and L. I. Zane (*Phys. Rev. Lett.*, **24**, 660; 1970) have put forward an explanation in terms of mass fluctuation waves which may account for the behaviour of this system.

A moving helium-4 atom has two important effects on a helium-3 lattice. It breaks up the N-fold degeneracy created by a static impurity atom, and by tunnelling through the lattice sets up an excitation corresponding to a fluctuation of mass. Guyer and Zane consider the ^{4}He atom in terms of second quantization operators, akin to simple Bose or Fermi creation and annihilation operators. Identifying the lattice by spin variables, they have found that the important part of the motion responsible for splitting the degeneracy is related to a combination of operators corresponding to a mass wave. This mass wave has its own dispersion relation.

Attention is drawn to the analogy with the cases of isolated inverted spins in ferromagnetic systems and lithium impurities in potassium chloride. In each case the degeneracy that would prevail in the absence of tunnelling is destroyed, the offending excitations being spin waves in a ferromagnet, tunnelling waves in potassium chloride and mass fluctuation waves in helium.

The mass waves couple strongly with phonons. For NMR processes at low temperatures, Guyer and Zane introduce the idea of an energy bath for the mass fluctuation waves which comes rapidly to equilibrium with the ^{3}He system and provides a strong link for transferring energy from the particle motions to the phonons. They point out that when the ^{4}He motion and the consequent phonon perturbation are taken into account in NMR relaxation, a good description of the low temperature measurements is obtained for concentration of ^{4}He below about one part in 2,000.

A similar effect should arise for ^{3}He atoms in ^{4}He, they point out, although it would be much harder to observe. The anomalous specific heat for this system may also be explained qualitatively on the same model, by equating the transfer of energy between the mass fluctuation waves and the phonons with the change in energy of the ^{4}He system. The anomaly depends on the ^{3}He–^{4}He tunnelling rate, which, it seems, is under investigation now at the Laboratory of Atomic and Solid State Physics at Cornell University.

TECHNOLOGY

Control by Flow

from a Correspondent

A MIXTURE of the fluid dynamical sciences with control technology and a good dash of commercial interest provided the topics for the Cranfield fluidics conference held from March 17 to 20. The contributions suggested that current research interests are directed towards improving sensing devices and developing hybrid fluidic/moving part and non-fluidic moving part devices. Both are movements in a realistic direction dictated by commercial necessity.

Dr H. M. Schaedel (Technische Hochscule, Aachen) performed a useful service in bringing together information about the a.c. behaviour of the variety of non-linear elements which make up fluidic circuits, and showing how this could be used for design purposes by methods derived from electrical network theory.

Interesting applications of unbounded turbulent jets in measuring air flows were outlined by Mr J. W. Tanney (National Research Council, Canada) and Mr M. Carbonar (von Karman Institute for Fluid Dynamics, Belgium). This principle of measurement has advantages over the pitot tube at low flows, and over hot wire anemometry in dusty and water laden air streams. There are possible applications in the measurement of low frequency velocity fluctuations in air–sea interaction studies. Tanney also suggested techniques for three axis flow sensing and gas density measurements using the same basic device.

The use of fluidics for control purposes is indicated in situations where air flows are being controlled so that the air itself can supply the power for control. This is especially important where electrical power failure would be disastrous and where manually operated air pumps or air cylinders are available. Mr G. Belforte (Politecnico di Torino, Italy) described an ideal application of this type—the artificial respirator. With the control system described, it was possible to perform both automatic and assisted respiration with the start signal given by the patient himself. Both cycle frequency and the inspiration–expiration ratio were adjustable.

Considering the possibilities of fluidics in oceanography, Dr M. Briscoe (Saclant ASW Research Centre, Italy) listed eighteen possible novel applications and went so far as to suggest the companies and research organizations that might cooperate in their development. He pointed out that until the communication chain—oceanographer to oceanographic equipment manufacturer to fluidic equipment manufacturer to fluid dynamicist—is formally set up, few of the benefits of these low cost fluidic sensing and control devices will be realized in oceanographic research. The same holds for the application of fluidics in many other lines of research.

MITOSIS

Questions of Identity

from our Cell Biology Correspondent

THE nature of the signals which control the cell cycle and the onset of mitosis remains anyone's guess. It is not surprising that tissue culturalists attach great significance to the so-called serum factors—an apparently mixed bag of molecules in serum which have to be supplied to keep cultures of most cell lines alive and multiplying. At present, however, ignorance of the precise chemical nature of these serum factors, which superficially at least have much in common with endocrine hormones, is more or less complete. And even when their chemistry has been deciphered the problem of how they function—how, for example, they induce the initiation of DNA synthesis or the structural changes at mitosis—may remain unanswered. Discovering the structure of the steroid hormones has not, after all, given many clues about how they act.

One possibility, of course, is that at least some of the control mechanisms regulating mitosis involve localized changes in the intracellular ionic environment. It has been suggested often that the condensation of chromosomes during prophase, and perhaps the polymerization of the mitotic spindle, is controlled in this way. Certainly manipulation of the tonicity and ionic composition of a cell's environment can induce