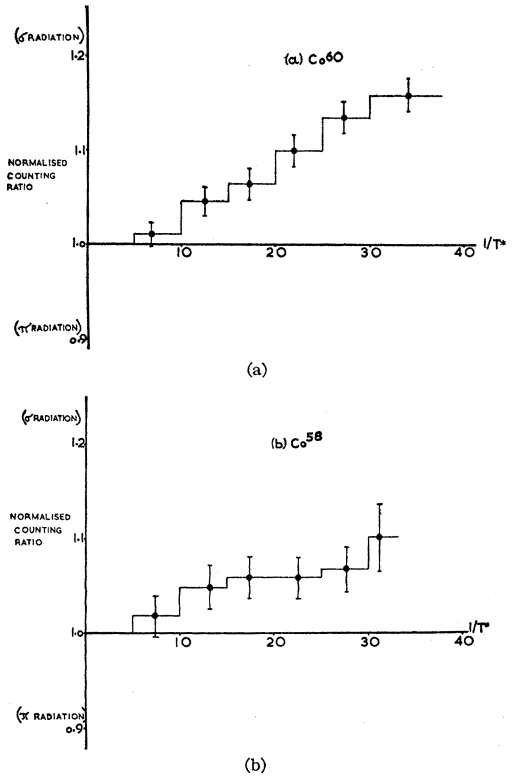

FIG. 1. (a) Polarization of γ-rays from Co^{60}; (b) Polarization of γ-rays from Co^{58}.

established fact[3,4] that the transitions are both $E2$; for Co^{68} we find the transition to be $E2$ also.

The source in each case was a stack of single crystals of the composition (1 percent Co, 12 percent Cu, 87 percent Zn) $Rb_2(SO_4)_2 \cdot 6H_2O$ mounted in a demagnetization cryostat with the b axis and the K_1 axis both horizontal. (K_1 is the direction of maximum susceptibility for the Co^{++} ions in this salt.) There are two axes of alignment in these crystals each making an angle of 53° to the b axis. For complete alignment, the radiation emitted along the b axis should be elliptically polarized (see Condon and Shortley[5]) with the major axis of the ellipse described by the electric vector vertical or horizontal, corresponding to $E2$ or $M2$ transitions, respectively.

The radiations emitted along the b axis were observed using a polarimeter, which relies on the fact that the differential cross section for Compton scattering is dependent on the polarization of the initial γ-ray. Radiation is collimated on to a liquid scintillator (4 percent terphenyl in toluene) where it is scattered. Radiation scattered through 90° in the horizontal and vertical directions is detected by two NaI crystals, which are screened from the direct radiations of the source by the collimator. The coincidence counting rates between each NaI crystal and the liquid scintillator give the number of γ-rays scattered by the scintillator in each direction. For unpolarized γ-rays these counting rates are the same, except for small geometrical differences. Polarized γ-rays are preferentially scattered in a direction perpendicular to the electric vector, and thus the ratio of the coincidence counting rates is in general different from unity. For partially polarized γ-radiation, the coincidence counting rate ratio has a value intermediate between unity and the value for plane polarized radiation. A detailed calculation by Steenberg[6] and Tolhoek and Cox[7] shows that the counting ratio increases from unity to its limiting value as the nuclear alignment becomes more and more complete. The limiting value for complete alignment is greatest for radiation emitted along the b axis (along which we observed).

The salt containing radioactive cobalt was cooled by adiabatic demagnetization to a temperature of approximately 0.01°K, and as the salt warmed up to 1°K the coincidence rates were observed for 15-second intervals. Simultaneously the temperature of the salt was obtained by measuring its magnetic susceptibility. The ratio of coincidence rates normalized to the ratio at 1°K is plotted in Fig. 1 as a function of $1/T^*$ (T^* is the temperature found according to Curie's Law from the susceptibility). Each point is an average obtained from several demagnetizations and the errors indicated are the standard deviations. Frequent tests demonstrated that the counters were stable and that the counting rates observed follow the usual Gaussian curve.

In Co^{60} two $E2$ γ-rays are emitted in a 4–2–0 cascade; the electric vectors of the two γ-rays are therefore parallel at all corresponding positions on each polar diagram. Our results [Fig. 1(a)] are consistent with this scheme. In consequence of imperfect screening, some of the coincidences observed are the result of the cascade γ-rays. The coincidence rate resulting from this cause is temperature dependent and would give a ratio mistakable for an $M2$ transition. However, calculation and experimental data show that the coincidence ratio is not changed by more than 2 percent.

The decay of Co^{58} by K capture (85.5 percent) and β^+ (14.5 percent) branching leads to the 805-kev excited level of Fe^{58}. The observed coincidence ratio [Fig. 1(b)] is of the same nature as that found for Co^{60} indicating that the transition to the ground state of Fe^{58} is electric. Previous measurement of the polar diagram[8] of the emitted radiation establishes the transition as quadrupole. There are some coincidences resulting from the annihilation radiation produced by the positrons, which can bring the coincidence ratio closer to unity but cannot alter the nature of the result. An $E2$ transition from the first excited state of the even-even nucleus Fe^{58} is expected from shell model considerations.[9]

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Angular Dependence of Inelastic Scattering of Protons on Be^9†

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THE fact that the 2.4-Mev level in Be^9 was apparently quite sharp and clearly separated from any neighbors[1–7] made it an appropriate subject for studying the angular dependence of inelastic scattering of protons. A modified form of a camera originally developed by Wilkins[8] (Fig. 1) was used to obtain intensities for scattering angles between 20° and 160° at ten-degree intervals. Eastman NTB plates (1 in.×3 in.) were used and were inclined at about 4° to the scattered protons. Al stopping foils of appropriate thickness were interposed between the target and the various detector plates so as to reduce the track length and resultant background of elastically scattered protons, while at the same time making the tracks of inelastically scattered protons shorter and more easily recognized. The University of Rochester 26-inch cyclotron was used as the source of the 7.1-Mev incident protons, with an appropriate slit system in the fringing field of the cyclo-

