THE INFRA-RED ABSORPTION OF SOME OXIDES OF NITROGEN

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The following is intended merely as a preliminary report of work taken up in an attempt to add to the data bearing upon the considerable theory already developed for the infra-red absorption of gases made up of simple molecules. The theory in the case of a simple diatomic gas assumes that the molecule is made up of two atomic nuclei separated by only a short distance. These nuclei are held together by a ring of electrons rotating about an axis joining the two nuclei and between them. According to the quantum theory it is possible for a molecule to rotate about an axis at right angles to the line joining the nuclei with definite but different velocities. If the moment of inertia does not change, these different velocities of rotation will manifest themselves as simple absorption bands in the far infra-red region. If, on the other hand, isotopes of one of the atomic nuclei exist, there will be different moments of inertia of the molecule. The different moments of inertia will not differ greatly and instead of a series of simple bands, we shall find a series of more complex bands, for example, triplets, where two isotopes of one of the nuclei exist.

If the nuclei vibrate along the line joining their centers with a simple harmonic motion, the vibration will manifest itself as an absorption band in the near infra-red region. This frequency of vibration may combine with a rotation frequency to produce a series of bands in the region of the vibration frequency. If the vibration frequency is not simple harmonic on account of large nuclear displacements, such a vibration will give rise to harmonics whose frequencies are approximate multiples of a fundamental frequency. These in turn may combine with the rotation frequencies to produce the complicated system of bands in the region of the harmonic frequencies. In short, there should be rotation frequencies, vibration frequencies, harmonic frequencies, and combination frequencies. These, however, need not

necessarily all be manifested as absorption bands in a single gas.

The evidence supporting such a theory is very meager, and this investigation was undertaken in an attempt to add more data to the general problem. Accordingly the absorption of NO, NO_2, N_2O_4, and N_2O was investigated by means of a grating spectrometer and a radiometer in the region from 1 u to 4.5 u. A large number of new bands was found in each case in this region. No attempt has yet been made to apply the theory which has already been developed.