J. Indian Inst. Sci. 63 (B), June 1981, Pp. 161–180

BOOK REVIEWS

Einstein : the first hundred years edited by Maurice Goldsmith, Alan Mackay and James Woudhuysen, Pergamon Press, Oxford, 1980, pp. xiii + 200, $ 19·95.

Why does the name of Einstein outshine all other great scientists ? There are many who had a more visible impact on society and civilization than him, but they do not measure up to Einstein. He stands like a colossus dwarfing others. Is it because he revolutionalized our commonsense concepts of space and time and gave the strange notion that space is curved ? Is it his extreme kindness and humanism dealing with men and society, his fight against German militarism, violence and injustice and championing of one world ? No ! It is his total personality, his inner greatness, his complete involvement in the search of the harmony and the laws that control the nature and the universe, his concern for the entire human world but with the detachment of a rishi.

The book under review is an attempt by the editors to present the total picture of Einstein as man and his impact on science, society, world affairs, art and literature. This they try to achieve through a collection of articles by different authors on various facts of his life. This then is the account of twenty persons giving their glimpses of this great giant of a man and a scientist. The writers include some very eminent scientists, men of letters, architects, philosophers, pacifists and historians of science. They are Dirac, Bondi, Wheeler, Bohm, Snow, Rotblat, Courtenay, Arthur Clarke, etc., to name a few.

After a brief foreword by Bondi, we have a long assessment of Einstein as a man by C. P. Snow. The normal character of Einstein was already formed before he was sixteen. To summarize his own comments on himself is perhaps the best description. He never belonged whole-heartedly to a country, a state, a circle of friends or even to own family. His personal external conditions had relatively a small role on his thoughts and emotions. From his early adolescence his supreme aim was to perceive this world through pure thought discarding everything subjective. While still young, he realised the futility of the hopes and aspirations that most people pursue throughout their lives. He even ridiculed the pursuit of wordly happiness.

These are the early symptoms of a self-realised person, a rishi ! He did succeed in submerging his self despite having a hefty ego. And this is not a small achievement for a young man who came out with three major breakthroughs in physics in one year and was proclaimed to be a genius within four years of waiting and scrutiny.

Yet he maintained the zest for life—being both witty and merry with a reverbrating laughter. The failure of his first marriage did produce a fallow period scientifically for some time. But his second marriage to a person who was undemanding and rather protective of his interests enabled him to reach creative ecstasy. And indeed came the creation of the general theory of relativity, perhaps the highest product of human thought. Its experimental vindication catapulated Einstein to the rank of Newton and other all time great scientists. Talking of creativity, Einstein's experience is that the best creative work is never done when one is unhappy. Infedl's article is quite touching written on the 75th birthday of Einstein near the end of his life when he had done his job on earth. Einstein's life was that of his powerful mind which had subdued the world of sense impression. 'His heart did not bleed, his eyes did not cry, yet his deeds are those of a man whose heart bleeds and whose eyes cry.'

Einstein's impact on science is analysed by several sets of authors. Cawkell and Garfield citation analysis shows the expected, that his important papers are still cited. Dirac's assessment of the excellence of Einstein's theory of gravitation (general theory of relativity) is a model of deep analysis putforth in the most simple language. The impact was felt in 1918-1919 when everyone sick of the First World War was looking for something different, a new style of thinking, a new philosophy. They got through the profound implifications of the theory almost stunning impact. Till to-date no discrepancy with the Einstein theory of gravitation has observationally occurred.

Although Einstein did initiate the quantum revolution, he did not accept the modern quantum mechanics that developed in the twenties. He could not reconcile with the fundamental and irreducible indeterminism of quantum mechanics pioneered by Bohr and Heisenberg. He was equally opposed to the non-locality inherent in quantum mechanics. Bohm and Hiley give an extremely pedagogical discussion of Einstein's stance on the non-locality issue. Both sides have been misunderstood and Bohr and Einstein drifted apart with little communication. It appeared for some time that Einstein was completely isolated on the issue of the interpretation of quantum theory. But some of the questions raised by him will continue to be the subject of serious theoretical researches.

Blanpied's article on Einstein as guru, discusses more of Bose's background and how he accepted Einstein with the mystical reverence.

These studies are followed by the assessment of eight authors on Einstein's impact on society, world affairs and arts. His demonstration that the mystery of the world becomes comprehensible by means of thinking leaves one in awe.

Much is made of Einstein's role in the birth of the nuclear bomb. It is true that he wrote the crucial letter to President Roosevelt in 1939 which led to the start of the work. But he deeply regretted this calling it one great mistake of his life. He gave strong support to scientists engaged in creating awareness of the perils and unprecedented

destructive powers of these new weapons which affect the victors and vanquished equally. In this context the Russel-Einstein manifesto which he approved a few weeks before his death is a landmark.

In the fag end of his life—he felt rather frustrated—a lonely man, his dream of one world almost shattered to pieces. This is echoed in his statement that if he were to be a young man again, he would rather choose to be a plumber or a peddler.

Yet no body enjoyed doing science as sensuously as Einstein did. His was a joyful participation in the creative process. And he influenced architects, painters and poets profoundly. The Einstein tower in Potsdam designed by Erich Mendelsohn (in 1919) is more than an observatory-represents a fusion of two different concepts, matter and energy and that 'nothing in the universe is without relativity to the cosmos, without-connection to the whole'. Le Corbusier and Fuller were equally influenced as manifested by geodesic domes. so were many painters, the emergence of the fourth dimension among cubists, acoustic space, are important examples quoted.

