that the following areas need revolutionary progress, if globalization of trade is to confer substantial economic and human benefits.

- Productivity per units of land, water and time;
- Quality in terms of nutritive, culinary, organoleptic, processing, storage and transportation;
- Net income and *new* on-farm and non-farm employment;
- Innovations in management and institutional structures, which can confer on small producers the advantages of scale, both in the production and post-harvest phases of agriculture.

Our achieving the first position in the world in milk production is clear evidence of the power of scale which cooperatives and other institutional structures have given to the over 50 million women and men who produce over 80 million tonnes of milk. Without a small producer management revolution, it will be difficult to keep our agriculture economically and socially alive.

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Essentials of Biophysics. P. Narayanan. New Age International (P) Limited, 4835/24, Ansari Road, Daryaganj, New Delhi 110 002. 2000. 510 pp. Price: Rs 250.

'We have boiled everything down to signs,
And Reasoning's done on strict mathematical lines.
If God's a point, as cylinder he just won't pass,
You can't stand on your head while sitting on your...'

Karl Marx in his poem *Mathematical Wisdom* (*Collected Works*, Progress Publishers, 1975, vol. 1).

The book under review has four sections: Biomolecular structures, Physical techniques in structure determination, Bioenergetics, and Biological systems along with four appendices and a glossary. The section on biomolecular structures has five chapters dealing with small molecules and macromolecules. The physical techniques section goes chapter-wise through spectroscopies, NMR, microscopies (sic), X-ray diffraction, lasers and holography. The bioenergetics part is made of two chapters on thermodynamics, photo and chemobioenergetics. Biological systems cover neurobiophysics, biomechanics and radiation biophysics. Each chapter has a synopsis. Acknowledgements are given for figures. Suggestions for further reading and references are given at the end of each chapter. The organization is exhaustive and the book, at a first glance, seems to be good.

In the author's words, 'For the understanding and progress of any subject, especially for students and researchers in that field, good books dealing with most of the aspects of the subject (preferably in one volume) are essential. The need is more acute for a multidisciplinary subject like biophysics. Where as (sic) a large number of standard and good books are available in biochemistry, microbiology, genetics and molecular biology, there is a dearth in the case of biophysics. The lacuna is acutely felt by all the students, researchers and others who deal in this subject. The present book is an attempt to fill this lacuna... . This book is intended for all students and researchers with Physics, Chemistry, Biology and Medicine background. It is to serve people with biological and medical background, to make them knowledgeable about physical principles and techniques which have become integral part of biological and medical sciences. It is also intended to serve as an introductory source to make the physicists and chemists and other physical scientists aware of the essential aspects of biological sciences and the trends and progresses in the *natural sciences*'. The aim and intentions are laudable, and definitely a book that fulfils it will be required and useful.

I tried using this book for teaching my course. Students and teacher alike did not find the book comparable to other standard books like the ones by Cantor and Schimmel or Hoppe or Campbell and Dwek. Like a parcel that is covered with whatever is available, the book covers too much and reveals little. The details are uneven and many numbers and figures are given that help to hide understanding. There are errors (serious and trivial) evenly distributed all over the book, a listing of which would take up the whole review.

Unfortunately, the focus of the book is on introducing terms and names (names of persons are given in bold to make them stand out, and in some cases even the designation like professor being given in bold). Concepts and understanding are the sufferers. The linkage of chapters and ideas are absent. Each chapter is almost compartmentalized and separate. The nomenclature for equivalent entities is not maintained through the book. Equations and terms are introduced in many places without explanation and in a cryptic fashion. The book is packed with details, much of which is not required. The small print size allows all this to be packed in one volume of 500-odd pages. The author has put in a lot of effort, much of which gets wasted because of lack of care in presentation.

A book that definitely does not do justice to biophysical wisdom, but must be bought and checked as a typical example of what a good book in biophysics should not be. The lacuna remains.

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Nitric Oxide and Inflammation. D. Salvemini, T. R. Billiar and Y. Vodovotz (eds). Birkhauser Verlag AG, P.O. Box 133, CH-4010 Basel, Switzerland. 2001. 304 pp. (hard bound).

