The 4th Desty Memorial Lecture for Innovation in Separation Science

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Have you ever walked into a building and felt not only its presence but also those of the people who have worked in it? Maybe this is a strange question to ask logical analytical scientists. However, walking into the Royal Institution (London, UK) on 18 October last year for the 4th Desty Memorial Lecture for Innovation in Separation Science, I was suddenly struck by this remarkable building and the sense of history arising from all the remarkable scientists that have worked in its laboratories. Fourteen Nobel prize winners have arisen from work at the Royal Institution and 10 chemical elements were discovered in its laboratories. The Royal Institution has a reputation second to none, not only from the scientists that have worked there, but also from the people who have worked in it? Maybe this is a strange question to ask logical analytical scientists. However, attempting to use such high pressures creates many difficulties.

This was the building above all others that Denis Desty enjoyed lecturing in. He, like all the other great scientists, enjoyed the dissemination of science to the widest possible audience.

This, the 4th Desty Memorial Lecture, sponsored by Waters (Milford, Massachusetts, USA), was to be a very special event. The guest list included Jim Lovelock, Jim Jorgenson, Hans Poppe and Graham Nickless, together with the winner of the 1999 Desty Award, Alan Howard, from the University of Southampton, UK, for his paper Thin-Layer Chromatography With Potential.

In recognition of Jim Lovelock’s achievements in science, Ted Adlard, on behalf of the Chromatographic Society, presented him with a Royal Institution miner’s lamp. It was a great honour that Jim Lovelock, together with his wife Sandy, attended this year’s lecture and presented the Desty Award.

In supporting this event the Chromatographic Society presents its own awards. This year the Martin Medal was presented to Hans Poppe (University of Amsterdam, The Netherlands) for his life-long achievements in chromatography and the Jubilee Medal was presented to Graham Nickless (University of Bristol, UK).

Jim Jorgenson, the 1999 Desty Award guest lecturer, in the speakers’ room, Royal Institution.

The Desty guest speaker was Jim Jorgenson (University of North Carolina, Chapel Hill, North Carolina, USA). In his lecture Jim outlined some of the history in high performance liquid chromatography (HPLC) as a progression towards the use of columns packed with particles of decreasing size. He outlined how decreasing particle size led to smaller plate-height values and faster optimum velocities and how, because of pressure limitations of existing HPLC equipment, this trend has translated not into columns of increasing separation efficiency, but instead into columns offering much faster analysis times. The 400 bar pressure limit of current HPLC technology is an arbitrary limit. The use of tenfold higher pressures, for instance, would allow the use of columns one metre in length, packed with 1.5 micron particles, delivering 300,000 theoretical plates with total analysis times of approximately one hour. However, attempting to use such high pressures creates many difficulties.

Hardware (pumps, valves, injectors, connecting tubing, columns) must be made to withstand such high pressures while in contact with solvents ranging from aqueous salt solutions to polar organic to non-polar organic solvents. It is difficult to find suitable pump materials that can handle this range of conditions. Significant amounts of heat can be generated in pumping solvents at optimum velocities through such a highly restrictive bed of particles. In a column of conventional diameter (4.6 mm), this heat will result in axial and radial temperature gradients, which will lead to excessive band spreading. Packed capillary columns can be used to reduce this difficulty. Analyte distribution coefficients are also a function of pressure. This could
result in inconvenient and/or confusing changes in relative retention times of analytes as a function of operating pressure. The design and performance of an LC system with packed capillary columns at pressures in excess of 5000 bar (75 000 psi) were described.

There could have been no better lecture for this meeting in such a building. Faraday himself would have been proud of the way Jim is pushing the boundaries of science and the capabilities of our instrumentation. This is the same as Denis Desty tried to do; especially when he demonstrated his new gas burners in the Royal Institution and nearly set fire to the building.

The 1999 4th Destiny Award was made to Alan Howard of the University of Southampton, UK. In presenting the prize, Bruce Compton, the chemical R&D director of Waters, noted how Denis Destiny was associated with the University of Southampton and how the judges thought that Alan's paper had a touch of Destiny in its experiments.

Alan's paper discussed the application of high potential electric fields to thin-layer chromatography (TLC). He described how early observations of electroosmotic solvent flow in vertically mounted thin-layer media are now believed to have been caused, at least in part, by thermal effects leading to eluent migration by capillary action. This migration has been shown to be dominated by evaporation caused by Joule heating of the solvent and coronal discharge, which is concentrated in a restricted region of the vertically mounted chromatographic plates. This thermally induced solvent flow has been shown to be a useful means of increasing the elution rate in TLC and, as there is no theoretical limit to the run time, the technique can be particularly effective in enhancing the separation of low Rf sample components.

Electroosmotic solvent flow has been demonstrated in horizontally mounted planar chromatography media with the application of an 800 V/cm field. With conventional silica TLC plates, solvent migration rates of 0.039 and 0.210 cm/s can be attained with ethanol and acetoni trile, respectively. When applied to the separation of pirimicarb and a group of related compounds, electroosmotically driven electropherography resulted in elution characteristics that were similar to those obtained by TLC. Whilst conventional TLC took approximately 18 minutes to complete, the same elution sequence was obtained by electroosmotic thin-layer electrophoresis (TLE) in 90 seconds. Reduced band broadening was also evident with the electropherographic elution.

The third form of separation that can be achieved by electrically driven TLC is caused by the electrophoretic migration of sample components in the electric field. Whilst most commonly encountered in systems employing aqueous solvent systems, electrophoresis can also be performed using conventional TLC media and in non-aqueous solvents. This technique, which combines elements of chromatographic retention, electrophoretic solute migration and in some instances electroosmotic solvent flow, is demonstrated by the separation of dyes.

Applications for the 5th Destiny Memorial Award will be accepted from January 2000. The competition is open to all scientists and science students currently working in the field of separation science. An international panel of judges will award the prize to the most innovative paper. The winner receives a personal prize of £1000 and will be asked to present their paper in The Royal Institution in the autumn of 2000.

Finally I would like to draw your attention to "The Heart of Science Campaign" being led by Susan Greenfield, the director of the Royal Institution. In her words "The Heart of Science Campaign is being launched to build on a remarkable history. I want to place the Royal Institution at the centre of a new age when science will take its proper place at the heart of all our lives. " One of her objectives in doing this is to expand all those areas of our work that take science out of the ivory towers and into the community, schools and regions. For this we need teachers, the like of my former science teacher Tim Packer. Tim, together with his wife Ed, made the trip from Yorkshire to attended this year's Destiny Lecture. He removed the ivory towers from science in the 1960s when he first taught me. To this day he continues to instil enthusiasm and excitement to the pupils he still teaches at Longcroft School, Beverley, (Yorkshire, UK) because he, himself, is an enthusiast, very much in the spirit of Denis Destiny.

Please visit the Royal Institution website at http://www.ri.ac.uk and if possible help in The Heart of Science Campaign.