Arthur Clarke, the science fiction writer, poses some profound questions in his one page article. Einstein has put the speed of light as the upper limit in communication ; no signal or influence can travel faster than this. But light takes billion years to cross even a part of the Universe (God's creation). How does He control the universe? One may invoke his omnipresence but this amounts to influence moving at an infinite speed. This God *versus* Einstein presents amusing paradox. But then Einstein did not believe in a God of the type Clarke is visualising He saw God in the symmetry, the harmony and the laws governing the micro- and macrocosmos.

There is a very readable article on relativity theory and quantum mechanics in modern literature by Calcraft quoting profusely from Durrel's "The Alexandria quartet", Huxley's "The Genius and the goddess", etc.

The books ends with an afterword by J. A. Wheeler in his own inimitable style. He cites cases of creative persons in different walks of life and how they discovered unity, perfection and harmony through intuition and created new systems and laws. Here again Einstein emerges as the master perfectionist and his theory of general relativity (law of gravitation) can be put in a single sentence of Wheeler 'Space tells matter how to move and matter tells space how to curve."

In summary, this is a valuable book and the editors have done a very good job in projecting the total effect of Einstein on science, world affairs, and many facets of human endeavour. And there is no abatement of the influence as we enter the second hundred years.

K. P. SINHA

Department of Applied Mathematics
Indian Institute of Science
Bangalore 560 012.

Steady-state cosmology re-visited by Fred Hoyle, University College Cardiff Press, 1980, pp. 72, £ 3.25.

The study of the origin and the future of the universe is now a respectable subject. Among several models, the 'standard model' which says that the universe started with a big bang from a hot supercondensed state and has expanded over the twenty billion years, appears to be widely accepted. On the other hand, the steady state theory of Bondi and Gold, and of Hoyle and his collaborators, which envisages that the universe does not change with time, has been in disrepute for some time owing to its apparent disagreement with observations. In order to keep the density constant as the universe expands new matter must be continually created via the C-filed. Further the steady-state theory makes definitive predictions about the relation between luminosity, distance and the redshift of a source or the counts of sources. Observational results have been at variance with these predictions but observations often improve with more sophisticated techniques.

Accordingly, in the present book the author tries to reanalyse these predictions in the light of current observational data. He has come out with graphs and values which are in accord with steady-state theory (his claim).

But the biggest blow to the steady state theory comes from the existence of isotropic cosmic black body microwave radiation (3 K). This strongly suggests that the universe has evolved from a hot dense stage starting with a big bang over 20 billion years ago. In contrast, the steady-state theory would require some means of thermalizing the shorter wavelength radiation into the much longer microwaves. And the author and his collaborator have been inventive enough to come out with the idea that graphite particles of the right sizes and shapes in the intergalactic space as well as in galaxies exist. In fact, these have to be rod like objects about 50 μm long. But this requires stringent conditions to be formed which are unlikely to have occurred in the past.

Nevertheless, the author is undaunted in his efforts to defend the steady-state theory. This he does by attacking the hot big-bang theory as it cannot make galaxies owing to the explosive expansion of the fire ball. There is an interesting section on white holes (objects which throw away matter and radiation, just the opposite of black holes) within the framework of steady-state theory. The larger universe contains many white holes. It has the potentiality of redeeming several shortcomings of the steady-state theory.

Perhaps the most potent argument against big bang and in favour of the steady-state is presented in the context of the information content of the universe which shows itself quantitatively in one of the biomolecules, say an enzyme. The chance of getting the 2000 different independent enzymes as a random process turns out to be ten to the power of minus forty thousand. This infinitesimal probability shows that life even as a cosmic phenomenon could not start from a big bang without a large intiial supply of

information. The author sees the only possibility which saves the situation is his steady-state model when the time axis is opened in the past.

The book has a small chapter giving a short historical and personal accounts as to how the idea of steady-state started in Cambridge in 1946-51. the principal characters ; why Maurice Pryce published one-tenth of what he should have (the reviewer knows this having worked with him) and why there was so much reaction against the steady-state theory. The picture that emerges is that scientists are human and can be carried away by personal feuds, and, as a result, observational astronomers sought a disproof of steady-state theory.

It is a sad situation if this were to be true. Let us hope that improved observations, as time passes, will bring us nearer an objective picture.

Well ! this book is a valiant attempt by the author to revive the steady-state theory. In the history of science, the so-called rejected ideas reappear in different forms strengthened by improved knowledge. Thus Newton's discarded corpuscles of light came back as Einstein's photons, the aether dispensed with by Einstein is being resurrected as superfluid and quantum aether.

Who knows the steady-state theory might see a revival in the future. But odds are against it now. However, aesthetically it is a very attractive idea and the book is worth reading.

Department of Applied Mathematics
Indian Institute of Science
Bangalore 560 012.

K. P. SINHA

Practical astronomy with your calculator by Peter Duffett-Smith. Cambridge University Press, 1979, pp. xi + 129, £ 3.95.

There is a sudden burst of interest in Astronomy owing to spectacular successes in space science in the last three decades. In fact, in many countries there are amateur astronomers who wish to look at various heavenly objects. Sometimes comets, and new objects are discovered in this process. This, however, requires some precise knowledge of astronomy namely the orbits of planets, satellites, phases of the moon, etc. Even ameteurs must know how to calculate the positions of these objects in the sky, their masses and distance from the earth, calculate solar and lunar eclipses. These are based on precise mathematical formulae. The book describes the method of calculating the values of various quantities using a simple pocket calculator. In fact, this book is extremely valuable and persons interested in astronomy are advised to keep a copy of this.

