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Profile

Varinder Aggarwal

Professor of Synthetic Chemistry, University of Bristol, UK

Organic & Biomolecular Chemistry profiles Professor Varinder Aggarwal

Varinder Aggarwal was born in 1961 in Kalianpur, a small village in North India. Without the privilege of more than just a basic education, life was hard for his parents raising their six sons; even water for the family had to be carried daily from the local village pump. In 1963 the family emigrated to the United Kingdom where the sons were in a fortunate position to take advantage of the excellent educational opportunities. Varinder has enjoyed living in several cities around England and now lives in Bristol with his wife, Meena, who is a PhD Pharmacist. They have two lively sons, Lukha (4) and Romi (2), and when not at work, family life occupies most of his time. They find Bristol a wonderful historic city to live in, with a lively multicultural atmosphere, excellent leisure activities, restaurants and beautiful countryside nearby.

1986: University of Cambridge, PhD, Supervisor Dr Stuart Warren

1986–1988: Columbia University, Post-Doctoral Fellow, Supervisor Professor Gilbert Stork

1988–1991: University of Bath, Lecturer, Chemistry

1991–1997: University of Sheffield, Lecturer and Reader, Chemistry

1997–2000: University of Sheffield, Professor, Chemistry

2000 to date: University of Bristol, Professor of Synthetic Chemistry

When did you first realise you wanted to work in Chemistry?

Not until my first year at University. I actually went to Cambridge University to study physics because I was particularly fascinated by astrophysics. I remember answering a question at school on the Doppler effect which revealed to me for the first time that the universe was expanding. I was struck by the philosophical implications it generated: What is the universe expanding into? How long could it go on expanding? What would happen then? These are of course standard questions in physics but to an impressionable 18 year old they were profound and I wanted to try to find the answers. The University physics course involved taking three other subjects in addition to physics and for one of these I selected chemistry. This was particularly fortunate for me because in my first year I found physics abstract and unintelligible. In contrast chemistry, and organic chemistry in particular as presented by Ian Fleming and Dudley Williams, appeared to me to be beautiful, logical, relevant and important. Thus my interest was turned away from physics and the seeds of my love for chemistry sowed. I realised then, as I do now, that the quality of teaching is vitally important and can influence the directions of young people.

Who was the first person to inspire you to research in Chemistry?

The combination of the outstanding organic chemistry lectures, the high quality tutorials by Ian Fleming and the excellent teaching books by Stuart Warren showed me what an elegant and logical subject organic chemistry was. From this study I knew that I wanted to continue within the field. I therefore decided to undertake a PhD with Stuart Warren who was one of the best teachers in chemistry at Cambridge. In addition to learning a tremendous amount of chemistry during my time with him, he was also a great inspiration and gave me the self-confidence to think independently.

Tell us something about the areas of Chemistry you are currently researching.

Our research is broadly based but focuses on the development of new methodology, asymmetric synthesis and new strategies for synthesis. We are exploiting reactions involving sulfonium, phosphonium, arsonium and ammonium ylides for asymmetric synthesis. Another strand of our work is taking established cascade reactions which normally give certain products, and through analysis of the reaction intermediates attempting to divert the course of the reaction towards new products. We are also looking at developing new strategies for target-orientated total synthesis. Much of our work is methodology driven but we are now seeking to exploit the new chemistry that we have developed in natural product synthesis.

Why did you decide to research in these areas of chemistry?

My research training was in synthesis, an area that continues to excite me. When I started to develop my own research programme, asymmetric synthesis and catalysis were clearly some of the important themes on the horizon and so we established a research program in this area. The great fun in this area is the broad array of diverse chemical principles which are brought together to create new effective catalytic processes. It is complete chemistry because it requires a substantial amount of synthesis, an intimate understanding and knowledge

Photographs show Professor Aggarwal, Professor Aggarwal with Lukha, Clifton suspension bridge during the balloon festival and Professor Aggarwal's group in the laboratory.

