

means was provided for rapidly interchanging and accurately positioning the samples in another resonance detector located close to the reference resonance probe.

The tuned r-f coil of the measuring probe was coupled through a high impedance to a low noise 24-Mc crystal oscillator also supplying the reference probe. The r-f voltage across this coil was detected by a high vacuum diode and the resulting audio output fed into a 30 cycle-sec. lock-in amplifier. The diode method of detection was used to eliminate the effect of the dispersion component of the signal, so that the true center of resonance could be obtained. Even with the H₂ gas, which gives a weak signal, the signal-to-noise ratio was sufficient to obtain a consistency of measurement that resulted in an average deviation of 1 part in four million over 10 determinations of the H₂ gas→H₂O shift. This average deviation was somewhat greater than in the determination of the other shifts measured.

It is assumed that the time average of the field seen by a particular molecule in the sample is that which would be computed if it were in a spherical cavity surrounded by a diamagnetic medium of volume susceptibility χ . Hence the time average value of the local field is decreased by the fraction $4\pi\chi/3$. But, since the sample itself is spherical and is located in a medium of zero susceptibility, an increase in the field of $4\pi\chi/3$ is produced which causes the net correction to the local field to be zero, at least in the first order of χ .

The actual shifts from H₂ gas for oil and water are respectively: $\Delta H/H = +1.6 \times 10^{-6}$; and $\Delta H/H = -0.6 \times 10^{-6}$. Combining these shifts with the diamagnetic correction for H₂ gas calculated² by Ramsey, the diamagnetic corrections for mineral oil and water are, respectively, $\delta_{oil} = 28.4 \times 10^{-6}$, and $\delta_{H_2O} = 26.2 \times 10^{-6}$.

The comparison of the standard sample used in the determination of the proton gyromagnetic ratio with the H₂ gas indicates that a diamagnetic correction of 28.1×10^{-6} should be made on the uncorrected value of γ reported¹ earlier. This makes the present corrected value $\gamma = (2.67530_5 \pm 0.00006) \times 10^4$ sec.⁻¹ gauss⁻¹ and the previously reported¹ value $e/m = (1.75891_2 \pm 0.00005) \times 10^7$ e.m.u. gram⁻¹.

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¹ Thomas, Driscoll, and Hipple, *Phys. Rev.* **78**, 787 (1950).

² N. F. Ramsey, *Phys. Rev.* **78**, 699 (1950).

³ H. A. Thomas, *Phys. Rev.* **78**, 339 (1950).

Spectrum of the Boron Monosulfide (BS) Molecule

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THE spectrum of the boron monoxide (BO) molecule has been analyzed by Mulliken¹ and Jenkins and McKellar,² but the analogous spectrum of boron monosulfide has not yet been described. Recently, however, the writer has observed three extensive band systems in an electric discharge through boron trisulfide and has attributed these bands to the BS molecule.

The apparatus consisted of a vacuum system of Pyrex glass, and a quartz discharge tube of the end-on type. Through this tube helium or argon was circulated at low pressure by means of a mercury diffusion pump. A quartz tube, having a glass stopper at one end, contained amorphous boron in a silica boat, and projected horizontally from the one end of the capillary of the discharge tube. A reservoir containing vacuum distilled sulfur protruded vertically downwards from the center of this tube. By means of a cylindrical electrical heater, the amorphous boron could be heated to the desired temperature, while the amount of sulfur vapor entering the system could be controlled separately.

The sulfur vapor was carried over the heated boron by the circulating helium or argon gas.

At about 700°C, boron trisulfide (B₂S₃) was formed, and this substance was carried into the capillary of the discharge tube. When this reaction started, the brilliant S₂ spectrum, excited in the capillary at the early stages of the heating process, disappeared and was superseded by a very intense spectrum resembling a "daylight" fluorescent lamp.

The following three strong band systems were observed in the discharge:

(a) An extensive system of open bands in the visible, red, and infra-red regions of the spectrum, degraded to the red. This system will be referred to as the α -system of BS.

(b) A strong system, consisting mainly of two band groups, each with several heads. This system which is degraded to the violet, has a very close fine structure.

(c) A system of double double-headed bands in the ultraviolet region, degraded to the red. This system also has a close fine structure and will be referred to as the γ -system of BS.

The bands of the α - and γ -systems have been arranged in Deslandres Tables. The band heads were measured on plates taken on a large Hilger spectrograph and in the first order of a 21-foot concave grating in a Paschen mounting.

The bands of the α -system originate from a ${}^2\Pi \rightarrow {}^2\Sigma$ transition, and the rotational analysis showed that the Π -state is inverted. This is analogous to the α -system of BO. These band heads are given by the following equations:

$${}^2\Pi_{3/2} \rightarrow {}^2\Sigma: \nu_{\text{head}} = \begin{matrix} 15663.0 \\ 15668.4 \end{matrix} \\ + [749.37v' - 4.77v'^2] - [1173.93v'' - 6.37v''^2],$$

$${}^2\Pi_{1/2} \rightarrow {}^2\Sigma: \nu_{\text{head}} = \begin{matrix} 15996.7 \\ 16002.1 \end{matrix} \\ + [749.37v' - 4.77v'^2] - [1173.93v'' - 6.37v''^2].$$

The ultraviolet bands originate from a ${}^2\Pi \rightarrow {}^2\Sigma$ transition, with a normal splitting of the Π -state. These band heads are given by the following equations:

$${}^2\Pi_{1/2} \rightarrow {}^2\Sigma: \nu_{\text{head}} = \begin{matrix} 38785 \\ 38796 \end{matrix} \\ + [884.7v' - 6.60v'^2] - [1173.3v'' - 6.40v''^2],$$

$${}^2\Pi_{3/2} \rightarrow {}^2\Sigma: \nu_{\text{head}} = \begin{matrix} 38899 \\ 38912 \end{matrix} \\ + [884.7v' - 6.60v'^2] - [1173.3v'' - 6.40v''^2].$$

The ${}^2\Pi_{3/2} \rightarrow {}^2\Sigma$ components of the (2,1), (3,0), (4,0), and (5,0) bands of the α -system have been analyzed from plates taken in the third order of the grating. The following constants were obtained:

$$B_e'' = 0.7949_0 \text{ cm}^{-1}, \quad \alpha_e'' = 0.0060_5 \text{ cm}^{-1}, \\ B'_{e,\text{eff}}^{(1)} = 0.6213_1, \quad \alpha'_{e,\text{eff}}^{(1)} = 0.0058_8 \text{ cm}^{-1}.$$

Preliminary analyses of the (0,0) and (0,1) bands of the γ -system have been made from plates taken in the sixth order of the grating. The following tentative values were obtained:

$$B_e'' = 0.793 \text{ cm}^{-1}, \quad \alpha_e'' = 0.006 \text{ cm}^{-1}, \\ B_0' = 0.702 \text{ cm}^{-1}.$$

The vibrational and rotational analyses prove that the α - and γ -systems have the same lower state (${}^2\Sigma$).

The bands of the blue-green system have not yet been interpreted.

A paper giving further details of these band systems is being prepared at present and will be published in the course of time.

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¹ R. S. Mulliken, *Phys. Rev.* **25**, 259 (1925).

² F. A. Jenkins and A. McKellar, *Phys. Rev.* **42**, 464 (1932).