One Hundred Reasons to be a Scientist. K. R. Sreenivasan (ed.). The Abdus Salaam, International Centre for Theoretical Physics, Trieste, Italy. 2004. 260 pp. Price not mentioned.

What is it about science that can capture the imagination of a youngster, and motivate him or her to take up a career in the subject?

This is the question asked – and answered – in this compilation of interesting brief pieces by approximately one hundred distinguished scientists the world over, and drawn from all disciplines. This collection is the brainchild of K. R. Sreenivasan, the current director, who brought out this book on the occasion of the 40th anniversary of the founding of the International Centre for Theoretical Physics (ICTP) at Trieste, Italy. The primary purpose of the collection is to expose young school and college-going students to personal accounts by active scientists, outlining their motivations and their lives in science; hopefully it would lead some young readers to think about careers in science for themselves.

The resulting fare makes for lively reading, and should be of interest to any practising scientist, in addition to the target readers. The respondents are drawn from mathematics, physics, engineering, chemistry, biology and economics. Included are about a couple of dozen Nobel Prize winners, and five Fields Medallists. Not surprisingly, one encounters a large variety of backgrounds and experiences, which make an interesting pastiche, but which distil into a few themes that recur through the volume. There is some unity in the diversity!

One such theme concerns common sources of inspiration in childhood. Supportive parents, exemplary teachers and inspiring books are mentioned most often as the agents which awakened or encouraged a fledgling interest in science. Individual experiences are fun to read. For instance, six-year-old Douglas Osheroff, who later went on to discover superfludity in He^3, was presented an electric train set, which he immediately proceeded to dismantle to see what made it work. This curiosity so impressed his father that instead of rebuking young Douglas, he gave him a watch to open up, to figure out its workings. The father of physicist Joanna Levelt Sengers was a Ph D chemist, and would discuss science at dinner time, using oranges and apples to explain the movement of planets. And Jayant Narlikar's uncle would pose 'challenging problems for JVN' on the family blackboard, which whetted the school-going Jayant's appetite and aptitude for problem-solving.

The collection also includes several examples of well-known scientists whose paths have taken twists and turns before leading to a career in science. In this category is theoretical physicist Anthony Leggett, who took classical languages and literature courses at school, was taught mathematics informally by a priest, and was attracted to physics rather than philosophy for a career, as he found the standard for judging what is good and bad in philosophy to be a matter of fashion rather than based on objective criteria. Susan Greenfield, known today for her work on neuronal activity, found herself turned-off by school biology and science, and went to Oxford to study philosophy, but was attracted to psychology instead. Handling a human brain, as part of her course, proved to be a defining moment which set her off in her new career. Vitaly Ginzburg, theoretical physicist, graduated from school in the chaotic times of Russia in the 1930s, when it was required to learn a proletarian trade in a factory. Working as a laboratory assistant in a metallurgy institute, he picked up experimental skills before a change in the educational system allowed him to enrol in Moscow State University to pursue physics.

It is especially interesting to read about the experiences of scientists in this part of the world. C. N. R. Rao vividly describes the thrill of seeing his early research contributions in print. He quotes his scientific hero, Michael Faraday, as exhorting 'Work, finish and publish' – advice that C. N. R. seems to have followed in his own research. M. G. K. Menon's choice of science as a career was the outcome of a chance meeting with C.V. Raman. He underscores the unmatchable thrill of unexpected observations which led to a new understanding of natural phenomena. Before he left for Cambridge, Jayant Narlikar had an interesting encounter with Mr R. P. Paranjpye, a former Senior Wrangler, who asked whether Narlikar intended to go in for the Indian Administrative Service (IAS), as a Cambridge degree was a good stepping stone to the IAS. Fortunately for Indian science, Narlikar's answer was in the negative. Roddam Narasimha was led towards science both by his father, who had earlier studied with Meghanad Saha, and by a couple of outstanding teachers in school, one of whom presented him with two books which gave him a glimpse of the 'strange intellectual world of science'. In his pursuit of fluid dynamics, he was strongly influenced by Satish Dhawan, who was 'informal in manner and serious about work (just the opposite of most other faculty . . .)'. K. Kasturirangan's fascination for astronomy was triggered in his native Ernakulam by the sight of the Milky Way, which created a sense of awe and wonder. After a successful career in space science and technology, he emphasizes the necessity of nurturing not only basic research, but also the calibre of scientific leaders, especially in the Third World.

Science deals with ideas, and it is interesting to see what scientists have to say about them. As working scientists know well, flashes of insight do not appear in a vacuum, but rather are the by-products of months and years of hard work. Mathematician Lennart Carleson, who took almost 20 years to establish a result on the convergence of Fourier series, adds casually that 'this long process is rather standard'. Michael Atiyah notes that 'good ideas have a long life and frequently make a comeback after having been ignored for many years'. High energy physicist Maurice Goldhaber advises: 'Listen to your inner voice and do not give up too easily when an idea is criticized'. Commenting on his own experience of the process of discovery, economist Partha Dasgupta says discovery has meant 'a growing realization, not a blinding revelation' and adds that he suspects 'there is nothing common among the processes by which we gain an understanding of the world around us'.

The symbiotic relationship between physics and mathematics is a thread that weaves through many of the contributions. E. C. G. Sudarshan echoes thoughts about the unreasonable effectiveness of mathematics when he says: 'The great miracle is that the real world can be understood in terms of mathematical models'. Daniel

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.

MUSTANSIR BARMA

Department of Theoretical Physics,
Tata Institute of Fundamental Research,
Mumbai 400 005, India
e-mail: barma@theory.tifr.res.in

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-