dresses them in the R. R. Wilson Lecture of 1979, and here he partly returns to the themes of the Ryerson Lecture. He presents to us G. N. Watson's description of the transports of joy he felt on encountering some of Ramanujan's mathematical formulae; Boltzmann's reactions to Maxwell's work on the dynamical theory of gases; Einstein's emotions on the completion of his general theory of relativity; Weyl's giving precedence to beauty over agreement with experiment in his work in physics; and once again the passage from Heisenberg on the discovery of matrix mechanics. Chandrasekhar expresses himself thus: 'It is, indeed, an incredible fact that what the human mind, at its deepest and most profound, perceives as beautiful finds its realization in external nature.' From these many instances it emerges that scientists always use the language of the arts in describing the beauties of science—there is no other way to communicate these matters! But Chandrasekhar also sounds a note of caution—astounding success in science can later lead to an excess of confidence in oneself, to errors of judgement, and the loss of a critical and balanced attitude. Here it is amusing to remark that in his 1946 essay Chandrasekhar had said, speaking of appropriateness and coherence in scientific theory: 'I admit that these are things which cannot be defined any more than beauty in art can be defined; but people who are acquainted with the subject have no difficulty in recognizing or appreciating it.' But by 1975, in speaking of evaluating scientific theories as works of art, he is rather critical of an almost identical statement of Dirac from 1939; for he says: "It will not do, I think, to dismiss such an inquiry with an assertion such as Dirac's (made in a different context): 'Mathematical beauty cannot be defined any more than beauty in art can be defined, but which people who study mathematics usually have no difficulty in appreciating.'"

The case of the general theory of relativity has special appeal to Chandrasekhar, and on more than one occasion he tells us why 'It is probably the most beautiful of all existing theories'. He sees it in the fact that the theory brings together space and time on the one hand, and matter and motion on the other; that like Moore's characterization of the greatest sculptures as revealing new aspects of beauty at every distance from which they may be viewed, this theory too is beautiful at all levels, all scales of examination. And as he expounds in great detail in the concluding essay, the appreciation of its aesthetic base has been of direct relevance in formulating and solving highly nontrivial physical problems within the theory.

The three biographical essays are devoted respectively to Edward Arthur Milne, Arthur Stanley Eddington, and Karl Schwarzschild. Each of them is written with a master's eye and pen. This is not the place to recall any of the technical matters dealt with in these pieces. Suffice it to say that on going through them, one gets a fine picture of the founding of the various branches of the modern science of astrophysics, and of the seminal contributions made by each of these three figures. Chandrasekhar is of course eminently qualified to speak of them, having known both Milne and Eddington personally over long periods of time; and in the case of Schwarzschild not merely because Chandrasekhar himself is one of the ablest practitioners of the general theory of relativity. The portraits of Milne and Eddington are vividly drawn with sympathy and sensitivity, and yet with a critical and discerning attitude to their work and personalities. With Milne, Chandrasekhar finds his style and approach to physical problems to have been of more lasting value than his actual accomplishments. In the Eddington essay one reads of the 1935 incident that had such a decisive influence on Chandrasekhar's own career; and of the successive controversies in which Eddington was involved with Milne and Jeans. Chandrasekhar expresses very high regard for Eddington's early mastery of the general theory of relativity, and for his book on it, but finds that he achieved less than he was capable of. The final lecture shows in brief how much Karl Schwarzschild accomplished in so many fields in so short a time; and brings home the tragedy of his early death due to a disease contracted on the war front in 1915.

To sum up: there is a continuity of thought and expression in the essays in this volume, a concern for beauty and motivation in scientific endeavour, a caring for music and literature in a complete personality. Each piece stands as a model of composition and craftsmanship, evidence of command over expression and elegance. In reading them one cannot but keep remembering Chandrasekhar's own scale and depth of achievement. In an interview he had once said: 'One of the unfortunate facts about the pursuit of science the way I have done it is that it has distorted my personality. I had to sacrifice other interests in life—literature, music, travelling. I have devoted all my time, every living hour practically, to my work.' But one feels that this cannot really be the case, as one finds here a sensitivity to art, to music and literature, to Shakespeare and Shelley, Keats and Eliot and Beethoven, no less than to Newton and Einstein.

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Topics in physics

Electricity and Magnetism. A. S. Mahajan and A. A. Rangwala. Tata-McGraw Hill Publishing Co., New Delhi. 1988, 508 pp.

This book is a useful addition to the list of good undergraduate textbooks in electricity and magnetism. As the authors say in the Introduction, the book is aimed, apart from engineering students, to second-year undergraduates in science. This perhaps is the reason why the book omits some important topics like radiation from accelerated charges, waveguides, reflection and refraction of light and so on. In my opinion, a more comprehensive coverage, possibly in two volumes would have been more useful.

