

With Compliments

Dr Joshi

Enclosed are two copies of the galley proof of the review "RAMACHANDRAN: A biography ...". Kindly go through the proof, mark corrections and return it.

Also enclosed is a copy of the review by R. Kuppu Rao. He has corrected the proof. This is for your information. Both the reviews have been scheduled for the 10 April issue.

CURRENT SCIENCE

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Regards

M.S. Venkatesh

RAMACHANDRAN – A Biography of Gopalamudram Narayana Ramachandran, The Famous Indian Biophysicist. Raghupathy Sarma. Adenine Press, 2066 Central Avenue, Schenectady, NY 12304 USA. 1998. Price: Rs 500. 235 pp.

Science has a unique way of distinguishing between ephemeral fame and enduring reputation. Newspapers and popular science magazines glorify the sensations of the moment; textbooks and scientific dictionaries record discoveries of lasting importance. Thus, the Smiling Buddha (and what a smile that was, my countrymen!) is unlikely to be remembered even a few years from now. On the other hand, even after a century or more, practitioners of science will continue to study the Bose (Einstein) statistics, the Raman effect, the Mahalanobis distance, the Chandrasekhar radius – and the Ramachandran plot.

We have been fortunate enough to see the publication, in recent years, of very comprehensive biographies of eminent Indian scientists such as Srinivas Ramanujan, C. V. Raman and S. Chandrasekar. It is only fitting that this extremely timely and readable biography of G. N. Ramachandran (GNR) to his colleagues, students and admirers), has now been added to this list. The author, Raghupathy Sarma, has successfully portrayed the brilliant scientific career as well as the succession of triumphs and setbacks of his former teacher. The story of GNR is the story of a ceaselessly active mind that even today prefers to be engaged in intense intellectual pursuits.

In terms of lasting scientific contributions originating in post-independence India, GNR can rightly be described as the most accomplished of the Indian scientists. Most textbooks, monographs and research publications dealing with protein conformations and especially the articles reporting newly determined protein structures prominently feature the 'Ramachandran plot'. This simple, powerful and elegant visual representation not only provides (to the initiated) many insights into the secondary structures of proteins but also serves as a quality-control device for evaluating the reliability of the reported crystal structures. This, however, is but one example of the many major contributions he has made to

several areas of science, ranging over X-ray crystallography, optics, molecular biophysics, image reconstruction and mathematical logic. More importantly, almost all of this work was carried out entirely in India, and that too against great odds. An account of his struggles and victories is therefore a source of tremendous inspiration. Publication of the (eagerly awaited) biography of GNR written by Raghupathy Sarma is thus a very welcome development.

However, when I actually saw the book, my immediate reaction was a sense of acute disappointment. Instead of the famous Ramachandran map, the background of the cover page depicted a bizarre map of India showing, of all things, places like Taxila, Hastinapura, Ayodha, Kasi and Mathura! The publisher's note inside provides an even more weird explanation of the choice – which includes an atrocious analogy involving characters from Mahabharata. The pedestrian beginning of the book (how else can you describe it when the opening line is just a statement of the year of birth!), was therefore a welcome relief. The description of the social and cultural scene of the southern India of 1920s was somewhat charming though mostly dull – and seemed mildly irrelevant. However, as I reached the part of the book where GNR begins his research under the supervision of Sir C. V. Raman, the account suddenly became quite fascinating. The sheer volume and range of research projects successfully tackled by GNR, and the level and quality of scientific creativity displayed by him in the brief stint as a graduate student was phenomenal. The author has very ingeniously included the summary of GNR's MSc thesis in the book – and the reader can immediately see why the examiner described it as worthy of at least two Ph Ds.

Another highlight of the book is an enchanting description of the next two decades, spent by GNR under the enlightened and benevolent reign of Sir A. Lakshmanaswamy Mudaliar, the vice-chancellor of Madras University. Thanks to Sir Mudaliar's whole-hearted support based on mutual respect, the Department of Biophysics and Crystallography founded and developed by GNR became one of the finest centers in that subject – comparable to those in the best of Western universities. However, when

universities. However, when GNR's discoveries threatened to overshadow those of the established stalwarts in the field, things took a very different turn. What follows next is the most absorbing part of the book where the author has described the roller-coaster ride of dramatic successes and severe setbacks. The announcement of the extremely original and beautiful collagen structure was immediately followed by the infuriating gamesmanship of the competitors and their persistent attempts at denying the credit to GNR. Fortunately, the acute disappointment did not last long. The fight-back in response to the unfair criticism of his collagen model led to the development of the stereochemical criterion that provided a rational and quantitative method of judging the validity of biomolecular conformations. This approach eventually produced the celebrated Ramachandran plot. In the two major international symposia organized at Madras in the 1960s, these as well as other outstanding results (dealing with anomalous dispersion, Fourier synthesis, etc.) were highly appreciated by the international community of eminent scientists.