The ubiquitous role that the simple gas nitric oxide (NO) plays in the body, from maintaining vascular homeostasis and fighting infections to acting as a neurotransmitter and its role in cancer, has spurred a lot of interest among researchers all over the world. One prominent researcher, Jonathan Stamler of Duke University and the Howard Hughes Medical Institute, has received

10 patents for his work on NO and has applied for more than 50 patents in all (*Scientific American*, November 2001). The naming of NO by *Science* in 1992 as the 'molecule of the year' and the 'Nobel Prize in Physiology and Medicine' in 1998 given to three US researchers for the same, reflects the importance of this molecule. Recent studies by a number of laboratories have implicated NO as an important modulator of a variety of acute and chronic inflammatory disorders. NO has been 'reinvented' as a suppressor of inflammation. Therefore, this text edited by Salvemini, Billiar and Vodovotz is a timely one which gives an overview of the role of NO in inflammation.

The book runs into fifteen chapters and covers a broad range of topics in inflammation. The foundation of the book is laid on inducible nitric oxide synthase (iNOS), the principal enzyme involved in inflammation. The chapter by Bradley Taylor and David Geller describes in length about the molecular regulation of murine and human *iNOS* gene. There are also very fine experiments to distinguish the transcriptional control mechanisms from the post-transcriptional and translational regulation of NO expression in both mouse and human.

In biological systems, NO is derived from L-arginine and oxygen in a reaction catalysed by a family of NO synthases. NO generated by eNOS and nNOS serves as a signalling molecule participating in various physiological forms, ranging from regulation of vascular tone to development of learning and memory. The iNOS expression is often induced by inflammatory substances like cytokines and microbial endotoxin, which produces high level of sustained NO. In addition to NO, NOS also produces superoxide anion ($^{\bullet}O_2^-$). Until very recently, not many studies were done to understand the regulation of $^{\bullet}O_2^-$ synthesis and the role in physiological and pathological processes. With the availability of recombinant NOS, the biological significance of $^{\bullet}O_2^-$ has been unveiled. In L-arginine-depleted macrophages, iNOS derived $^{\bullet}O_2^-$ and NO form potent peroxynitrite ($ONOO^-$), which contributes to the cytotoxic actions of macrophages in inflammation and immune defence. The second chapter by Yong Xia and Jay Zweier furnishes evidence for the role of iNOS in $^{\bullet}O_2^-$ production by electron paramagnetic resonance spin trapping experiments on macrophage cell lines using various NOS inhibitors.

Inducible NOS is regulated by cytokines, both positively and negatively. At the same time, elevated levels of NO have a negative feedback on iNOS. The review by Yoram Vodovotz and Mary Barcellos-Hoff, talks about the direct effects on transcription of iNOS mRNA, translational and post-translational effects on iNOS protein, and indirect effects on cytokines that induce the expression of iNOS.

An important link between NO and cyclooxygenase (COX) pathways was established by Salvemini and coworkers in 1993. In the fourth chapter, the editor has unfolded the complexities of NO regulation of eicosanoid production. NO activates COX-1 and COX-2 enzymes. In inflammatory conditions where both iNOS and COX-2 systems are induced, there is an NO-mediated induction of COX-2, leading to increased formation of pro-inflammatory prostaglandins (PG) resulting in exacerbated inflammatory conditions. COX-2 activation by NO contributes to ischemic brain injury, cerebral ischemia and renal volume depletion. Therefore, the dual inhibition of NO and PG by iNOS inhibitors may prove useful in such disease conditions.

One of the early events in vascular inflammation is endothelial activation. Upon activation, the endothelial cells express surface adhesion molecules such as intercellular adhesion molecule-1 (ICAM-1), E-selectin and vascular cell adhesion molecule-1 (VCAM-1). NO is known to be a major factor that modulates endothelial cell adhesion molecule expression. NO has numerous effects on the vessel wall, including vasodilation, inhibition of platelet aggregation, inhibition of smooth muscle cell proliferation and inhibition of leukocyte endothelium interaction. Therefore, intracellular NO levels can lead to several endothelial dysfunctions. Further exploration of the effects of NO will provide new insights into its role in vascular biology.