Department of Applied Mathematics
Indian Institute of Science
Bangalore 560 012.

K. P. SINHA

An introduction to quantum physics by A. P. French and E. F. Taylor. The M.I.T. Introductory Physics Series, Thomas Nelson and Sons Ltd., 1979, pp. xviii + 670 (PB), £ 8·95.

The birth of Quantum Physics has revolutionised our concept of nature, particularly at the microsopic level. Even after sixty years of its formulation (Schrödinger equations, matrix mechanics, uncertainty principle, etc.) it is difficult to comprehend essential ideas for a young person who is used to observing nature through his sense of perception. Some of the common sense ideas have to be discarded at the quantum level. Accordingly the teaching of quantum physics is to be carried out in such a manner that the students are exposed to the subtle ideas of this field so that they understand the full significance of this profound theory.

This book constitutes one of the volumes of the M.I.T. Introductory Physics Series. It is the culmination of a careful study, planning, and development carried out by the educational research center, in the last twenty years. The authors have done a splendid job. The authors start with a historical perspective and deal with the crucial experimental discoveries which prompted the formulation of modern quantum mechanics. We have a good description of wave properties of particles, wave particle duality, the solution of Schrödinger equations in one and three-dimension ending in hydrogen-like systems. The description of photons and their various polarization states is carried out in a very transparent manner. All these are covered up to chapter six, and then in chapter seven we have the formalism of quantum mechanics, state vectors and a fairly good mathematical machinery. This is followed by the time dependent quantum state, scattering of particles and the penetration of barriers in chapters eight and nine. Having disposed of this aspect the authors deal with the angular momentum of atomic systems and thereby give a complete account of the hydrogen atom. It is in dealing with many particle systems that the full quantum features emerge namely, the symmetry of many particle wave functions. In chapter thirteen they deal with the spin of electron, the exclusion principle and the antisymmetry of many electron wave function. The book ends with the important problem of interaction of radiation with matter, selection rules for radiation patterns (abs rption, emission, etc.). After each chapter the authors have given a great number of exercises to be solved for proper understanding of what has been discussed. This is indeed the most important feature of this book. This book is full of graphical illustration and experimental figures and of many theoretical ideas which aid the understanding of the subject.

I strongly recommend this book to those who desire an experimental and theoretical understanding of quantum mechanics at an elementary level. It will be useful to teachers who intend to give a course on this subject.

Department of Applied Mathematics
Indian Institute of Science
Bangalore 560 012.

K. P. SINHA

Reviews of mathematical physics Vol. I, Soviet Scientific Reviews/Section C, edited by S. P. Novikov, Harwood Academic Publishers, New York 10003, 1980, pp. xi + 207, (HB) $ 44.50.

This volume presents a collection of authoritative surveys by eminent Soviet physicists of the most significant advances in the mathematical physics of (i) classical non-linear evolution equations (solitons) and their quantization and (ii) equilibrium statistical mechanics, made by Soviet physicists. There are four surveys comprising four chapters. In chapter I, I. M. Kricherev and S. P. Novikov survey the modern algebraic geometrical approach to solving the KdV type non-linear wave equations and obtaining, specifically, the so-called 'finite gap' periodic solutions. The latter are shown to exist because of a 'hidden symmetry' related to the algebraic geometry of the problem in an essential way. Its impact on the inverse scattering method is also discussed. Next, there is a review by V. G. Drinfel'd and Yu I. Manin (Chapter II) of the algebraic geometric approach to non-abelian Young-Mills gauge fields leading to a classification of instantons. The review includes a brief but very readable account of differential geometry, differentiable manifolds, differentiable mappings, topological charges, holomorphic bundles and related concepts. There is also an excellent review by L. D. Faddeyev of the quantum inverse problem method leading to a direct quantization of non-linear classical equations which are completely integrable by the classical inverse problems method. Its relationship to Onsager's solution of 2-dimensional Ising model and the Bethe *ansatz* for one-dimensional quantum mechanical problems is elucidated. Then there is a survey by R. L. Dobrushin and Ya. G. Sinai of some rigorous probability-theoretic results on equilibrium statistical mechanics concerning the existence and uniqueness of Gibbsian distribution. Phase transition as well as the normalization group theory is discussed within this frame work. The last review is by N. N. Bogolyubov, Jr., A. M. Kurbatov, D. Ya Petrina and D. P. Sankovich, on the theory of approximating Hamiltorians which are asymptotically equivalent to the model Hamiltorian in the thermodynamic limit. The possibility of realizing approximating Hamiltorions having factorizable interaction and lower operator powers is considered in great detail. The surveys are rather brief, terse and meant for specialists. Exhaustive bibliography (Russian) has been included. The book will be valuable addition to any library serving physicists and mathematicians.

N. KUMAR
Department of Physics
Indian Institute of Science
Bangalore 560 012.

Plasma astrophysics (Vols. 1 and 2) by D. B. Melrose, Gordon and Breach Science Publishers, One Park Avenue, New York, 1979, Vol. 1, 290 pp, $ 46 ; Vol. 2, 434 pp., $ 64.50.

It is only recently that the broad discipline of plasma physics has begun to be sub-divided into three main areas : laboratory plasma physics, plasma astrophysics and

solar system plasma physics. Though, there is a fundamental and complementary relation between the study of plasma physics in the laboratory and in cosmic plasma physics, plasma astrophysics takes place in the natural environment and therefore lays emphasis on plasma phenomena different from that studied in the laboratory. Therefore, though there are many books covering the areas : introduction to basic theory of plasmas, linear and nonlinear waves in plasmas and radiation processes in plasmas, a book in plasma astrophysics mainly written with a view to acquaint the graduate students with the basic plasma processes relevant to astrophysical studies is very timely and will prove to be very useful for students and researchers.

