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BOOK REVIEWS

Niels Bohr: The man, his science, and the world they changed by Ruth Moore. The MIT Press, 55, Hayward Street, Cambridge, Massachusetts, 02142, USA, 1985, pp. 436, $11.44. Indian orders to: Affiliated East-West Press Pvt Ltd, 25, Dr. Muniappa Road, Kilpauk, Madras 600 010.

Niels Henrik David Bohr was one of the three physicists who showed the way and bridged the transition from the world of classical physics to the quantum world. The other two were, of course, Max Planck and Albert Einstein, respectively, twenty seven and six years older than Bohr. However, in many ways, and notwithstanding the crucial insights due to the more senior men, one really thinks of Bohr as the carrier and spokesman of the finally completed quantum theory, since it was he who much more than the other two struggled to fashion a new philosophy and epistemological view point to accommodate the new world view offered by quantum theory.

This biography of Bohr by Ruth Moore is a very well-written book which does justice to the great gifts and human qualities that made Bohr the giant that he was. His was an unusually rich life, in which he was able to directly help the growth and flowering of many outstanding talents from many parts of the world. One realizes in reading this book how much he was influenced by being born into a highly distinguished and academically oriented family in a small country—the values of goodness, scholarship and a thoroughly supportive environment evident at every stage of his life. (And one cannot help remembering at the same time how different life was in these respects for Einstein). Probably the fact that Denmark is a small country made it that much easier to be encouraged from the very beginning to study and admire the English and the German scientific traditions, which is just what occurred in Bohr's case. In particular, his extremely close relationship with Rutherford at Manchester in the most crucial and formative stage of his career is clear evidence of this, his deep affection and feeling for the English.

We read with great interest of his early years at school and then university, the scholarly atmosphere at home in which he grew up, the brief stay in Cambridge with the unfulfilled hope of interacting with J. J. Thomson, and then the move to Manchester. Then follows the period of the three great papers—which achieved a synthesis of Planck's and Einstein's ideas when applied to the structure of matter—and the years when, after some initial skepticism, the Bohr theory was universally accepted as a truly fundamental advance. One reads of the progress of physics in the midst of war, the founding of the Institute of Theoretical Physics at Copenhagen, followed soon after by the award of the Nobel Prize in 1922. At the same time we are aware of the tremendous experimental advances being made by Rutherford and those around him in piercing the atom. The features of Bohr's Institute that made it absolutely unique—openness, collaboration, gentle guidance from the Master, and the collective search for understanding—a rebirth after many centuries of Plato's academy, these are features well worth remembering again and again in these days.

By this time, a younger generation—Kramers, Pauli, Heisenberg, Dirac—had come up; and in this period after 1925 and the birth of quantum mechanics, Bohr played the role of guide, philosopher and assesser of the wider impact of the latest developments both within science and in a broader

framework. Moore's book describes the many sessions at the successive Solvay conferences at which the Einstein-Bohr dialogue was conducted; these are stirring accounts indeed from human and psychological points of view. In some respects one sees emerging a basic difference between Einstein and Bohr; while after a certain stage the former more or less withdrew into himself as far as contemporary science was concerned, the latter continued all his life to work with many younger people, and kept in close touch with experimental advances. This is what enabled him to come up with the compound nucleus hypothesis in the 30s, and soon after with the theory of the fission process.

The description of the war years is quite gripping as it shows in detail how hard Bohr tried 'alter the course of history' a second time, after realising the power of large-scale nuclear fission. In a sense, this part of the book is more satisfying than the earlier more scientific part as it is written by a nonspecialist for a general audience. The many meetings with high government officials, the interview with Roosevelt followed by the disastrous one with Churchill, and even thereafter his persistent efforts to guide global political thinking in the direction of international cooperation and openness to avoid an atomic arms race, show us most clearly the nature of the man, his vision and how much it encompassed.

All in all this is a fine biography of a marvel of a human being. It captures well Bohr's largeness of heart, compassionate and human nature, the care and concern he brought to all his work as well as to his helping so many around him to grow. And in so many instances we are also told about his quaint and unusual methods of working, writing and lecturing, his deep philosophical concerns about the natures of science, language, understanding, communication and society. It would seem that the world of science has changed irreversibly and it is unlikely that we will ever again witness such a personality, from so modest but complete a background, who was able to unite, inspire and teach so many. But it is good to be reminded, and so well, that there was one such not long ago.

