percent.

Since Dymond's experiment, from the figure given in his publication, is of the "reflection" type, the expected asymmetry should be considerably smaller than that predicted by the original theory.

Further experiments on this problem are being carried out with coincidence counters in place of single counters; a complete discussion of this as well as the present work will be published in the near future.

* Now with The Texas Company, Beacon, New York.
1 Mott, Proc. Roy. Soc. **135**, 429 (1932).
2 Dymond, Proc. Roy. Soc. **145**, 657 (1934).
3 Kikuchi, Proc. Phys. Math. Soc. Japan **22**, 805 (1940).
4 M. E. Rose and H. A. Bethe, Phys. Rev. **55**, 277 (1939).
5 C. T. Chase and R. T. Cox, Phys. Rev. **58**, 243 (1940).
6 J. H. Bartlett and R. E. Watson, Phys. Rev. **56**, 612 (1939).

The Behavior of Proportional Counter Amplification at Low Voltages

M. E. ROSE AND W. E. RAMSEY
Bartol Research Foundation of the Franklin Institute, Swarthmore, Pennsylvania
January 10, 1942

IN a recent paper[1] an investigation of the general character of gas amplification in proportional counters was described. This work was confined to the measurement of high amplification factors as a function of counter voltage, counter geometry, nature of gas filler, and gas pressure. Instrumental limitations prevented the pursuit of these studies into the region of low gas amplification where the transition to ionization chamber behavior is to be expected. In order to explore this region and to verify the essential correctness of the ideas previously presented the measurements have been extended by a radically different method.