The main problem of astrophysics is the analysis of the spectra of celestial objects which require the understanding of different radiation mechanisms. The emission, absorption and transfer of radiation in plasmas, therefore, form the main topics of plasma astrophysics. These topics are introduced and treated in detail in a very systematic way in volume 1 of the book. The introductory chapter gives introduction to various emission processes in astrophysical studies and to plasma physics. The following chapter on plasma waves gives the basic understanding of various modes of wave propagation which a plasma can support. The rest of this volume covers the radiation processes : spontaneous emission, gyromagnetic, synchroton and inverse compton emissions ; the induced processes and quasi-linear theory of particle-wave interactions and the absorption and transfer of radiation. Each chapter is followed by problems ranging from quite simple to difficult. The answers to the problems are given at the end of the book.

Plasma astrophysics differs from laboratory plasma physics also in the appreciably larger role played by fast and relativistic particles (cosmic rays), the acceleration of which in the cosmic plasma is a necessary consequence of the collective processes occurring in this plasma. Cosmic rays play an important role in many of the astrophysical phenomena. The scattering and acceleration of fast particles in plasmas are discussed in volume 2. Cosmic rays in galactic and interplanetary media are discussed in chapter I and acceleration of charged particles in magnetosphere in the Crab nebula and solar corona in chapter II. The other important chapters in this volume are on the interpretation of synchroton spectra, the plasma emission processes dealing with Langmuir turbulence and nonlinear particle-wave and wave-wave interactions and on the solar radio bursts. The radio emissions from pulsars and Jupiter in the last chapter make a very interesting reading. The inclusion of chapter on magnetoionic mode and mode coupling in the inhomogeneous plasma in volume 2, however, raises a doubt about the logical division of the matter into two volumes. Perhaps the inclusion of this chapter in volume 1 would have made the first volume more complete and comprehensive as far as the study of radiation processes in plasmas related to astrophysical phenomena are concerned. A few problems in this chapter would have been very helpful for students undertaking a course in astrophysical plasmas.

One cannot help criticising the definition of the term "plasma astrophysics" as the sub-branch of astrophysics concerned with microscopic plasma processes in astro-

physical context, given by the author. Looking back into the origin of this term, Kaplan and Tsytovich (*Plasma Astrophysics* by S. A. Kaplan and V. N. Tsytovich translated and edited by D. ter Haar, Pergamon Press, 1973), who were the first to introduce this term, defined it as a section of physics and astrophysics which solves its own specific class of problems. Hence, the class of problems based on orbit or macroscopic fluid theory of plasma cannot be separated out from the field of 'plasma astrophysics.'

Finally, one wonders what the author means by modern plasma physics when he states in his introduction to plasma theory that modern plasma physics is based on kinetic theory. The plasmas (of any kind), depending on the specific problem to be solved, can be defined by any of the three mathematical descriptions: orbit fluid or kinetic. The introduction to plasmas in volume 1 lacks this concept. It would have been better and would have helped in easy reading of the books if all the three descriptions of plasmas were given in the introductory chapter. The author actually uses all these theories in volume 2 for topics related directly to astrophysical applications.

Overall, the author has succeded in giving a well-balanced account of plasma processes which are necessary to understand the basic theory of plasma astrophysics.

Department of Applied Mathematics
Indian Institute of Science
Bangalore 560 012.

C. UBEROI

Mean-field magnetohydrodynamics and dynamo theory by F Krause and K H Rädler, Pergamon Press Ltd., Oxford, 1981, pp. 271, $ 36.

Hydrodynamic turbulence is already so complex a phenomenon that it has to be studied using mathematical definitions and assumptions whose physical meaning may not be obvious to a beginner. Mean-field magnetohydrodynamics deals with magnetic field in the presence of turbulence in a conducting fluid and, therefore, inevitably involves what may appear a mathematical jargon.. Its initial formal development which took place in late sixties was mainly in the German language. Although an English translation of the original papers was available since 1971 (Roberts and Stix, NCAR Technicall Note No. IA–60), a 'systematic introduction' to the basic theory of mean field magnetohydrodynamics must have been missed by many interested physicists. On the other hand, applications of the theory, which deal mainly with astrophysical dynamo problems, have proliferated at such a rapid pace that a 'survey' of these applications was also long over due. Both these long-standing complimentary needs have been fulfilled in this book, fortunately by two pioneers of the initial formal development.

The distribution of the topics in the systematic introduction of the basic theory over the first ten chapters as well as the distribution of applications surveyed in the remaining

seven chapters follows a neat logical order. The maize of mathematical definitions, assumptions and approximations, along with their physical content, are made as lucid as possible. In this attempt the language has become somewhat dull and at times somewhat queer (*for example* : "....all suppositions will apply which are necessary for its justification...." on p. 13).

When it comes to applications, the validity of the assumptions and approximations in the real systems are not discussed critically. For example, Piddington's well-known criticism on the applications of the theory to astrophysical (and especially solar) dynamos is not even referred to. The 'back reaction of the magnetic field' is discussed only in one out of the ninetyeight sections in the seventeen chapters. The theory and the applications are thus almost wholly kinematical, and hence the term 'magnetohydrodynamics' in the title is not entirely appropriate.

In spite of these short-comings, the book will be an extremely useful addition to the literature in magnetohydrodynamics and astrophysics.

Indian Institute of Astrophysics.
Bangalore 560 034.

