Freedman intended to take up medicine, but in college was drawn to physics and found it 'eye-opening and astounding that calculus can describe physical phenomena in a precise way'. A fascination with numbers led the young Freeman Dyson to take up a problem on ranks of partitions as a student, before going on to a career in which 'a teaspoonful of elegant mathematics' led to insights into problems in physics, engineering, astronomy and biology. Edouard Brézin was led to physics through his initial interest in mathematics. But after almost 40 years of dealing with mathematics in physics, Brézin realizes that 'Nature knows remarkably how to go around mathematical theorems'; for instance, in presenting us with structures such as quasicrystals that are endowed with symmetries would seem to be forbidden. David Mumford moved from his love of physics and astronomy in school to mathematics 'which creates worlds which are not physically real, but are as colourful and idiosyncratic as anything on earth'. Atiyah was attracted by chemistry in school, but moved to mathematics because of its intellectual appeal and coherence. He likens the beauty of mathematics to a 'landscape whose terrain may be rough but the mountain peaks shine through'.

Several pieces discuss broader issues of concern to scientists. Leo Kadanoff says he was drawn to mathematics and physics by their possibilities of finding out and describing true things. Can science and scientists then serve as 'an example of an area in which falsehoods are neither prevalent nor rewarded?' His own assessment is pessimistic, based on recent incidents involving fraudulent data. Joel Lebowtiz believes that scientists have special responsibilities in the area of human rights, as the scientific perspective emphasizes the things humans have in common, and shows the intrinsic insignificance of differences of race and religion. Klaus van Klitzing believes that scientists have a special responsibility to help build a world without unacceptable gradients in living standards. The opening piece of the volume, based on various interviews with Abdus Salam, makes the point that a world divided between the haves and have-nots of science and technology cannot endure in equilibrium. It was this thought, and the necessity of a meeting ground, that ultimately led to the founding of the ICTP.

Finally, let us return to books which inspire and motivate young people towards science. Many instances are detailed in the compilation. Chemist John Fenn recalls that as a child he was entranced by Arthur Mee's 20-volume *The Book of Knowledge*. Both Mildred Dresselhaus and Leon Lederman were drawn towards science at a young age on reading Paul De Kruif's *Microbe Hunters*, though both ended up in physics rather than biology. Alexander Polyakov found his 'moment of epiphany' when he bought a second-hand volume of *Mechanics* by Landau and Lifshitz. 'The intellectual intensity of the book left a permanent impression on me', he says. James Yorke found for himself that the biggest impact came from books on astronomy from the planetarium bookstore, and in later years from books such as E. T. Bell's *Men of Mathematics*. Shing Tung Yau recalls spending hours sitting in a bookstore in Hong Kong, reading lots of books on science; he regarded them as his 'secret weapon'.

In the same vein, is it likely then that this book will succeed in its purpose of motivating young people to take up science? Time will tell, but I think that the chances of success are high. In the meanwhile, this book remains an informative and interesting reservoir of the experiences of well-known contemporary scientists, and is as interesting for the messages carried by the pieces as for the glimpses they provide into the human and scientific personae of the respondents.

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Chlorophyll *a* Fluorescence: A Signature of Photosynthesis. George C. Papageorgiou and Govindjee (eds). Springer, Dordrecht, The Netherlands, 2004; 818 pp. Price: 270 Euros (special price to members of the International Society of Photosynthesis Research 202.50 Euros).

This 19th volume of the series on *Advances in Photosynthesis and Respiration* (series editor: Govindjee) is dedicated to L. N. M. Duysens, whose simple but elegant experiments in the 1950s–1960s, established the conceptual framework of theoretical developments and several techniques related to the measurements of chlorophyll (Chl) fluorescence and its diverse variants. The content of this volume is replete with such instances. The book is a mine of information with lucid treatment of many aspects of fluorescence and photosynthesis that are significant in pure and applied fields.

The first three chapters cover brief history, introducing the basic topics dealt with in the rest of the book, as well as the methodology of interpreting the changes in Chl *a* fluorescence as a probe of photosynthesis along with a simple and lucid treatment of the common errors. The next four chapters address the mechanism of energy transfer following light absorption; in addition, the physical nature of interactions amongst the constituents participating in energy transfer that are early events in optimum utilization of light energy. There is a discussion of fluorescence in cyanobacteria and red algae.

Two chapters describe PSII and PSI functions that are directly sensed by Chl *a* fluorescence changes, relate the flash-induced oxygen evolution with Chl *a* fluorescence changes in the context of Kok's model of *S*-state transition and provide data on PSI fluorescence, especially discussing excitation energy transfer.

