

## BOOK REVIEWS

**Thomas Kuhn – A Philosophical History for our Times.** Steve Fuller. The University of Chicago Press, Chicago. 1999, 472 pp.

Most of the writings on science and its development fall into three categories. First, as a kind of manual or textbook, writing on science has sought to detail the laws and discoveries of science under various disciplines like physics, chemistry, biology, astronomy, etc. Along with them go the biographies of the scientists and the struggles they had to put up to achieve their goals. The second kind of writing is in the nature of surveys of the disciplines, not on the basis of the individual pursuits and achievements, but on the basis of theoretical orientations leading to a comprehensive understanding of the topology of the subject. The third kind of writing has been in the nature of historiography of science relating to the topological upheaval marking the shift from one paradigm to another and consequent seminal changes in the vision that science afforded of the knowledge of 'reality'. But not many attempts had been made to relate science to human endeavour as a whole, or in other words, to relate it to the comprehensiveness of human activity. This kind of writing in science required an understanding of the philosophy of science.

With the publication of Popper's *The Open Society and its Enemies* and later Kuhn's *The Structure of Scientific Revolutions*, a new field of cognition relating to science in its societal and social placement was opened up. This kind of writing sought to understand science as a phenomenon in the realm of human values. Science was looked upon neither as a dependent nor as an autonomous human activity, but as a symbiotic growth in the context of human life and endeavour.

Time was when science was what a scientist did. It later came to include how he did it. Now on the testimony of Fuller, it would seem to mean the whole range of political and economic forces which induce, support, control or pervert the development of science. In the process, it has come to mean an account of the governance of science.

Even the recognition of science as a distinct intellectual activity was slow to come by. Science had to wait till Bacon

to win its distinctness and scientists had to wait till Whewell to acquire credentials for their profession. The direction for scientific development both in the instrumental and realist lines of research came about only in the wake of Mach and Planck.

Fuller traces the development of science under a liberal dispensation from the middle of the seventeenth century and under a communitarian ethos from the second half of the nineteenth century. He finds the origins of the former in the fora of ancient Greece, where the Sophists tried to prove anything if paid for it and of the latter in the Academy of Plato, which by the simple device of starting the tradition of writing down the ideas bandied about, gave it a corpus of logic and legitimacy. It is this tradition leading to paradigmatic consistency, even if not of logic, that gave rise to a society for the pursuit of knowledge in the place of freelance pursuit of knowledge. Fuller disapproves of liberalism and communitarianism for the excesses to which they lead in the organization of science as a directed activity. He opts for republicanism in scientific development.

Fuller agrees with Karl Popper in that the proper ethos for scientific pursuit is the open society which guarantees one the right even to be wrong. This is not available either in the liberalist pursuit of science which harnesses science to market values or in the communitarian pursuit of science which fetters it to political correctness. The development of science in post-Newtonian period was governed by the needs of the Industrial Revolution and colonialist expansion and in the period around the two world wars by the needs of the political correctness laid down by the prevalent regime. Even in the post-war period, USA censored altogether the experiment to find out the cognitive level of the blacks, because political correctness demanded it.

Science has developed today to an extent where the pursuit of knowledge for its own sake is made impossible by the scale on which the pursuit is undertaken, by the elaborateness of the framework of credential and citations that is now necessary for obtaining the space and means to pursue knowledge, by the ends to which the pursuit is increasingly harnessed, by the peer-pedigree involved to legitimize the pursuit, and by the setting up of paradigms to legitimize the pedigree.

Fuller's republicanism would seem to require the removal of all these shackles to the freedom of thought. The scientist must have the freedom to be wrong, but not be branded wrong on the basis of his pursuit being not duly sanctioned by 'Big Science', by acceptable scholastic credentials or citations, by being related correctly to political, economical or social ends, by the approval of self-styled peers or by conformity to a prescribed paradigm.