M. H. GOKHALE

Electromagnetic fields by R. V. Buckley. Published by Macmillan Press, London, 1981, pp. 164. (PB) £ 4.50.

The book will form a very good supplementary reading material for a course on electromagnetic theory. It contains a good sample of worked examples and problems of varying difficulty. covering the broad field. For example, the chapter on electromagnetic waves contains a 3-page summary of the main results. 21 pages of detailed working of about 10 problems and a further set of 11 problems, all on the same topic This gives an idea of the type of material presented in the book. This series of books concentrates on teaching by means of worked examples, with a brief introduction of the theory. A selection of problems are then given with answers for the students to solve and thereby get a better grasp of the subject. From this stated objective, the book must be considered a good addition to the literature on the topic.

The sequence of the chapters is however a little unusual and is obviously dictated by other considerations. The first chapter is on electron ballistics before the second chapter on electrostatic fields. Similarly, the third chapter on electromagnetic theory comes before chapter 4 on electromagnetic induction. The fifth chapter on electromagnetic waves and the sixth one on guided waves are on a more logical sequence. There is a 2-page appendix on Stokes' theorem and a brief bibliography of eight books for further study. In a book of this nature there is no appendix. The reviewer would have however liked a brief appendix. because some of the worked examples concern

themselves with important applications or themes. Also a chapter on magnetostatics would have given a sense of completeness to this book.

However, each book is written to suit a particular audience, who dictate the coverage. This book is aimed at the electrical engineering undergraduate students, though some of the problems and examples are indeed tough and more appropriate of our post-graduate levels. In the Indian scence, it would cater to the B.E./B.Tech. students in a good way, especially in the electrical electronics/telecommunication streams.

The book is well produced and free of obvious slips or mistakes. The editorial work and printing are good. It is interesting to note that the book has been printed in Hong Kong. If it were to appear in the low-priced Indian edition, it would have a considerable market. As it stands, the price of £ 4.50 puts it out of the reach of most Indian students.

Department of Physics
Indian Institute of Science
Bangalore 560 012.

E. S. R. GOPAL

Molecular motion in polymers by ESR edited by Raymond F. Boyer and Steven E. Keinath. MMI Press Symposium Series Vol. 1. Harwood Academic Publishers, New York, 1980, pp. 340, $ 44.

Magnetic resonance has by now become an established technique for studying molecular motions in all states of matter. The wide range of situations that can be usefully studied is a consequence of the wide variety of microscopic interactions possible for nuclei (NMR and NQR) and unpaired electrons (ESR). This book deals mainly with ESR studies.

Polymers have always been an active field both for basic researchers, and applied scientists. The relation between microscopic properties and long range correlations in these systems continue to be actively studied. This is where studies of molecular motion, reactivity, and structure in these systems by ESR using spin label and spin probe techniques yields insights that are not available by other methods.

The book presents the collected proceedings of an international conference held in 1978 at a time when the field had acquired firm foundations, and was already in a period of dynamic growth. Thus the reviews, and other papers in the book are particularly valuable to all workers in the field now, and for a few years to come.

The introductory chapters provide self-contained reviews of the background to ESR techniques, instrument capabilities, and spin labelling methods. The original articles and discussions covney to the reader the wide range of studies possible in both polymer solutions and in the solid state. The chapters on new techniques could well be interesting reading for a much wider readership than just those interested in polymers.

The book is not only a timely specialist publication for polymer scientists, but also a good source of information on spin labels and spin probes for all ESR practioners.

Department of Physics
Indian Institute of Science
Bangalore 560 012.

R. SRINIVASAN

Radiation protection by the Commission of the European Communities. Harwood Academic Publishers, P.O. Box 786, Cooper Station, New York 10003, 1980. $ 130.

This is an annual progress report of work on radiation effects and protection, under contracts between the Commission of European Communities and various research groups. The topic has assumed great importance since the advent of nuclear energy and the present report covers the main aspect:

(*a*) Methods of reduction of radiation exposure.
(*b*) Effective means of acting and treatment of accidental acute radiation dosages.
(*c*) The control of general environmental radiation.

The radiation dosimetry with simulated structures (phantoms) yields a picture of the dosage distribution in the different regions of the body. A number of projects refer to methods of radiation dosimetry, and include newer methods as lyoluminescence in many classes of organic compounds in addition to classical methods based on thermoluminescence (TLD).

Another series of projects deals with radioactivity contamination of the environment and the projects relate to the measurement and effects of radiations on soil, oceans, plants and bacteria, their chromosomal and other biologic effects, the hereditary effects of ionizing radiation, including the genetic effects—mutation, DNA damage and repair and other radiobiological effects.

The somatic effects of the ionizing radiations are themselves discussed in terms of :

(*a*) the short term effects, which deal mainly with the treatment of the pathological effects of high dosage radiation.
(*b*) The more long term somatic and other effects.

Newer techniques, *e.g.*, Compton-scattering tomography (with 90° Compton-scattering of γ-rays) supplement those of X-ray tomography and their applications are described.

The progress reports of the various contracts are highly informative and very useful to workers in the field.

Department of Physics
Indian Institute of Science
Bangalore 560 012.

V. S. VENKATASUBRAMANIAN

Radioactive waste management and disposal edited by R. Simon and S. Orlowski. Harwood Academic Publishers, P.O. Box 786, Cooper Station, New York 10003, USA. 1980. S 82.

The management and disposal of radioactive waste products is of great importance in view of the increasing use of nuclear power plants for energy production, necessary at least for the next few decades, as the newer energy sources are either imperfectly developed, economically not viable, etc. This book which represents the proceeding of a conference on this topic organized by the European Economic Community (Luxemberg 1980) deals with the disposal of the waste products of nuclear energy production, to ensure the safety of the environment, and the health of the community.