This golden era, unfortunately, came to a rude end once Sir A. L. Mudaliar retired. His successor, with a mindlessly petty attitude, effectively stifled almost all the ongoing research. In fact, running the department itself became an ordeal. GNR, therefore, was forced to move out of Madras. The Indian Institute of Science in Bangalore, fortunately, offered him an opportunity to start a new research programme in molecular biophysics (an old and unfashionable name for a topic that is currently being aggressively marketed as the exciting discipline of structural biology).

This transition from Madras to Bangalore began on a very promising note. However, in the long run, it did not seem to have worked out too well. The problem was never with GNR's creativity or productivity – both remained undiminished for the next several decades. Thus, in the early seventies, he pioneered the development of a highly efficient mathematical method for reconstructing the three-dimensional shape of an object from its two-dimensional projections. Unfortunately, for want of adequate support, he could not proceed with the

implementation of this idea. Other scientists outside India perfected this technique – which eventually led to the CAT scanners, and a Nobel Prize. Literature on that subject acknowledges GNR's contributions both directly and intentionally by citing his pioneering articles, as well as indirectly and unintentionally by using the notation $G_n(R)$ for the density function that describes the object. The next important project was the mathematical formulation of SYAD-NYAYA, the doctrine of the 'May Be', and related ideas that matured towards the end of 1980s. Work on RAGA, a novel method for determination of crystal structures by modifying the electron density at fixed gridpoints, had also started in the early 1980s, though the pioneering paper was published only in 1990. That none of these projects blossomed into major successes was due to the rather dismal environment. In complete contrast to Sir Mudaliar, the powers-that-be seemed to have a rather patronizing approach towards GNR and the support offered to him was grudging, indifferent and inadequate. The response of peers, colleagues and students to the intense intellectual adventures envisioned by GNR was not as enthusiastic as he had desired. Eventually, he had to continue his work almost entirely on his own. Of course, hindrances like advanced age, failing health and lack of assistance were utterly powerless to stop GNR's research. The seventy-six Mathphil reports single-handedly authored by him during this ten-year period are a glowing testimony to GNR's intellectual stamina and vitality.

This motif of triumph–disappointment–triumph seems to be a hallmark of GNR – the triumph of coming out with yet another important and original contribution; the disappointment stemming from the unwillingness or inability of peers to grasp and recognize its significance. In an astonishing and welcome contrast to this overpowering gloom comes one of the most attractive parts of the book – a collection of no less than twenty-five poems written by GNR. All of them reflect an optimistic, cheerful and occasionally even a playful mind – here celebrating logic, reason and know-

re celebrating logic, reason and knowledge, there gently making fun of experts, and mostly expressing the deep and mysterious ideas of the philosophy of Vedanta with refreshing clarity. The same clarity of thought and expression is seen in the masterly article "Biomolecular Conformation: Retrospect and Prospects" (A Philosophical Review) – written by GNR in 1981 and reproduced in the book.

In fact, the most readable portions of the book are not at all the ones that are written by the author. The direct quotations from GNR, his article, the summary of his M Sc thesis, his list of publications, and, above all, the poems stand out from the rest of the text, which is rather banal in most places. The only exception is provided by the technical descriptions of crystallographic matters. The author is a practicing protein crystallographer with more than three decades of experience. His account of the intricate details of structure of collagen and of the subtle features of the X-ray diffraction pattern was a pleasure to read.

A critical book review can sometimes become quite unfair to the author, especially if the reviewer is unaware of the motivation and tribulations of the author. Luckily, I did get an opportunity to listen to the very appealing and moving speech by the author, about why and how this book came to be written. Among many other things, the author pointed out that in his opinion, there are quite a few people who would have produced a much better book – but they did not seem to be willing to undertake this extremely important task. Having read the book several times, I am happy and grateful that the author intelligently rushed in where others feared to tread.

To say that this must have been an extremely difficult book to write is an understatement. Many of the turbulent events were so multifaceted that they defy any comprehensive description. Moreover, many of the participants of these episodes are also colleagues, friends, potential readers and well-wishers of the biography project – and this book is far too limited in scope to

cover their diverse viewpoints and versions.