Says Fuller 'Nothing in the nature of society demands that it has an institution specially devoted to the pursuit of knowledge as pure inquiry. That such institutions have existed, typically associated with science is a matter of socio-historical fact. There is no guarantee that once science has flourished, it will do so forever, let alone in the same form. These are cardinal principles of my research programme, social epistemology'.

For science to exist and thrive as knowledge through pure inquiry, it may need self-discipline and not self-constraints. Science has to be an individual pursuit in a social or political ambience, but cannot allow itself to be constrained by social and political considerations of either liberalism or communitarianism. 'Thought is free', even if it was Trinculo who said it.

Fuller's writing is bewilderingly sourced. The annotations are not confined to the footnotes. The sentences are also annotative of each other. He also plays with words, catchwords, watchwords and passwords. The result is that development of an argument is frittered away in a burst of exuberant references and brilliance inevitably fades into fleeting sparks.

Fuller's is not merely a refutation of Kuhn's structure, it sets out to be its demolition. And he achieves it with a linguistic implosion that would have been spectacular if it were not insidious. Fuller is out to prove that something good can come out of Nazareth. But then, should he for the sake of Nazareth demolish Babylon, Athens, Rome and Carthage – and the last with paranoiac fury of Scipio Aemilius Africans?

S. V. SESHADRI

45, Kalyani Street,  
Lakshmanaperumal Nagar,  
Kottivakkam,  
Chennai 600 041, India

**Van Rawats – A Tribe in Peril.** Prasanna K. Samal, Yesh Pal S. Topal and Pushpa Pant. G.B. Pant Institute of Himalayan Environment and Development, Kosi-Katarmal, Almora 263 643. 2000. 132 pp. Price: Rs. 400.

Researchers from the G.B. Pant Institute of Himalayan Environment and Development (GBPIHED), Almora have studied the numerically small, forest-dependent and recently settled tribe – the Rajis of the Central Himalayas, from a development perspective. The book claims to understand the reasons for declining growth rate, backwardness, impact of development interventions and acculturation of the Raji tribe and attempts to evolve a framework for its development based on existing resource base, ecology and culture.

The demographic data covering all 123 households of the tribe, reflect the shorter life span of the Raji females and of their declining sex ratio in the age group 51–60 years. Poverty, hard work, nomadic way of life, improper food intake and lack of maternity care have been highlighted as the reasons for the shorter life span. Besides, the population growth rate of the tribe has been very slow, which the authors attribute to the low level of development and quality of life.

The dependence of the Rajis on wage labour seems substantial, contributing to half of their total income. The authors have not discussed the nature of wage labour and the places where they undertake this work. It would have been appropriate if there was more focus on the wage labour aspect, since it could be a starting point of development intervention. The remaining income of the Rajis comes from forests, which contribute up to 27% of the total income and 12% from agriculture, in spite of the fact that 88% of the households own land. On the expenditure front, the Rajis spend 74% and 11% of their total income on food and clothing, respectively, indicating their status of existence.

The crude literacy rate of the Rajis is about 27%, out of which only 2% have passed high school. Non-customized textbooks and learning through Hindi are highlighted as the reasons for low literacy, since the language of the Rajis belongs to the Tibeto-Burman group. Lack of a resource base for support of higher

education for the children is identified as a major social handicap. The authors speak about the higher degree of discipline required from parents and children regarding attendance in schools. A value-loaded statement is made by the authors, 'lifestyles based on generations experience of pleasure principle', which is unfortunate, coming from a group of social scientists addressing development issues.

The section on apathy of development agents to the development of the Rajis is well focused. For example, livestock is a priority for economic development, while markets for their products are not, a fact that has been overlooked. Similarly, the book laments at the lack of investment in carpentry, in spite of the fact that the Rajis are good craftsmen. In addition, the authors identify tailoring units and bee keeping that should have been given priority.

The book repeatedly mentions about wooden implements and utensils that were made by the Rajis and bartered for rice, clothes and essentials, but fails to describe or detail this aspect anywhere. This is so because if the Rajis had such a practice, it would be a nice starting point for development, based on their skills and knowledge. A possibility of marketing some of their products as tourist articles through governmental and non-governmental agencies exists.

