kg/cm² and 9390 kg/cm², T_λ was 0°C and +30°C. These points, together with T_λ at atmospheric pressure, enabled the equilibrium curve to be drawn. The slope at −30°C could thus be found, and was, in fact, 68.2 kg/cm²-deg., differing from the calculated value by 2 percent.

While the agreement is to a certain extent fortuitous, in view of the assumptions involved, the fact that the results will be of the same order can only mean further support for the thermodynamical interpretation of the λ-point phenomena.

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Microwave Spectra: Methyl Iodide*

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THE $J=1$ to $J=2$ rotational transition of the symmetrical top molecule, CH_3I, has been examined in the region of 30,000 megacycles with the method previously described.[1] Figure 1 shows the relative positions and estimated intensities of the eleven lines which were observed. Since no isotopes exist in sufficient amounts to cause detectable lines, the hyperfine structure observed appears to be caused by the interaction of the quadrupole moment of the iodine nucleus with the molecular field. About ten percent of the molecules would be in an excited vibrational state at the temperature of observation, and it is possible that some of the lines on the low frequency side originate from these excited molecules. We will test this by repeating the observations at lower temperatures.

The exact value of the moment of inertia, I_B, depends upon a quantitative interpretation of the hyperfine structure. The I_B determined from the strongest line, which is near the center of gravity of the group, is 111×10^{-40} g cm². Assuming the bond angles and CH distances to be the same as those in methane, the C—I bond length is determined as 2.13A. This value is probably accurate to one percent. The deviation from the configuration assumed for the CH_3 is not likely to influence the C—I distance more than one percent, and the uncertainty caused by the hyperfine frequency spread is of this order. Widely conflicting values for the C—I bond length in this molecule have been obtained from infra-red vibrational spectra[2] (2.00A) and from electron diffraction (2.28A). The value obtained in the present work is close to the electron diffraction value[3] for the C—I distance in CI_4 (2.12A).

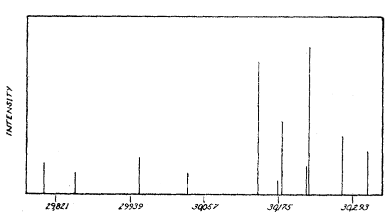

FIG. 1. Chart showing frequencies and estimated intensities of $J=1$ to $J=2$ transition in methyl iodide.

A more complete analysis of the spectra of this molecule is being made.

We wish to thank Dr. Walter M. Nielsen for his constant interest in this project.

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Protons from the Deuteron Bombardment of Separated Neon Isotopes

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ENRICHED neon samples obtained by thermal diffusion have been bombarded with 3.2-Mev deuterons from the cyclotron. Samples of 99.5 percent Ne^{20}, of 0.5 percent Ne^{22}, and of 55 percent Ne^{20} with 45 percent Ne^{22}, have provided sufficient change in concentration of the heavy isotope to allow definite assignment of several proton groups to each of the two reactions $Ne^{20}(d, p)Ne^{21}$ and $Ne^{22}(d, p)Ne^{23}$.

The gas was bombarded within a bombardment chamber[1] at a pressure of approximately 15 cm of mercury. This pressure provided a sufficiently high yield of protons for fast counting, and sufficiently low absorption for the gas to be treated as a thin target (about 0.4 cm of air equivalent). The 3.7-Mev deuteron beam passed through an aluminum foil (1.86-cm air) into the gas bombardment chamber. Protons were counted at right angles to the incident beam by the use of double coincidence proportional counters.[2,3]

Composite curves of typical runs are shown in Fig. 1. The curve for the 99.5 percent Ne^{20} sample shows the proton groups from the $Ne^{20}(d, p)Ne^{21}$ reaction alone. Comparison with the curve for the sample enriched in the heavy isotope shows clearly the additional groups due to the $Ne^{22}(d, p)Ne^{23}$ reaction. Subtraction of curves of the two types (after correcting for the proportion of Ne^{20} present) allows a more accurate determination of the groups due to the heavy isotope. Table I lists the Q values

TABLE I. Reaction energies and energy levels of the neon isotopes.

Proton range (cm)	Q (Mev)	Energy level (Mev)
$Ne^{20}(d, p)Ne^{21}$		
20.7±0.6	0.90±0.11	3.58
28.1±0.5	1.65±0.10	2.83
40.3±0.5	2.73±0.09	1.75
59.4±0.7	4.17±0.09	0.31
63.6±0.8	4.48±0.10	0.00
$Ne^{22}(d, p)Ne^{23}$		
24.4±1.0	1.23±0.15	1.66
31.1±1.0	1.90±0.15	0.99
42.9±0.9	2.89±0.11	0.00

