

sponding to the three different isotopic masses of Si. However, the uncertainties in the absolute values of the isotopic masses do not permit the evaluation of accurate values of the molecular configuration from these three nearly parallel equations relating the structural parameters with the moments of inertia. In order to avoid the parallelism it is necessary that one of the three moments of inertia be measured for a structure resulting from an isotope variation in another atom; in either the fluorine or the hydrogen atoms in this case.

Assuming an angle of $111^\circ \pm 1^\circ$ for the HSiH angle, as is indicated from measurements on other monohalogen silanes, we compute $d_{\text{SiF}} = 1.593 \pm 0.002 \text{ \AA}$ and $d_{\text{SiH}} = 1.503 \pm 0.036 \text{ \AA}$ from the measurements on $\text{Si}^{28}\text{H}_3\text{F}$ and $\text{Si}^{30}\text{H}_3\text{F}$. These values were then checked with the measurements on $\text{Si}^{29}\text{H}_3\text{F}$ and found to be consistent. The d_{SiF} is thus about 0.04 \AA longer than the corresponding distance (1.555 \AA) found in SiHF_3 .¹ This is consistent with the shortening (about 0.06 \AA) of the CF bond in CHF_3 over that found in CH_3F .² Our value of 1.593 \AA for d_{SiF} is considerably shorter than the sum of Pauling's covalent radii (1.81 \AA). That this observed bond shortening is likely to be due to resonance with an ionic structure is born out by the sum corrected according to the Schomaker-Stevenson rule, *viz.*,

$$d_{\text{SiF}} = r_{\text{Si}} + r_{\text{F}} - 0.09 |X_{\text{Si}} - X_{\text{F}}| = 1.61 \text{ \AA},$$

where the quantity in bars is the electronegativity difference of the silicon and fluorine.

From measurements of the Stark effect of the $\text{Si}^{28}\text{H}_3\text{F}$ line, we compute the dipole moment to be $1.268 \pm 0.013 D$.

The authors gratefully acknowledge the assistance of Dr. Paul Zemany of this laboratory who checked the purity of the gas sample on the mass spectrometer.

¹ John Sheridan and Walter Gordy (private communication).
² Gilliam, Edwards, and Gordy, *Phys. Rev.* **75**, 1014 (1949).

Temperature Variation of Decay Times of Scintillation Phosphors

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A DECREASE in the decay times of gamma-scintillations with decrease in temperature of organic phosphors has been found by Kelley and Goodrich¹ of Oak Ridge and also by this Laboratory. Measurements made at this Laboratory of the variation of organic phosphor times with temperature using a shorted line technique give the following results: anthracene at 290°K — 3.2×10^{-8} sec.; anthracene at 80°K — 1.4×10^{-8} sec.; anthracene at 4°K — 6×10^{-9} sec., which was within the resolving time of the photo-multiplier. That this behavior is probably characteristic of the molecules rather than the lattice is shown by the fact that mixtures of anthracene in naphthalene yielded approximately the same variation with temperature. These preliminary measurements are believed to have an over-all accuracy of better than 20 percent and are based on pulse shapes having the form $e^{-t/\tau}$. More accurate determinations of temperature variation are now in progress.

¹ G. G. Kelley and M. Goodrich, *Phys. Rev.* **77**, 138 (1950).

Interpretation of Underground Cosmic-Ray Data

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IN a recent note of the same title,¹ the author misrepresented the conclusions of Barnothy and Forro, and implied that the results of Miesowicz *et al.*² opposed the existence of the penetrating, non-ionizing component hypothesized by Barnothy and Forro.

Actually, the soft, isotropic, non-ionizing radiation studied by Miesowicz *et al.* had been detected and investigated many years ago by Barnothy and Forro,³ who originally suggested that it was largely composed of gamma-rays of radioactive origin, in agreement with the recent conclusions of Miesowicz. The penetrating non-ionizing radiation, suggested by Barnothy and Forro as necessary to interpret their absorption curves, is supposed to be of a quite different character, and on the question of the reality of this radiation the work of Miesowicz *et al.* apparently presents no information.

¹ K. Greisen, *Phys. Rev.* **76**, 1718 (1949).

² Miesowicz, Jurkiewicz, and Massalski, *Phys. Rev.* **77**, 380 (1950).

³ J. Barnothy and M. Forro, *Phys. Rev.* **55**, 870 (1939).

N₂O Bands in the Solar Spectrum*

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NITROUS oxide in the earth's atmosphere was first detected spectroscopically by Adel¹ through observation of the ν_1 fundamental at 7.8μ . Subsequent confirming observations of other N_2O bands at 3.9μ , 4.1μ , 4.5μ , and 8.6μ were made by Migeotte² at Ohio State University and by Shaw, Sutherland, and Wormell³ at Cambridge University.

The laboratory observations of Plyler and Barker⁴ suggest that additional weaker bands of N_2O may appear in the solar spectrum in the spectral region below 3.6μ accessible to the high dispersion spectrometers and Cashman PbS cells⁵ of the McMath-Hulbert Observatory at Lake Angelus and at the Mount Wilson Observatory. The expected bands, $2\nu_2 + \nu_3$ at 2.97μ , $2\nu_3$ at 2.26μ , and $2\nu_1 + \nu_3$ at 2.13μ , have all been found in the solar spectrum. The 2.97μ and 2.26μ bands are badly blended, the former with a band of H_2O and the latter with lines of CH_4 and H_2O . The bands at 2.13μ and 2.26μ are absent on tracings made with the noon-day sun but appear quite plainly at solar altitudes less than about 10° . Comparison of telluric and laboratory intensities suggests an atmospheric abundance for N_2O equivalent to that in a layer 4 mm thick at NTP.

Study of the solar tracing of the 2.13μ -band has revealed that each line is asymmetrically widened on the long wave-length side, indicating the presence of a weaker overlapping band of the same spacing. The asymmetry of the lines has been confirmed by a laboratory tracing made with a carbon arc as a source and an absorption cell containing 25 cm of N_2O at atmospheric pressure. The laboratory tracing shows two additional very weak bands of N_2O , not recorded by Plyler and Barker, at 2.16μ and at 2.28μ . The latter band is overlapped by the negative branch of the 2.26μ -band. The band at 2.16μ is very probably caused by the transition from the ground state to $\nu_1 + 2\nu_2 + \nu_3$, for which the calculated position is 4633.9 cm^{-1} . It has not yet been determined whether the faint bands overlapping those at 2.13μ and 2.26μ are isotopic or perhaps originate from an excited vibrational state.

The 2.16μ -band has been found in the solar spectrum on a sunset tracing made by Mr. Dale Vrabec at the Mount Wilson Observatory on September 25, 1949. The path length involved was of the order of 50 air masses.

We wish to thank Dr. I. S. Bowen for making available the Snow Solar Telescope under a guest investigator arrangement between the Mount Wilson and Palomar Observatories and the McMath-Hulbert Observatory. We also acknowledge with gratitude the continued assistance by McGregor Fund of Detroit.

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¹ A. Adel, *Astrophys. J.* **90**, 627 (1939).

² M. Migeotte, *The Atmospheres of the Earth and Planets* (University of Chicago Press, Chicago, 1949), p. 284.

³ Shaw, Sutherland, and Wormell, *Phys. Rev.* **74**, 978 (1948).

⁴ E. K. Plyler and E. F. Barker, *Phys. Rev.* **38**, 1827 (1931).

⁵ Robert R. McMath and Orren C. Mohler, *J. Opt. Soc. Am.* **39**, 903 (1949).