

Guest Editorial

The present century has been identified as the century of information technology and biotechnology. It is therefore appropriate that the Defence Research and Development Organisation (DRDO) has decided to bring out a Special Issue of *Defence Science Journal* devoted to biotechnology in the first year of the present century, which is also the first year of the present millennium (contrary to popular belief, the present millennium began on 01 January 2001, and not on 01 January 2000). The synergism of information technology and biotechnology (an offshoot of which is bioinformatics) could greatly enhance the utility and scope of each of these two new technologies.

The Concise Oxford Dictionary, 1999 Edition, defines biotechnology as: 'The exploitation of biological processes for industrial and other purposes, especially the genetic manipulation of microorganisms for the production of antibiotics, hormones, etc'. It was perhaps in 1917 that the term biotechnology was first used. However, the origin of the technology goes nearly 8000 years back. The use of yeast to make bread, wine (and later cheese) was practised a few millennia before Christ.

Major scientific advances in the field began around the middle of the 19th century. Some of the milestones are: Pasteurisation in 1861; George Mendel's epoch-making work in genetics in 1865—which, however, had to wait another 35 years before being noticed by the scientific community; the hypothesis in 1903 that genes are located in chromosomes—which was validated in 1910; the concept of genetic information in 1910, that genes can transfer from one strain of bacterium to another; gene mapping techniques in 1922; demonstration in 1943 that DNA is the carrier of hereditary information; and the unravelling of the genetic code in 1953.

The modern era of biotechnology can be considered to have begun in 1973 when the recombinant DNA methodology (also popularly called genetic engineering—although the term had been used as early as 1941) was developed. The next two decades witnessed unprecedented developments—the birth of the first test-tube baby; monoclonal antibodies; cloning of the human gene; introduction into the market of the first genetically engineered product, viz., human insulin; and polymerase chain reaction. The human genome project was started in 1990 and was completed in 2000, surprisingly ahead of time; this achievement has been lauded as the biological equivalent of landing on the moon.

Biotechnology holds untold promise in the fields of agriculture, health care, industry, the preservation of environmental integrity, and one of the means of sustainable development. But, like any other modern technology, it has two sides—it is a double-edged sword. One of the major concerns is the possibility of development of newer biological strains and their introduction—intentionally or inadvertently—into the environment, which may pose as yet unpredictable long-term effects for the human race (as well as the plant and animal kingdoms); a specific case is the development of biological weapons. The recent anthrax scare is a matter of worldwide concern. Genetically modified foods may hold great potential for ensuring adequate sources of food supply for the increasing human population, but the safety of genetically modified foods has been a matter of concern among some experts; intense debate is currently going on in many countries, including India.

There are ethical concerns as well. In the famous Diamond versus Chakraborti case, the US Supreme Court ruled in 1980 that genetically altered organisms may be patented. The impact of liberalisation of the Indian economy, and our adherence to the World Trade Organisation and Intellectual Property Right Protocols have their own serious implications for India and other developing countries. The terminator gene looks a fiendish invention, but we have to live with such developments in the present world scenario.

The present Special Issue of *Defence Science Journal* addresses itself to some of these questions—the immense potential of biotechnology as well as the challenges it poses. The series of articles give an overview of some aspects of the situation—these are illustrative rather than exhaustive. Das briefly traces the evolution of modern biotechnology and indicates the benefits we are likely to reap. He draws attention to the rich biodiversity of our country. Dando and Pearson analyse the enormous changes in society that the genomic revolution could bring, as well as the growing concern about its potential misuses; they also indicate the implications of biotechnology in the military context, and draw attention to international efforts like the Biological and Toxin Weapons Convention to control such misuses. Pandit and Lalji Singh point out that all living organisms on this planet are made up of just four letters [adenine (A), guanine (G) cytosine (C) and thymine (T)] which are capable of generating so much biodiversity that it is mind-boggling. They take us through the exciting adventure of the human genome project. Ananda Kumar reviews the significant strides made in the past 10 years in plant biotechnology and the scope of transgenics in developing improved varieties of crops. Padmanaban discusses the role of health care biotech industries in our country's health care context. Kiran Mazumdar-Shaw reviews the scope of biotechnology in pharmacogenomics and gene therapy as well as the role the pharmaceutical industries can play. Nagaratnam summarises the current status of biotechnology in India and

concludes that we are fairly advanced in this area, with promise of a rewarding future.

It is but natural that the DRDO is interested in the military applications of biotechnology, and this Special Issue of the Journal has two articles devoted to this area. Pearson and Roberts assess the potential threats faced from biological and chemical weapons, and the necessity of biotechnology preparedness in meeting such threats. Lazar Mathew gives a detailed account of biotechnology in military applications for both offence and defence. The article by Talwar, although not in the mainstream of biotechnology shows how simple indigenous herbal products can go a long way in providing cost-effective means of control of diseases.

I am grateful to Dr SS Murthy, former Director, DESIDOC, Dr Mohinder Singh, the present Director, DESIDOC and the Editorial staff of *Defence Science Journal* for their valuable contributions in bringing out this Special Issue.

A. Nagaratnam
Consultant, DRDO
Jodhpur-342 001