

# **THE CONFLUENCE OF CHEMICAL AND BIOLOGICAL SCIENCES: IMPLICATIONS, OPPORTUNITIES AND CHALLENGES**

S. Sivaram  
CSIR Bhatnagar Fellow  
A 201, Polymers and Advanced Materials Laboratory  
National Chemical Laboratory,  
Pune 411 008.

E mail: [s.sivaram@ncl.res.in](mailto:s.sivaram@ncl.res.in)

## **ABSTRACT**

The rapid integration of chemical and biological sciences is one of the distinguishing features of twenty first century science. The walls dividing the two disciplines, once considered separate and distinct, are being rapidly brought down. The key motivation for this integration is the inability of either discipline alone to provide answers to some of the most emergent and complex problems facing humanity, namely, energy, materials, environment, health, food and agriculture. The future of human civilization on planet earth is inextricably linked to the symbiosis of chemistry and biology.

This lecture will begin by briefly tracing the history of natural sciences in the preceding two centuries and seeking to understand what caused the divide between the disciplines. We will explore, whether in the twenty-five years since Arthur Kornberg first articulated this conflict between the two cultures of chemistry and biology (*Biochemistry*, 26, 6888, 1987), the scientific enterprise has made progress towards integration of the two disciplines.

The forces that are currently driving this integration will be discussed with illustrative examples. These include sustainable production and consumption of chemicals, materials and energy using bio-catalysis and tools of synthetic biology, novel materials inspired by biology using supramolecular chemistry and self assembly and photosynthetic machinery of green plants inspired development of molecular devices capable of splitting water and production of hydrogen (“artificial leaf”).

One of the important factors that will accelerate the pace of integration will be how we educate our future generation of students who will pursue science as a career. Science education has to become more integrative, wherein, we must increasingly use examples from biology to illustrate concepts in chemistry and vice versa. In the ultimate understanding life in all its biological diversity needs the language of chemistry. It is also the language of chemistry which links the physical sciences to the biological sciences. Biology needs to master this language because in the words of Kornberg “chemistry explains where we came from, who we are and where the physical world will allow us to go”, in short, finding answers to the eternal questions of science.