The strength and weakness of the book under review is that it is written not by a professional writer, but by a scientist. It can be far more easily read and appreciated by crystallographers and structural biologists. This is true especially of the earlier chapters, where technical terms like reciprocal lattice, meridional reflection, etc. are used extensively and without adequate explanations. The sequence of some of the major chapters is based on themes, and not on strict chronology; this is a little jarring at times. Some of the non-technical part, especially that dealing with health aspects seems to have been retained merely for completeness, and could easily have been omitted. On the other hand (and this is one of my major complaints), the author has been completely (and inexplicably) silent on his scientific interactions with GNR. The book would certainly have been richer had the author shared with the readers how it was to work with his research supervisor. Another negative point is the surprisingly large number of minor errors in the book, e.g. names spelt wrongly, an incomplete list of students, omission of the brief post-UK stint in Bangalore from the list in the appendix, the not-so-accurate description of the RAGA method, etc. Lack of adequate time and the author's dependence on numerous other sources were probably responsible for these avoidable lapses. This sloppiness is rather unbecoming for a book on GNR, whose insistence on meticulousness is remembered with awe by all his associates. One hopes that the second edition of the book will take care of these aspects.

In summary, a most inspiring and interesting book, a welcome addition to the collection of scientific biographies, and a must-read for all practicing and aspiring scientists.

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Eco-restructuring: Implications for Sustainable Development. Robert U. Ayres (ed.). United Nations University Press, The UN University. 1998.

'Sustainable development' is amenable to many interpretations and there is still no acceptable definition of what sustainable development is and is not. Viewed against this backdrop, this book, under review, reflects a 'growing concern for environmental degradation associated with industrial development, economic growth and energy use ranging from local air and water pollution, soil contamination, and reduced bio-diversity to stratospheric ozone depletion and the damage potentially caused by global climate change' (p. 149) without prejudice to two fundamental premises, viz. (i) that economic growth must continue at least for the foreseeable future, and (ii) the nature of that growth must change radically in order to satisfy the basic requirement of long-term eco-sustainability. It is equally true that lack of economic growth and development translate into increased poverty and population growth which, in turn, lead to accelerated environmental deterioration (p. 173). In order to arrest this trend and save the mankind from possible total extinction, the contributors stress on the imperative need for global eco-restructuring which alone can act as an effective deterrent to the emerging ecological imbalance; but whether it would be compatible with eco-sustainability and how far it is attainable on a global scale, has not been addressed adequately. These two approaches are mutually contradictory and resembles a two-in-one transistor which would be discernible in review. Controversial issues have been avoided without realizing that it will boomerang on the essential objective of eco-sustainability. The threat of environmental degradation is no longer controversial; but the magnitude of threat perception varies enormously. This threat perception variance is one of the many critical issues that needs to be tackled from a socio-political angle, on priority, and in right earnest to lend credence to the attainable prospect of 'Our Common Future' envisioned in the Brundtland Report (1987). The contributors are silent on this. The prospect seems quite unlikely because the cost of protecting the environment should not

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exceed the benefits—a product of irrepressible economic logic.

The contributors cover a wide gamut on a key range of critical issues on eco-restructuring and its implications for sustainable development; while doing so, they scan the technical contours from a perspective which can neither be called 'global' nor 'regional/national'; with an inappropriate mix of these two ingredients, the contributors keep vacillating between these two extremes and in the process, the impression that is sought to be given is that it breaks new ground in raising and resolving the contentious issues. The answer to this is a qualified yes. Whether the prospect of better 'planetary governance' is attainable, however intractable and elusive, is very much suspect. (p. 403). With a complex subject such as eco-restructuring, it is unfortunate that not a single contributor is drawn from the group of Asia and Latin America which between them account for a populace of nearly three billion to express its viewpoint vis-à-vis its varied technical knowledge, experience and expertise which would have greatly enriched the utility of the book. The two Indian contributors along with the editor are based in the USA and cannot be said to represent the third world.

Faye Duchin (p. 265) has classified the world community under four groups – (1) the rich industrialised countries; (2) the economies of eastern Europe and the former Soviet Union; (3) the newly industrializing countries, and (4) the rest of the developing countries. The grouping is fairly in order notwithstanding the fact that each group differs in terms of its natural endowment of soil, water, primary materials, its infrastructure, pool of skilled manpower and the characteristic ways in which these factors of production are used. As a corollary, the type of technology deployed by each of these groups also tends to vary. What has been lost sight of is that, there is, presently, no common denominator on issues concerning the global eco-restructuring not only between those four groups but also within each of them. This aspect has not been adequately addressed as the efficacy of eco-restructuring compatible with eco-sustainability hinges on the emergence of a common denominator.

