Singh's book provides a timely opportunity for introspection as to how it all began, how far we have travelled and what needs to be done to chart the future course. It is hoped that this voice of experience will be paid heed to!

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The Refrigerator and the Universe: Understanding the Laws of Energy. Martin Goldstein and Inge F. Goldstein. Universities Press (India) Ltd. 1997. Reprinted by arrangement with Harvard University Press. 1993. 433 pp. Rs 225.

Two kinds of people reach for a book with this kind of title: the curious youngsters who are on the lookout for reading what is 'in' and the aged who need to find ways and means to enhance communication while teaching. It was written by those who had a need to teach. It caters much less to those with a need to practise, i.e., practise the application of thermodynamics to areas like biology wherein disappointment exceeds promises.

On the positive side, the book is written by those who perceived the need for learning thermodynamics for didactic reasons. The book attempts to convey a strong sense of history. Is the Napoleonic injunction (those who do not know history are condemned to repeat it!) relevant? The book deals with the laws of thermodynamics taking the historically relevant examples. Throughout the text, there has been a pointed effort to be simple, clear and helpful. Whether this helpful attitude is a result of having to teach or learn from courses in thermodynamics (which the authors apparently took) *while being in the army* is not clear. The worth of the book is primarily in three areas: its simple exposition of basic textbook stuff, its capacity to give a historical account, including bibliography, of a similar kind and thirdly its user-friendliness. It is basically an undergraduate book in its content. It indicates that the authors are not particularly aware of or deliberately ignored (unlikely from the references they have otherwise given) the shortcomings of thermodynamics as seen in the recent decades. Perhaps, the glorious debacles on the application of thermodynamics, the unwritten text in this book, would have made better reading. On the other hand, if you want to know who was Carnot (we learn that he was named after a Persian poet who was popular in France at that time) or Mayer's heartburn over Joule, there are interesting things here. If you want to know the basic descriptions of the laws, information, entropy, etc., they are all there. The book is a compendium of standard reading material and touches thermodynamics in relation to chemistry, geology, cosmology among other things. If we are to go by what has been done in physics and biology, the description is general and to that extent superficial. I believe I have stated enough regarding the limitations of the book. The book is moderately priced and is worth acquiring as an excellent addition to undergraduate reading in physical sciences and even postgraduate students in other areas including biology.

However, I suggest some serious caution to the readers: while the ideas may be alright, it is worth double-checking the sources of the statements made in a book such as this since it attempts to paint a broad canvas. I was taken aback by the statement that myoglobin is the oxygen-binding protein from the blood (*sic*) of whales while haemoglobin is that from humans!!! This is when the clock strikes thirteen making us wonder about all that has transpired.

If I am to follow the editor's views on reviewing a book for *Current Science*, I must summarize, however briefly, what I would have liked to see here and why this approach turns me off, without in any way decrying the didactic value of the book. The major thing about thermodynamics (equilibrium thermodynamics is the major concern here barring a small reference to nonlinear dynamic systems and chaos) is that it is opaque to mechanism. This equilibrium thermodynamics has no variables with the dimension of time in it. It has a metatheoretic ambience in that it makes rules for others to follow. In itself, it offers consistency rather than proof. Obviously, since physics arrogates itself to be theory knowledge (Feyeraband once mentioned to me that the reason is that the physical laws came from the brow of Zeus), thermodynamics has attempted, once upon a time (e.g. Lord Kelvin), to arrogate itself to a central position in physics. Those who fell for its charisma mistook the grammarian for the poet. That is about the only reason we can account for the preoccupation with the General Systems Theory of Van Bertallanffy followed by Laszlo and many others (Arthur Koestler at a more popular level). Open systems *per se* did not lead us far. This indeed was followed by Brussels school of dissipative structures. Predictivity remained elusive. Much reading has become indeed a weariness to flesh. Open systems in biology were attempted to be explained and even solved by formulations on irreversible thermodynamics, starting with Katchalsky followed by Kedem, Kaplan and others. Curiously the initial formulations themselves were wrong, leading to absurdities like vectorial cross-coefficients, which was pointed out by us in a paper in *Current Science* (Vaidhyanathan, V. S. and Sitaramam, V., *Curr. Sci.*, 1991, **62**, 604–608). Response of the practitioners (of some 2–3 decades standing) in the West was interesting. A primary journal in which much of the initial work on irreversible thermodynamics was published did not wish to publish this fundamental error on the grounds that 'while the arguments (ours) are right, there is no *urgency* to publish this clarification'!

Logical positivism notwithstanding, much of the Western science is dominated by 'the King is dead, long live the king' syndrome . . . except that they themselves would prefer to remain the king-makers. The lesser mortals may not commit the effront of pointing out the errors. Much of the progress is also illusory based on over-elaborate 'straw man' hypotheses. Take the case of the so-called metabolic control theory. The situation is reminiscent of Catastrophe theory in the seventies which was applied to everything from reflections in a swimming pool to Vietnam wars and biology. It took Gina Bari Kolata to declare in *Science* in 1970s that it is much akin to Emperor's new clothes. Smell also did that among the more professional mathematicians. Why does this happen? Obviously it stems from academic greed. A grammarian may not usurp the position of the more utili-

tarian researcher who has an application. Such theories provide a framework which only throws up possibilities for those who come with real situations. The latter still have the primacy of contribution to the real world of empirical science. However the temptation to being a know-all is probably hard to resist. 'Substantive' results are unfortunately in the province of the empiricists. Physicists have made their peace with this dichotomy. Biologists and physical biochemists have not.

