psychometric data on 35 of these people as their average age rose from 64 to 73 years and found, overall, no significant decline and, indeed, an apparent improvement on some sub-tests as age increased. From 73 to 84 years the picture was less encouraging and, when group mean scores were considered, all test scores declined.

This does not yet answer the question since group mean scores might decline because particular individuals within the group might become ill and approach death just before testing, and the proportion of people showing such terminal changes in performance and contributing to mean scores would be certain to increase as the group aged. Jarvik's analyses of her data bore out this possibility. Individual subjects showed little or no decline in performance through the seventies and into the eighties. Moreover, abrupt declines in performance in individuals were good statistical predictors of impending death. Equally interestingly, elderly peoples' self-rating of their own health status was also a good predictor of their actual future survival — as good as, but (perhaps disappointingly!) no better than, their physicians' predictions.

All longitudinal studies are certain to be criticized because at the time when they yield their richest data the focus of scientific interest is bound to have changed. One cannot, alas, time travel 20 or 30 years to include cases or use tests which become crucial as the state of the art advances. However, investment in really adequate longitudinal studies need only be very modest. Such studies are expensive to initiate, but very cheap to run once they are begun. Jarvik's study illustrates, but does not resolve, the great simple questions about changes in human efficiency with advancing age. If we want to know more about our own personal futures, and about the futures of the societies we have to plan, no single investment can yield so much useful information for so modest an outlay. □

Engineering organic molecular layers

from C. W. Pitt and I.A. Shanks

SCIENTISTS and engineers are taking a renewed interest in thin films of organic materials deposited, molecular layer by molecular layer, by an unconventional process attributed to Irving Langmuir and Kathleen Blodgett and dating from the 1930s. Such films can exhibit a remarkable perfection of structure over large areas and as the successive monomolecular layers may be of the same or different materials, a kind of 'molecular engineering' is made possible.

Long hydrocarbon chain molecules, with a hydrophilic group at one end and a hydrophobic group at the other, can be made to form a continuous film by spreading them on a water surface. The nature of the groups at the ends of the molecules ensures that one tip of the molecule is immersed in the water while the other remains in the air. A movable barrier which penetrates the water surface may be used to compress the film into a condensed layer exactly one molecule thick in which the oriented molecules are held together by van der Waals' forces. The film may then be transferred from the water surface on to a solid substrate by dipping the substrate through the surface and then withdrawing it whilst continuing to compress the film. Repeating this process allows a multilayer film to be progressively built up.

The Langmuir-Blodgett (L-B) technique undoubtedly emerged at a time long before the technology to exploit its unique capabilities was available. A recent three day symposium* made it clear that the situation has now very much changed. Recent work has highlighted materials that have attributes which can be readily exploited when they are deposited as L-B layers. Many of these material systems have been developed as modified molecular structures tailored specifically for this deposition technique.

Typical of the molecular structures reported were the diacetylenes — a monomer/polymer system incorporating a conjugated triple bond which may be induced to cross-link using an electron beam or by UV or visible radiation. Diacetylene films are being investigated as gate region insulators in indium phosphide field effect transistors and as layers in optical waveguiding devices. Double bond molecules, such as ω-ticosenic acid, have been deposited as very thin electron beam resists capable of defining lines less than 600Å wide, while even the simple fatty acids have found application, in very pure form, in modifying the surface properties of semiconductors used in Schottky barrier diodes and photodiodes.

A radically new approach to modelling biological membranes is also offered by the L-B technique. The fluid bilayer of lipid molecules may be simulated by a simpler structure fabricated from reconstituted purified natural membrane components and laid down by the L-B process. Protein complexes, such as bacteriorhodopsin, can be immobilized in such layers, simulating the natural system. Possible applications of these biocomposite films include filtering solutions with chemically selective elements incorporated in the L-B layer. Entirely synthetic membranes, such as polypeptide layers, have also been fabricated, although applications are less apparent at this stage.

A technique for retaining the interesting properties of non-amphiphilic molecules, while enabling L-B deposition, is clearly emerging; that of attaching a hydrocarbon chain and a polar group to an aromatic ring-type molecule. Tetraphenylporphyrins, anthracene, perylene and pyrene were all reported as molecules which have been treated in this manner. Applications include tunnelling layers and electro-fluorescent display panels.

In addition to using these films in device applications they are also of interest as investigative tools in the understanding of a wide range of other phenomena. Examples are the use of manganese stearate monolayers to explore existing theories of two-dimensional magnetism and of monolayers of fatty acids and their salts to probe the mechanisms of the sliding friction between surfaces. The similarity between L-B multilayers and liquid crystals has also been noted and papers were given on the deposition and properties of *n*-pentyl cyanoterphenyl and other liquid crystalline materials. □

*A three-day symposium of forty invited scientists and engineers was organized by the Rank Prize Funds to explore the science and optoelectronic applications of Langmuir-Blodgett layers. The participants included both junior researchers in the field and eight invited speakers from Europe, the US and the UK.

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100 years ago

RARELY has so distinguished and representative an assembly been seen in Westminster Abbey as that which met to pay the last honours to Mr. Darwin, on Wednesday last week. The Abbey indeed was crowded. The character of the long line of distinguished men who followed the honoured remains to the grave, may be seen from the list of pall-bearers: — The Duke of Devonshire, the Duke of Argyll, the Earl of Derby, Mr. J. Russell Lowell, the American Minister, Dr. W. Spottiswoode, P.R.S., Sir Joseph Hooker, Mr. A.R. Wallace, Prof. Huxley, Sir John Lubbock, and the Rev. Canon Farrar, Mr. Darwin has been buried close beside the grave of Sir John Herschel, and within two paces of that of Sir Isaac Newton.
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