The Unit's overall research programme fits into a domain which has come to be called "liquid state physics". The specific area in which studies are being carried out is the experimental and theoretical investigation of transport properties (diffusion, conductance, viscosity) in various liquids. Most effort on the experimental side has been concentrated on the technique of tracer-diffusion. Data from the latter type of experiment can be used to calculate the rather unique isotopic friction coefficient, a close approximation to an interaction parameter between like molecules which is particularly important in the testing of theories.

Progress on various research projects is detailed below under appropriate sub-headings.

Diaphragm Cells

A considerable proportion of the Unit's technical effort has been used to develop a pumped diaphragm cell. The pump has very severe specifications such as negligible heat input but a prototype has been successfully developed and is now under test. Advantages of this system are considerable such as continuous monitoring of radioactivity and consequent very high precision. It is also essential for the liquid rare gas work which is being planned. (R. Mills)

An alternative monitoring system utilising built-in surface-barrier detectors has also been developed and is being used to follow Sr$^{89}$. It has however fairly severe limitations regarding the $\beta$-particle energies that can be measured. (J. Tilley, R. Mills)

A mathematical and experimental study was also made during the year of operating procedures in diaphragm cells. The results of this study established simpler procedures which are advantageous for difficult systems such as molten salts and liquid rare gases. (R. Mills, L.A. Woolf, R.O. Watts)

A manuscript on "The theory and practice of diaphragm cells in liquid diffusion" is being prepared and may eventually be published as a monograph. (R. Mills, L.A. Woolf)
Liquid Rare Gases

The study of diffusion in the liquid rare gases is one of the Unit's main future objectives. Work during the year has been directed to establishing the necessary techniques and procedures. Many of the studies in the preceding section have been undertaken with this in view. In addition we are testing miniature photomultiplier tubes and cryostatic equipment. (R. Mills)

Molten Salts

Experimental work in this liquid medium has now been terminated. During the year, a contentious explanation for the mechanism of transport in molten carbonates was advanced and has since been published. (R. Mills, P.L. Spedding)

Non-electrolyte Systems

Diffusion data for three non-electrolyte molecules in aqueous solution have been measured. Friction coefficients are being calculated and their correlation with molecule size and dipole moment is to be attempted. (J.F. Tilley, R. Mills)

In this area, a study is also being made of precision counting of Cl with a flow cell. (L.A. Woolf)

Theoretical Studies

It is becoming increasingly important to have a theoretical component in the Unit and we are fortunate to have a competent scholar in this field. During the year he has been mainly concerned with finding a numerical solution to the Percus-Yevick equation by extensive use of the computer. Radial distribution functions have been obtained from which thermodynamic functions of liquids can be calculated. This work is being reported at ANZAAS in January, 1967. (R.O. Watts)

STAFF:

Academic staff numbers are adequate although two more students could well be accommodated. The lack of a second technician is very keenly felt, particularly as much of the Unit's programme is of a developmental nature.

PUBLICATIONS:

Albright, J.G.

"Measurements of the intradiffusion coefficients at 25° of the ternary systems (labelled L - α-alanine) - (DL - α-alanine) - water and (labelled β-alanine) - (β-alanine) - water."


Mills, R. and Ellerton, H.D.

"Diffusion of the solutes at trace concentrations in the ternary system, water - sucrose - mannitol at 25°."


Mills, R. and Spedding, P.L.

"An Interpretation of the Concentration-dependence of Mobilities in Fused Alkali Carbonate Mixtures."

Spedding, P.L. and Mills, R.

"Tracer diffusion measurements in mixtures of molten alkali carbonates".