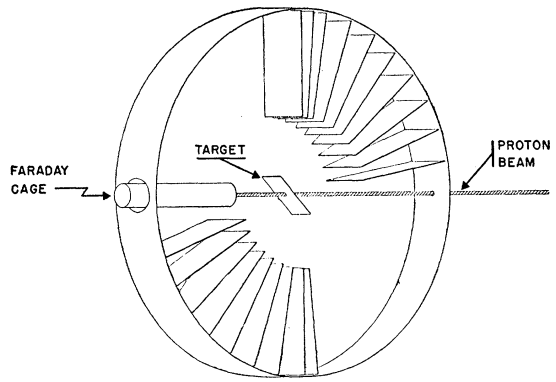

FIG. 1. Scattering camera with 7.1-Mev protons incident from right.

tron. The magnetic flux density in the camera proper was nowhere found to be greater than 40 gauss and at the target was determined to be less than 30 gauss. In view of these measurements, curvature of the proton paths in the camera was extremely small, and all trajectories were taken as straight lines without serious distortion of scattering angles. A control run in the absence of a rarget foil showed the background owing to slit edge scattering and similar sources to be negligible. The early apparent narrowness of the 2.4-Mev level has been confirmed in refined measurements by later observers[5] and is of particular interest since the level is a virtual one, being more than 780 kev above the dissociation energy.

The experimental results are given in Fig. 2. It can be seen that the scattering is essentially isotropic over the range 60° to 160° but then rises to more than three times this value by the time it reaches 20°. It is clear that the counts at the smaller angles cannot be attributed to elastically scattered protons since the distinction in length was easily and clearly made. Longmire[9] has calculated the expected angular distribution on the basis of the simplified model of a neutron and Be^8 previously used by Caldirola. His results gave either (a) isotropic scattering (for $n-p$ force completely exchange) or (b) average predominance of forward and backward compared to 90° scattering as 3 to 1 ($n-p$ force of ordinary, nonexchange, type). If the sharp increase in scattering observed in the forward direction is interpreted as *inelastic Coulomb* scattering, one secures general agreement with (a) i.e., a pure exchange force between n and p since the theoretical calculations did not include the Coulomb force on the proton.[10] It would seem that the rise is too fast for nuclear scattering. If

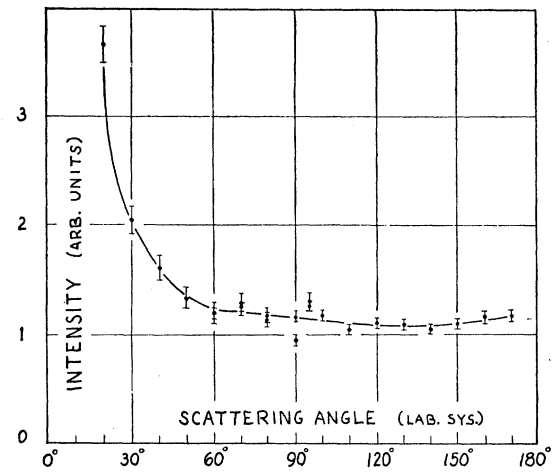

FIG. 2. Angular distribution of inelastically scattered protons from Be^9 (2.4-Mev level).

information could be secured at angles as small as 10°, a continued steep rise would tend to bear out this hypothesis. Longmire properly points out that the model used is a highly simplified one and conclusions based on it cannot be made in fine detail.

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Color Centers Generated in Sodium Chloride by Electrolysis

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HACSKAYLO and Groetzinger[1] have recently reported the existence in sodium chloride crystals subjected to electrolysis of two ultraviolet absorption bands lying at 2260A and 2850A. These writers do not speculate on the origin of these bands. It is of interest to note, however, that a band identified as V_2 has been observed in NaCl colored by x-rays at 2226A by Casler, Pringsheim, and Yuster.[2] This V-band is attributed to trapping of "holes." Furthermore, Uchida, Ueta, and Nakai[3] have reported a band, designated K, at 2900–2950A in NaCl colored by electrolysis. It appears likely that these are the two bands observed by Hacskaylo and Groetzinger.

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Errata

Similarity Properties of the Two-Fluid Model of Superconductivity, E. MAXWELL [Phys. Rev. **87**, 1126 (1952)]. Through an oversight a minus sign was omitted in Eq. (2). The first part of Eq. (2) should read: $F_g = -\frac{1}{2}\gamma T^2 x^\alpha$.

Optical Focusing in Constant Radius Accelerators, DAVID C. DEPACKH [Phys. Rev. **86**, 433 (1952)]. It has come to the attention of the writer that Wideröe[1] published the idea for sequential focusing by magnetic lenses in 1947. It would appear that all work subsequent to that time on sequential focusing in constant radius accelerators, including the writer's, must admit this prior claim, and the writer regrets his not having encountered reference 1 before his own publication.

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Interaction between Electron and One-Dimensional Electromagnetic Field, NATHAN ROSEN [Phys. Rev. **87**, 940 (1952)]. Equation (14) is incorrect in the general case and corresponds to the assumption that the electromagnetic field is moving in the positive direction of the Z axis. For consistency with this assumption further changes in the calculations are necessary, including the deletion of Eq. (22a). The final result remains essentially unchanged, but is subject to the restriction of this assumption.