As a matter of fact the integrated fountain effect between 0.5°K and 0.8°K was about 5 cm, while (1) predicts 7.3 cm. Below 0.5°K the integrated fountain effect is not more than a few millimeters, while (1) predicts 1.3 cm.[2]

Supposing that down to 0.6°K the formula

$$\rho_n=\rho_s T(dp/dT)^2/\rho^2 C_v V_{II}^2 \quad (2)$$

may be applied, where C_v and V_{II} denote the specific heat[2] and the velocity of second sound,[3] while ρ_n and $\rho_s=\rho-\rho_n$ are the densities of the so-called normal fluid and superfluid, then ρ_n may be calculated. It is found to fall very steeply with decreasing temperature, remaining approximately proportional to C_v. In Landau's picture[4] this would confirm the rapid disappearance of the roton contribution to ρ_n below 1°K.

The original set-up for this investigation was made by Mr. G. J. de Vries.

Details will be published in *Physica* and the *Communications from the Kamerlingh Onnes Laboratory*.

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OH in the Airglow at High Latitudes

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(Received April 21, 1953)

IN November 1952 a brief expedition to Thule Air Force Base in northern Greenland resulted in a few spectra of the airglow north of the auroral belt. The spectrograph contains a grating ruled with 15 000 lines per inch and an $f/0.8$, five-inch, flat-field Schmidt camera. In the photographic infrared we used hypersensitized I-N plates in the first order of the grating with a dispersion of 138 A/mm, whereas the second order was used in the red-green region with the 103a-F(3) emulsion.

Our measured wavelengths are in fair agreement with those of other observers;[1-6] discrepancies of 1 or 2 angstroms are common, but this does not seem unusual in view of the resolving power and dispersion that have so far been employed. Also, wavelengths for the 6–2, 5–1, and 4–0 bands are consistent with those observed in oxy-acetylene flames under high dispersion.[7-10] Figure 1 illustrates microphotometer tracings in a region of the spectrum where the OH bands are relatively weak. In four bands that seemed to be free from distortion by overlapping images, the relative intensities of the rotational lines indicate temperatures between 300° and 350°K, which are somewhat higher than those determined from spectra made at intermediate latitudes.[2-4]

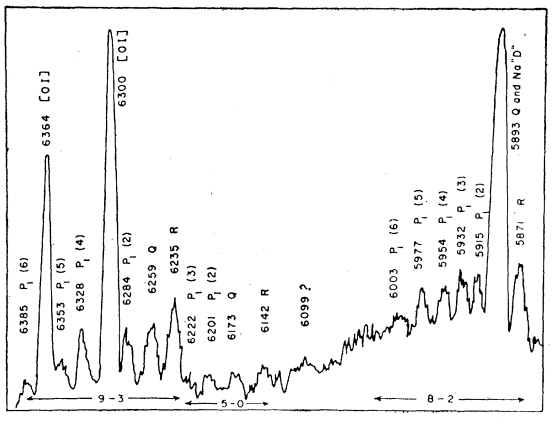

FIG. 1. The 9–3, 5–0, and 8–2 OH bands observed at Thule, Greenland. Note the blending of the 8–2 *Q* branch with Na "*D*"

Recently Herman and Hornbeck[10] have determined the rotational and vibrational constants of the ground ($^2\Pi$) state from their laboratory infrared bands and the data of Dieke and Crosswhite[11] on the ultraviolet OH bands. They find the usual power series involving ω_e, $\omega_e x_e$, etc., gives an excellent representation of the vibrational energy levels observed in the laboratory (i.e., $v\leq 6$) and have presented constants for three- and four-term power series. Their three-term solution, however, gives energy levels that are very discordant with the airglow data when $v'=7$, 8, or 9. When $\omega_e z_e$ is considered, the agreement is much better, although small systematic residuals still exist for the higher levels.

In Table I are presented band origins determined from the strong P_1 lines ($^2\Pi_{\frac{3}{2}}$ state) in the airglow. In deriving these values of ν_0 we have used the rotational constants, B_v and D_v, of Herman and Hornbeck and the Hill and Van Vleck[12] formula for spin doubling. The five band origins marked with an asterisk (*) have been estimated from the measurements of other observers, whereas the data for the other seven bands were obtained from our own spectra. For comparison we have also listed band origins computed from Herman and Hornbeck's four-term constants.

