NEWS AND VIEWS

Hunting for Molecules among the Stars

INTERSTELLAR molecules seem to be starting the new year in a continued blaze of publicity, as the discovery of yet more complex molecules encourages increased attention from observers. In the last issue of *Astrophysical Journal* for 1970 (**162**, L203) the first six atom interstellar molecule was announced (see *Nature Physical Science*, **229**, 36; 1971), and the first two issues of *Astrophysical Journal* for 1971 now report further developments in this fast growing area of astronomy.

Work carried out at the NRAO's Green Bank radio observatory in West Virginia has revealed the existence of microwave radiation characteristic of the cyanoacetylene molecule (HC_3N) in the emission from the galactic radio source Sgr B2. This discovery is particularly interesting because the molecules of cyanoacetylene are linear, with a configuration H—C≡C—C≡N; the spectra of such molecules are simplified because the electrons are paired off, leaving no net electronic angular momentum, and although there remains some splitting of the spectral lines caused by quadrupole interactions, this is smaller than the broadening of the lines arising from turbulence and the Doppler effect. B. E. Turner reports the presence of features attributed to ground state first transitions of this molecule, Doppler shifted by an amount corresponding to roughly 64 km s^{-1}, in good agreement with measurements of formaldehyde and hydroxyl features in the same source, all of which show velocities just over 60 km s^{-1} (*Astrophys. J.*, **163**, L35; 1971). Although a search of other galactic sources containing molecules of OH, H_2CO, and HCN has failed to produce any more evidence for HC_3N, other reports recently published also add positively to the growing store of knowledge concerning interstellar molecules.

B. Zuckerman, of the University of Maryland, and J. A. Ball and C. A. Gottlieb, of Harvard College Observatory, have also used the 140 foot Green Bank telescope to good effect, and they provide more information about the microwave characteristics of formic acid, the simplest organic acid, in a letter in the second part of the same volume of *Astrophysical Journal* (**163**, L41; 1971). The source of this radiation is Sgr B2, which is rapidly becoming a star source for the hunters of complex molecules. A rather less definite observation of a line attributable to this acid has been made in the direction of Sgr A, but this is overshadowed by the Sgr B2 discovery, which again corresponds to a line Doppler shifted by a velocity close to 60 km s^{-1}.

The smaller telescopes at Green Bank are also providing valuable information. Using the 36 foot telescope, L. E. Snyder, of the University of Virginia, and David Buhl, of NRAO, have studied emission spectra from hydrogen cyanide molecules containing two different isotopes of carbon, $H^{12}CN$ and $H^{13}CN$. This work shows how rapidly the study of interstellar molecules is moving away from simple discoveries into applications which can reveal otherwise hidden features of the way our galaxy is constructed. One of the two sources definitely containing $H^{13}CN$ is Sgr A, restoring the balance with Sgr B2 to some extent, and the other is Orion A. The two sets of observations give, by comparison with $H^{12}CN$ emission from the same sources, carbon isotope ratios ($^{12}C/^{13}C$) of 4.7 and 8.3 respectively (*Astrophys. J.*, **163**, L47; 1971). On Earth, this ratio is 89 and although, by themselves, these two measurements cannot be taken as meaningful for the galaxy in general, continued work along these lines will clearly help studies of our galaxy.

More work carried out with an NRAO 36 foot antenna, this time at Kitt Peak, by P. Solomon, K. B. Jefferts, A. A. Penzias and R. W. Wilson (the last two well known for their detection of the "3 K" background radiation) has also concentrated on using microwave molecular lines in measuring characteristics of a galactic source rather than looking for new lines. This study of the CO lines in the source IRC+10216 was inspired by the importance of this object at infrared wavelengths—at 5 μ it is the brightest source outside the solar system, and has the large apparent diameter of 4″ in the visible spectrum and 0.7″ in the infrared. It is clear from the broad, flat nature of the CO line that it originates in a shell expanding away from a central object at 15 km s^{-1}. Extrapolation backwards in time suggests that this expansion started from the centre some 500 years ago, assuming that the shell was created in a single explosive event at the central, old carbon star associated with the nebula. But perhaps a more realistic process for the origin of this expanding source lies in the suggestion of Hoyle and Wickramasinghe that bright carbon stars must be continually losing mass as radiation pressure blows graphite outwards in a spectacular stellar wind (*Mon. Not. Roy Astr. Soc.*, **124**, 417; 1962).

So the study of interstellar molecules is rapidly forging a useful tool for the investigation of our galaxy. Isotopic abundances look likely to cause some puzzles, if they follow the lines of recent observations, and the evidence so far available does suggest that these abundances differ significantly from those in the solar system. A strange feature of the abundances of the molecules themselves lies in the way certain molecules seem to be favoured over others in the production mechanisms operating in the interstellar medium. Organic molecules seem to be favoured over simpler compounds such as NH_3 and OH, and the reason for this is at present a mystery. Making maps of the distribution of clouds containing complex molecules, in the same way that maps of hydrogen clouds have been made, will certainly improve our understanding of the geography of our galaxy. But in the public eye (and, indeed, to many specialists) this prosaic work is overshadowed by the growing conviction that clouds exist which contain even more complex molecules, including some, such as amino-acids, necessary for the development of life as we know it, and that these might be discovered at any time.