THE FOUNDATION FOR SCIENCE AND TECHNOLOGY

THE LORD LLOYD OF KILGERRAN LECTURE

Lighting up the brain: a 25 year journey from basic science to commercial instrument

Held at The Royal Society on 10th December, 2008

The Foundation is grateful to the Engineering and Physical Sciences Research Council, the Royal Academy of Engineering and the Michael John Trust for supporting this meeting.

Chair: **The Earl of Selborne KBE FRS**
Chairman, The Foundation for Science and Technology

Speaker: **Professor David Delpy FRS FREng FMedSci**
Chief Executive, Engineering and Physical Sciences Research Council

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PROFESSOR DELPY outlined the work that had led from the initial understanding of the transparency of human tissue, and the way it responded to light, to the development of medical instrumentation that enabled doctors to measure the patterns of oxygenation in the brain of new born babies. He showed the differential effects of the absorption of light by oxygenated and deoxygenated haemoglobin. With infrared light it was possible to see the pattern of blood vessels beneath the surface skin so that there could for example be accurate insertion of a needle into veins. This technique was extended by the development of infrared spectroscopy machines which enabled oxygen levels in the blood of baby brains to be observed in real time. After initial funding through Research Councils and Vickers Medical, long-term funding had been secured through a Japanese company, Hamamatsu Photonics.

Infrared spectroscopy could now show changes in oxygenation and diminishing oxygenation in relation to breathing and heart beats. It could also be used for muscle exercise studies, which could be valuable, for example, in Olympic training. He noted that Duke University, where some of the original research had taken place had patented work done there but these patents had not been exploited. This meant that development had been hindered in the USA, where the patents applied, to the benefit of EU and other countries where the patents did not apply.

Further development had led to the ability to show activity in the brain and understand the brain's reaction to stimulus or pain in a patient who would not keep still or be restrained. He described how the light followed random paths as it passed through brain tissue. Clever analysis of the detected signal enabled features of the brain to be observed. The techniques had value not only in the brain, but in other parts of the body such as the breast, where the results of treatment of tumours could be observed over time without invasive surgery or high doses of X-Rays.

He drew two important lessons from the development process he had described - first, the importance of team working, and second, reading broadly around and outside his own narrow discipline. The teams he had worked with were interdisciplinary, and, although focussed and led, had been given the opportunity and discretion to develop their own ideas. Reading outside ones subject was the best way of discovering insights which others had and which could have benefit for his own project. It was, he said, always the Journal next door to the one that you ought to be reading that contained the ideas which might be of real value.

Several speakers in the following discussion had been impressed by the willingness of Hamamatsu to undertake long term funding for the project, compared with the short term perspective of Vickers, and, no doubt, other UK companies. Was this the result of differing cultural perspectives? It probably was, in the US, the UK and EU countries there was an emphasis on returns within a shorter time period than in Japan, where there was a social and corporate tradition of building up a new industry over the long-term. But it was noted that Japanese practice may now be coming closer to the Western norm.

Other questioners were concerned about the impact of over zealous protection of intellectual property (IP). Professor Delpy felt that there was a real danger in Universities being too keen in protecting their research through IP; he felt that, if they did, product development would be impeded. There was no need to worry about whether a good idea would be picked up if not protected, nor that the prizes would go to others than the originator of the research. Commercial success came through product development and the application of know how. That is what academics must understand, and if they wish to share in the results they must themselves understand how commercial products were developed.

Also raised in discussion were the problems that must arise in using new techniques on babies, when possible side effects could not be known. How did you persuade parents to consent to their children participating in experiments? The answer was only through charm, frankness, and understanding of the parents' concerns. His team had been successful in persuading an American lawyer mother to allow their baby to participate in one of the earliest studies, so it certainly was possible.

There was also questions about whether this technique would make MRI redundant; the answer was no; they were complementary. The technique was not yet suitable for detecting early signs of Alzheimer's.

It was difficult to estimate the total costs of developing the technique and the value of the diagnostic market using these techniques. But, in very general terms over 25 years, the cost of development from the Research Councils, charities and Hamamatsu was around ten million pounds; the value of the market depended on the type of machine and its comparators - Hamamatsu was now the market leader.

Professor Delpy had emphasized the importance of engineering skills in developing the apparatus he described. But speakers were concerned about the shortage of skilled engineers and the reluctance of students to undertake engineering degrees. The solution could only be through long term advice and encouragement given through school careers. Professor Delpy said that one of the best ways of enthusing students was by young researchers going into schools and demonstrating what exciting and important engineering projects there were. He was glad to say that many young researchers are willing to do this.

Sir Geoffrey Chipperfield KCB

The lecture is on the Foundation web site at www.foundation.org.uk.

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