TABLE I. Band origins, ν_0(vacuum), for OH in the airglow.

$v'-v''$	ν_0(obs)	ν_0(comp)
7–3	11 323*	11 329.9
6–2	11 985.0	11 984.5
5–1	12 637.2	12 636.9
9–4	12 896.4	12 911.3
4–0	13 291.7	13 291.5
8–3	13 731.8	13 746.2
7–2	14 562*	14 570.1
6–1	15 387*	15 388.4
9–3	15 980.5	15 989.0
5–0	16 204*	16 206.6
8–2	16 979.5	16 986.5
7–1	17 976*	17 974.0

A solution for the vibrational constants based on these airglow measurements gives results which are discordant with the more accurate laboratory data; previous determinations[1,3] based on airglow data also do not satisfactorily represent the lower vibrational levels. Since there may be significant errors in the wavelengths, arising from the low resolving power, vibrational constants based only on airglow measurements are undoubtedly inferior to the laboratory constants. However, inasmuch as the term $\omega_e z_e$ becomes important only for $v>6$, it would be very useful to have accurate measures of the high-excitation airglow bands, which unfortunately have not yet been observed in laboratory spectra. Thus a consolidation of precise measurements from various sources will be needed to give an accurate representation of the vibrational energy levels.

In the red and infrared there are a number of faint features whose origins are unknown. In view of some recent work[13] which indicates that starlight is much more important in the blue end of the spectrum than is generally believed, it seems likely that some of these features may be due to the continuous spectrum of the galactic starlight. That is, the background stellar radiation may produce the weak infrared and red continuum, in which case the intervals between stellar absorption lines would have the appearance of faint emissions.

We wish to acknowledge the cooperation of S. Wolnik, J. Scanlon, and C. Sheehan, who assisted in various phases of this work. Thanks are also due Dr. R. C. Herman of The Johns

Hopkins University for supplying information on the laboratory analysis of OH.

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Indications of the Interaction of Electric Field Gradients and Nuclear Electric Quadrupole Moments in Angular Correlation*

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THE influence of extranuclear fields on the angular correlation of successive nuclear radiation has been discussed by several authors.[1] It was generally assumed that the interaction between the nuclear magnetic dipole moment and magnetic fields, due to either the electron shell or the surrounding of the decaying atom, is mainly responsible for the reduction of the angular correlation. The dependence of this reduction on the source material was attributed to the difference in recovery time of the excited and ionized electron shell.

However, several directional correlations were reported recently, where the reduction of the anisotropy of the correlation could not be understood on the basis of the magnetic interaction alone, e.g., α-γ correlation of $RdTh^{228}$,[2] γ-γ correlation of Cd^{111},[3] and of Ta^{181}.[4] Abragam and Pound[5] were able to show that the coupling between the nuclear electric quadrupole moment in the intermediate state and the grad$E$ in axial crystals provides an explanation for the observed α-γ correlation of $RdTh^{228}$. It is well known that the Cd^{111} γ-directional correlation depends strongly on the chemical state[3,6] and on the environment[1] of the decaying In^{111} atom. This was explained hitherto by magnetic interaction. However, magnetic decoupling experiments with a magnetic field of 7000 gauss applied in the direction of the propagation of one γ-ray showed no tendency to restore the maximum directional correlation (Table I). This field is probably too small for a complete decoupling of I and J (complete Paschen-Back effect of the hyperfine structure or Back-Goudsmit effect), but nevertheless it is large enough to cause a partial breaking of the (I, J) coupling (incomplete Back-Goudsmit effect). An increase in the anisotropy much larger than the experimental error of the measurements should have been observed if the magnetic coupling were the predominant cause for the attenuation of the correlation in the sources investigated. Similar results with even higher fields have been obtained by Heer *et al.*[7] This result seems to indicate that the attenuation of the Cd^{111} correlation in solid sources is due to the interaction between the crystalline grad$E$ field and the electric quadrupole moment of the 0.247-Mev excited state of Cd^{111}, for which a rather large value of the quadrupole moment is expected from shell model considerations.