The classical (and perhaps commonsense !) method is that of 'dilution- release.' As pointed out in the Conference, we are living with this—the nuclear test explosions have released about 16 Mega Curie of ^{137}Cs, and about 25 mega Curie of ^{90}Sr over a 10-year period (and 4 tonnes of plutonium too, as a bonus !). A number of papers deal with this low and medium-level waste, as well as the conditioning and treatment of gaseous wastes (*e.g.*, ^{85}Kr, etc.) of the waste from 'cladding' of fuel elements from reactors, etc. The other method of disposal comes under the broad head of 'concentration-confinement.' A number of methods of treatment and packaging have been covered in the various papers—incorporation in concrete, or in thermosetting resins, immobilization in bitument, vitreous material (*e.g.*, borosilicate glasses), etc. A number of papers deal with 'alpha-waste' with confinemetnt of the short-range alpha particles. These, however, have a long half-life, and various possibilities have been considered, *e.g.*, conversion of the long-lived actinides into fission products of short half-life by neutron irradiation, etc.

Another important problem relates to the final disposal of the radioactive waste. Apart from exotic schemes, as ejection by rockets outside the earth's gravitational field, the current practical ones relate to disposal under stable deep strata on land or under the sea-bed. Various aspects of this problem are discussed *e.g.*, clay formations with admirable adsorptive properties, hard-rock formations with low permeability to solutions, problems of engineering technology, but with advantages of temperature stability, etc.

Also of importance is a study of the leaching by solutions of the various radionuclides, and the monitoring of the activity level by particle and radiation detectors, and detectors of integrated flux. The volume provides comprehensive and up-to-date information in this area and is strongly recommended.

V. S. VENKATASUBRAMANIAN

Department of Physics
Indian Institute of Science
Bangalore 560 012.

Ordinary differential equations and stability theory by S. G. Deo and V. Raghavendra. Tata McGraw-Hill Publishing Company Limited, New Delhi, pp. 244 (PB), Rs. 16·80.

Ordinary differential equations play a fundamental role in many branches of science including social science. Unfortunately, only a very few of these differential equations can be solved in terms of known functions. This necessitates the development of the qualitative analysis of differential equations and accordingly this has been one of the central topics of research in recent years. The book under review presents a brief introduction to the subject in a very lucid manner, keeping the pre-requisites for it to the minimum.

The first three chapters of this book deal with the classical theory of ordinary differential equations (o.d.e.) and the fourth chapter deals with systems of linear differential equations. Chapter Five presents the existence and uniqueness of solutions of an o.d.e. as well as systems of o.d.e. The qualitative analysis of differential equations starts with Ghapter Six where the oscillation properties have been discussed. In Chapter Seven the theory of classical Sturm-Liouville problem has been presented. Chapter Eight mainly deals with the behaviour of linear differential equations with a passing remark on critical points of non-linear systems. The discussion on stability theory to non-linear systems comes in Chapters Nine and Ten with an eye on its application to control theory. The book contains many illustrative examples both worked out as well as to be worked out. The bibliography, however, could have been made much longer and this would have undoubtedly helped the readers in their future studies.

Department of Pure Mathematics
University of Calcutta, Calcutta 700 019.

JYOTI DAS

Continuum mechanics by A. J. M. Spencer. Longman Mathematical Texts, 1980. pp. 183, £ 5·30.

This is a delightful little book consisting of about 168 pages of text material and 3 pages of Appendix. According to the author, the aim of the book is to provide an introduction to the theory of continuum mechanics in a form suitable for undergraduate students. The author has successfully achieved this aim. Starting with a brief introduction to matrix and cartesian tensors, the book covers materials on particle kinematics, stress, motions and deformations, conservation laws, linear constitutive equations, analysis of finite deformation, non-linear constitutive equations, and cylindrical and spherical coordinates. At the end of each chapter, there are a few problems for which answers are given.

The arrangement of the material is quite logical and the book is easy to read. The notations adopted and the figures used to explain are appropriate. The book can

be adopted as a text for undergraduate engineering courses. Senior undergraduate and post-graduate students of engineering can easily use this as a self-study book.

Department of Mechanical Engineering
Indian Institute of Science
Bangalore 560 012.

L. S. SRINATH

Coalition and connection in games by Silviu Guiasu and Mircea Malitza, Pergamon Press. Oxford. 1980. pp. viii + 156. $ 28.

This book presents an excellent account of the main problems and solution concepts of modern game theory. Starting with the two-person zero-sum and two-person nonzero-sum games, the authors discuss how radically the situation changes with the addition of one more player—the possibility of coalition formation. Thus while saddle points since they are both interchangeable and equivalent) give the solution to a two-person zero-sum game, there is no universally acceptable solution concept for other types of games. This embarassing diffusion is sometimes euphemistically termed richness of solutions. Each solution concept requires additional assumptions and logic which can be viewed as the application of a super criterion. Thus various solution concepts such as the characteristic function, von Neumann-Morgenstern solution, Shapley valve, Aumann-Maschler theory have all been well presented and critically examined.

There are well-known difficulties/shortcomings of game theory arising from different factors : One is structural, because of the multi-criteria-multi-decision-maker environment, variety of possible information structures and communication aspects among players. These are common to some large-scale system problems. Second is that the game formulation in terms of strategy sets and performance indexes is incomplete. The information, communication and side paymets aspects are outside this structure. A related difficulty is that the normal form of a game clouds the dynamics and evolutionary nature of the game. This also makes the solution concepts appear static. Yet another facet is the interrelation between game theory on the one hand and rationality, utility and social dynamics on the other.