The twelve chapters in the book follow the standard development. The first chapter is devoted to vector analysis following which one has the usual sequence of electrostatics, current electricity, electromagnetism leading up to Maxwell's equations (with discussion of its solutions only in simple cases).

The authors must be congratulated for the meticulous care they have taken in being correct in both the physics presented and the mathematics invol-

ved—a refreshing change indeed from several textbooks published in India. There could be minor differences in approach at some points; e.g. I certainly feel that the correct definition of a vector should be given right in their book. I am also not very comfortable, when in defining the gradient of a scalar field, the authors start with a scalar function $\varphi(\vec{r}(t))$ with time entering the picture. Apart from such minor disagreement, the presentation is excellent. Finally, the large number of solved problems and exercises are a very positive and distinct feature of the book. A few tougher problems marked out with an asterisk for the more intelligent students perhaps would have been even better.

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Statistical Physics. A. W. Guenault. Routledge, London. 1988. 186 pp.

This is a rather brief introduction to the subject, written in an engaging style by an active low-temperature physicist. It is designed for use in a physics honours (B Sc) degree course in Britain. The best feature of this book is, I think, the easy passage from theory to application, found in most chapters.

I would not call the text unsophisticated (although the author does, in the Preface) because the derivations it presents are terse with much of the argument condensed into a few lines of conversational prose. What is more, it expects the reader to be thoroughly familiar with basic quantum mechanics. These features, incidentally, make it unsuitable for B Sc programmes in this country. At the same time, it is limited in its coverage (as befits a beginning text), treating only the ideal gases and some non-interacting model systems, and touching briefly on the mean-field theory of the Ising model. This rules it out as a text for M Sc or Ph D courses in India. It will probably make useful supplementary reading for B Sc and M Sc students (and their teachers).

At a formal level, the main drawback of the book is its restriction (section 1.4) to non-interacting systems. The manner in which this is done will give the beginning reader the impression that entropy, temperature, etc. are meaningful only for such systems. The author would have done well to pose the general problem of statistical physics without such assumptions. Also, in the matter of phase transitions, the author treats only the rather non-representative case of the Bose gas, and (briefly) the second order transition in the Ising model in mean-field theory. A text which defines partition functions could easily demonstrate that ($B=0$, $T<T_c$) in the Ising model is a line of first order transitions.

Finally, a more serious shortcoming is the absence of any mention of computer simulation. Very illuminating demonstrations of equilibration, order–disorder transitions, diffusion, and even tests of the 'averaging postulate' (section 1.3) can be made on a PC using easily available programs.

Despite these shortcomings, the book remains a reasonable supplement to a first course in statistical mechanics.

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Horizons of Physics. A. W. Joshi. Wiley Eastern Limited, New Delhi. 1989, 383 pp.

The book is the first in the series planned by Indian Association of Physics Teachers to provide review articles in the frontiers of physics and related interdisciplinary areas. The authors have tried to describe recent developments with minimum of mathematics.

The series of three articles 'Fundamental particles and their interactions' by R. M. Godbole, 'A tale of two bricks: quarks and gluons' by B. K. Agarwal and 'Quark structure of hadrons' by S. P. Pandya and S. B. Khadkikar, depict the present status of elementary particles and the quark structure of matter. The astrophysical aspects of stars and the galaxies are discussed in articles 'The Sun and its family' by S. Chandra and U. S. Pandey, 'Astrophysics' by K. D. Abhyankar and 'Radio astronomy' by V. R. Venugopal. The series of articles provide the reader an up-to-date information in the relevant areas.

The articles 'Quantum mechanics' by P. M. Agarwal, 'The physics of X-rays' by S. I. Salem and A. Kumar, 'Development in nuclear physics and future challenges' by M. Z. R. Khan and 'Scattering in a generalized central potential' by H. C. Sharma will be useful even to M Sc students in view of the appropriate coverage of topics. For researchers in the field the articles 'Recoilless emission and absorption of gamma radiation or Mössbauer effect' by V. K. Garg and 'Amorphous and liquid semiconductors' by A. Kumar will serve as useful references.

For topics of general interest and for emphasis on the concepts, the articles 'The theories of relativity' by J. V. Narlikar, 'Understanding physics from a philosophical point of view' by A. W. Joshi and D. P. Khandelwal, and 'Comments on Faraday's Law' by H. S. Mani are strongly recommended for reading.

The articles are generally well written and are recommended for reading by all interested in obtaining a good understanding of physics. Perhaps a few comments may help in improving readability of the book. For example, the photographs in article 'Fundamental particles and their interactions' are not of good quality. Some reference books could have been included in the reading lists for articles 'The physics of X-rays', 'A tale of two bricks: quarks and gluons' 'Astrophysics' and 'Radio astronomy'. Page numbers can be provided on the contents of each chapter at the beginning.

On the whole the book serves as a good reference book and is recommended for reading by every student of science and physics in particular. It is recommended for purchase by the library of every University and College.

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