a vibrating wire viscometer to show that the viscosity of the liquid fell rapidly with decreasing temperature below the higher temperature transition in the so-called A phase of the liquid, and even more rapidly in the B phase below the second transition (*Phys. Rev. Lett.*, **30**, 962; 1973). This result strongly suggested the onset of superfluidity but the evidence was not conclusive in that the experiment did not demonstrate unambiguously the presence of any fluid with zero viscosity.

Fourth sound is a phenomenon well known in the case of liquid ^4He , which can be regarded as an homogeneous mixture of normal and superfluid components; it is a wave motion which can occur when the liquid is absorbed into a tightly packed powder. In these conditions the normal fluid component, which has a finite viscosity, is effectively immobilised but the superfluid component, with zero viscosity, is still entirely free to move. The pressure wave which can thus be transmitted through superfluid in the interstices of a tightly packed powder is known as fourth sound; and the densities of the normal fluid ρ_n and of the superfluid ρ_s can be deduced from measurements of its velocity. This wave mode can exist only if some superfluid is present, so it was natural to search for a possible fourth sound mode in each of the new phases of liquid ^3He .

The experimental cell used by the San Diego group was constructed from an epoxy resin and was tightly packed with finely ground crystals of the paramagnetic salt cerium magnesium nitrate (CMN). Pressure transducers were positioned at either end of the cell so that fourth sound, if it existed, could be both excited and detected. The function of the CMN was threefold: its adiabatic demagnetisation enabled the liquid ^3He trapped in the interstices to be refrigerated to the required temperature; it acted as the superleak in which the fourth sound could be excited; and the temperature could be deduced from measurements of its paramagnetic susceptibility. In the event it was found that fourth sound could indeed be propagated, not just in one, but in both of the new phases, proving beyond doubt that both are superfluids.

The velocity measurements were used to derive values of ρ_s , which turned out to be surprisingly low: much lower, in fact, than may be deduced from the Helsinki viscosity experiment. The reasons for this apparent inconsistency are not yet clear. The San Diego group admit, however, that their values of ρ_s may perhaps be strictly relevant only to liquid trapped in fine pores, since it is known that for ^4He under similar conditions ρ_s is somewhat smaller than in the bulk liquid. Be this as it

may, the group's experiment has now confirmed what many physicists had come to believe would probably turn out to be the case: that, with the discovery of the new phases of ^3He , the number of known superfluids in nature has been doubled.

Resolving conflicts by time sharing

from our Animal Behaviour Correspondent

MUCH is now understood about the control of drinking in thirsty animals and feeding in hungry animals, but relatively little attempt has been made to understand how animals behave if they are made both hungry and thirsty and given access to both food and water. Problems of such motivational 'conflicts' are of great interest in finding out how behaviour in general is organised as most animals are probably in some form of conflict for much of their lives; for example, whether to attack a rival or flee, to feed or incubate eggs. McFarland and Lloyd (Q. Jl. exp. Psychol., **25**, 48-61; 1973) now suggest that at least in the case of feeding-drinking conflicts some animals may resolve their conflicts by operating in a manner analogous to 'time of sharing' in computers.

It had previously been found (McFarland, *Rev. Comportement Anim.*, **4**, 64-73; 1970) that in doves, the normal course of feeding or drinking is characterised by pauses during which other types of behaviour occur. For example, a hungry dove would pause at various times during feeding and if water were present, it would drink during these pauses. Interestingly, the times when the pauses in feeding occurred were not affected by either the presence of external drinking stimuli or, within limits, on how thirsty the doves were. On this basis, the drinking was said to occur by 'disinhibition': it was allowed to occur during preprogrammed breaks in the dominant behaviour of feeding.

McFarland and Lloyd define a dominant behaviour as one which is always resumed following an interruption and a subdominant behaviour as one which is resumed only if the duration of the interruption is less than that of the preprogrammed break in an alternative (dominant) behaviour. Primarily hungry animals interrupted during feeding return to feeding, and primarily thirsty animals interrupted during drinking return to drinking, so that by suitable manipulation of food and water deprivation schedules, either feeding or drinking could be made to be the dominant motivation. Their new evidence suggests that not only does the dominant system determine when subdominant behaviours occur, it also determines how long the

behaviour continues. They found that when a primarily hungry animal is interrupted while drinking or a primarily thirsty animal while feeding, the same behaviour is resumed after a short interruption, but changes to the alternative behaviour after a long interruption. In other words, if a subdominant behaviour is interrupted for a period which is longer than the pre-programmed break in the dominant behaviour, when the interruption is over it will be time for the animal to return to the dominant behaviour. An interruption which does not last longer than the allowable break in dominant behaviour will be followed by resumption of subdominant behaviour.

McFarland and Lloyd argue that when, as in the present case, the occurrence of an activity is determined by another motivational system both in terms of frequency and duration, then this should be called 'time sharing', by analogy with similar systems used on computers to overcome a similar problem—namely, to deal efficiently with simultaneous demands from several sources on limited parts of the machine.

Solvent reorganisation around a 'giant dipole'

from our Chemical Physics Correspondent

It is difficult to find a new corner of science to develop these days, even a small corner can be elusive. This is, however, what Struve, Rentzepis and Jortner seem to have found in their paper on the kinetics of solvation (*J. chem. Phys.*, **59**, 5014; 1973). The thermodynamics of solvation of ions and molecules is a well studied subject but for kinetic information one must find a non-equilibrium, non-solvated species and then follow the development of solvation in the next few nanoseconds or less.

Jortner and his colleagues have solved this problem by studying the process after electronic excitation in *p*-dimethylaminobenzonitrile. In its ground state such a molecule is only weakly solvated, but its second singlet excited state corresponds to a quinoid formula (see figure) with its very large charge separation and a dipole moment of $77 \times 10^{-30} \text{ C m}$ (23 debye). Each end of the molecule will be heavily solvated, at least in polar solvents whose molecules will align themselves around the separated charges. At the instant of electronic excitation the molecule finds itself essentially unsolvated and it is the rate of subsequent solvation which