The authors use information theory aspects to measure the interaction, the connection between the components of the game or system. The degree of organization is defined as the difference between the sum of entropies of the system components and the entropy of the whole. Such a measure allows selection of an optimal proper coalition essential to the evolution of the game. Also a rational player is assumed to maximise not only his mean utility but the uncertainty of his actions. This gives rise to the concept of surprise to other players whenever he changes his random strategy. This brings out the evolution of the game along with learning and prediction.

The book is self-contained and readable. The mathematics is kept low. For the first time methods belonging to systems theory and information theory are used in game theory. The book is recommended for students of mathematics, mathematical sociology, coalition theory and behavioural psychology..

School of Automation
Indian Institute of Science
Bangalore 560 012.

U. R. PRASAD

Experiments in environmental chemistry—a laboratory manual by P. D. Vowles and D. W. Connell. Pergamon Press, New York, 1980, $ 9·95.

During the last decade, the growth and interest in environmental protection have been tremondous as evidenced by the number of scientific papers and books published and new courses that have been instituted in universities. Amongst the various aspects of environmental degradation which have a direct impact on the living species including man, air and water pollution, food contamination, noise and odours have attracted attention. Any concerted effort in pollution control and environmental management calls for a detailed understanding of the underlying phenomena and precise methods of estimating environmental impacts. Many manual and instrumental methods of analysis have been evolved in recent years for the estimation of a variety of pollutants. These are essential not only for evaluating the extent to which the environment has deteriorated but also to assess the effectiveness of any control technique. It is in this context that this book is very timely. It caters to a variety of needs like a laboratory manual for analysis, for planning field surveys and for introductory courses in environmental chemistry.

The experiments have been divided into five parts : Biochemical processes in aquatic systems, toxic substances in the environment, food additives and contaminants, chemical ecology and field surveys. For a laboratory manual, the present one is rather limited in scope since many other aspects such as pollution from a variety of industries, pollution from automobiles, etc. have been ommitted. However, the subjects that have been included have been dealt with in a precise manner and the experiments have been described in such a way that these could be carried out without any difficulty.

Inspite of the limited scope, this manual should be very useful for those teaching courses in environmental chemistry and for those involved in pollutant analysis such as industrial laboratories, public health authorities, research institutions and so on.

Department of Chemical Engineering
Indian Institute of Science
Bangalore 560 012.

M. RAVINDRAM

Principles of mineral behaviour by A. Putnis and J. D. C. McConnel, Blackwell Scientific Publications, Oxford. 1980, pp. x + 257, £ 9·80.

A text book on mineral behaviour has broader relevance to different disciplines of Earth Sciences. One may expect, quite naturally, such a text book to contain various processes which the minerals undergo depending on pressure and temperature changes, or under the influence of variation in chemical environment. Thus, a general treatise on this topic should not only deal with minerals under cooling and consolidation of igneous rocks but also under metamorphic conditions, sedimentary processes as well as chemical weathering. Thermally activated processes in minerals alone are too limited in application for the wider arena of evaluation of various rock types. The text book hardly reaches this expectation. As from the contents, the text book could have been better titled Mineral Transformation or Phase Transformations in Minerals. Having accepted the limitations of the book, by way of contents, it can be a good source for those who seek to have the basic concepts in mineral transformations, except that the chosen minerals, as examples, are limited to the current interests of the authors. All the more this limitation is glaring because the book does not demand any background knowledge in crystallography or thermodynamics necessary to understand the microstructural and atomistic approach in transformations.

The book is divided into nine chapters : the first one being introductory, stating the problems and the modes of approach. It is intended, as stated in the text, that the sequence of chapters parallels the processes during the cooling history of the minerals from high temperature. However, the second chapter, titled 'Minerals at high temperature' considers only randomness as the criterion for high temperature behaviour of minerals. It is hard to judge what a beginner can comprehend from such a singularly motivated treatment. The third chapter is routine and can be found in any text book on mineral chemistry. The basics of thermodynamics (Chapter 4) is nothing but a casual treatment on random aspects of this multifaceted topic which is vital to most of the disciplines of physical sciences. The processes in minerals, the subject-matter of Chapter 5, essentially deal with the structural and thermodynamic aspects of phase transformations in minerals. The subsequent chapter is utilised to present the kinetics, the driving force and the activation energy barrier of transformation as well as the formation of metastable phases. Through the remaining three chapters, the authors look at a few selected mineral transformations in some detail. The emphasis is on mineralogical aspects of pyroxenes, feldspars and sulfides, including exsolution processes, and kinetics-dominated metastable transformations. These are documented with well chosen electron micrographs to illustrate the changes in microstructures. The treatment in the latter chapters of the book is certainly interesting to students of mineralogy with respect to transformations.

The book is written in a straight forward language with little distraction. It provides appropriate information to generate interest in transformation mechanisms. However, from the contents, the book falls short in showing the reader 'the wood rather

than the trees' with respect to mineral behaviour, to be useful in evaluating the complete range of geological events and chemical environments.

Department of Inorganic and Physical Chemistry
Indian Institute of Science
Bangalore 560 012.

T. R. N. KUTTY

A panorama of the world of oils by H. G. Muralidhara. National Education Society, Balaraj Urs Road, Shimoga, Karnataka, pp. xvi + 320, Rs. 15.