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Collected papers of J. Glimm and A. Jaffe, Vol. I: Quantum field theory and statistical mechanics, expositions, and Vol. II: Constructive quantum field theory, selected papers, Birkhäuser Verlag, P.O. Box 34, CH-4010, Basel, Switzerland, 1985, pp. Vol. I: 418, Vol. II: 533, S. Fr. 328.

Quantum field theory was introduced in the 1920s to combine together the two pillars of twentieth century physics—quantum mechanics and the special theory of relativity. In the following sixty years, the theory has developed spectacularly both in the depth of its conceptual foundations and in its ability to correctly describe the world of elementary particles and their interactions. In spite of these successes, certain aspects of the theory have always troubled its practitioners. These aspects have to do with the infinities or divergences inherent in the theory. These infinities can appear from long-distance correlations, from short-distance singularities (these are due to the infinite number of degrees of freedom present in any field theory and are normally cured by a prescription called renormalisation), and from large orders in perturbation expansions (leading to divergent series expressions for physically measurable quantities). While physicists developed a set of working rules to counter all these difficulties, mathematicians were left feeling extremely uneasy.

In the 50s, A. Wightman, R. Haag and others began a programme called constructive or axiomatic field theory to put everything on a mathematically rigorous foundation. The programme was initially

limited to showing that consistent and nondivergent quantum field theories could exist. Most of the examples given thereof were in the physically uninteresting regime of two and three space-time dimensions. In the 70s, however, interesting four-dimensional theories began to be analysed from this point of view. This advance owed much to the concurrent growth in our understanding of statistical mechanics and critical phenomena. The connection that exists between statistical mechanics models at their critical points and quantum field theories is a profound one and it has led to an immense enrichment of both the areas.

J. Glimm and A. Jaffe are two of the foremost workers in constructive quantum field theory today. In a series of papers since the 60s, they have made immense contributions, both fundamental and expository. The selection of papers presented in these two volumes will introduce the reader to many of the ideas and technical tools which are needed to begin working in this subject. The prerequisites for reading these books are an M. Phil. or Ph.D. level exposure to quantum field theory (including path integrals) and functional analysis in Hilbert spaces. The topics covered in Volume I include a variety of bosonic field theories in two space-time dimensions, high-temperature or weak-coupling cluster expansions, the spectra of stable and unstable particles, and some discussion of the critical phenomena/quantum field theory connection. In Volume II, the important idea of phase-cell localisation is illustrated in various field theories. This method enables one to separately study a few of the infinite degrees of freedom at a time. Following this, the authors continue their exposition of critical behaviour and its application to bosonic ϕ^4 theories in various dimensions. These are the simplest, interesting and nontrivial theories. Two, three and four dimensions are each studied in some detail. They prove that as the various coupling constants are changed, phase transitions can occur between a symmetric phase and an asymmetric phase. Bounds on the physical value of the quartic coupling constant are then derived. They do not discuss the important recent result that in four dimensions, the bound is actually zero and that the ϕ^4 theory is therefore trivial. This has implications for the modern theory of electroweak interactions.

This brings me to a certain criticism of these volumes. Although published in 1985, they do not describe the important advances made after 1980. The triviality of ϕ^4 mentioned above is perhaps the most significant of these. While these books are quite useful as they stand, they would have been for more so if the Editor had commented in a footnote on the most important works of other researchers in this field. The reader should take this collection to be a stepping stone to understanding the vigorous developments which are now taking place. These are continually bringing this previously esoteric branch of mathematical physics closer to the mainstream of physics.

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Iterative aggregation theory: Mathematical methods of coordinating detailed and aggregate problems in large control systems by L. M. Dudkin, I. Rabinovich and I. Vakhutinsky. Marcel Dekker Inc., New York, 1987, pp. 273, $89.75.

Optimization methods concerned with many real-world planning problems often lead to large-scale mathematical programming models, the global solution of which is computationally difficult due to the associated size complexities. These complexities have led to the development of many iterative approaches aimed at optimal or near-optimal solutions to such problems. Potential applications such as those in cutting-stock problems of the paper, log and steel industries and inter-product and inter-industry input-output analysis of economic systems have aroused interest in the development of

appropriate algorithms to these models. The column-generation method of Gilmore-Gomory and the decomposition principle of Dantzig-Wolfe are some classical examples of early iterative algorithms in which the special structure of the model is exploited. Following these developments, considerable research attention has been focussed on the solution of large-scale optimization models using aggregation principles.

