

UK medical schools. In Liverpool, Richard also mentored and brought another group of young colleagues into research on muscle including John Coakley, Phil Smith, Maria Stokes and Bob Cooper. At this stage, Richard also developed a major interest in the causes and alleviation of chronic fatigue syndrome (or ME) and developed exercise interventions to alleviate this condition that are still used today.

In 1996, Richard accepted an invitation to become the Professor of Research and Development for Health and Social Care at the University of Wales College of Medicine and Head of Research and Development for the NHS in Wales, based in Cardiff. This was a new departure for him, but was an influential position impacting on the direction of NHS-funded research undertaken in Wales. He eventually retired from that position in 1999.

On retirement, Richard put his enthusiasm and great energy into his home, garden and extensive woodlands in Nantmor, North Wales, a place where he was happy until his unexpected death following a cardiac arrest on 5 December 2009. He is survived by Eleri, his wife of 45 years, his daughter Rhiannon and grandchildren, William and Non. He will be remembered as a fantastically enthusiastic and energetic physiologist and clinician who was highly respected internationally and who inspired a generation of colleagues to work in this research area.

Malcolm J Jackson

School of Clinical Sciences,
University of Liverpool

The Society also notes with regret the deaths of James Black, Johann Edge and Alastair Hosie.

James Black was awarded a Nobel Prize in 1985. He was elected a Member of The Physiological Society in 1962 and was made an Honorary Member in 1989.

Alastair became a Member in 2004.

Johann became a Member in 2007.

AD Bangham

(1922–2010)

Most academics believe earlier generations of scientists were more enthusiastic, and more eccentric about research than the present cohort. We can all reminisce about scientists who illustrate this statement, and for me the six decades of active science in Alec Bangham's life are a perfect example. Alec had a tremendous enthusiasm and genuine curiosity in his scientific career. He was always interested in big, important issues, and was prepared to enter new areas with radical and passionate ideas. Although the liposome must be his abiding memorial in research, he contributed in many other areas, including anaesthesia, lung surfactants, haemoglobin polymorphisms, water structure and the evolutionary origin of life. My first experience of his laboratory at Babraham was making surface charge measurements on single red cells using a very dilapidated microscope and electrophoresis chamber set into a grubby old aquarium as a waterbath, which nevertheless gave excellent results. Working in the lab allowed discussions on far-reaching and varied topics with Alec and his visitors, which was a true scientific pleasure.

The discovery that made Alec's lab a Mecca for visitors was the invention of the liposome (or smectic mesophase or bangosome) which offered a perfect experimental paradigm for the cell membrane. From his original EM observations with Bob Horne on hydrated lipid films, the lab developed a simple technique for making multilamellar, and later unilamellar lipid vesicles to be used in permeability and drug delivery studies in a vast number of applications. Protein incorporation was an obvious next step in mimicking cell membranes, and proteoliposomes remain a major tool for functional analysis of membrane transport. Immediate questions that could now be answered included the passive permeability



Alec with his iPhone.

of the cell lipid membrane to water, ions, important non-electrolytes (glucose, amino acids, urea) and lipid-soluble molecules. Manipulation of lipid composition (particularly cholesterol) and charge, saturation and chain length, defined the properties of pure lipid membranes, and lipid preferences of inserted proteins e.g. phosphatidylserine and phosphatidic acid supporting Na^+/K^+ -ATPase activity added important information on annulus lipids.

Besides offering an ideal system for investigating the biophysical properties of the membrane, liposomes were developed as drug delivery systems, and with trapped haemoglobin as artificial red cells requiring several modifications of surface (adding polyethylene glycol) and size to avoid rapid removal from the circulation. The final use of liposomes that Alec learnt of whilst walking through the Beauty section of a local department store was in cosmetics. His approach to the elegant lady behind the counter saying 'You know, I invented liposomes', led somewhat surprisingly to a VIP invitation to Paris to dine with the President of Christian Dior, an occasion he greatly enjoyed.