The authors have not done justice to the section on the economy of the Rajis. The chapter claims that the Rajis depend on the forests for their livelihoods, but fails to substantiate the importance of collection of forest products. This is in the light of numerous studies on non-wood forest produce (NWFP), from fields and fallows. The authors mention that forest laws were responsible for the loss of livelihood of the Rajis, but fall short to capture the manner in which it affected them. The link between forest laws and loss of livelihood is unclear. The book does not capture the changes in the lifestyle of the Rajis after the Indo-Chinese war of 1962, which led to the large-scale physical infrastructure development, especially roads in the region. The problem of sedentarization of a nomadic tribe and its consequences to life-styles coupled with acculturation with other social groups leading to elaboration and increasing complexity of life cycle rituals is clearly brought out.

Finally, the book identifies development priorities for the Rajis within the framework of the Swarnjayanthi Gram Swarozgar Yojana (SGSY). The SGSY is held as the panacea for the development of the Rajis. Development problems and stakeholders are identified, course of action prescribed, which calls for the customization of SGSY to fit in their unique conditions of existence. Target areas for development interventions are agriculture, livestock, bee keeping, horticulture and wooden crafts clubbed with markets. The book also calls for restructuring of the local District Rural Development Agency (DRDA) on the lines of North Eastern Council (NEC) and the involvement of local democratic institutions for effective implementation of development programmes.

On the whole, the volume of material about the Rajis presented in the book is little, preference being given to other details. The book is written in an implicit form that lets the readers do a lot of reading between the lines and draw their own conclusions.

V. ARIVUDAI NAMBI

*M.S. Swaminathan Research Foundation,  
III Cross Road,  
Taramani Institutional Area,  
Chennai 600 113, India  
e-mail: nambi@mssrf.res.in*

**SEWANA (South Europe, West Asia and North Africa): Durum Research Network. Proceedings of the SEWANA Durum Network Workshop, 20–23 March 1995, ICARDA, Aleppo, Syria.** Nachit, M. M. *et al.* (eds). International Centre for Agricultural Research in the Dry Areas, P.O. Box 5466, Aleppo, Syria. 1998. 334 pp. Price not mentioned.

This book is a record of an important international meeting of Durum (*Triticum durum*) researchers primarily from South Europe, West Asia, North Africa

(SEWANA) and few other countries held at ICARDA's headquarters in Aleppo, Syria in March 1995. The workshop was held to discuss, develop and integrate the knowledge generated in various disciplines towards improvement of productivity of durum wheats in the Mediterranean region.

Durum and bread wheats form the staple component of the diets of millions of people and the basis of farming systems throughout much of the world. Durum is perhaps best known for its use in pasta in the international scale, but it is also an important food for rural communities for products such as couscous, burghul and durum bread. About 90% of the world's durum wheat is grown in the Mediterranean region, particularly in the drier areas. As manufacturing and marketing of durum products are also concentrated in the region, the majority of durum research is also conducted in Mediterranean countries. Until recently, the various Mediterranean durum research programmes tended to work independently. A collaborative programme was initiated by the CIMMYT/ICARDA with durum-breeding programmes in West Asia, North Africa and various southern European universities with multiple objectives, including improvement of durum wheats by combining high grain quality with resistance to the main abiotic and biotic stresses encountered in Mediterranean region, to use the available genetic variation found in durum local landraces and wild relatives and to use DNA molecular markers in durum breeding.

In the Mediterranean region drought may occur alone or in combination with temperature extremes (cold, frost and heat). Irrigation is limited and in many areas nonexistent. Therefore genetic manipulation of plants to improve productivity and stability by increasing abiotic stress tolerance is the only practical solution. In addition, the biotic stresses, poor crop management and weed control inefficiency also curtail durum wheat yields. The CIMMYT/ICARDA durum-breeding programme has developed a strategy that aims at breeding improvement germplasm resistant to drought as well as to cold and heat and with responsiveness to improved conditions when they occur.

