In this issue

The wisdom of Francis Crick

Francis Crick's *What Mad Pursuit: A Personal View of Scientific Discovery* is reviewed (**page 330**) by V. Nanjundiah, another physicist-turned-biologist. J.D. Watson, in *The Double Helix*, dramatized the discovery of the structure of DNA so much that it has been told and retold a million times, in the media, in books and in schoolrooms, and is now folklore. Through all this Francis Crick has ridden the wave and has been the central figure of molecular biology for more than a quarter of a century.

When one reads what Crick has written or what has been written about him, one is reminded of the conversation between Enrico Fermi and the particle physicist Majorana, which Chandrasekhar, the Nobel Prize-winning astrophysicist, recalls in his book *Truth and Beauty: Aesthetics and Motivations in Science* (see review by N. Mukunda, *Curr. Sci.*, **59**, 284):

Majorana: There are scientists who 'happen' only once in every 500 years, like Archimedes or Newton. And there are scientists who happen only once or twice in a century, like Einstein or Bohr.
Fermi: But where do I come in, Majorana?
Majorana: Be reasonable, Enrico! I am not talkng about you or me. I am talking about Einstein and Bohr.

But the question does arise - where *does* Francis Crick come in? In *his* 'personal account', Watson, as if to answer this question, says grudgingly, 'Some day he [Francis Crick] may be considered in the category of Rutherford and Bohr.' History will decide whether this is a proper assessment or not.

What Mad Pursuit is a remarkable book. It has to be read and reread. The beauty of its style and the elegance of its presentations mask much hard science.

Many reviewers have speculated on why Crick chose this title, from Keats' 'Ode on a Grecian Urn'. The immortal ode ends with

> A friend to man, to whom thou say'st,
> Beauty is truth, truth beauty,
> That is all ye know and all ye need to know.

One goes back to Chandrasekhar's *Truth and Beauty*. Elegance and aesthetic beauty are said to fulfil an important role in physics as it has to conform to deep mathematical laws. Biology presents complexity of a staggering order, although Francis Crick seems to be one who possesses the unusual quality of distinguishing what is significant from what is not. The beauty that the biologist seeks is not the stark, aseptic beauty of the mathematical physicist. For elegance and simplicity are dangerous guides to correct answers in biology. Elegance, if it does exist in biology, may be more subtle. Indeed, in the case of biology, one may have to move very much away from the mathematical physicist's concepts and redefine for biology what beauty and elegance signify. Here one may take a leaf out of Francis Crick. His approach to science is lusty and it throbs with life. It would be natural to seek such beauty in biology.

The book is sparkling, and spiced with anecdotes. Sometimes these make us pass over the pearls of wisdom that Crick scatters before us. For example, 'One should not work so hard as to leave no time for serious thinking'. The reviewer is also reminded of the mathematician Harish-Chandra's statement: '...knowledge by advocating caution tends to inhibit the flight of imagination. Therefore a certain naiveté, unburdened by conventional wisdom, can sometimes be a positive asset.'

The book is full of surprises. Said another reviewer, 'The detailed quest for DNA ... is skated over; indeed Crick manages, on page 64, to tell the entire story in one bathetic paragraph....' And another, 'Crick's account of events between 1953 and 1966 should be studied by all who are interested in science and in how scientists explore a new field that suddenly opens.'

But now biology is big business — the major goal is the Human Genome Project in which the chemical structure of the entire human genetic material will be mapped and stored in a computer. What will Crick say about all this? He has (wisely?) left molecular biology (after determining the structure of DNA and cracking the genetic code!) and moved into neurobiology.

Perhaps the greatest shock to the reader of this book will come from a different direction. No one has ever accused Francis Crick of modesty. Who does not remember the Graham Greenish opening sentence of Watson's *The Double Helix*, 'I have not seen Francis Crick in a modest mood'? And yet one has to read this book to understand the stuff Crick and many of his ilk are made of. The greats put on a blustering show to all of us mortals, as though they are ashamed to show us their innate modesty, humility and even reverence when they approach nature. Crick says, 'The glamour belongs to the molecule, and bliss it certainly was to have been caught up in its aura.'

Agricultural planning for India

A country as big and populous as India cannot afford not to be self-sufficient in agriculture. Jawaharlal Nehru, India's first prime minister, perhaps better known for his advocacy of rapid industrialization to combat poverty, once said, 'Everything can wait, but not agriculture.' Nehru went further and saw symbiotic linkages between agriculture and industry, indeed an underpinning of the Indian economy by agriculture primarily. In an article beginning on **page 303** M.S. Swaminathan provides the background to the challenges facing Indian agriculture by briefly describing Nehru's agricultural policy under four major concerns. These were agrarian reform, protection of ecological foundations of development, rural economy, and application of modern science and technology to achieve agricultural progress. While co-operative farming, advocated by Nehru to enable effective adoption of scientific agriculture, did not work, it is interesting that commodity-oriented co-operatives, like dairy co-operatives, have been successful. But Swaminathan argues for a reappraisal of the concept of co-operative farming in a situation where the majority of agricultural holdings belong to small and marginal farmers.

Among the technological factors that will need attention in the context of India's agriculture, Swaminathan includes safety of foods produced by genetic modification; ability to integrate traditional technologies with frontier technologies such as biotechnology, information technology and space technology; promotion of environmentally friendly technologies; and 'anticipatory research' to adapt to altered growing conditions caused by changes in climate and sea levels. Biotechnology offers attractive opportunities in agriculture. Swaminathan stresses the importance of an international agreement on the sharing of plant and animal genetic resources and on patenting laws to ensure fairness to all countries in reaping the benefits of biotechnology.

Differentiation in cultured plant tissue

In the highly empirical technique of plant tissue culture, some general rules for inducing differentiation of cultured tissue did emerge. For example, relative concentrations of auxin and cytokinin in the growth medium control root and shoot differentiation. But genetic engineering of plants often involves regeneration of whole plants from single, genetically altered cells, and so plant biotechnology requires a much deeper understanding of the control of growth and differentiation. Urmil Sethi and Sipra Guha-Mukherjee review (**page 308**) current understanding of the biochemical and molecular events that underlie proliferation and differentiation of plant cells in culture.

The authors' own work has concentrated on *Brassica oleracea*. In *Brassica* cultures, as in many others investigated, methionine, S-adenosylmethionine, polyamines and ethylene stimulate proliferation, while inhibitors of polyamine biosynthesis and ethylene antagonists check growth and induce differentiation. Two enzyme markers of differentiation and the transition to differentiation are also known. Threonine deaminase and glyoxalase-I show reduced activity in the differentiation phase. Sethi and Guha-Mukherjee also give examples of the use of gene probes to identify specific changes in gene expression during differentiation.