the gold alloy made from four gold pieces by refinement when $v_i = 9, 7, 10, 8$ *vanni*s, $w_i = 6, 5, 8, 7$ *tola*s respectively, and $W = 20$ *tolas*.' The answer given is $V = 9$ *vanni*s. It should have been 11¼ *vanni*s, obtained from a straightforward application of the formula $V = (\Sigma v_i w_i)/W$.

In problem (3.20) discussed on p. 138, one of the input values of w_i differs from the value specified by Pherū on p. 20 (and translated in p. 63). So, the answer given is also wrong. An input-error occurs also for the problem (1.91) (original verse, translation and explanation on p. 15, p. 55 and p. 123/124 respectively).

Ṭhakkura Pherū himself has committed a mistake in proposing a solution for the problem (3.24), to find the unknown weights of all the n component pieces (w_i) in a simple mixture (where the total weight of the mixture W is the sum of the weights of the component pieces w_i), when the purity of the individual components (v_i) and that of the mixture (V) are given. Pherū's answer is

$$w_i = a_i W / \left(\sum_{i=1}^{n} a_i \right),$$

where $a_i = 1/|V - v_i|$.

Considering the fact that there are only two relations among the weights w_i,

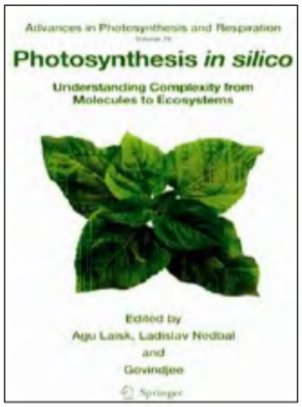
$$\sum_{i=1}^{n} w_i v_i = WV \quad \text{and} \quad \sum_{i=1}^{n} w_i = W,$$

the weights w_i are actually indeterminate except when $n = 2$ (two components). In that case, the given (correct) solution is the same as the one given by Mahavira in *Ganitasārasamgraha*. For $n > 2$, the equations are indeterminate. It can be shown that the rule is plainly wrong when n is odd. When n is even, the expressions for w_i correspond to one particular solution, when among the v_i, $n/2$ of them are greater than V, and $n/2$ of them are less than V. This is not commented upon in the explanatory notes, at all.

The present volume is a result of painstaking team-work of four well known researchers. It is praiseworthy that they took up a work composed in the popular *apabramsa*. All the scholarly norms of indologists are adhered to. Apart from an apt introduction, edited text and mathematical commentary, it has several appendices, indices, glossary and a comprehensive bibliography. It would be a very useful addition to any library which has a place for history of mathematics, or an individual collection of a serious scholar in the field. It has been brought out well by Manohar publishers also. However, I wish that the authors had addressed the book to non-scholars also (apart from indologists), who would be more interested in the contents of the verses and would like to know more about the Indian way of doing mathematics, and appreciate it. The explanations could have been more detailed, and at several places, diagrams would have been very helpful.

M. S. SRIRAM

Department of Theoretical Physics,
University of Madras,
Guindy Campus,
Chennai 600 025, India
e-mail: sriram.physics@gmail.com



Advances in Photosynthesis and Respiration. Photosynthesis *in silico*: Understanding Complexity from Molecules to Ecosystems. Agu Laisk, Ladislav, Nedbal and Govindjee (eds). Springer, Dordrecht, The Netherlands. 2009. Vol. 29, 508 pp. Price: US$ 279.

The book deals with biological modelling of photosynthetic apparatus. Photosynthesis researchers are quite familiar with modelling. Many basic concepts of photosynthesis did emerge out of models including the Hill and Bendall Z-Scheme, the quencher Q-model of Duysens and Sweers, Kok's model for oxygen evolution, and even the Calvin–Benson cycle that won a Nobel Prize. However, these models provided mostly interpretation of results.

The current book is a new and massive effort to document global scale models and their complexities in photosynthesis. It aims at getting views from laboratory exercise to ecology. This volume is unique in many ways, not only in the content but also in concepts. This book explains events of photosynthesis in canopies, crop field, and grasslands and in nature. The preface of the book sets the tone and texture of the book. In 20 chapters, 44 experts belonging to 15 countries tell the readers what would be the shape of photosynthesis research in the future.

The volume contains five parts; the first part contains two chapters on the problem of modelling. Modelling usually involves a simplified visual representation of a system for understanding complex phenomena occurring within it. Data from experimental observation lead to information and information can be understood in terms of correlation between the entities existing within a system or subsystem. A model should not only explain the existing data but also predict future experimental results. Most of the biological models in earlier era were lacking association of mathematical equations. The models were qualitative representations. Moreover, there were no means to put together models of two different subsystems so that a model could emerge for the whole system. In the modern era the models include quantitative logical components. However, it remains a great challenge for understanding dynamic processes that are the essence of living systems. Computational methods appear to be the only medium to meet the challenge. The target can be achieved only if there are methods to merge e-models and grow them to a holistic model of biosystems. Achievement of this target demands platform-independent format for representing e-models. System Biology Markup Language (SBML) has been developed which can be helpful in achieving the target. Minimum Information Requested In the Annotation of biochemical Models (MIRIAM), System Biology Ontology (SBO) and Virtual Cell (VC) are the results of efforts in the area of biological modelling.

