TABLE II. Estimated line widths for electric quadripole radiation.

Nucleus	γ-ray	τ	ΔE line width	ΔE hyperfine
Mg^{24}	2.75 Mev	1.4×10^{-12} sec.	2.8×10^{-3} ev	0.01×10^{-3} ev
	1.38	22.	0.18	
Ni^{60}	1.30	19.	0.21	0.08
	1.10	38.	0.11	
Sr^{88}	1.90	35.	0.11	0.12
	0.91	680.	0.006	

It is improbable from these data that an asymmetry can exist, though one as large as the minimum expected is not completely excluded. Until it can be demonstrated otherwise, magnetic coupling between the nucleus and the atomic electrons seems the most plausible reason for the distribution not being observed. Such a coupling will interfere with the distribution unless the lifetime of the nuclear state is very small compared with the precession times of the nuclear moment in the magnetic field of the electrons; that is, the width of the gamma-state must be large compared with the hyperfine splitting. Table II gives a summary of the estimated line widths for electric quadripole radiation, based upon a calculation of Lowen.[5] The right-hand column which is this coupling with a penetrating electron is not too significant because the materials were all in the solid state. However, consideration must be taken of the fact that when the gamma-rays are emitted, the atoms are most probably in deeper than optical degree of excitation due to the initial radioactive transformations. The right-hand column represents then a reasonable lower limit of coupling energy, and it is seen that the conditions for observing the distribution may not be met, in the case of quadra—or higher pole radiation.

A limited attempt was made to de-couple nucleus and electrons by the use of strong magnetic fields. The argument is that according to the assumptions of the theory, the components of angular momentum in the direction of the first gamma-rays are constants of motion. In the limit of an infinitely strong magnetic field parallel to the first gamma-ray, the nucleus and the atom become de-coupled, with their components along the magnetic field constant, thus satisfying the condition assumed by theory. Since this is true for strong fields, it should be true to lesser degree for finite fields. The experiment was attempted with a magnetic field of about 17,000 gauss. Counters were placed in the pole pieces of the magnet, 180° apart, and a difference was sought in the coincidence rate with the field on and the field off. No effect was observed outside the error of the data which was only sufficient to detect asymmetries of forty percent or greater in the form of the distribution. It is regretted that this work was terminated by the war and in the light of the paper of G. Goertzel in this issue of *The Physical Review* it is desirable to pursue the investigation further.

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** Now at Clinton Laboratories, Oak Ridge, Tennessee.

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Stark and Zeeman Effects in the Inversion Spectrum of Ammonia

DONALD K. COLES AND WILLIAM E. GOOD
Westinghouse Research Laboratories, East Pittsburgh, Pennsylvania
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WE have observed Stark and Zeeman effects in the microwave absorption spectrum of NH_3 in the 1.25-cm region, using ammonia containing both N^{14} and N^{15}.

Ordinarily a rotational level of a symmetric top molecule is split by an electric field into $2J+1$ components, corresponding to the different values of M where $-J\leqslant M\leqslant J$. Because of the high frequency of inversion of the NH_3 molecule, however, there is no first-order Stark effect. The second-order effect is proportional to the square of the electric field E, and to M^2. Thus there are only $J+1$ levels corresponding to the different values of M^2.

Our d.c. electric field was parallel to the high frequency field as described previously,[1] so that only transitions corresponding to $\Delta M=0$ could be observed, with the transition $M=0$ to $M=0$ forbidden.

The increase in frequency produced by the electric field E is described approximately by the equation

$$\Delta\nu(\text{cm}^{-1})=1.5\times10^{-4}\cdot[MK/J(J+1)]^2\cdot E^2,$$

where E is given in e.s.u. This equation applies to ammonia made with either N^{14} or N^{15}.

A shift of this amount corresponds roughly to a semi-permanent dipole moment of 1.5×10^{-18} e.s.u.

A magnetic field of 6600 oersteds perpendicular to the high frequency field splits a rotational line into a doublet with a separation of approximately 2.0×10^{-4} cm^{-1}, independent of J and K within experimental error. A magnetic field parallel to the high frequency electric field produced no observable effect.

Good,[2] working with ordinary ammonia, has reported that several of the rotational lines exhibit a hyperfine structure. We have now resolved a hyperfine structure in most of the rotational lines of $N^{14}H_3$. We interpret the structure as a splitting of the rotational energy levels by a coupling between the angular momentum of the molecule as a whole and the spin of the nitrogen nucleus. This interaction appears to result from an electric quadrupole moment of the N^{14} nucleus, and is described by the equation

$$\Delta\nu=[e^2qQ]\cdot\left(\frac{3K^2}{2J(J+1)}-\frac{1}{2}\right)\cdot\left[\frac{(\tfrac{3}{2})C(C+1)-2J(J+1)I(I+1)}{(2J-1)(2J+3)(2I-1)(2I+3)}\right],$$

where

$$C=F(F+1)-I(I+1)-J(J+1),$$
$$I=1,$$
$$F=J+0,\ \pm1,$$
$$[e^2qQ]=3.4\times10^{-4}\text{ cm}^{-1}.$$

$N^{15}H_3$ shows no trace of hyperfine structure. This is to be expected since N^{15} has a spin of $\frac{1}{2}$. The frequencies of the rotational lines of $N^{15}H_3$ are given approximately by the equation

$$\nu(\text{cm}^{-1})=0.7575-0.0047(J^2+J-K^2)+0.0019K^2.$$

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