The world population has doubled in a single generation and continues to grow at an alarming rate; if this is not con-

tained drastically, either voluntarily or by any other acceptable means it will culminate in social, political and maybe, even rise to insurgency forces from within the society triggering a military conflict. A catastrophe of this kind would be most undesirable negating all the social and economic achievements that the last two groups value so highly and assume to be guaranteed (p. 288). This warrants the challenging of conventional models of development and the policy frame which continues to rule the roost; ironically, the institutional framework of the society as it is structured today is not likely to allow any solutions to emerge spontaneously (p. 47). The soft option resorted to is to confine the eco-restructuring issues within the domain of technology free from any bumpy ride. In the process, social and cultural issues have been pushed into the backyard (as the editor himself admits with resignation on p. 2). Even though economics has taken a back seat there is no need to despair, for, it has played its role for too long as a contributory factor to the present environmental malaise. The other social scientists (from Sociology, Anthropology and Philosophy for example) have not played a useful role towards the objective of eco-sustainability. The key to the attainable goal of eco-sustainability lies in resolving the sensitive demographic issue; if it succeeds, 'half the battle' will have been won and the other half would have to be concentrated on bringing about the necessary changes impeding the developmental process with a multi-pronged attack—in particular—on poverty. This demographic issue does figure in the eco-restructuring process but most nonchalantly, for, to side-track this human factor would have meant a travesty of what the contributors are aiming for. The bulk of discussion is concentrated on technological issues, knowing full well that these cannot be evaluated in isolation (p. 79).

Presently, there is a dichotomy in the solutions offered by technologists and economists. The latter take the stance that given the right incentives—prices—and enough time (time frame is ambiguous) technology is capable of finding a way to avoid essentially any physical resource bottleneck, as long as the product or service in question is produced and exchanged within the competitive market system (p. 33). Whether the 'incentives'

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provided by the nation-states are equitable and in order has not been answered.

The underlying problem is that many current demographic, economic and industrial trends currently seem to point 'unmistakably' in the wrong direction, i.e. 'away from sustainability', The emphasis on the adverb 'unmistakably' is not supported by evidence or facts. As a matter of fact, as the title of the book itself indicates, whether eco-restructuring and its implications can be compatible with eco-sustainability implies a moratorium on economic growth. There is already a genuine concern about a potential conflict between economic advance in the countries of groups (3) and (4) and the protection of the environment vis-à-vis what the environment impact would be if economic growth is halted or slowed down (p. 172). To say that these countries are insensitive to environmental degradation is a figment of imagination. In saying so, there is a need to distinguish between environmental deterioration and environmental degradation. The former can be mitigated by appropriate international and national policy instruments. The latter is irretrievable. These two are not synonymous but there is a certain confusion about this on the part of the contributors. The affluent societies of the West are also confronted with this dilemma. (p. 172).

While focusing on eco-restructuring of agriculture, the fundamental problem of food as a basic right has not been given any importance. If this right is conceded by the United Nations unanimously and ratified by all nations and the UN General Assembly to be implemented both in letter and spirit, agricultural surpluses and shortages will loom large as socio-political issues; neither the FAO nor the WTO has shown any concern on these issues. The characteristic signs of agricultural unsustainability include soil erosion, deterioration of soil structure, exhaustion of soil nutrients, salinization of irrigated areas, over-use of water resources, desertification, deforestation (now contributing 14% to global climate warming potential), reduction of biodiversity, pest and disease build-up and pollution from agricultural chemicals in ground water and finally toxic chemicals intruding into our food supply (p. 284). These apply in varying degrees in all the under-developed regions of the world. The industrialized West is no exception.

This enumeration of critical inadequacies and limitations, the third world is already aware of and what it calls for is that different local conditions need prescription as is applicable to the area under consideration. There is no global solution to a local problem.

Mechanization and large-scale agriculture dominates the international scene. Within two generations, this has turned out to be unsustainable and calls for corrective action if civilized mankind is to survive. Evaluation of agricultural strategy, however, on a short-term basis in raising inappropriate expectations by driving the third world towards the industrial model has not undergone any material change. This 'systems coercion' has adversely affected (p. 285) ecosystemic requirements which need biodiversity, site orientation and a massive reduction of material flows. Western-style agro-business has only led to the massive problem of soil erosion and three quarters of this destruction is now taking place in the third world. As a corollary, productive agricultural area has declined by a staggering 16 million ha per year which is incommensurate with an ever-increasing population. Another most important limiting input is water.

