Since the estimates are extremely rough, it is not surprising that these values differ from the experimentally observed values[1] of 1 and $\frac{1}{8}$ by a factor of two. However, the ratio of the ratios, $(w_L/w_K)_{\text{Ga}}/(w_L/w_K)_{\text{Cd}}$, might be expected to be somewhat independent of the systematic errors in the rough estimate, and it turns out to be approximately $\frac{1}{8}$, in good agreement with the experimental value.

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December 21, 1939.

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[1] G. E. Valley and R. L. McCreary, Phys. Rev. **55**, 322 (1939).
[2] H. R. Hulme, Proc. Roy. Soc. **A138**, 643 (1932).
[3] H. M. Taylor and N. F. Mott, Proc. Roy. Soc. **A142**, 215 (1933).

On the Neutron's Magnetic Moment

As announced previously,[1] we have calculated in detail the influence of magnetization on the transmission of neutrons through polycrystalline iron. Since the coherent scattering is concentrated in Debye-Scherrer rings and since the transmission effect depends in a sensitive manner on the scattering angle, the final result differs radically from that previously calculated[2] for randomly oriented atoms.

The only essential uncertainties in the theoretical evaluation occur from minute deviations from magnetic saturation and from our incomplete knowledge of the distribution of the magnetically active shell in the iron atom. In these calculations the neutron's magnetic moment was assumed to be two nuclear Bohr magnetons. The depolarization effects due to incomplete saturation can only diminish the transmission effect.

To determine the extension of the magnetically active shell we have used various density functions presented in the literature. Slater's[3] hydrogenic functions give so small a form factor for the magnetic scattering that no effect could be expected. Adopting the analytic representation[4] for the Hartree distribution of the 3d electrons in Cu, to Fe, we obtained values for the transmission effects which are very much smaller than any observed previously and differ from those given by Bloch and Alvarez[5] by a factor of approximately $\frac{1}{2}$. The discrepancy is considerably enlarged due to the presence of depolarization effects which manifested themselves experimentally in a deviation from the law: added transmission proportional to the square of the thickness.

Attempts to explain the discrepancy can in our opinion only be based upon the two following possibilities: (1) The form factor used in these calculations is too small because either the charge distribution is too extended or due to some kind of spin orbit coupling the distribution of magnetic moment is contracted with respect to the distribution of charge. (2) Since only the gyromagnetic ratio for the neutron has been determined experimentally,[5] it is still possible to assume that the neutron's spin as well as its moment may be three times[6] as large. In this case the transmission effect observed would agree with the calculated value if a reasonable correction for the depolarization effect is introduced.

We are conscious that a value for the neutron's spin larger than $\frac{1}{2}$ would seriously change all theoretical considerations concerning neutron-proton-scattering.[7] We shall enter into this question more fully in a subsequent paper in which the theoretical aspects of the new hypothesis will be discussed. Here it may suffice to say that present experimental evidence[8] is far from being completely in favor of the commonly presented theoretical view.

Observations on the paramagnetic scattering[9] of slow neutrons allow the determination of the neutron's *magnetic moment* directly with comparative case. Assuming a spin of $\frac{3}{2}$ and using the gyromagnetic ratio as given by Bloch and Alvarez,[5] the scattering cross section of free Mn^{++} for a very long neutron wave-length should be approximately 100×10^{-24} cm^2. Observations on differential cross sections under small angles would clearly decide whether the discrepancy here discussed is due to cause (1) or (2) mentioned above.

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New York University,
University Heights, New York,
November 14, 1939.

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[1] O. Halpern and Th. Holstein, Phys. Rev. **55**, 601 (1939); Halpern, Hamermesh and Johnson, Phys. Rev. **55**, 1125 (1939).
[2] J. Schwinger, Phys. Rev. **51**, 544 (1937).
[3] J. C. Slater, Phys. Rev. **36**, 57 (1930).
[4] J. C. Slater, Phys. Rev. **42**, 33 (1932).
[5] F. Bloch and L. W. Alvarez, Phys. Rev. **57**, 110 (1940).
[6] To fit the spin of the deuteron and the demands of the Fermi statistics.
[7] J. Schwinger, Phys. Rev. **52**, 1250 (1937); H. H. Goldsmith and L. Motz, Phys. Rev. **53**, 947 (1938).
[8] M. Goldhaber, Nature **137**, 824 (1936); M. A. Tuve and L. R. Hafstad, Phys. Rev. **50**, 490 (1936); H. v. Halban, Nature **141**, 644 (1938); E. Amaldi *et al*., Phys. Rev. **56**, 881 (1939); T. Goloborodko and A. Leipunski, Phys. Rev. **56**, 891 (1939).
[9] O. Halpern and M. H. Johnson, Phys. Rev. **55**, 898 (1939).

On the Magnetic Moments of Light Nuclei

That the discrepancies[1] between theoretical and experimental values of nuclear magnetic moments may be due to oversimplifying assumptions in the theory concerning the ground states of the various nuclei has often been pointed out. A detailed investigation of an added interaction of the form

$$V=J(r)\left(3\,\frac{\boldsymbol{\sigma}_1\cdot\mathbf{r}\;\boldsymbol{\sigma}_2\cdot\mathbf{r}}{r^2}-\boldsymbol{\sigma}_1\cdot\boldsymbol{\sigma}_2\right)$$

in the case of the deuteron[2] led to consideration of this coupling as an explanation. Its possible effect on the magnetic moments of several light nuclei has been suggested[3] and the cases of Li^6 and N^{14} have recently been discussed.[4]

V has nonvanishing matrix elements between states having the same total angular momentum and the same spatial symmetry (i.e., characterized by the same "partition" quantum number). The sequence of observed moments for the stable nuclei having an odd number of protons and the same number of neutrons (H^2, Li^6, B^{10}, N^{14}) suggests an increasing proprtion of $^3D_1$ in the ground state, as provided by this coupling term, and calculations made on the basis of the Hartree model qualitatively confirm this suggestion. Furthermore, the $g=1.788$ and probable