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GUEST EDITORIAL

Balancing the equation

Chemistry, it is said, has neither the drama of physics nor the glamour of biology. Yet, the subject has a surfeit of riches, which its practitioners seem only too happy to gift away to other disciplines. This perception of chemistry as a central science, a language for other sciences, and a starting point for research in biology and materials sciences has led to a paradoxical situation. On the one hand, everyone knows that chemistry is an important subject. On the other, no one wants to be called a chemist. Ironically, all this is taking place at a time when the subject itself is in the throes of the most deep-seated changes it has ever undergone. Given all these variables, the chemistry community in India has its task cut out, in terms of harnessing the gains of modern research towards the overall progress of the country, at this most significant time in its economic development.

The problems begin at the school leaving level. Given the present ludicrous scenario wherein the brightest students in the country gladly embrace the indignities of the cram schools to obtain that all-important IIT seat, to then vanish into the maw of America four years later, it is a miracle that even a few of them opt to study science. Even here, biology wins hands down. Many students say they want to study 'biotechnology' or 'molecular biology' without knowing what these terms mean. How can poor old chemistry hope to survive in such a situation? Sadly, I conclude that many students study chemistry because they just have no other option.

Once they are in the B Sc and M Sc programmes, what do these students encounter? It would be accurate to say that the chemistry curriculum is totally out of date in all our institutions. The yawning gap between what is taught in the classrooms and what goes on in the research laboratories makes a mockery of the oft-repeated dictum that teaching and research go together. The age-old distinctions between organic, inorganic and physical chemistry are now completely passé. Chemistry is all about a few guiding principles and the many exceptions that seem to contradict these principles. It is this combination of quantitative and qualitative thought that lends the subject its great beauty and appeal. Its guiding principles are timeless and cannot be dispensed with, for then there would be no subject left at all. Likewise, the descriptive and qualitative domain

too needs urgent and major reform. The teaching of specialized topics that had appeal in the 1960s and 1970s should be discarded as they lack contemporary relevance. Mathematics in the chemistry curriculum too needs proper modulation. Students of chemistry do not need to be crack mathematicians (as many theoretical chemists would like us believe), nor need they be totally ignorant of it (as several synthetic organic chemists still maintain). The middle ground is lacking in this and all other matters pertaining to curriculum revision. It is naïve to expect the UGC to do anything. Charity begins undoubtedly at home, and leading chemistry departments in the country should start the clean-up. Why complain that good students do not take up chemistry as a career when we offer them such unappetizing fare in the classroom?

The research scenario is a mixed bag. Compared to the situation prevalent a decade ago, many talented Indians can be seen in the pages of the foremost international chemistry journals, the *Journal of the American Chemical Society*, *Chemical Communications* and *Angewandte Chemie*. But getting into a topnotch journal is just the beginning. How many papers written by Indian authors are well cited? Do these papers appear in these journals only because they reiterate the latest fads and trends prevalent in America, the UK and Germany? Why is it that Indian scientists are not opinion makers and real leaders in international chemistry? It is difficult to answer such questions but a hint may be obtained from the methods we use to recruit and mentor our new faculty. Typically, our faculty addition is a bright scientist who took his Ph D from a prominent Indian institution and then went abroad for one or more post-doctoral appointments. So far, so good. But when this aforementioned scientist returns to an independent position in India, his research is generally a watered down version of what went on in his post-doctoral mentor's laboratory. It is here that the system fails more or less regularly. Instead of discouraging this type of imitative research, we tend to encourage it because of an initial spurt of papers in international journals. The acquisition of a few (now almost mandatory) awards and recognitions completes the cycle and the researcher settles down to many years of well deserved obsolescence. Amazingly, the shadow of the post-doctoral mentor con-

tinues for decades. Originality and innovation, the lifeblood of research, are the main casualties.

Chemistry is a subject with many intimate and deep-seated connections with industry. Many major discoveries over the past 200 years have been prompted by practical considerations, whether it was Pasteur's discovery of stereochemistry, Haber's process for the fixation of nitrogen to ammonia or the discovery of polymers like nylon. A characteristic of the growth and development of chemistry in the US, Europe and Japan, is the synergism between academia and industry. For example in the 1930s, Roger Adams at the University of Illinois talked the management of Eastman Kodak Company into commercializing the fine chemical synthesis that undergraduates in Urbana undertook in their summer projects. This was the origin of Eastman Chemicals. The University of Illinois always attracted a very large number of students for its Ph D programme as they were assured of gainful employment in Kodak, Dupont or Dow. Such a synergy is missing in India. Those of our Ph Ds abroad who wish to return to India only do so if they are hired by an IIT, the IISc, a University or a CSIR laboratory. The question of their seeking employment in an industry in India simply does not arise, although they do not seem to have any inhibitions about an industrial research career in America. Indian industry is not helping the situation any by generally insisting that they want only foreign returned post-docs for their research laboratories. Why do not they hire fresh Ph Ds from our good institutions? Many large companies do not even have R&D establishments commensurate with their size. After all these years, why is it that so few chemists look towards companies like Reliance Industries for employment? All in all, the academic and industrial chemistry communities in the country are as far apart as ever.

Nowhere is this situation as peculiar as in the pharmaceutical industry, which is all set to become one of the big money spinners of the next decade. Research in the academic community often has little or nothing to do with what is going on in this industry. The Patent Act 2005 has trashed the whole idea of process patents and with it the concept of reverse engineering of pharmaceutical blockbuster molecules. Medium size pharmaceutical companies will succumb to outsourced work while the smaller ones will disappear. Indian organic chemists need to take a really hard look at what they are teaching their students because if the present pattern continues, our Ph Ds in organic chemistry risk becoming technicians in pharmaceutical sweat shops, initially maybe in New Jersey but surely and slowly in Hyderabad, Ahmedabad and the like.

It is fashionable in India to enumerate a number of problems, and then end by stating that despite all these problems, there is adequate progress and that sooner or later the situation will improve. I am not going to leave the reader in this comfort zone. Undoubtedly there are many opportunities in chemistry now. Any subject that is changing as fast as chemistry is today is bound to be full of opportunities. The economic situation in India too is changing fast. But unless there is a clear will to couple these developments in a cogent and constructive way, there will be no change in the way in which Indian chemists are perceived by our peers abroad. The Indian chemistry community is led by a rapidly aging gerontocracy which is not responding adequately to the blizzard of change that has now visited our subject. Unless and until there is a paradigm shift in the way we address ourselves and our institutions, I fear that we chemists will merely be a part of yet another gloriously missed opportunity.

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