fore exhibit a rather sharp maximum, and from the results of our experiments one can estimate that if such a sharp maximum exists it must lie in the neighborhood of the voltage used, namely 0.9 MEV.

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June 14, 1935.

1 Lauritsen and Crane, Phys. Rev. **45**, 493 (1934).
2 McMillan, Phys. Rev. **46**, 868 (1934).
3 Bethe, Phys. Rev. **47**, 633 (1935).
4 Bonner and Brubaker. Unpublished.
5 Crane, Delsasso, Fowler and Lauritsen, Phys. Rev. **48**, 100 (1935).
6 Cockroft, Int. Conf. Phys., London, 1934.
7 Lauritsen and Crane, Phys. Rev. **45**, 493 (1934); Cockroft, Int. Conf. Phys., London, 1934. Estimates of the efficiency of this process vary among experimenters, possibly because it is a capture process, and is therefore sensitive to bombarding voltage. Our most recent estimate is that, under our experimental conditions at 900 kv, from 100 to 500 C^{11} atoms are formed per second per microampere proton current.

A Note on the Spectra of Jupiter and Saturn

In addition to the many rotation-vibration bands of methane, the spectra of Jupiter and Saturn contain also the harmonic rotation-vibration bands of ammonia at 7920A and 6474A. First photographed in the planetary spectrum by V. M. Slipher,[1] they have since been traced to the ammonia molecule by R. Wildt,[2] and by T. Dunham, Jr.[3]

It is the purpose of this note to show that the bands are of the parallel type; namely, the fourth and fifth harmonics of the fundamental ν_1 at 3337 cm^{-1}.

Employing equivalent path lengths of ammonia up to 315 meter-atmospheres, the bands at 7920A and 6474A were photographed, as was also a band at 5520A.[4] These three bands possess identical structures, indicating that they are harmonics of the same fundamental vibration. In fact, the parallel fundamental at 3337 cm^{-1} and the above bands are connected by the formula:

$$\nu_N = 3389N - 50N^2 - 2N^3,$$

where N is the order of the harmonic.[5]

The structure of the fourth, fifth and sixth harmonics is clearly represented by the photograph and intensity trace shown in Fig. 1.[6] The harmonic bands of ν_1 should each consist of two nearly superimposed bands; that is, the band lines should be double in virtue of the ability of the nitrogen atom to pass through the plane of the hydrogens on its way from one position of equilibrium to the other. Dennison and Uhlenbeck[7] have shown the manner in which the doubling depends upon the amplitude of the nitrogen atom in the case of the harmonic vibrations of ν_3, the second parallel fundamental of ammonia. By applying this analysis to the harmonics of ν_1, a zeroth approximation to the doubling of the state $N\nu_1$ can be obtained. In the vibration ν_1 as opposed to the vibration ν_3 there is considerable motion of the hydrogens in their own plane. This motion renders it more difficult for the nitrogen atom to penetrate the hydrogen plane and thus decreases the doubling of the levels $N\nu_1$ below what it would be for a similar amplitude of oscillation of the nitrogen atom in the motion $N'\nu_3$. A somewhat better approximation can therefore be achieved by reducing the zeroth approximation to one-half or one-third its value. For example, the band $5\nu_1$ should exhibit a doubling in the neighborhood of 15 cm^{-1}. Several such line pairs have been located, but complete ordering of the lines has not yet been accomplished.

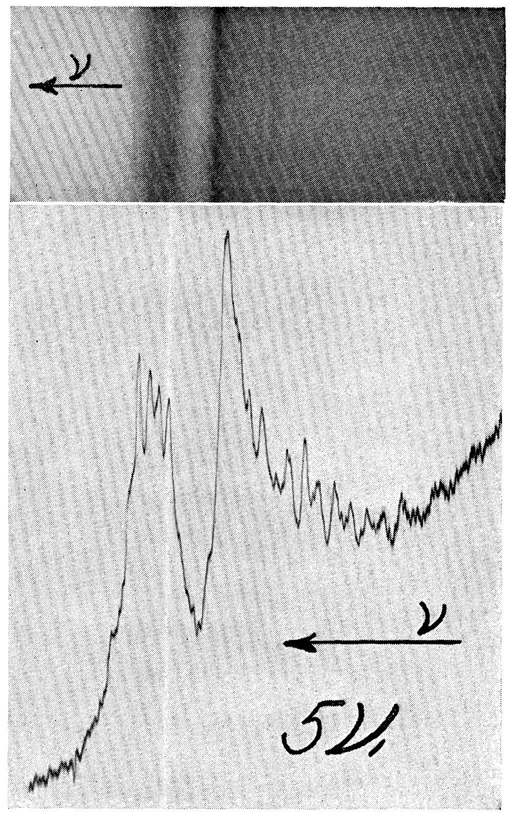

Fig. 1.

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University of Michigan,
June 18, 1935.

1 Slipher, Lowell Observatory Bulletin 42; Popular Astronomy, **37**, 140 (1929).
2 Wildt, Ver. der Univ. Sternw. zu Gött. Heft 22 (1932).
3 Dunham, P. A. S. P. **45**, 42 (1933).
4 For a description of the apparatus see A. Adel and V. M. Slipher, Phys. Rev. **46**, 902 (1934). Eastman P, B and G plates were used.
5 In the mode of vibration ν_1 the hydrogen nuclei move along median lines of the basal triangle while the nitrogen atom moves along a perpendicular to the plane of the hydrogens. See D. M. Dennison and J. D. Hardy, Phys. Rev. **39**, 938 (1932).
6 In the present experiment, this band was photographed with a glass Hilger E-I. With higher resolving power, each line seen in the figure splits into several fine ones. See R. M. Badger, Phys. Rev. **35**, 1038 (1930). It appears very likely that this hyperfine structure is caused by the failure to superimpose of the lines:

$$\left.\begin{matrix} J \to J' \\ K \to K \end{matrix}\right\} \begin{matrix} K = 0, 1, \cdots J \\ J < J', \end{matrix}$$

in virtue of the differing values of $(1/A - 1/C)$ in the ground and excited vibrational states. A and C are, of course, the moments of inertia of the ammonia molecule.
7 D. M. Dennison and G. E. Uhlenbeck, Phys. Rev. **41**, 313 (1932).

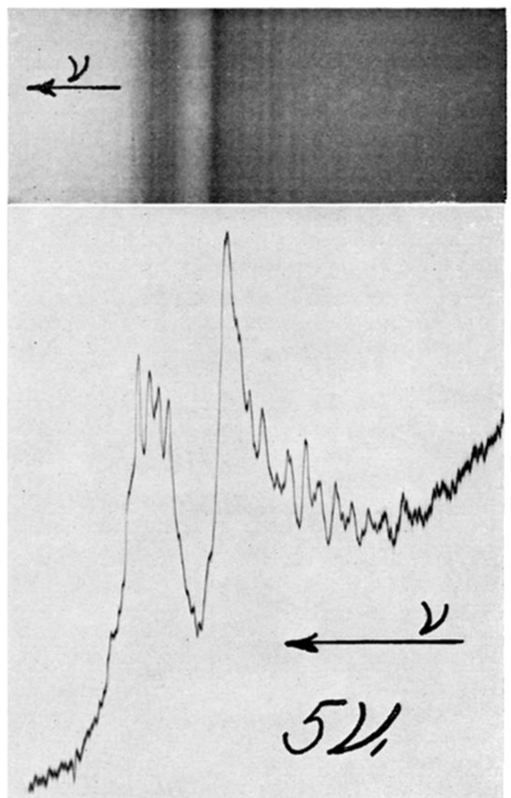

Fig. 1.