by Seeman and his collaborators in Toronto (*Biochim. Biophys. Acta*, **183**, 476; 1969) report detailed investigations on the membrane stabilizing properties of anaesthetics based on studies with erythrocytes and the products of their haemolysis—the so-called ghosts. In hypotonic solutions red cells swell, fissures appear in the membrane, and cytoplasmic material—including haemoglobin—is lost. Anaesthetics consistently block this process and stabilize the membrane, and the close correlation between red cell stabilization and narcotic action suggests that both have a similar mechanism. To measure quantitatively the membrane concentration of a local anaesthetic, Seeman *et al.* allowed chlorpromazine to interact with haemoglobin-free ghost membranes in concentrations known to be membrane stabilizing for both nerve fibres and erythrocytes. They found that the uptake of anaesthetic, in conditions of 50 per cent stabilization, was 0.033 mole/litre, in excellent agreement with the value (0.03 mole/litre) which the Overton-Meyer theory would predict for anaesthesia of 50 per cent of subjects. This alone, apart from the other data reported by Seeman, would support the extrapolation of results with erythrocytes to the situation in nerve.

In the latest *Biomembranes* issue of *Biochim. Biophys. Acta* (**193**, 92; 1969), S. M. Johnson and A. D. Bangham report studies on the permeability of artificial phospholipid structures, "liposomes", in the presence and absence of anaesthetics. Thermodynamic considerations lead them to suggest that anaesthetics increase the freedom of movement of groups in the lipid near the interface, increase the disorder in this region, and so block the action potential in the nerve axon. It is concluded that the biological endpoint in this phenomenon is the point at which a certain degree of disorder is reached and that anaesthetics—alcohols, for example—differ only in the amount required to bring this about.

ASTRONOMY

Temperature of Moving Background from a Correspondent

EVER since the discovery of the black body radiation at a temperature of about 3 K, with which space appears to be filled, there has been speculation about the possibility that the radiation may actually be anisotropic. The point here is that the anisotropy might be a proof of the existence of a frame of reference which is fundamental to the universe at large. The frame in which the radiation is isotropic is the new fundamental frame, and it is convenient to regard the radiation as "at rest" in this frame. When the radiation is viewed from the Earth the apparent temperature of the radiation will be highest in the direction in which the radiation is approaching, and lowest in the direction in which the radiation is receding. At present the upper limit for the velocity component of the Earth which lies in the plane of the Earth's equator is of the order of 300 km s⁻¹ through the cosmic background (Partridge and Wilkinson, *Phys. Rev. Lett.*, **18**, 557; 1967). In these discussions, the formula for the variation of apparent temperature with direction relative to the microwave background has been independently derived on several occasions, and one of these derivations was quoted in *Nature* a few weeks ago (**221**, 1100; 1969).

It seems, however, to have been forgotten that the first general formulae dealing with this variation of apparent temperature are due to Pauli (*Theory of Relativity*, Pergamon, London, 1958; *Relativitäts Theorie in Encycl. d. Math. Wiss.*, Teubner, Leipzig, 1921). Where the microwave background is concerned, the most pertinent of the formulae is the expression for the specific intensity or brightness per unit frequency

$$K(\nu, \theta, v) = \frac{2h}{c^2} \frac{\nu^3}{\exp\left(\frac{1 - (v/c) \cos \theta}{\sqrt{1 - (v/c)^2}} \frac{h\nu}{kT_0}\right) - 1} \quad (1)$$

at observed frequency ν , and angle θ to the relative velocity v .

Pauli himself introduced a temperature $T = T_0(1 - (v/c)^2)^{-1/2}$ as a kind of Lorentz-transformed temperature, but there has been some controversy over the propriety of using this (see *Nature*, **214**, 1069; 1967). It is important to note that the apparent temperature T' obtained from the exponent of equation (1) cannot be used as a Lorentz transformation of temperature by means of the expression

$$T'(\nu, \theta) = \frac{T_0 \sqrt{1 - (v/c)^2}}{1 - (v/c) \cos \theta}$$

This, after all, depends on the angle of observation as well as the velocity v and no temperature, even if generalized, can reasonably be expected to be dependent on angle.

Two lines of current investigations are seen to merge when the anisotropy of black body radiation is discussed: our motion through the background radiation and the question of special relativistic thermodynamics. In both areas work is continuing, and at a conference on thermodynamics in Pittsburgh in April this year several papers were read on relativistic thermodynamics.

The difficulty of defining a temperature in relativistic situations in which the thermometer may be moving relative to the system whose "temperature" is being measured (Landsberg and Johns, *Nature*, **220**, 1120; 1968) is largely due to a radiative drag force experienced by each of the two systems. The expressions obtained by Landsberg and Johns suggest that the force on a black sphere moving through cavity radiation at 3 K is generally small, but will go to infinity if the velocity approaches c . The drag has also been shown to be small by Heer and Kohl (*Phys. Rev.*, **174**, 1611; 1968), who confine themselves to velocities very much smaller than c . They were interested in estimating to what extent bodies are slowed down to the rest frame of the cosmic background radiation.

PARTICLE PHYSICS

Duality and Particle Spectroscopy

THE important role of the concept of duality in solving the riddle of the hadron spectrum has been further developed by two interesting applications. Mandula *et al.* (*Phys. Rev. Lett.*, **22**, 1147; 1969) have considered a large number of scattering processes and shown how the particles arrange themselves in highly degenerate sets. To do this they used finite energy sum rules and some additional information from experiment. More