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EDITORIAL

Chemistry: In search of icons

'Our old chambers had been left unchanged through the supervision of Mycroft Holmes and the immediate care of Mrs Hudson. As I entered I saw, it is true, as unwonted tidiness, but the old landmarks were all in their place. There were the chemical corner and the acid-stained deal topped table.'

The Adventure of the Empty House

'A remarkable wine, Watson.... Might I trouble you to open the window, for chloroform vapour does not help the palate.'

His Last Bow
Arthur Conan Doyle

A few weeks ago a forum of chemistry teachers in engineering colleges invited me to speak at the inauguration of a workshop on the 'revised syllabus in engineering chemistry'. They were clear and direct in their approach, telling me of their fears that chemistry would slowly be squeezed out of the engineering curriculum, rendering the teachers superfluous, unless they slowly moved towards teaching 'biotechnology'. My mandate, then, was to present a talk extolling the importance of chemistry in the education of engineering students, with the unrealistic hope that the assembled administrators would be influenced by the brief that I presented in the defence of chemistry. Like all such meetings, this one too passed off uneventfully; almost certainly chemistry would continue its inexorable slide in the esteem of the designers of engineering curricula. Coincidentally, not long after, my attention was drawn to a news report that the Royal Society of Chemistry had awarded an 'Extraordinary Honorary Fellowship' to Sherlock Holmes, the immortal and fictional detective, who was not only an amateur chemist, but also one who saw clearly the value of chemistry in the detection of crime; forensic science may have been born on the pages of Arthur Conan Doyle's engaging fiction. The resurrection of Sherlock Holmes (Conan Doyle fans would of course, recall that the author killed his most famous creation in a plunge to death over the Reichenbach Fall, while grappling with the infamous Prof. Moriarty in 'The Adventure of the Final Problem', but resurrected him in 'The Adventure of the Empty House') by the Royal Society of Chemistry might have been motivated by a desire to boost the public image of chemistry, a subject that seems to be increasingly in the grip of an identity crisis.

Not long ago, *Nature* in an editorial characterized chemistry as 'a discipline buried by success'. The journal went on to note: 'The subject's reputation is not a trivial issue. If chemistry is to achieve half as much in this century as it did in the last, it must fight to attract the brightest young scientists. And to do that, image is important'. (*Nature*, 2001, **411**, 399). Indeed, in these columns, some two years ago, I had wondered 'where has chemistry gone', noting that 'the richness of chemistry clearly lies in its role as a central science' (*Current Science*, 2000, **79**, 927). A news feature that appeared last year however begins: 'Chemistry likes to style itself as the "central science", but perhaps bridesmaid science would be more appropriate'. The article goes on to argue that many new developments in chemistry, 'from the discovery of life-saving drugs' to the 'work on carbon nanotubes ... often seem to end up being appropriated by other disciplines' (*Nature*, 2001, **411**, 408). Ironically, with over 160,000 members, the American Chemical Society counts itself as the 'world's biggest scientific organization'. The declining image of chemistry was highlighted by a recent survey in the United Kingdom, which raised an alarm about the dramatic decline in the number of students entering university chemistry departments, leaving 'up to a dozen chemistry departments in England vulnerable to closure' (*Nature*, 2002, **416**, 777). Chemistry is, of course, not alone in its struggle to attract students to its fold; physics has been struggling for sometime too, but that hardly seems a consolation for a discipline, which considers itself as critical for the advancement of science on a broad front, ranging from biology to materials science. The *Nature* report rubs salt into the wound by quoting 'a department head, whose physical chemistry laboratory is being handed over to sports science' as describing the move as one of 'redistributing resources'. With university funding in the UK being allocated on the basis of a 'research assessment exercise', departments with falling graduate student populations face grant cuts.