Much of the future energy demand growth stems from the relative price-insensitive transportation and heavy industrial sectors and once capital is invested, it is locked-in for many decades thereafter. While projecting the future scenario of global energy in this context—a most important component of eco-restructuring process—and the impending crisis of potential change caused by indiscriminate fossil-fuel use, Rogner (p. 159) seems worried about what he calls a zero-order understanding of the structure of a fully sustainable energy system. The model which he himself builds up is hypothetical and not factual; apparently, it fails to concentrate on the essentials of a global perspective. This is reinforced by the fact that the analysis is confined to the industrialized countries only and the third world has been left out from the discussion. At the same time, there is a philosophical flirtation that we must mimic nature's path, for, it is here that we come across symbiotic relationship between solar energy, hydrogen, oxygen and carbon. His study of a sustainable energy system also does not take into account the sector balance of the

economy; one of them is Weaver's study of the transport sector *equally exclusively* based on the industrialized West, which currently, poses the greatest environmental burden and badly needs restructuring (p. 339); all that the third world should do is to draw inferences and make appropriate changes in its transport infrastructure (p. 343) which is very much supply-based incommensurate with its existing scarce technological and financial resources while the need of the hour is proper balancing of demand and supply. We all know that West is characteristically autocentric and the third world influenced as they are by the World Bank, IMF and other funding agencies, have moved towards the same mobility patterns as in the West aggravating cumulatively the environmental deterioration by way of air pollution, fumes, smoke, noise pollution, time cost of chaotic traffic congestion, infrastructure not based on demand, etc. and what is more, is consuming a little over one-fourth of the world oil consumption for commercial use. Paradoxically, there is no discernible change in fuel economy. Although it is the automobile that is overwhelmingly responsible for the present carbon emissions and the build up of atmospheric concentrations of GHG as compared with freight transport, these two have to be considered together in considering the overall impact on environment. A shift in emphasis towards a combination of public transport and lowered mobility in rich as well as developing countries will ease pressure on the energy sectors and correspondingly, on the eco-restructuring of the deep energy system. Rogner himself recognized that settlement patterns, infrastructures and workplace arrangements that encompass telecommuting, dematerialization and decarbonization of the production process and recycling vis-à-vis environmentally reliable service technologies are all intimately tied up to be viewed as an integral part of the sustainable energy system. All these have been ignored for discussion. The energy system does not operate in a vacuum. If evolution has come about by a sequence of replacements, as Montroll puts it, the expectation of Rogner's anti-thesis moving towards a carbon-free currency (towards a hydrogen age) is equally preposterous and unrealistic.

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To sum up, Usui realizes the need for a supra-national authority based on the image of a 'third-generation world organization' or a UN renaissance (p. 366). Whether he is contemplating two organizations—one to deal with the maintenance of international security and peace-keeping operations a task now assigned to the UN Security Council and the other, because of declining importance in social-economic issues of the third world, this task is to be assigned to the new third-generation world organization, is unclear. What Usui fails to understand is that the UN as it is presently constituted with its veto power, renaissance is ruled out. He needs to be reminded that if any drastic amendment to the UN Charter is attempted and assuming that it would succeed, USA would cease to be a Member of the reformed UN. Efforts to subject the World Bank and IMF to some measure of accountability to the UN have not succeeded. The 1992 UN Conference on Environment and Development (UNCED) has brought about an environmental awareness which is manifested by the establishment of an Environment and Development (UNCED) has brought

~~about an environmental awareness which is manifested by the establishment of an Environment Department and there is hardly any nation today that has not taken some step or the other mandatorily to improve its environment. There is a bewildering maze of environmental laws which need to be monitored and reviewed from time to time at the national, regional and international levels. Currently, the greatest damage to the environment has been done by the industrialized West and their growing anguish is enhanced by the fact the third world should not make the same mistake by contributing its quota. The growing conflict is how to reconcile between the fast depleting finite fossil resources and the renewable resources which are emerging slowly. Exploitation of resources can only be carried to a logical limit beyond which even human ingenuity cannot provide the answer. Presently, all the international organizations are engaged in the task of environmental protection but confined to merely collecting, collating, analysing and exchanging information without disclosing the status of the environment. Since nation-states are governed by its perma-~~

nent interests, its erosion in the eye of international law is, by and large, a fiction notwithstanding the fact that the 'globalization of the world's societies has become a physical reality through modern telecommunications and modern transportation—the former has exposed the people in all but the remote locations instantaneously to the world's crisis situations and the ground realities in far away places and the latter has made it possible to travel and to trade and shift investments amongst distant locations quickly and extensively than ever before' (p. 259). This is the human tragedy that has to be faced squarely, in other words, the eco-restructuring process will remain totally impractical. This will remain like the Plato's ideal—the fundamental dilemma between what is and what ought to be—will always continue to plague mankind.

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