A number of papers discuss the durum wheat-breeding strategies in the countries of the Mediterranean region. The res-

earch has clearly shown that selection efficiency is greatest when selection is made (1) in the environment in which the varieties will be commercially grown; (2) for a combination of resistance to abiotic stresses and yield potential; and (3) for adaptation to variable environmental conditions. The genetic base of durum has been widened by using landraces and wheat relatives such as *Triticum turgidum* subsp *dicoccoides*, *T. monococcum* and *Aegilops* spp. for providing genes for biotic and abiotic stresses. The recombinants and the advanced populations obtained by crossing adapted durum genotypes and the wild relatives are tested in the labs and fields in SEWANA. A few papers discuss the techniques employed to solve the problems associated with inter-specific and inter-generic crosses.

Quality is a prerequisite for durum production and protein content is directly related to pasta quality. A number of papers have focused on the use of molecular tools such as PCR primers, for screening the quality parameters by identifying wheat storage proteins genes. Papers were also presented on the storage protein analysis in durum landraces and use of *T. dicoccoides* for improving grain quality in durum wheat.

This symposium proceedings will be very useful for the wheat workers in the national and international research institutes. In India, durum wheats are largely grown in central India, characterized by water-limited conditions associated with high temperatures. Improvement of durums for both productivity and quality is an important aim of Indian agriculture. The wealth of information on the various facets of improving durum wheat will be of immense value to the teachers, students and research scholars in the agricultural research institutions. Indian agriculture is now moving from self-sufficiency to global commercialization. While we had a production of 78 million tonnes of wheat in 1999–2000, we have hardly been able to export because of quality and phytosanitary requirements. The durum research provides us an opportunity to be in the international market provided that many scientists and laboratories could effectively participate in a common programme aiming to export durum wheat. We should have a similar intensive discussion to identify research priorities, individual scientists and groups

to achieve our objectives. I strongly recommend this book for the libraries of agricultural universities and national institutes working on improvement of wheat.

RENU KHANNA CHOPRA

Water Technology Centre,  
Indian Agricultural Research Institute,  
New Delhi 110 012, India  
e-mail: [renu\\_wtc@iari.ernet.in](mailto:renu_wtc@iari.ernet.in)

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**Probing Photosynthesis: Mechanism, Regulation and Adaptation.** M. Yunus, U. Pathre and P. Mohanty (eds). Taylor & Francis, 11 New Fetter Lane, London EC4P 4EE. 2000. 558 pp. Price: £ 85.00.

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This book has been written to commemorate the 60th birth anniversary of P. V. Sane, well known for his contributions in the area of photosynthesis. A profile of Sane has been portrayed by S. K. Sinha in the beginning of the book. One of the major contributions of Sane is building an indigenous thermoluminescence equipment with very fine resolution and using it to probe photophysical and photochemical phenomena in photosystems I and II, in collaboration with V. G. Tataka, T. S. Desai and S. S. Rane at Bhabha Atomic Research Centre. The editors have appropriately decided to honour Sane by bringing out a collection of articles highlighting techniques used to probe various aspects of photosynthesis.

Photosynthesis sits at the gateway of energy transduction process, hails solar energy and channels it to all living systems on the earth. Besides the academic interest, our attention to photosynthesis generates from its importance in crop productivity. Photosynthesis consists of a chain of processes starting from absorption of light occurring in femtosecond time scale to enzymatic reactions consuming several seconds and even minutes

and crop productivity taking a few months. All these processes are threaded together so that to understand one, the knowledge of the other is necessary. Therefore, whenever there is a discussion on photosynthesis, broadly the following topics are included:

- (1) Structure and function of the protein complexes: photosystems I and II, ATPsynthase, Rubisco (1,5-ribulose bisphosphate carboxylase-oxygenase);
- (2) Adaptation of photosynthetic process to natural changes in the climate and stress situations;
- (3) Crop productivity.