Three chapters are devoted to regulation of electron transport at longer timescale (covering electrochemical conversion and ATP synthesis) than the intrinsic fluorescence decay time of Chl *a*, providing an overview of the technique of pulse–amplitude modulation fluorometry and its use, amongst others, in quenching analysis. A theory based on energy flux in biomembranes to explain fluorescence transients (Kautsky curve) is discussed. The complexity arising from overlapping time spans between spontaneous Chl *a* fluorescence, delayed light emission and their relation to thermoluminescence is analysed using a theory of charge recombination mechanism that is generally accepted, derived essentially from the one first proposed for thermoluminescence of solid phosphors.

The functions of compartmentalized components or specialized aspects of photosynthesis, reflected through Chl *a* fluorescence modulation caused by internal and external factors, are covered in the rest of the book. (So the 'trailer' of the book title: *A Signature of Photosynthesis* is fully justified.) Many of the chapters also provide considerable details of theoretical and experimental techniques, a few on preparation of mate-

rial and, most importantly, pitfalls of interpretations or limitations in their use besides possible future directions of development.

A particularly significant inclusion is that of techniques, handling of data and interpretation that is bound to become indispensable to study and assess the environmental stresses on vegetation in a global manner through satellite imaging (chapters 14–16, 27). Therefore, new entrants into research, pure or applied, will find this volume extremely useful as a starting material in most of the currently dominant and emerging fields related to physiology and stress biology of photosynthesis. As a non-invasive tool, imaging Chl *a* fluorescence reveals leaf characteristics such as spatial variations due to development, nutrition and physiology, pigment distribution as well as detection of biotic and abiotic stresses, besides its large-scale screening of photosynthetic mutants. The essentials and methodology, including analysis of image taken by this powerful, relatively new technique are described lucidly for beginners from nearly any discipline. One chapter exclusively describes the 'fluorosensing'-based techniques recently developed (light detection and ranging, Fraunhofer line discrimination) to analyse data from leaf to canopy by sensing fluorescence from satellite. It is needless to emphasize its future impact in ecology and environmental science.

If the rate of removal is lower than the pumping rate of unused energy due to high intensity of light, the damage can be destructive if not always lethal to the cells. Nine chapters (18–26) describe responses to different stresses in plants, algae and cyanobacteria. These include the processes that mitigate at least the immediate stress of unused high light as evidenced by the phenomenon of non-photochemical quenching of Chl *a* fluorescence; and to introduce the basics, instrumentation and utility of the emerging new techniques for global analysis of the quenching phenomenon that is linked to energy dissipation mechanisms. The term 'global' here refers to simultaneous observation of lifetime at different frequencies and time domains. The currently identified processes of dissipation of excess energy mediated by PsbS protein and xanthophyll cycles for deacidification of lumen are well covered. Four chapters are concerned separately with UVB, water, metal ions and osmotic stresses.

The power of genetic techniques is elucidated in three chapters. These are for the proposed investigation of state transition mechanism, on understanding the mechanisms of acclimation to light stress and, of light harvesting complex assembly in the process of chloroplast development.

One chapter deals with light adaptation and senescence through the effects on Chl *a* fluorescence and its correlation with the fate of other pigments in the process. It also presents a parameter, the Chl fluorescence decrease ratio, $R_{Fd,}$ as a non-destructive indicator of CO_2-fixation rates (P_N) and as vitality index of photosynthetic apparatus.

Chapter 29 is an excellent overview showing use of Chl *a* fluorescence for measuring carbon assimilation, electron transport rate, quantum efficiency; to track stress state from individual leaf to ecosystem, and provide direct estimation of radiation use efficiency from remote sensing. This, as the authors point out, would eventually be a useful technique to understand ecosystem processes and help in predicting changes due to perturbation that may differentially affect the species. The last two chapters address two contrasting-in-size ecosystems with a common object – aquatic plant: marine and inland water ecosystems respectively.

There are other features in the book that deserve special mention. The eight colour plates (total of 17 figures) placed in the beginning of the book are mainly focused, quite naturally, towards illustrating the power of the imaging techniques dealt with in various chapters. These are both a feast to the eye and highly instructive. A precautionary note, however: the colours are not natural, but software-processed to illustrate and accentuate the spatial and temporal changes following stimuli, explained clearly in the respective legends. Do not be put-off by black leaves or blue-ribbed leaves (CP-7, Figure 4)! A second significant feature is the photograph of smiling faces of all the contributors (with a couple of exceptions) that adds a lively flavour to the otherwise heavily information-loaded book.

I have no doubt that the book will remain in vogue for many years to come amongst students and researchers alike and eventually end up as a classic reference decades later, when the technologies overtake the contemporary levels so well discussed in this encyclopedic work. Papageorgiou and Govindjee need to be complimented for editing this fine collection of chapters from eminent contributors in their respective fields. I strongly recommend that libraries acquire the book for graduate students and researchers in plant biology, biochemistry and biophysics.

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