The hallmark of inflammation is the adhesion of leukocytes to post-capillary venular endothelium and the infiltration of leukocytes into the tissue interstitium. The seventh chapter highlights some of the evidences to demonstrate that NO produced by the lining of blood vessels acts as an endogenous inhibitor of neutrophil adhesion to the vascular endothelium. It is established that inhibition of NOS in the microvasculature could lead to the increase in leukocyte recruitment. However, non-specific inhibition of NO or inhibition of NOS may not be sufficient to obtain satisfactory anti-inflammatory results. Therefore, the effective way of therapeutically targeting NO may be via inhibition of NO or delivery of NO to a specific cell at a specific time, a proposition that is presently daunting.

There are conflicting results indicating the role of NO as a facilitator versus inhibitor of immune response. *In vivo* experiments demonstrate that NO participates in the destruction of islets in the progression of diabetes by several mechanisms. It is clear from studies on the effect of NO on lymphocyte function that this molecule is an important modulator of the immune response. In some lymphoid populations, exposure of NO seems to increase the intensity of the immune response due to inhibition of proliferation and/or induction of apoptosis. However, more *in vivo* experiments are required to demonstrate the effects of NO on the immune response and its role in various disease states.

Salvatore Cuzzocrea has explained the role of NO and reactive oxygen species in arthritis in the ninth chapter. Oxygen radicals are produced in abundance during the inflammatory process. At low cellular arginine levels, there is simultaneous production of NO and superoxide, leading to the generation of cytotoxic peroxynitrite ($ONOO^-$). Multiple lines of evidence strongly suggest that $ONOO^-$ is produced in arthritis. $ONOO^-$ interacts with proteins and nucleic acids causing DNA base modification and DNA single-strand breakage. Because NO is known to modulate inflammation, there is also an increased interest in its role in the pathophysiology of intestinal bowel disorder. The next chapter discusses the basic concepts of chronic gut inflammation and the role that NO might play in the disease process. The mechanism by which the sustained overproduction of iNOS-derived NO promotes chronic gut inflammation is not clearly delineated. The probable mechanisms include: (i) increase in vascular permeability of NO

accounting for the edema and tissue dysfunction during acute flares of inflammatory bowel disease; (ii) its ability to modulate COX-2-dependent production of prostaglandins; (iii) the production of O_2^- and $ONOO^-$. However, the role of iNOS-derived NO in the pathophysiology of IBD remains to be elucidated.

Is NO a friend or a foe? Controversy exists on the protective or detrimental role of NO in myocardial ischemic-reperfusion. NO plays protective roles in the heart by: (i) stimulating soluble guanylate cyclase and thus reducing $[Ca_2^+]i$ through cGMP-dependent protein kinase; (ii) terminating chain-propagating lipid radical reactions caused by oxidative stress; (iii) inhibiting the activation of platelets and neutrophils and their adhesion to the endothelial surface. *Ex vivo* experiments show inhibition of NOS is cardioprotective; however, no study assesses the actions of NOS inhibitors in myocardial ischemic-reperfusion injury *in vivo*. Further study of the role of $ONOO^-$ in the heart is required to understand cardiac ischemia and reperfusion injury better, which will give new insights into novel therapeutic targets for treatment.

The review on 'NO and myocarditis' by Lowenstein and Ohnishi, examines the role of NO in viral myocarditis. The survival of patients with mild forms of myocarditis is worse than those with severe fulminant myocarditis. This paradox is attributed to NO. Infections induce iNOS expression in cardiac myocytes. NO then inhibits the replication of pathogens. In addition to inhibiting pathogens, NO at low levels may protect the heart. Though the precise mechanism by which NO inhibits viral replication is unclear, it is understood that NO at higher concentrations inhibits viral replication. Patients with acute myocarditis may produce less NO, thus not completely clearing the viral burden. In the subsequent chapter, the role of NO in shock, sepsis and haemorrhage is described. The last chapter of the book discusses, NO-mediated IL-2 cardiovascular toxicity and antitumour activity. The authors focus on the development and testing of novel agents to dissociate IL-2-induced cardiovascular toxicity from the potential anticancer mechanism mediated by NO.

Overall, the book highlights a seemingly paradoxical effect of the short half-life radical NO in all facets of inflammation. The book is a good reading for scientists actively pursuing research in the area of inflammation.

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