activator centers. This mechanism requires that the excited centers responsible for emission be stable in a high field. The stability of the manganese center is well known, whereas the apparent stability of the arsenic and phosphorus centers is unexpected.

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Shift of Center Frequency of an Ammonia Inversion Spectrum*

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THE authors have found that the frequency of the Stark modulation atomic clock[1] can shift depending upon the ammonia pressure of the Stark cell and within a certain time interval after the gas was introduced into the cell.

The frequencies of the clock have been plotted *versus* the squares of Stark electric field for various states of the gas and the curves have all become very nearly parallel straight lines. From this fact, the above frequency shift can be ascribed to the shift of the center frequency of the $J=3$, $K=3$ inversion transition of ammonia, though the latter had been considered negligible at sufficiently low pressure in earlier work.[2–6]

In order to measure the frequency shift, the ammonia gas was prepared in two different states of which one (wet) was saturated with water vapor and the other (dry) free from it. The measurements were carried out by using a frequency meter of precision better than 2×10^{-9} which is employed as a frequency comparator between the ammonia inversion spectrum and the 100-kc quartz oscillator.

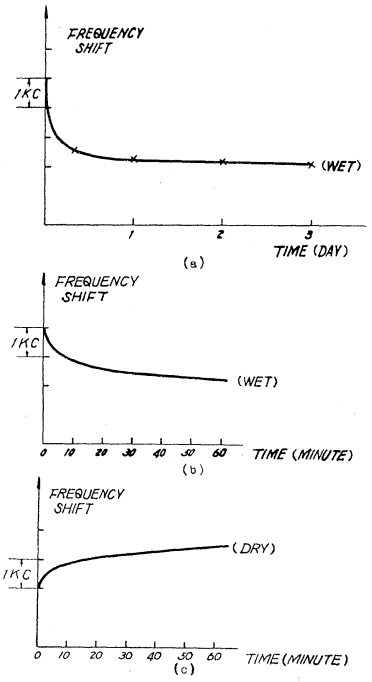

FIG. 1. Typical examples of the frequency shift, the initial frequency not being absolutely determined. (a) Long-time frequency shift of wet ammonia. (b) Continuously recorded frequency shift of wet ammonia for first hour. (c) Continuously recorded frequency shift of dry ammonia for first hour.

Figure 1 shows the shifts of the atomic clock frequency corresponding to the ammonia inversion spectrum ($J=K=3$) with the time beginning at the introduction of the gas into the cell at a pressure of 3×10^{-3} mm Hg. Figure 2 shows the pressure dependence of the frequency shift.

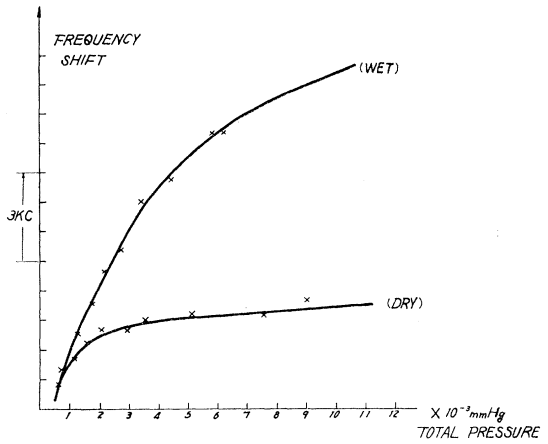

FIG. 2. Typical examples of frequency shift as a function of the total pressure. The shifts are measured at a definite time after the introduction of the gas.

The present experimental results give only qualitative information. However, two reasons for the frequency shift of the spectrum may be considered: (1) effects resulting from the adsorption of ammonia and other gas molecules contained in the cell by the wall, and (2) the interaction between ammonia molecules and foreign gas molecules.

It is planned to analyze quantitatively the sample gases at various time instants after the introduction into the cell and to measure the frequency shifts respectively when the gas is pure ammonia and when it is accompanied by foreign gases by using a Stark cell which is completely outgassed. This work is now partly in progress.

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