What is the status of chemistry in India? The view from the colleges is unencouraging. Majoring in chemistry is hardly an attractive option, with most undergradu-

ate courses having remained almost frozen in time, reflecting little of the phenomenal progress the discipline has made over the past fifty years. Since engineering and medical courses skim off the cream and commerce, management and computer applications appear to offer better employment opportunities, it is only the most highly motivated or those who have little choice that turn to science degrees. The amazing, and at times frightening, rise of undergraduate biotechnology courses, with little substance but full of the false promise of future opportunity, has further diminished the demand for undergraduate degrees in chemistry and physics. The increasing competition from foreign universities for students in these areas, both at undergraduate and postgraduate levels has not helped. At the level of research institutions the entry of students to Ph D programs in the physical sciences is also on the decline; all except the most sought-after institutions are hard hit. The situation in some colleges and universities for chemistry courses is alarming; empty laboratories and idle faculty may soon be the norm. Interestingly, chemistry is still a subject which provides employment for its practitioners. The chemical industry in India is well established and pharmaceutical R&D is growing rapidly, creating a constant demand for well trained organic, medicinal, analytical and polymer chemists. This may be contrasted with the prospects for 'biotechnology' graduates, who specialize only cursorily in a specific area and are dependent for employment on an industry, which appears to be more a creation of writers for business magazines and the publicity arms of government departments. Curiously, the biotechnology industry may eventually need more chemists and chemical engineers, than 'biotechnologists', if marketable products are to emerge in profusion.

Indian chemistry has also been characterized by an extremely conservative approach to emerging disciplines and by an inability to restore old and dying areas, which have acquired a new dimension because of advances in related fields. Almost up to the 1960s, the chemistry of natural products, primarily of plant origin, was a subject practised with considerable success. But, over the years the area has fallen out of fashion, sadly enough at a time when instrumental methods for separation and analysis of complex molecular mixtures has reached an unparalleled level of sophistication. The present day talk of exploiting biodiversity and traditional knowledge for discovering new molecular entities as the pharmaceuticals of the future, will remain idle, committee room discussion if a new generation of natural products chemists are not created. Chemists in India have also been slow to recognize opportunities at disciplinary boundaries; many chemistry departments in the US have reinvented themselves as departments of chemical biology, a signal that chemistry's frontiers must transcend traditional borders. Even in the area of materials science, physicists and engineers appear to have occupied the middle ground; preparative chemists have been left to graze on the fringes. The preparation of new and novel materials must be central to chemistry, but the composition and structure of most of our chemistry departments would hardly suggest that this is the case. The greatest blow to experimental chemistry, and here my prejudice must show, has been dealt by the overemphasis on computational and theoretical chemistry. Our major institutions abound with theoreticians and students often acquire a slanted view of, what is undoubtedly, a subject which thrives on experimentation. In our surroundings computational work appears to be a more attractive option; *Gaussian* sometimes seduces even the talented experimentalist. My suspicion is that 'biotechnology' too will go the chemistry way, if students are taught that bioinformatics is the true wave of the future. Chemists in India also cling too tightly to their disciplinary affiliations; the lines between organic, inorganic physical and theoretical chemistry sharply drawn. Subjects like analytical and polymer chemistry are practised by too few to be noticed. The reactions of most chemists I encountered after the award of this year's Nobel prize in chemistry are illustrative. While the Nobel committee appeared to be recognizing the prime importance of analytical methods in chemistry, most chemists appeared to regard Kurt Wüthrich, who successfully demonstrated the application of new NMR methodologies to the structure determination of large molecules as a 'structural biologist'. Very few seemed to regard the soft ionization procedures in mass spectrometry developed by John Fenn and Koichi Tanaka as critical to the development of chemical analysis. In all three cases the extraordinary applicability to molecules of biological interest seem to divorce these techniques from the realm of classical chemistry. This ability to look constantly inward and to exclude important areas appears to be a trait of chemists, worldwide. As *Nature* notes '.... eye catching interdisciplinary research offers chemistry a chance to polish its image. But first, chemists must learn to celebrate and promote their contributions' (*Nature*, 2001, **411**, 399).

Chemistry's public image often suffers in comparison with the sister disciplines of physics and biology. It does not have the glamour of the competing disciplines. Physicists can promise that their subject will cast light on the origins of the universe or eventually construct a 'theory of everything'. Biologists can revel in the mysteries of heredity or the grand philosophical implications of Darwinism and discuss the origins of man. Chemistry in its entirety has its roots firmly in the ground. It is a mundane, but critically important, science.

But, at the end I might ask, after Sherlock Holmes can chemistry recruit another icon to embellish its image? One possibility would be to turn to Isaac Newton who for almost six decades, spanning the late 16th and early 17th centuries, relentlessly practised alchemy (Dobbs, B. J. T., *The Janus Faces of Genius*, Cambridge University Press, 1991). With Newton and Holmes, promoting the discipline's public image, chemistry's star must surely ascend.

P. Balaram