The second chapter discusses the application of computational tools in e-photosynthesis. Photosynthesis has its own complexity in terms of timescale stretch-

ing from femtoseconds to a few seconds and spatial boundaries ranging from nanometre to metre. This requires mosaic partial modelling. The major problem is filling the gaps when validity ranges do not overlap any partial model and modelling inter-regulatory mechanism. Comprehensive Modelling Space (CMS) overcomes to some extent the problem of different timescales. These aspects are discussed with respect to e-model of photosystem II.

The Part II also contains two chapters – one is on modelling the light harvesting by the antenna and charge separation, and the other is on mathematical evaluation of the nature of antenna excitations. The kinetics of O_2 evolution and chlorophyll *a* fluorescence provide information on photoelectron transport in the photosynthetic organisms. Part III of the book contains four chapters, two on modelling of the chlorophyll fluorescence transient or induction, as induction of fluorescence transient is lavishly studied by many researchers, and the modelling of fluorescence phenomenology and kinetics are going to be of extreme use in modelling global photosynthesis. The two remaining chapters in the section deal with multi-particle modelling of the photosynthesis processes in the thylakoid membranes and the other on clustering of the electron transport components. Integrated solid versus diffusive electron transfer chain models are discussed in this chapter as well as the characteristics of the *in vivo* quinone domains. This draws the attention of readers from macroscopic averaging to the microscopic scale information to single molecule spectroscopy

The Part IV of the book deals with the dark reactions in photosynthesis and these meaty topics have very much influenced the photosynthesis and productivity research. This part contains seven chapters out of which five are on C_3 plants carrying out the Calvin–Benson type of metabolism, one on plants exhibiting the Hatch-Slack type strategic metabolism and the last one on the 'control fluxes' generated by genetically modified key enzymes controlling the metabolic fluxes. The models on Rubisco limited CO_2 assimilation rates and electron transport limited rates of carbon assimilation influenced our physiological and agronomic research for years.

In Part IV the readers get to visualize the predictions of overall photosynthesis from leaf gas exchange, chloroplast biochemistry, the activation and the reactions of Rubisco from gas exchanges, the temperature dependence on C_3-type photosynthesis and carbon/nitrogen partioning the computerized model for CO_2 concentrating mechanisms in different C_4 sub-type like NADP malic enzyme. Plants have been discussed to provide a new understanding of the concentrating mechanisms of bundle sheath (BS) cells in C_4 plants that maintain strict ATP and NADPH stoichiometry.

Simulations and fitting of the experimental data to the models under CO_2 saturated and CO_2 limiting conditions have been copiously illustrated. The metabolic fluxes are regulated by enzymes. The fluxes are sensitive to small change in enzyme concentration. This provides a control coefficient, varying from 0 to 1. Chapter 15 evaluated the flux control analysis for CO_2 assimilatory power of plants and transgenics.

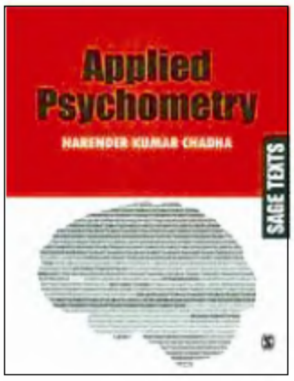
The last part of the book discusses the modelling of photosynthesis machineries from leaves to canopies and to the global environment. This section has five chapters dealing with packaging of global scale models of daily and annual C gain in canopies, biogeochemical cycles, interactions of different cycles, and global scale models of terrestrial and marine as well as coastal ecosystems. The fifth chapter in this part has opened a global space for the e-photosynthesis discussing issues like increasing productivity by increasing specificity of Rubisco for carbon dioxide over oxygen in Chapter 17. This part integrates various aspects of e-photosynthesis, namely, the biotechnology for increasing production and its limitations, biogeochemical cycles, canopy and global perspective. This gives a philosophical flavour to rigorous mathematical expressions.

The book imparts a separate status to e-modelling in photosynthesis. It can serve as a resource for research students and scientists working in the area of photosynthesis, especially in the area of modelling. The book also caters to the need of a text book for advanced higher level course in 'Systems Biology in Photosynthesis'. Overall, it is a book which all plant scientists must go through. It is expected there would be initiation of dialogues between experimenters and theoretical analysts through these models. The computers could mimic the structure and functional correlation in the plant cells, leaves, trees, canopies, ecosystem and our beautiful earth by appropriate programing.

Lastly, the review of the book will remain incomplete if a comment on the cover page is not included. Leaf canopy bearing the imprints of silicon circuits expresses the theme of the book that is e-modelling from leaf to canopy to globe. This book is recommended not only for photosynthesis researchers but other scientists interested in biology, agronomy, ecology, biogeography and biomathematics. The new programmes involving integrated courses should find a robust reference text in this book. Libraries will find this book useful for their readers.

PRASANNA MOHANTY[1,*]
MUKESH KUMAR RAVAL[2]

[1]*Devi Ahalya Visvavidyalaya, Indore 452 001, India*
[2]*Department of Chemistry, G.M. College, Sambalpur 768 004, India*
**e-mail: photosis@rediffmail.com*



Applied Psychometry. Narender Kumar Chadha. SAGE Publications India Pvt Ltd, B1/I-1, Mohan Cooperative Industrial Area, Mathura Road, New Delhi 110 044, India. 2009. xiii + 362 pp. Price: Rs 395.

This book addresses an important branch of the science of measurement. Measurement science becomes complicated when researchers want to attribute numeric values to variables that have no apparent measurement metric (such as, latent variables). Paper–pencil tools serve as instruments designed to measure