Devaux and McConnell (*J. Amer. Chem. Soc.*, **94**, 4475; 1972) have introduced a spin-labelled phosphatidylcholine derivative into planar bilayers, arranged in stacks, of native phosphatidylcholine. This kind of system, containing the spin-labelled derivative at low concentration, was used in earlier work from McConnell's laboratory to study the nature of hydrocarbon chain motion. In the new experiments, however, the spin-labelled phospholipid was introduced at rather high concentration, and incompletely mixed into the matrix, so that the molecules were distributed in large clusters, rather than randomly, in the bilayer. Unpaired electron spins close together interact, with gross broadening of the e.s.r. line widths, and this is what is observed in the clustered system. With time, however, the lines begin to sharpen, and after two days or so, the e.s.r. spectrum is not very different from that of a random system. Knowing, from microscopy, the diameter of the patches of the coloured, spin-labelled phospholipid, and the dependence of the line width on concentration, the evolution of the spectrum with diffusional dilution can be simulated, and the rate of spreading then gives the diffusion coefficient. This works out at about 2×10^{-8} cm^2 s^{-1}—a sizable value, although a good deal smaller than for molecules of this size in free solution. If the diffusion is treated as a hopping process between lattice points, this diffusion coefficient corresponds to about 10^7 jumps s^{-1}. This is not very different from McConnell's earlier estimates[1] of the rotational isomerization rate of the hydrocarbon chains in the bilayer, or of rates of rotation of guest molecules.

With a similar objective in mind, and also using the shape of the e.s.r. signals from a spin label incorporated into an artificial bilayer, Sackmann and Träuble have arrived at a closely similar conclusion. Theirs, however, is an equilibrium method, and is related to that of Devaux and McConnell only in the technique of observation. They are also concerned with the differences in the structure of the bilayer above and below the transition temperature, at 41° C in their system, which can be observed as a discontinuity in a variety of physical parameters. By way of preamble (*ibid.*, 4482), they have used the e.s.r. spectrum, and the fluorescence and absorbance of dye molecules soluble in phospholipid, to follow the transition in a system consisting of spin-labelled androstane as a guest molecule in a dipalmitoyllecithin bilayer. The optical labels respond to the transition, largely in virtue of increased solubilization in the membrane above the transition temperature. This loosening of the lattice is also reflected in the diminution of the e.s.r. line widths from the spin label, in consequence of increased freedom of tumbling. When the spin label is present in high concentration, a large line broadening effect occurs if the temperature is below the critical value. The results are analysed in a second paper (*ibid.*, 4492). Spin-spin interaction can elicit line broadening by two separate mechanisms, exchange (which requires van der Waals contact) and dipole-dipole interaction. The effects of these two perturbations on the line shapes are readily calculated, and comparison of simulated with observed spectra leads to the interpretation that exchange predominates, and decreases dramatically when the temperature is raised above the phase transition. In their third paper, Träuble and Sackmann (*ibid.*, 4499) show that the exchange efficiency obeys expectations in regard to its dependence on concentration of the unpaired spins and the temperature (to which it responds in a characteristic manner, different from that of dipole-dipole interactions). The exchange frequency is proportional to the number of collisions of spin-labelled molecules in unit time, and this in turn gives a diffusion coefficient of about 10^{-8} cm^2 s^{-1}. This applies only to the temperature range above the transition, for below this the dependence of exchange on concentration is consistent with the onset of phase separation, the androstone forming substantial clusters within the phospholipid matrix.

Scandella, Devaux and McConnell (*Proc. US Nat. Acad. Sci.*, **69**, 2056; 1972) have used the same approach to the observation of the diffusion of spin-labelled phosphatidylcholine in sarcoplasmic reticulum membrane, dispersed by sonication, but native in the sense that the calcium pump is still functional. The labelled lipid spontaneously diffuses into the bilayers, and only at very high concentration does it inhibit the ATPase. Above about 40° C, concentration broadening of the signals is dominated by exchange, as the temperature dependence shows. As before, the collision rate, and hence the transitational diffusion coefficient were determined, and the value of the latter, some 10^{-7} cm^2 s^{-1}, is quite similar to that in vesicles of lipids derived from the same membrane. At low temperatures there is again evidence of phase separation. The rapid translational diffusion of phospholipid (which may move at 5 to 10 μm s^{-1}) is therefore a reality in a biological membrane under more or less physiological conditions. Scandella *et al.* point out, however, that different membranes will vary in this regard, and in some, in which the hydrocarbon chains appear to be much more extended and less flexible, translational diffusion will not be expected to operate on the same time scale.

STRONTIUM METABOLISM

Fallout and Spin-off

from a Correspondent

THE human foetus discriminates between radioactive and stable strontium. This remarkable conclusion was reported in

Recognition of Gravitational Radiation

A COMMUNICATION in next week's *Nature Physical Science* (September 18) points out a feature of gravitational radiation which could assist in the vital task of positive identification. So far the art of identification has consisted of what the author, W. L. Burke, calls "Holmesian sleuthing", in which one eliminates as impossible all more probable sources of disturbance to the detecting apparatus and concludes that gravitational radiation, however improbable, is the only remaining possibility and must be the truth. Weber's important experiments have observed disturbances in massive objects from which all other sources of disturbance have been eliminated. Because it is impossible to remove all other sources completely, it has been necessary to have more than one antenna and to observe coincidences between disturbances with a time lag between antennae as evidence for a travelling gravitational wave. Moreover, because only large sudden disturbances are observable, Weber's experiments have been able to reveal only wave fronts with a pulse-like structure.

Burke points out that gravitational waves have a unique feature permitting their identification. In the equation of motion of a weighted spring driven by a gravitational wave, the disturbance does not consist of a driving force, but appears as an extra term in the proper acceleration measured at the end of the spring—in fact as a pseudoforce. The second time derivative of the strain is not equal to the proper acceleration, but differs from it by this pseudoforce term. Only general relativity can so influence our ideas of inertia.

The effect of this feature is to alter the phase relation between the strain and the elastic force. Instead of being 180° out of phase for the input of a cosine wave, the proper acceleration has a phase shift dependent on frequency and with a peak at resonance.

Burke's communication shows that there is, in principle, an internal method for positive identification of gravitational waves with a single antenna. It is not restricted to pulse-like wave fronts, but identifies cosine waves and (by means of cross-correlation) arbitrarily structured disturbances.