Thermodynamics has this tantalizing story to tell, probably with much detail and discussion. Much of this is still happening. No one has yet taken the trouble to tell. And yet there is a soft undercurrent of independent thinkers who apply physical reasoning to biology in the best tradition of physics, which the practitioners of thermodynamics have often forgotten. It is the creed of the physicist using the formal ideal world to simplify the observational space to an ever-decreasing minimum of postulates to achieve a tangible description of the real world. There is this stoicism, governed solely by parsimony and aided equally exclusively by insights, that underlies an increasing number of publications. This *bare-bone* approach reduces a lot of patterns, structural and behavioural, to a minimum set of rules and processes to explain varied patterns, sand piles, coffee stains and assorted things. There are those who wish to achieve mechanism by using nonlinear dynamics, though the approximations so made barely model the outline of the complex real/biological world. This reasoning, however, will gain ground in biology too. Classical thermodynamics, however inadequate now, also started, as all physics, to understand reality in a real, empirical way. Or else, why should we continue to be preoccupied with random movement of suspended pollen grains or in the attempt to conquer the beauty of form?

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Ancient Yoga and Modern Science. T. R. Anantharaman. Munshiram Manoharlal Publishers Pvt Ltd, 54 Rani Jhansi Road, New Delhi 110 055, 1996. Rs 170. 103 pp.

Ancient Yoga and Modern Science is a nice slim volume on yoga philosophy and its relevance to modern living and science. In a short span of 100 pages, this volume covers good ground on various yogas and their multiple aspects. It clearly carries the imprint of the erudite personality of its author, T. R. Anantharaman, one of the best known metallurgists of India and a life-long practitioner of yoga.

The author clearly sets out the practical and spiritual goals of yoga: 'In Yoga we are concerned with those aspects of *Paravidya*' (spirituality) and *Aparavidya* (science) which have a direct bearing on human growth and evolution at different levels; the physical, emotional, intellectual and spiritual. Thus, in some way, particularly from the practical view point, yoga is even more important for our students than science and spirituality as such, because of its direct involvement in the integrated growth, total health and ultimate fulfilment of human being'. In support he quotes the *Bhagvad Gita*: '*Adhyatma-vidya vidyanam* (*aham*)'.

Indeed, one of the distinctive features of this volume is the chapter 'On Yoga of *Bhagvad Gita*'. Although the Upanishads and Patanjalis' yoga sutras are authoritative accounts of yoga, they are not as accessible to common man as the *Bhagvad Gita*. It is rarely emphasized in books on Yoga philosophy that even though the *Gita* (as the Song of God is briefly, affectionately and more commonly referred to) is a major work on Karma Yoga, it has given enough attention to other Yogas. Indeed, it gives all essentials of Dhyana Yoga in fair detail: who is fit to follow it, how to sit, breathe, concentrate one's vision between the eyes, make the mind one pointed and practise meditation on the self to purify mind–intellect complex. And, of course, what distinguishes a self-realized yogi and sthita-prajna.

Chapter 6 gives ancient yoga in modern idiom. Referring to *Yoga Sutras*, *Upanishads* and the *Gita*, the author brings out aspects of Bahiranga Yoga and Antanranga Yoga – the outer-physical and mental – and spiritual limbs of yoga practices and their effects. The early signs of the evolution of a yoga practitioner and more basic changes in later stages are clearly brought out. For example, the first signs of advancement in yoga are lightness of body, good physical and mental health, non-covetousness, clearness of complexion, pleasing voice, agreeable body odour and scantiness of excretions. The more advanced yogi becomes a sthita prajna (as defined in *Gita*) with definite attributes – beyond passion, fear and anger.

To describe the supramental state that a yogi attains to, the author extensively quotes Aurobindo, one of the most cerebral mystics of modern times: normal mental nature and thought are based on a consciousness of the finite, but supramental nature is in its very grain a consciousness and power of the infinite; hence arises our difficulty in understanding and describing supramental nature. He then quotes extensively from the *Life Divine* by Aurobindo to explicate the nature and levels of consciousness as experienced by Aurobindo himself. The phenomenon of shedding of veils – the so-called sheaths – to get a tangible view of the Ananda state is clearly delineated. The author refers to the experiences of the French mystic Teilhard de Chardin and compares them with those of Aurobindo and ones described in the Upanishads.

The scientific explanation and connection with yoga brought out in the book (to my understanding) are rather tenuous. There are some excellent analogies in the book such as from the field of metallurgy, the area of scientific specialization of the author, and nuclear science to describe evolution of consciousness. But these are analogies nevertheless, in the same spirit as given earlier by the sages; the latter referred to real life observations. The sterling progress that is now being made in this respect is by psychologists and physicists in the emerging area of consciousness to which the author refers rather briefly.

I have a couple of points of disagreement with the author. Jawahar Lal Nehru was a great humanist and a poet (remember his tryst with destiny) and, of course, a politician, but he can hardly be placed in the company of Vinoba Bhave or Gandhi. I do not find much discussion of Gandhi's experiments with some