about 15/1, while the corresponding ratio of meson intensity is only 2/1.

Hence we may say that it appears almost certain that high energy nucleons and σ-mesons play the principal role in the creation of these stars. The latter may be spoken of as "local indicator" of these components of cosmic radiation.

If this assumption is justified, we may deduce, by comparing the measurements under air and lead, the following value for the total cross section of this component:

$$\sigma \cong 3A^{2/3}\times 10^{-26}\ \mathrm{cm}^2.$$

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Preliminary Analysis of the Microwave Spectrum of Ethylene Oxide*

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FOUR strong lines of the pure rotational spectrum of the asymmetric rotor, ethylene oxide, have been observed in the region near 24,000 Mc/sec. (see Table I). The frequencies of the lines and their Stark effects allow identification of the transitions and determination of the moments of inertia of the molecule.

The Stark splitting is of the form $\Delta\nu=\mu^2E^2(A+BM^2)$ where $\Delta\nu$ is the difference between the frequencies of the Stark component and the undisplaced line. The number of components and their relative spacings allow a determination of the lower value of J involved in each transition.

TABLE I. Ethylene oxide absorption lines.

Frequency Mc/sec.	Designation
23,160	3_1-3_3
23,614	$3_{-1}-3_1$
24,855	4_0-4_2
24,948	$2_{-2}-2_0$

Relative intensities of the components are proportional to M^2, which indicates that $\Delta\cdot J=0$ for all four transitions.[1]

For $\Delta J=0$, $\nu_{J\tau;J\tau'}=(a-c)/2(E_\tau{}^J-E_{\tau'}{}^J)$, where $E_\tau{}^J$ is a tabulated function[2] of J, τ, and κ. Only values of $\kappa=\pm0.395$ allow fitting the observed lines in frequency, and the Stark effect shows that $\kappa=+0.395$ is the correct choise between these two values. In addition to determining κ, the line frequencies give $(a-c)/2=0.1898\ \mathrm{cm}^{-1}$.

The Stark pattern of the $2_{-2}-2_0$ transition is very sensitive to the ratio of $(a-c)/(a+c)$. Changes of 1 percent in the value of this ratio vary the ratio of the Stark effect coefficients A/B by 3 percent, giving $(a-c)/(a+c)=0.2756\pm0.003$, and $(a+c)/2=0.689\pm0.007\ \mathrm{cm}^{-1}$.

For the analysis, ethylene oxide was considered to be rigid and the effective moments of inertia rather than the equilibrium moments are determined. They are:

$$I_A=31.9\times10^{-40}\ \mathrm{g\ cm}^2,$$
$$I_B=36.7\times10^{-40}\ \mathrm{g\ cm}^2,$$
$$I_C=56.7\times10^{-40}\ \mathrm{g\ cm}^2.$$

As a check on the structure, the Stark patterns of the 3_3-3_1, 3_1-3_{-1}, and 4_2-4_0 transitions were calculated and the ratios of various coefficients involved were compared with the experimental values (see Table II).

TABLE II. Ratios of Stark effect coefficients for observed lines. [Stark displacement $\Delta\nu=\mu^2E^2(A+BM^2)$.]

Ratio	Calculated	Observed
$A_{3_1-3_3}/B_{3_1-3_3}$	0.69	0.69
$A_{3_{-1}-3_1}/B_{3_{-1}-3_1}$	−0.20	−0.18
$B_{3_1-3_3}/B_{3_{-1}-3_1}$	0.67	0.66
$A_{4_0-4_2}/B_{4_0-4_2}$	0.002	0.01
$A_{2_{-2}-2_0}/B_{2_{-2}-2_0}$	0.233	0.233
$B_{4_0-4_2}/A_{2_{-2}-2_0}$	−0.62	−0.62

If the C−H distance is assumed to be 1.09A, then the H−C−H angle is 121°.

Further work is contemplated to study isotopic species and to obtain more accurate molecular constants.

* Work supported by the Signal Corps.
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On the Production of Showers of Penetrating Particles

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THE purpose of the present experiments[1] was to study the cross section for the production of penetrating showers in various materials.

The penetrating showers were detected by a pair of "telescopes" shielded by lead from all sides (of the type used by G. Wataghin[2]). The registered radiation had a minimum range of 18 cm Pb. The telescopes were separated by 16 cm Pb.

Two series of measurements were planned. In the first one we distributed an equal number of nucleons (equal masses) of different materials in the same volume, and we obtained the frequencies of showers produced in these materials as the difference of the frequencies of the showers registered with and without the materials. In the second series (which is being performed) equal numbers of nuclei of two different elements are distributed in equal volumes. In this case the frequencies of the showers produced in the materials are proportional to the average cross sections of the respective nuclei.

In the present note we give the results of the first series, which consisted of experiments A and B. The shower-