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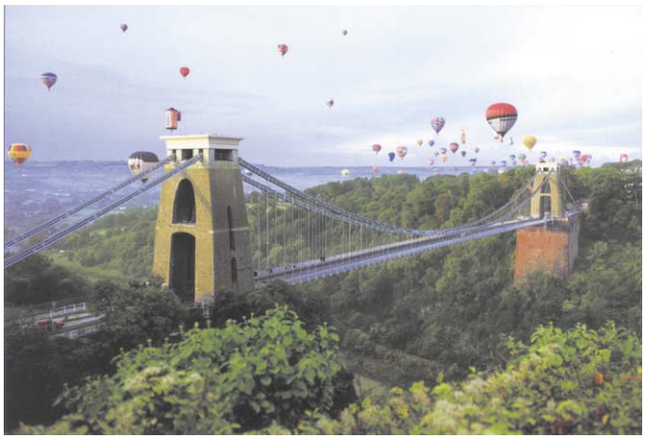

of mechanism, a detailed understanding of the interactions involved when molecules come together and rates of reaction. The work of Sharpless and Noyori is exemplary in this field. Taking chemical cascades apart and re-engineering them to effect alternative transformations is great fun and extremely interesting. Not only does it involve challenging the existing orthodox views on how the cascade process occurs and what the intermediates are, but also these intermediates are exploited in new and different ways. This is tremendously exciting if it can be achieved. I continue to find enormous interest in the simple Baylis–Hillman reaction, another cascade reaction which occurs through a series of intermediates before reaching the final product. The more we look into this simple reaction the less I feel we understand it. This continuously motivates us to understand it better, and then to exploit it further in synthesis and catalysis, including asymmetric catalysis.

Finally, there is no better way of showcasing new methodology or new strategies than to demonstrate them through total synthesis of natural products. This continues to be a challenging but very rewarding activity for us. The chemistry involved is not only interesting, but I believe it also gives the students and post-docs an excellent training in thinking about design and reactivity of molecules, it reinforces the basic principles and it also provides training in organic synthesis.

Where would you like to see your research in both the short- and long-term?

I hope we can develop some new and useful methodology for asymmetric synthesis. I hope that other researchers will find some of our processes genuinely useful because of their broad substrate scope and robustness. I also hope that we can develop a fundamental understanding of how these chemical processes work and the factors that control enantioselectivity and diastereoselectivity.

What would you most like to achieve in your lifetime in Chemistry?

It would be very satisfying to have made an impact on the development of some new chemical process which benefits the environment through either using more easily accessible raw materials or through the development of processes which generate less waste. In addition I would like to feel that I have created a family of chemists who believe in themselves and their abilities to work independently. Stuart Warren gave this to his research group and I would like to pass this invaluable experience on to my group.

What do you find most enjoyable about your job on a daily basis?

I very much enjoy the interaction with my research group and my academic colleagues. In particular, I take great satisfaction in seeing students and post-docs develop self-confidence and grow into free thinking, independent scientists.

What frequently annoys you about your job?

The administration associated with running my research group. This activity, although unfortunately essential, means that I find it difficult to interact with my research group, read the literature and think about chemistry as much as I would like.

Which scientist do you most admire through history and why?

Archimedes. I still remember the physics lesson as if it was yesterday on the problem given to him by King Hiero II of Syracuse who wanted to know whether his crown of gold had been diluted with silver. The story of how the solution came to Archimedes in his bath and of him running naked through the streets of Syracuse shouting "Eureka! Eureka!" was amusing. But what left a deep impression was that from simple observations of the displacement of fluid by objects that are placed in them, Archimedes not only developed a solution to the problem given by King Hiero II but also developed his Law of Buoyancy. This was a brilliant example of observation with lateral thinking. Bath time for me was never the same again, as I performed my own experiments on floating objects. Closer to home, two of my chemistry heroes are Stork and Evans. Their teachings through the chemical literature have been monumental for me. From my period at Columbia University with Professor Stork I found him to be the most gentlemanly of human beings and a total scholar. He left a deep impression on me.

If you could successfully solve any scientific problem what would it be and why?

I would love to be able to solve the problems of degenerative brain disorders because I feel that this is one of the most debilitating human conditions. Indeed, understanding the brain and how it works remains a huge problem. For example, what is the chemical basis for memory? If we could begin to answer this question, the consequences for chemistry, biology, medicine, computing and philosophy would be enormous. As I've no idea where to start, I will just go into the lab and try to help my group with some of their synthetic problems instead.