Table 6·3 **Interstellar molecules**

year	name	formula	wavelength
1937	methylidyne	CH	4 300 Å (0·43 μm)
1940	cyanogen	CN	3 875 Å (0·3875 μm)
1941	methylidyne ion	CH^+	3 745–4 233 Å (0·3745–0·4233 μm)
1963	*hydroxyl	OH	2·2, 5·0, 6·3, 18 cm
1968	ammonia	NH_3	1·20–1·26 cm
1968	*water	H_2O	1·35 cm
1969	*formaldehyde	H_2CO	1, 2·2, 6·2 cm; 2·0, 4·0 mm
1970	*carbon monoxide	CO	2·60 mm
1970	*cyanogen	CN	2·64 mm
1970	hydrogen	H_2	1 100 Å (0·11 μm)
1970	*hydrogen cyanide	HCN	3·38 mm
1970	*formyl ion	HCO^+	3·36 mm
1970	*cyanoacetylene	HC_2CN	3·30 cm
1970	methanol	CH_3OH	0·3, 1·2, 36 cm
1970	formic acid	HCO_2H	18·3 cm
1971	carbon monosulphide	CS	2·04 mm
1971	formamide	$HCONH_2$	6·49 cm
1971	silicon monoxide	SiO	2·30 mm
1971	carbonyl sulphide	OCS	2·74 mm
1971	methyl cyanide	CH_3CN	2·72 mm
1971	isocyanic acid	HNCO	0·34, 1·36 cm
1971	*hydrogen isocyanide	HNC	3·31 mm
1971	propyne	CH_3C_2H	3·51 mm
1971	acetaldehyde	CH_3CHO	28·1 cm
1971	thioformaldehyde	H_2CS	9·5 cm
1972	hydrogen sulphide	H_2S	1·78 mm
1972	methyleneimine	CH_2NH	5·67 cm
1973	sulphur monoxide	SO	3·49 mm
1974	ethynyl	C_2H	3·43 mm
1974	dimethyl ether	CH_3OCH_3	3·47, 9·6 mm
1974	*methylamine	CH_3NH_2	3·48, 4·1 mm
1974	*hydrodinitrogenyl ion	N_2H^+	3·22 mm
1975	cyanamide	NH_2CN	2·98, 3·73 mm
1975	silicon sulphide	SiS	2·75, 3·30 mm
1975	ethanol	CH_3CH_2OH	2·8, 3·3, 3·5 mm
1975	sulphur nitride	SN	2·60 mm
1975	sulphur dioxide	SO_2	3·46, 3·58 mm
1975	acrylonitrile	CH_2CHCN	21·86 cm
1975	methyl formate	HCO_2CH_3	18·6 cm
1976	*formyl	HCO	3·46 mm
1976	cyanodiacetylene	HC_4CN	2·80, 11·28 cm
1976	methyl cyanoacetylene	CH_3C_2CN	3·46 mm
1977	cyanoethynyl	C_2CN	3·03, 3·37 mm
1977	ketene	CH_2CO	2·94, 3·00, 3·67 mm
1977	nitrosyl hydride	HNO	3·68 mm
1977	ethyl cyanide	CH_3CH_2CN	2·58–3·06 mm
1977	cyanohexatri-yne	$HC_2C_2C_2CN$	2·95 cm
1978	nitric oxide	NO	1·99 mm

*Several isotopic forms are known.

diameter, that is more than 600 000 times greater. The strength of the OH lines varies markedly over periods of a few months.

All these factors point to some sort of amplification occurring in the production of the OH lines, and such sources are called MASERS (an acronym for *M*icrowave *A*mplification by *S*timulated *E*mission of *R*adiation), the microwave equivalent of LASERS. The maser process is, as yet, not well understood. It is clear that the OH molecules absorb energy by some process and convert it into radiation; but the amplification can only occur under extremely critical conditions of density, temperature and magnetic field. Some masers appear to be identified with stars which are in the process of formation, while others are associated with very late-type red stars, such as Mira variables and NML Cyg. Recently, other masers – water vapour (H_2O), silicon monoxide (SiO), methyl alcohol (CH_3OH) and methylidyne (CH) – have been discovered, and it is hoped that they will provide more clues to the working of the mechanism.

All molecules, whatever process they are undergoing, are basically unstable in the hostile environment of space. Those which have been discovered must, therefore, be relatively young; and astrochemists are currently working hard on theories of their formation. It appears that the simpler diatomic molecules can be built up on the surfaces of dust grains; but the complex varieties need to be assembled by collisions between atoms in dense gas clouds and there is no general agreement as to how this happens.

Conditions in space are vastly different from those in terrestrial laboratories, which makes prediction of the end result that much more difficult. A few outspoken scientists have even suggested that the complex molecules which make up living creatures were originally built up in space.