A NEARBY EXAMPLE OF A GIANT MOLECULAR CLOUD

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We have mapped an extensive molecular cloud in Perseus in the 115 GHz line of ^{12}CO. Observations were made every 10' in right ascension and declination over most of the cloud, and every 2' in the regions of most intense emission, near the open cluster IC 348 and near the reflection nebula NGC 1333. We also obtained 110 GHz ^{13}CO data every 2' in the latter regions, as well as every 10' in several long strips across the cloud. A total of 812 positions were observed in ^{12}CO, and 200 in ^{13}CO. This work was done using the 5 m antenna of the Millimeter Wave Observatory of the University of Texas. The half-power beam size was 2'.6.

The cloud is elongated (Fig. 1), with its longest dimension, about 6°, corresponding to 35 parsecs at an assumed distance of 330 parsecs. The width is variable, typically 1° to 2°. The long dimension is inclined to the galactic plane at an angle of about 50°. The mean velocity of the emission shows a smooth gradient from 7 km/s near the western end to 10 km/s near the eastern end (Fig. 2). In the several regions of enhanced emission apparent in this figure $T_A^* \geq 9$ K, implying a brightness temperature ≥ 14 K. This indicates significant heating above typical dark cloud temperatures by imbedded stars, probably recently formed B stars, with the most luminous occurring near NGC 1333. This activity appears scattered throughout the cloud, and there is no evidence of sequential star forma-

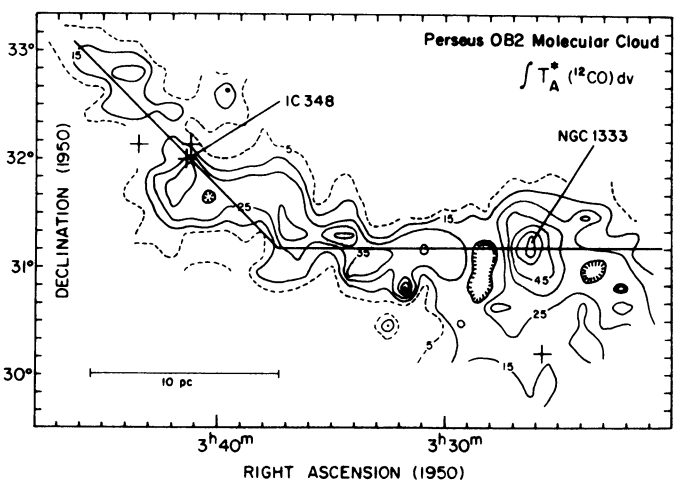

Fig. 1. Integrated intensity in ^{12}CO in units of K km/s. Crosses represent stars belonging to the Perseus OB2 association. o Persei is the northernmost of the two stars near IC 348.

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tion. The velocities of these 'hot spots' are displaced by as much as ±1.5 km/s from the median velocity of the emission at their positions along the length of the cloud. The components that appear at velocities of 1-4 km/s seem to be smaller separate clouds overlapping the main cloud along the line of sight.

LTE column densities for ^{13}CO range up to $6.5 \times 10^{16} cm^{-2}$ in the 'hot spots', with $1 \times 10^{16} cm^{-2}$ being a typical value. Assuming $N(^{13}CO)/N(H_2) = 1 \times 10^{-6}$, we estimate the cloud's mass to be 2.5×10^{4} solar masses. Sargent (Ap.J. 1979 233, 163) finds from CO observations a mass consistent with ours, if adjustment is made for her use of a different $^{13}CO/H_2$ ratio. The somewhat higher mass found by Baran (Ph.D. Thesis, 1979, Columbia University, in prep.) includes a second molecular cloud to the northeast. These two clouds, together with several smaller fragments, may form a cloud complex associated with the Perseus OB2 association, whose center of expansion lies between them.

A much smaller region near NGC 1333 has been mapped in detail and analyzed by Loren (Ap.J. 1976 209, 466) in ^{12}CO and ^{13}CO. He presented evidence that a collision of two clouds furnished the immediate triggering mechanism for the intense star formation known to be taking place there. The clouds considered by Loren are seen here to be small sections or wisps of a much larger structure, whose gross velocity contours (Fig. 2) show no evidence of separate clouds in collision.

The star o Per, which has a rich ultraviolet and optical interstellar spectrum (e.g. T.P. Snow, 1976, Ap. J. 204, 759) is projected on the edge of the Perseus Molecular Cloud. The molecules observed in uv and optical absorption therefore represent the material on the edge of a true dense molecular cloud rather than a "diffuse" interstellar cloud. The radiation from o Per may be dissociating the edge of the molecular cloud.

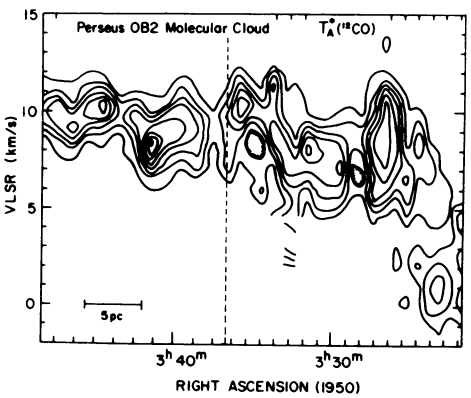

Fig. 2. $T_A^*(^{12}CO)$ along the bent line shown crossing the cloud in Fig. 1. Horizontal scale is linear in length along the line. Contours every 2 K, starting at 1 K.

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