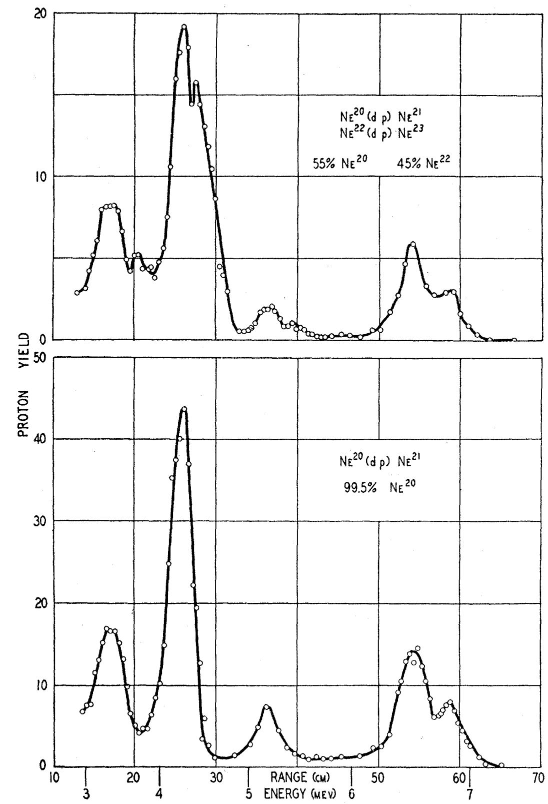

FIG. 1. Proton groups from deuteron bombardment of neon.

calculated from the extrapolated ranges and maximum beam energy, and also the corresponding energy levels.

The levels obtained for Ne^{21} are in essential agreement with previous work by Pollard and Watson[4] and Schultz and Watson.[5] The doubling of the ground state found by the latter is here confirmed. The levels for Ne^{23} are new values. The ground-state Q value agrees with the value suggested by Pollard and Watson,[4] although in their work the concentration of the heavy isotope was not sufficiently high for detailed measurement.

Mass values obtained from these reactions are summarized in Table II and compared with other values. The mass value (II) obtained for Ne^{21} exceeds the mass spectrograph value (III) by more than the estimated error. There is no mass spectrograph value for comparison with the value (V) for Ne^{23}. A cross check on the values obtained

TABLE II. Mass determinations of the neon isotopes.

	Isotope	Mass	Source	Reference
I	Ne^{20}	19.99896±0.00007	Mass spectrograph	8
II	Ne^{21}	21.00074±0.00019	$Ne^{20}(d, p)Ne^{21}$ with (I)	
III	Ne^{21}	20.99983±0.00027	$Ne^{20}H^{+}-Ne^{21+}$ doublet with (I)	9
IV	Ne^{22}	21.99864±0.00036	Mass spectrograph	9, 10
V	Ne^{23}	23.00213±0.00048	$Ne^{22}(d, p)Ne^{23}$ with (IV)	
VI	Na^{23}	22.99714±0.00038	$Na^{23}(d, \alpha)Ne^{21}$ with (II)	6
VII	Na^{23}	22.99717±0.00069	$Ne^{23}\rightarrow Na^{23}+\beta$ with (V)	4
VIII	Na^{23}	22.99715±0.00020	$Ne^{20}(\alpha, p)Na^{23}$ with (I)	4, 7

for Ne^{21} and Ne^{23} can be derived, however, from an independent calculation of the mass of Na^{23} from each of the two neon masses. The value (VI) in the table is obtained from the data given by Murrell and Smith[6] on the reaction $Na^{23}(d, \alpha)Ne^{21}$, using our value (II) for Ne^{21}. Using Pollard and Watson's[4] value for the maximum beta-ray energy from the disintegration of Ne^{23} into Na^{23}, the independent value (VII) is obtained. These two values are in excellent agreement with each other, and also with the value of Pollard and Brasefield[7] (VIII) as corrected by Pollard and Watson[4] (and recalculated using Mattauch's Ne^{20} value (I) instead of the earlier one of Jordan and Bainbridge[9]).

A check on the consistency of these masses could be obtained by observing the $Ne^{21}(d, p)Ne^{22}$ end group. So far the enrichment of Ne^{21} has not been adequate to enable this to be done.

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Further Cosmic-Ray Experiments above the Atmosphere

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ANOTHER in the series of experiments to determine the nature and reaction of the primary cosmic radiation above the atmosphere was performed in a V-2 fired on March 7, 1947 from the White Sands Proving Ground, New Mexico, to an altitude of 102 miles. A counter-tube telescope was arranged so that the percentage of particles penetrating 2 cm, 6 cm, and 12 cm of lead could be determined. The number of threefold showers under these same thicknesses was also measured.

The telescope was mounted vertically in a specially designed warhead so that it looked directly through the warhead nose as shown in Fig. 1.

The heavy load shielding aroung the lower half of the telescope was introduced in an attempt to reduce the number of rocket showers found in previous experiments.[1,2] This shielding in conjunction with the absorbing lead plates was sufficient to eliminate most of the registered rocket showers of primary or non-primary electronic origin. It was found that the number of rocket showers actually doubled over that of previous unshielded experiments. This would indicate that these showers must be of non-electronic origin. By the use of eight anticounters 2, 4, and 5 used in groups of 2, 4, 6, and 8 (quantity, not counter