suspensions of single cells by disruption of the tight junction, then phospholipid could freely diffuse over the entire cell surface.

Not all amphipathic molecules are segregated in this way by the tight junction, and some can freely diffuse from one surface of the cell to the other. These differences appear to be correlated with the ability of the label to undergo the so-called 'flip-flop' motion between the two halves of the bilayer membrane. Phospholipids are known to undergo this motion very slowly, and a phospholipid added to epithelial cells remains in the outer half of the membrane. Some amphipathic molecules can, however, rapidly flip between the two halves of the membrane, and it is these labels that can diffuse past the tight junction. It therefore seems that the tight junction acts as a diffusion barrier only for the outer half of the membrane and so allows the epithelial cell to maintain a difference in phospholipid compositions between the outer halves of the apical and basolateral surfaces of the cell.

Restricted diffusion of phospholipids and other amphipathic compounds can also result from the simple equilibrium mixing properties of the components of the membrane. One clear example has been studied by McConnell and his colleagues over the last few years (Recktenwald and McConnell *Biochemistry* **20**, 4505; 1981). There is now much evidence that in mixtures of phospholipids and cholesterol some kind of highly ordered structure is formed. Although the full details are still controversial, the suggestion is that the structure resembles a ploughed field with furrows of pure phospholipid separated by ridges made up of a mixture of phospholipid and cholesterol. Diffusion will then tend to occur preferentially parallel to the ridges and furrows rather than across them. In extrapolating this conclusion to real membranes, many of which contain high concentrations of cholesterol, it is of course necessary to consider the effects that proteins might have. Effects of protein on the diffusion of amphipathic molecules are considered by Laggner in a recent issue of *Nature* (**294**, 373; 1981).

If spin-labelled fatty acids are incorporated into membranes at relatively high concentrations, then the ESR spectra of the spin labels become broadened as a result of motion of one spin label relative to its neighbours. Laggner has observed that this concentration broadening is less in membranes of sarcoplasmic reticulum than in lipid bilayers prepared from phospholipids extracted from sarcoplasmic reticulum. He suggested that this could reflect the presence of two phospholipid environments — bulk phospholipid and annular phospholipid adjacent to membrane proteins, with only the fatty acid incorporated into bulk phospholipid being free to diffuse within the membrane. The pattern of diffusion of amphipathic molecules in biological membranes is clearly complex. ☐

# The gassiest comet?

*from David W. Hughes*

COMET BRADFIELD, 1979X, is the comet in question and recent measurements indicate that the ratio between the mass of gas and the mass of dust emitted by this comet per unit time is higher than that measured for any other comet. The underlying message is that no two comets seem to be the same and when they near the Sun their gas and dust emission depends on a whole range of factors. Among the most important of these must be the time interval between perihelion passages, the orientation of the nucleus spin axis with respect to the orbital plane and the evolutionary stage the comet happens to be in.

Knowledge of gas production has been greatly improved by two factors. First, high-resolution spectra of bright comets can be obtained from the International Ultraviolet Explorer (IUE) satellite. The satellite has two echelle UV spectrographs that have a total wavelength range of 1,150–3,200 Å and a possible resolution of 0.2 Å, over a rectangular field of view of 10×15 arc s. Data have been collected from objects as faint as 17th magnitude. Second, an upsurge in interest in the UV end of the spectrum has helped the ground-based astronomer and it is now realized that reliable, absolute photometry can be carried out from a good site down to wavelengths of around 3,080 Å.

Considerable extinction occurs in the atmosphere at low wavelengths due to Rayleigh scattering by air molecules, aerosol scattering by suspended particles and molecular absorption by ozone. Most of the ozone resides between the altitudes 10 and 35 km and the column density varies with season and latitude. Its contribution to extinction is, for example, 20 per cent smaller at the latitude of Hawaii than at the latitude of Flagstaff, Arizona. Unfortunately the extinction caused by Rayleigh and aerosol scattering varies exponentially as a function of height — for UV observations the higher you are the better. Extinction can, however, be measured by making repeated observations of a standard star as it rises and sets. The results obtained vary from 80 to 20 per cent as the wavelength increases from 3,100 to 4,100 Å.

Ground-based observations of comet Bradfield have been made by Michael F. A'Hearn (University of Maryland), Robert L. Millis (Lowell Observatory, Arizona) and Peter V. Birch (Perth Observatory, Australia) and their results have been published in a recent edition of *The Astronomical Journal* (**36**, 1559; 1981).

Comet Bradfield came very close to the Earth and although it was not unusually luminous, it was possible to make detailed photometric measurements from a time just after its discovery, when it was 0.57 AU from the Sun, up to the time when it was 1.65 AU away. All observations were postperihelion. The unusual apparition geometry meant that the comet quickly changed its position on the celestial sphere and had to be observed progressively from Perth, Australia; Mauna Kea, Hawaii; and Flagstaff, Arizona. Photometric measurements were made of the comet using a series of filters with pass bands of around 100 Å. The coma of the comet contains many gas molecules which undergo fluorescence excitation by solar radiation. Filters centred on 3,085, 3,365, 3,870, 4,060, and 5,115 Å pick up the radiation from OH, NH, CN, $C_3$ and $C_2$ respectively. The dust-scattered continuum was sampled by using filters centred at wavelengths of 3,300, 3,675 and 5,240 Å.

Using a specific coma model the authors converted the observed cometary molecule column density to a value for the total number of molecules in the coma and then, by dividing by the lifetime of the species, to a value for the production rate from the nucleus. To check their work they compared their ground-based observations of the production of OH with those determined from the IUE spacecraft. The agreement was excellent.

The production rate of all molecular species was found to vary as $r^{-3.2}$ where $r$ is the heliocentric distance of the comet. This is remarkably steep and contrasts with the $r^{-2}$ variation found for comet West. One suggestion is that the nuclei of the two comets differ. Bradfield is perhaps covered with an outer 'frosting' of relatively volatile material. However, frosting is generally thought to be associated with a long residence ($10^5$–$10^7$ yr) in the boundary regions between stars, whereas comet Bradfield has an orbital period of only about 300 yr. Maybe the surface of the nucleus is heterogeneous or suffers from the buildup of an insulating crust.

The gas to dust ratio of the comet was found to be higher than for any other comet observed previously. The equivalent widths of certain $C_2$ Swan bands indicate that this could have been as high as 22 when the comet was about 0.8 AU from the Sun, decreasing to about 3 at 1.65 AU. This is three to four times greater than values observed for previous very gassy comets such as P/Encke and comet Kohler (1977 XIV).

Changes occurred in the relative molecular production rate as a function of heliocentric distance. The comet was CN rich when it was discovered at $r = 0.57$ AU. Over the range $0.6 < r < 1.0$ AU the abundance ratios were normal and they stayed constant. However, a peak in $C_2$ production relative to CN occurred around 1 AU and OH and $C_2$ decreased relative to $C_3$ and CN as the comet went further away. ☐

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