While there are many excellent monographs on different aspects of oils and fats by foreign authors such as Lewkovitsch, Jamieson, Hildrith, Bailey, Eckey, Markley, Martinenghi, Bernardini and others, few are found by Indian authors except a general text book on oil technology by Vidyarthi and a tome on cottonseed chemistry and technology by Murti and Achaya.

The book under review fulfills, to certain extent, this lacuna. The author does not claim absolute orginality but says it is not mere compilation but embodies results of many years of his practical experience in the field.

In view of the use of word 'oil', there appears to be a natural temptation to give information on different materials called 'oils', namely, non-essential oils or fatty oils, essential oils or scent-bearing oils and mineral oils or oils from underground. While the information on former two oils is useful to one set of information-seekers, that on mineral oils would not be useful to them.

Chapter II on oilseed-bearing plants, IV on oil from animals, V on oils of perfume are highly interesting and useful and function as ready reference to even seasoned active researchers. Chapters III on oil extraction methods, IV on oil structure and composition, VIII on oil technology, IX on oil role in industry would be useful to students and candidates appearing for interviews. Chapter XII gives useful statistical data on oils. I think that Chapter XI, oils and fats—technical data at a glance, could have been integrated with Chapter II, oilseed-bearing plants.

Although the author has put in large amount of diligence in collecting data, he could have given specific Indian work on such subjects as tea seed, coffee waste, tung seed, jute seed, sunflower, watermelon seed, etc. There are illustrations of several oilseed bearing plants, a commendable feature of the book.

The author would have avoided such popular fallacies as "When Aryans entered India" or redundancies as "It (sunflower oil) contains no cholesterol", since no vegetable oil contains cholesterol.

There is scope for better editing in view of the spelling mistakes and capital letters for common nouns in the middle of a sentence. In spite of such minor defects, the

book is well printed. The format is handy and priced modestly within the reach of students and researchers.

The author and the publishers have done great service to oil technology by bringing out this publication which would prove a *Vade mecum* on the subject.

Oil Technological Research Institute
Anantapur 515 001.

S. D. THIRUMALA RAO

Coal deposits by J. H. Tatsch. Tatsch Associates, 120, Thunder Road, Sudbury, Massachusetts 01776, USA, 1980, pp. 590, $ 156.

In view of the depleting sources and escalating prices of oil and gas, and consequent energy crisis, coal being the most abundant fossil fuel, has assumed very great importance in meeting the ever increasing energy needs of the world. However, even coal is becoming increasingly difficult and expensive to explore and exploit, and it is necessary to make all-out efforts to understand better than we do now, the origin, evolution and characteristic features of coal deposits. Against this background, the appearance of a book like "Coal Deposits" by Tatsch is very timely.

According to the author, it belongs to a series of books written by him on natural resources of the world. However, it differs from his earlier books in being more detailed and comprehensive than the companion volumes entitled 'Petroleum Deposits', 'Uranium Deposits' and 'Geothermal Deposits'.

Chapter 1 analyses the origin, evolution and geographical distribution of coal. The factors affecting rank of coal are also discussed in detail. In Chapter 2 we find figures showing how different countries share total world coal resources and reserves. USSR heads the table with an estimated total coal resources as much as 9 trillion tons.

In Chapters 3 and 4, the author digresses from the main topic, to explain his concept of Tectonospheric Earth Model and shows how the Earth's present surficial features and phenomena can be understood in terms of the seismotectonomagmatic (STM)-belt concept of the Tectonospheric Earth Model. The STM belts are certain elongate belts on the surface of the earth, which are characterized by varying degrees of seismic, tectonic and magmatic activity. According to the author, today's coal deposits are associated with the present network of STM belts as well as with vestiges of former STM belts. In general, coal deposits of a particular geologic period formed within low-lying vestiges of earlier episodes of STM belt activity, that were filled by material eroded from higher lying vestiges during that period.

Chapters 5-8 contain detailed description of the coal deposits of the Precambrian, Palaeozoic, Mesozoic and Cenozoic periods respectively. Besides describing the coal deposits of different continents, the author has tried to show the relations of these deposits to the STM belts. From Chapter 5, we learn that the earliest 'true' coals

formed from algae during the early-mid proterozoic, in northern Michigan (USA) and southwestern Greenland. However, very few precambrian coals are known today. From Chapter 6, we learn that coal deposits formed during the carboniferous time are most abundant and comprise about 2/3 of the world's coal supplies. In Chapter 8, we are told that much of the Cenozoic coal deposits now found on earth are in the form of peat and lignite.

Chapter 9 gives many interesting figures regarding the present distribution of coal deposits. It is interesting to note that (i) the world's coal reserves are estimated to be about 30 trillion tons and (ii) with 0·1 trillion tons of reserves, India ranks 8th in the list of 10 nations having the largest total geological reserves of coal.

The last chapter (Chapter 10) deals very briefly with modern exploration techniques for coal. Here, the author suggests that his concept of Tectonospheric Earth Model should be used as a supplementary geological tool in the coal exploration.

A brief exposition of the author's new concept of Tectonospheric Earth Model is added in Appendix.

The information on the various coal deposits of the world given in the book is up-to-date and contains enough details to be useful to researchers as well as students of coal. The author's analysis of the origin, evolution and present characteristics of coal deposits in terms of his Tectonospheric Earth Model is new and this has been emphasized with sufficient force in the book. The bibliography is very elaborate.

National Geophysical Research Institute
Hyderabad 500 007.

M. PODDAR

Published by T. K. S. Iyengar, Executive Editor, Journal of the Indian Institute of Science, Bangalore 560 012 and printed at the Bangalore Press, Bangalore 560 018