Molecules in Space

In 1944 van de Hulst had derived the important result that the atom of neutral hydrogen has two states for its electron, an upper energy state when it is spinning parallel to the proton and a lower energy state when it is spinning anti-parallel to it, and a transition from the former to the latter gives rise to a wave of 21 cm wavelength. In the early days of radio astronomy, this wavelength played a major role in identifying the presence of neutral hydrogen as the predominant component of the interstellar medium.

Nevertheless, astronomers by and large were not prepared to accept the presence of molecules distributed in giant clouds in the interstellar space, as proposed, for example by Fred Hoyle with R.A. Lyttleton in 1940. Although, Andrew McKeller discovered CH and CN by using optical methods, the real burst of activities began when in 1963, OH was discovered by S. Weinrab, A.H. Barrett, M.L. Meeks and J.C. Henry at the radio wavelength of 18 cm.

Because molecular transitions occur at such energies that the resulting photons are by and large emitted in the millimetre wavelengths (rather than at the radio wavelengths), antennas suitably designed for receiving radiation at such wavelengths began to be set up. The lead was taken by the NRAO at Green Bank in the USA and by the CSIRO in Australia. Thus in 1968, H_2O and NH_3 were discovered at wavelengths of 1.35 cm and 1.26 cm respectively as predicted by Charles Towns in 1955.

The sixties and the seventies saw molecular astronomy come into its own, with the realization that there are giant clouds with molecules filling the interstellar space. A typical molecular cloud is around a light year across, whereas, there may be hundreds of such regions in a giant molecular cloud extending to 100 light years. The process of star formation takes place in the relatively denser molecular clouds.

But what has been impressive is the wealth of molecules found, organic as well as inorganic. The latter are naturally larger. For example, HC_9N (cyano-octa-tetrayn), is an example of a molecule with 11 atoms. Other more familiar molecules include, methanol, acetaldehyde, dimethyl ether, etc. The origin of these molecules and their interaction in space form topics for the newly emerging branch of 'astrochemistry'.

The presence of organic molecules in space has also strengthened the speculation that extraterrestrial habitats for life may exist in the Galaxy.