The largest anisotropy found for nonmetallic solids is exhibited by In_2O_3 and $In(OH)_3$. Both are cubic crystals with relatively small values of grad$E$ at the position of the In, due to the high symmetry of their space groups: T_h^7 and T_h^5, respectively. As a result of the preceding decay, however, these atoms may be displaced from the original lattice point and may be in regions of larger grad$E$ values during a time comparable with the lifetime of the intermediate state.

TABLE I. Directional correlation of Cd^{111} with different sources and with application of a magnetic decoupling field.

Source	B gauss	Anisotropy: $A=\frac{W(\pi)}{W(\pi/2)}-1$
Solid sources:		
$InCl_3$, dry (20°C)	···	-0.012 ± 0.005
$InCl_3$, dry (20°C)	7000	-0.015 ± 0.005
$InCl_3$, dry (540°C)	···	-0.022 ± 0.006
InI_3, dry (20°C)	···	-0.020 ± 0.006
InI_3, dry (20°C)	7000	-0.019 ± 0.006
InI_3, dry (200°C)	···	-0.021 ± 0.006
$In(C_9H_6OH)_3$	···	-0.020 ± 0.006
In_2O_3	···	-0.045 ± 0.004
$In(OH)_3$, dry	···	-0.035 ± 0.006
$In(OH)_3$, dry	7000	-0.036 ± 0.007
In metal, electrodeposited (20°C)	···	-0.051 ± 0.005
In metal, electrodeposited (150°C)	···	-0.048 ± 0.006
In metal, electrodeposited (20°C)	7000	-0.056 ± 0.007
Liquid sources:		
$InCl_3$, aqueous solution	···	-0.221 ± 0.005
$InCl_3$, aqueous solution $+10^{21}$ Fe^{+++} ions/cc	···	-0.215 ± 0.006
InI_3, liquid salt (220°C)	···	$-0.19\ \pm0.02$
$In(C_9H_6ON)_3$ in $CHCl_3$ dissolved	···	$-0.20\ \pm0.01$
In, liquid metal (180°C)	···	$-0.20\ \pm0.01$

A further indication that the attenuation of the Cd^{111} correlation in the solid sources is caused by crystalline grad$E$ fields stems from the fact that, without exception, liquid In^{111} sources of very different character give the maximum correlation (Table I). In the liquids used the character of the local configuration around a nucleus and thus the gradient of the electric field changes in a time much smaller than the lifetime of the intermediate nuclear state. Consequently the average perturbation on the nuclear m substates due to the quadrupole interaction is zero over the lifetime of the nuclear state.

During the progress of this work a convincing proof for the electric quadrupole interaction on the Cd^{111} correlation has been given by the beautiful experiments of the Swiss group[7] by using single crystals of indium as sources.

Attenuation effects very similar to those exhibited by the Cd^{111} correlation have recently been measured by McGowan[4] on the Ta^{181} γ-cascade. Liquid sources of Hf^{181} also show a much more pronounced anisotropy than solid sources.[4] Moreover, there is evidence that the $P_4(\cos\theta)$ term in the angular correlation function is less attenuated than is the $P_2(\cos\theta)$ term, a result which is impossible with magnetic interaction alone.[8] Both effects, however, are explained easily if electric quadrupole interaction in the intermediate state of Ta^{181} is assumed. For this nucleus a very large electric quadrupole moment in the lower excited states is to be expected from shell model considerations, the ground state of Ta^{181} having one of the largest quadrupole moments known.

A more detailed account of this investigation will be submitted for publication in the near future.

* Supported by the U. S. Atomic Energy Commission.
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Search for 1-Mev Gamma from N^{16} Decay*

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IN the β-decay of N^{16} to the 1^- (7.1-Mev) and 3^- (6.1-Mev) excited states of O^{16}, respectively, a discrepancy exists between the branching ratio of about 1:1 determined from absorption measurements on the β-spectrum,[1] and the ratio of