THE BASIC ASSUMPTION

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As the last of the panel speakers it is perhaps my duty to examine the basic assertion underlying this conference, i.e., when a supernova occurs there is a release of sufficient energy to ionize a large amount of the surrounding interstellar material and that the Gum Nebula is an example of this process.

The validity of this statement must be checked by examining the observational facts available in the case of the Gum Nebula since theoretical arguments are seldom completely convincing by themselves when the subject is so complex. The first fact would appear to be the establishing of the pulsar in the supernova remnant and the two of them near the center of the Gum Nebula. This pulsar was the first to be found in a supernova remnant and there can be little doubt from both the position and age of the two objects that they are associated. The distances derived by Milne and by Harris for the supernova remnant are relatively uncertain but the finding that the stars previously thought to be the source of ionization of the nebula are located at this same distance may argue in favor of the pulsar being a member of the B-association.

The dispersion measure gives the total number of electrons in the path independent of distance to the pulsar and therefore the total number of electrons in the nebula depends not on the distance to it but only on the height assumed for the nebula. The total estimate of the energy involved, i.e., about 5×10^{51} erg can not easily be changed by a large amount.

This amount of energy is near the total released during the main sequence lifetime of a star. It is also comparable to the binding energy of a neutron star and hence presumably to the energy released by a supernova. A star whose energy output is mostly at wavelengths below the Lyman limit could produce the observed number of electrons if no recombination occurs. Since with the interstellar densities involved recombination is fast with respect to the main sequence lifetime of the stars, an ordinary stellar source for the nebula may be ruled out. The supernova explanation becomes plausable.

Before the supernova explosion a nebula must have existed around each of the hot stars, with the largest one surrounding the pre-supernova itself. These nebulae would be unaffected by the supernova explosion since the gas is already ionized and their temperatures remain the same, i.e. about 10^4 °K. The

The Morrison-Sartori model of a supernova explosion predicts a temperature of a few times 10^5 °K, and this distinction may suggest a way of determining which of the bright nebulae correspond to stellar ionization and which have their origin in ionization by the supernova.