

Coming of age in biotechnology

In today's biotechnology, one has to run to keep one's place. Is India prepared to be at the cutting edge of a field whose frontier is advancing rapidly?

The last decade has seen a significant increase in government funding for science. The biological sciences have been particularly encouraged by the strong support provided by the Department of Science and Technology and, later, by the Department of Biotechnology. While advances in basic biology have already dramatically altered our perceptions of life processes, research in molecular biology also promises many practical dividends. Crop improvement in agriculture, development of vaccines and diagnostic procedures for parasitic diseases, and even the prospect of rational drug design are some areas of special relevance in India. The project to sequence the human genome has propelled biology research into the realm of big science, and the fallout in this country is all too visible. Indian molecular biologists—a broad term that encompasses biologists of various persuasions: biochemists, biophysicists, crystallographers and even some poorly disguised chemists and physicists—have successfully ridden the bandwagon of the scientific revolution in this area in the West. In so doing, they have propelled themselves into the position of standard-bearers of the promised biotechnology millennium in this country. Is biotechnology truly a new discipline? Will its promises be realized in the foreseeable future? Does it deserve a special place in the Indian scientific scene? Should there be a more focused and critical approach to the formulation of large projects in this area? These are some of the issues that must be addressed.

The origins of biotechnology predate the era of molecular biology. Today's molecular biologist would probably place the Boyer-Cohen experiments on DNA cloning at the top of the list of historically important events in this discipline. However, biotechnology as a subject is probably being rediscovered for the third time, albeit in a different manifestation, in this century (R. Bud, *Chemistry in Britain*, 1988, 24, 441). Historical lessons, well learnt, can sometimes be useful in charting future courses. In the twenties, commercial hopes of

producing useful chemicals by biological processes reached a high point with Chaim Weizmann's use of *Clostridium acetobutylicum* to convert starch into butanol and acetone, the latter an essential component of explosives during World War I. This era of fledgling biotechnology was soon swept away in the chemical avalanche, where the burgeoning petrochemical industry used oil as a natural starting material to provide a host of useful chemicals. Microbiology reared its head in the service of man once again during World War II. Biotechnology was reborn in the production of antibiotics, penicillin being the forerunner. The technologies of fermentation have always held deep promise for the production of chemicals. Indeed, the techniques of biology and synthetic chemistry have often been viewed as being competitive. An apocryphal statement attributed to Steinmetz in a conversation with Carl Bosch goes, 'I know you can make indigo cheaper than God, some day you will make rubber cheaper than God, but you will never make cellulose cheaper than God.'

Biotechnology's most recent reincarnation is a direct result of one of the century's greatest scientific upheavals, the amazing development of a whole host of genetic technologies that have spawned the recombinant-DNA revolution. How far the promises of today's biotechnology will be realized and how well a country like India will adapt to a constantly changing scientific frontier are matters of special concern. At present, biotechnology is being touted as a panacea for many pressing problems, and the dangers of uncritical support of a discipline are all too clear. High expectations place a special responsibility on the professed practitioners of biotechnology. In highlighting this area in our pages we hope to stimulate informed discussion, which, in turn, may contribute in a constructive manner to the efforts aimed at developing biotechnology in India.

P. BALARAM
S. RAMASESHAN