Accordingly, the editors organize the above three topics in the first three parts. The fourth part deals with the instrumentation and theories of some recent techniques used to probe photosynthesis. Govindjee, who has travelled nearly half a century with the progress in photosynthesis, discusses the 'Milestones in the photosynthesis research' in the opening chapter. The chapter not only gives a brief account of the development in research on various fields in photosynthesis, but also provides a critical evaluation on the state-of-the-art of research in the area. The article orients the mind of a reader to proceed with the elaborate discussion on different topics discussed subsequently in the book.

Part I of the book contains articles on structural and functional aspects of the light-harvesting antenna complexes, ATP-synthase, electron transport system and oxygen-evolving complex. Discussion by Itoh and Iwaki (chapter 2) on the role of novel chlorophyll-*d* (in oxygenic photosynthetic organism *Acarychloris marina*) and Zn-bacterial chlorophyll-*a* (in anoxygenic photosynthetic organism *Acidiphylum rubrum*) reminds one with a pleasant surprise that nature has a never-ending

hidden treasure of biodiversity. Our knowledge on even types of chlorophylls in nature is incomplete.

The grey areas in photosynthesis are probed by three major groups of tools, usually in combination, spectroscopy, enzyme kinetics and molecular biology. Enzyme kinetics is the ubiquitous tool in all biological studies and photosynthesis is no exception to it. Ahrling and Styring review the probing of oxygen-evolving catalytic Mn-centre, which is spectroscopically rich in information. The complexity of this tetranuclear metal centre can be appreciated by the fact that even after accumulation of data spinning out of two very powerful tools in metal ion studies – electron paramagnetic resonance (EPR) and extended X-ray absorption fine structure (EXAFS) – the organization, oxidation states and magnetic properties of the centre still await an unambiguous solution. Reviews on Rubisco, carbon assimilation, biodiversity and adaptation to stress reveal how powerful molecular biology is, as a tool to probe photosynthesis. These reviews also provide clues regarding how this tool can further be utilized to produce mutants with higher carbon-assimilating capacity, hence the crop productivity, which is the ultimate goal of research in photosynthesis.

Another powerful spectroscopic probe for the study of photosynthesis is chlorophyll. This is the important pigment in photosynthesis. Looking at the subtle changes in the fluorescence properties of the molecule yields many important inferences regarding photosynthesis. Technical progress in the instrumentation of fluorescence has sharpened the tool to cut deep into the process for a better insight into the phenomenon. The discussion on pulse amplitude modulated (PAM) fluorescence spectroscopy in part IV of the book brings home the power of

this technique in the hands of a photosynthesist. This part includes three more chapters discussing details of theory, instrumentation and methodology of other techniques, namely Fourier transform infrared (FT-IR) spectroscopy, electro spray-mass spectroscopy (ES-MS) and photoacoustics. Barber and Sharma discuss the precise determination of oxidation and phosphorylation sites in D1 protein of photosystem II complex using ES-MS. It would have been a difficult task to arrive at such inference by biochemical methods. ES-MS has been shown to be the tool of choice for structural and post-translational modification studies on membrane proteins. FT-IR difference spectra are effective in monitoring various redox-active species of photosystems I and II. Therefore, it can throw light on the mechanism of photosynthetic processes. Photosynthesis involves conversion of some part of absorbed light into heat (thermal effect), uptake of CO<sub>2</sub> and release of O<sub>2</sub> (photobaric effect) and change of volume of molecules (chroic effect). These result in small and rapid changes in the pressure of the system detected by piezoelectric transducers or microphones. Hence photosynthetic samples are ideal for photoacoustic technique. These elegant tools are recently being used to probe photosynthesis.

The book under review has the quality to be popular among the photosynthesists as a handbook of research. Graduate students will like it as an advanced textbook. Research scholars will consider it as a valuable reference book.

M. K. RAVAL

*PG Department of Chemistry,  
Rajendra College,  
Bolangir 767 002, India  
e-mail: mraval@yahoo.com*