JOURNAL NOTES

Helium 3 Isotope

In 1939 Alvarez and Cornog, at the University of California, discovered that helium gas present in the earth's atmosphere contained a stable isotope of mass 3. In 1946 more accurate measurements by Aldrich and Nier, using a mass spectrometer of great precision, showed that this isotope was present in approximately one part per million. It has long been known that ordinary helium gas when reduced to a liquid exists with a temperature lower than that of any known substance, being about 4° C above absolute zero. In recent years it has also been recognized that normal liquid helium exists in two modifications, obeying quantum mechanical laws in one, and 'classical' or normal laws in the other.

The present research makes use of these facts in the study of the properties of an entirely new kind of solution, in which the solvent is a 'quantum' liquid, the mass 3 isotope being used as a 'tracer.' In all other known binary solutions, the dissolved atoms are found in both the liquid and vapor phases; but it turns out that in the case of the quantum liquid, all the solute atoms are trapped in the liquid and none is in the coexisting vapor. This is a quite unusual state of affairs, inexplicable in any 'classical' theory of solutions. If liquid helium is brought into a state in which it becomes a non-quantum liquid, then the isotope distribution becomes normal again, and the solution is found to obey the usual classical laws.

C. T. L.

Distribution of He^3 Between Liquid and Vapor He^4
H. A. Fairbank, C. T. Lane, L. T. Aldrich, A. O. Nier
Physical Review, 73: 729, April 1, 1948

Phase Relations in Hearing

The two input channels of the human auditory system are connected together in a very special way. Changing the phase relation between the sound waves in the two ears shifts the apparent position of the source of the sound. The results of the present experiment indicate that interaural phase relations also affect the intelligibility of speech heard against a background of noise like that made by escaping steam.

As we listen to speech with conventional headsets, the diaphragms of the earphones vibrate back and forth in unison, inward together toward the center of the head, then outward together away from it. By reversing the connections to one of the earphones, however, we can make both diaphragms move in synchrony, first to the right, then to the left. Even in the absence of noise, this reversal of phase makes a clearly recognizable difference in the sound of the speech; but what happens in the presence of noise is quite dramatic. If, with the speech and noise both 'in phase' in both ears and the speech just audible above the noise, we reverse the phase of the speech (but not of the noise), the speech and the noise appear to separate from each other, and the speech becomes noticeably more intelligible.

These observations suggest that a listener in a noisy location may do well to reverse the leads to one of the earphones in his headset. They suggest also that the process that underlies the masking of one sound by another is by no means confined exclusively to the cochlea or inner ear; part of the process must occur in the central nervous system beyond the point of convergence of the afferent pathways.

J. C. R. L.

Influence of Interaural Phase Relations Upon the Masking of Speech by White Noise
J. C. R. Licklider
Journal of the Acoustical Society of America, 20: 150, March 1948

Relaxation Effects

Resonance absorption is observed when a substance containing magnetic nuclei—protons, for example—is subjected to a strong constant magnetic field and to a weak radiofrequency magnetic field. The intensity of the absorption and the width of the resonance line depend on the interactions between the magnetic nuclei and their surroundings in two ways: (1) The exchange of energy between the nuclear magnets and the internal degrees of freedom of the substance ("spin-lattice" interaction) brings the nuclear spins into thermal equilibrium. (2) The interaction between neighboring magnetic nuclei ("spin-spin" interaction) broadens the resonance line. This paper reports the first comprehensive experimental and theoretical study of both effects in organic liquids, aqueous solutions, some solids, and hydrogen gas. The effect of the spin-lattice interaction, which is described by the *thermal relaxation time,* is found to depend on the thermal motion of the molecules in the liquid and is closely connected with the viscosity of the liquid. Relaxation times as long as several seconds and as short as one-thousandth of a second have been observed. The spin-spin interaction is drastically modified by the thermal motion; one remarkable result is the extraordinary narrowness of the resonance line in most liquids, which is explained by the rapid fluctuations of the local magnetic fields that would, if stationary, strongly perturb the nuclear magnets. The theory proposed accounts satisfactorily for these effects and thus provides a basis for the study of certain features of the structure of liquids and solids by means of nuclear absorption.

E. M. P.

Relaxation Effects in Nuclear Magnetic Resonance Absorption
N. Bloembergen, E. M. Purcell, R. V. Pound
Physical Review, 73: 679, April 1, 1948

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