The mechanism of action of general anaesthetics was and remains a major topic for debate. Liposomes contributed to research in this area

initially by replacing the classical ancient olive oil–water partition as an index of hydrophobicity with a membrane-relevant parameter, and subsequently assessing effects of temperature and pressure on permeability changes in liposomes treated with relatively high doses of general anaesthetics. This led in 1976 to Bangham and Deamer proposing that anaesthetics might collapse the pH gradient across liposomes, and affect accumulation and release of charged neurotransmitters in vesicles. Coincidentally, Victor Whittaker working in an adjacent lab to Alec at Babraham, had just isolated synaptosomes, identifying the organelle for which the liposome was a model.

Babraham research on anaesthetics was not confined to pure lipid membranes. Experiments on goldfish behaviour were also pursued, and for a while Alec was excited by the fact that the Tubifex worms used to feed the goldfish also showed behavioural responses to anaesthetic alcohols, effectively eliminating the need for the fish. However, these experiments were interrupted by the supply of worms ceasing as the Thames became cleaner, and in spite of a false hope from Harrods' pet shop (who assured Alec they had Tubifex available but they turned out to be freeze-dried) work reverted to goldfish.

As every medical student knows, lung surfactant is lysolecithin and this was therefore an obvious topic of interest for a lipid enthusiast like Alec. He was able to identify the most effective solid phospholipids for this effect, and devise a delivery system to use phospholipid snuff to treat respiratory distress in premature babies.

Most recently, Alec's ideas became reminiscent of Susskind's Perfume in suggesting individuals have a 'fingerprint' of volatile organic molecules which are weakly ionized and both contribute to identity, but also alter surface charge on cells

and affect immunological tolerance, a factor Alec considered might be important to the fetus.

Alec was renowned for his insightful but sometimes forceful comments, and for his party piece, a demonstration of the power of lipid monolayers. In this experiment he would set fire to a Langmuir trough full of water saturated with ether. As the flames rose he would add a phospholipid emulsion to the trough which spread as a surface monolayer and extinguished the flames. In a curious antithesis to Sydney Ringer's experiment, on one occasion his technician used very hard tap water to make the ether solution,



Portrait by Humphrey Bangham.

resulting in the precipitation of the phospholipids as a calcium soap, and the flames persisting and getting bigger and bigger with no phospholipid effect.

Two wonderful examples of Alec's comments are first his question to Max Perutz after Alec had shown quite unexpectedly there were electrophoretic variants in horse haemoglobin, and Perutz had toiled for years on the X-ray structure of haemoglobin, to the effect 'Which haemoglobin are you studying?'; second on asking Robin Post what he was working on at the moment, and being given a recent reprint on the Na⁺/K⁺ pump, Alec noticed a major error in the abstract, which

said K⁺ was pumped out and Na⁺ into cells, so he handed it back saying he understood it worked the other way around. However, occasionally comments were not so positive. After the Nobel prizewinner Arthur Kornberg spent three months in Alec's lab (and worked quite hard at the bench) his parting remark on leaving, and thanking Alec for his hospitality was 'I think there is a great future in membranes – for proteins'.

Alec set great store on family and friends. Those who worked with him were guaranteed a lifelong friendship, and I treasure the occasional letter with enclosed photographs and news of science and family I have received from him over the past thirty years. He was also as passionate over his hobbies (photography, sailing, gardening and Caucasian rugs) as his science and would lecture visitors enthusiastically on any or all of these.

I regard it a privilege to have known Alec, whose enthusiasm, scientific courage and dare I say eccentricity, made him a scientific icon. He will be severely missed.

Clive Ellory

Deamer D & Bangham AD (1976). Large volume liposomes by an ether vaporization method. *Biochim Biophys Acta* **443**, 629–634.

Ann Silver adds:

Clive mentions cosmetics among the spin-offs from Alec's work. Others included the wonderful meringues that were a feature of Bangham hospitality: these solved the problem of what to do with the egg-whites left over from the production of lecithin from the yolks. Alec's Funeral Service, held outside in the Great Shelford Burial Ground, was taken by his one-time co-worker Martyn Hill. He recalled that Alec's response to the news he was going into the Church was 'Good, you can conduct my Funeral.' An apt (and cheering) feature of the Funeral was the blowing of bubbles – with typical Bangham imagination we were each given a bubble kit on arrival.