Many planning processes at the macro-economic or hierarchical organisation level involve several sub-systems. Generally, these planning problems are associated with a set of global resource constraints at the central level which are related to the sub-systems. Additionally, the decision-variables of the sub-systems are also constrained by local limitations and policies. The optimization of the factors at the sub-systems (decentralized decisions) need not necessarily give the global optimization results of the overall system (centralized planning decisions). The integration of all these constraints in an overall modelling framework leads to large optimization systems with block angular and coordinating structures. This book presents several iterative aggregation algorithms for solving such systems.

The book is divided into three parts, each containing two chapters. The first part begins with a brief introduction to the general methods of solving systems of equations and extremum problems. The nature of decomposition methods and some traditional algorithms to tackle them are presented in chapter two.

In part two, a series of iterative aggregation algorithms for solving the general system of equations is presented. The class of models associated with inter-product input-output analysis is described in the third chapter. This is followed by a set of aggregation algorithms for solving large-scale general linear systems.

The third part of the book is devoted to special algorithms for solving large-scale extremum problems. In chapter five, methods for solving unconstrained optimization problems based on one- and two-level aggregations and conjugate gradient methods are presented. Constrained optimization problems are considered in the last chapter Methods involving variable aggregation and constraint aggregation are discussed along with general schemes for constrained optimization.

A special feature of the book is the set of appendices provided at the end of each chapter in which detailed mathematical analysis and convergence properties of the various algorithms are presented. The book excels in its mathematical rigour The basis for coordinating solutions of aggregate models with those of decentralized sub-systems is well discussed. The development of some of the algorithms presented in the book is based on the actual macro-level planning exercises in the USSR, in which the authors were directly involved. In this framework, the authors have interpreted iterative aggregation algorithms as part of the planning process for national-level planning, although many traditional large-scale optimization models are associated with hierarchically managed organizational systems.

Perhaps a major drawback of this book is that it is totally void of examples. Although some interpretations are given in the planning context, numerical examples illustrating the efficiency of the algorithms would have substantially enhanced the value of the book. Notwithstanding this, the book would be useful to mathematical economists involved in macro-economic planning and those interested in algorithms for large-scale mathematical programming models.

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Graded orders by L. Le Bruyn, M. Van den Bergh and F. Van Oystaeyen. Birkhauser Verlag, CH-4010, Basel, Switzerland, 1988, pp. 208, S. Fr. 42. Indian orders to: Springer Books (India) Pvt Ltd, 6, Community Centre, Panchsheel Park, New Delhi 110 017.

The aim of this little book is to give a coherent account of orders graded by a group. Beginning with the definition of orders, the book ends with a classification of orders of global dimension too. The first chapter which is introductory in nature, deals with graded Krull domains, in particular graded Dedekind domains. The second chapter begins with a graded version of Goldie rings. It also deals with divisorial graded rings and a suitable analogue of the classical theorem of Artin-Rees. After a brief discussion of graded rings satisfying polynomial identities, this chapter deals with the work of L. Silver on tame orders over Krull domains in a suitable generality. Chapter III begins with the study of orders graded by a torsion-free abelian group. In the next section, results similar to those of Section 1 for orders graded by finite groups are proved. The chapter ends with an application of the theory of divisorially graded rings to the study of extensions of tame orders. The fourth chapter deals with regular orders. It is proved, for instance, using the concept of moderated Gorenstein algebras that such algebras of finite global dimension have an integrally closed centre which turns out to be Cohen-Macaulay in many cases. The generalised Rees ring constructions are then used to construct moderated regular orders. The last two sections of this chapter deal with the notion of graded Brauer groups over graded rings and the Brauer-Severi schemes of smooth maximal orders.

The final chapter considers orders of finite representation type. It is proved that the representation theory of two-dimensional tame orders is determined by a rational double point, together with the action of a cyclic group on its category of modules. A structure theorem for tame orders of such two-dimensional orders of finite representation type is also proved.

Though the topics treated in this book are rather specialised, the book is well written and pleasant to read. One must mention however that there are a fair number of misprints.

The get up of the book is excellent. Birkhauser too deserves praise.

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Lectures on air pollution modeling edited by A. Venkatram and J. C. Wyngaard. American Meteorological Society, 45, Beacon Street, Boston, Mass. 02108–3693, USA, 1988, pp. 390, price not stated.

Modelling of air pollution is assuming ever greater importance in the light of the exponential growth of industry. Effects of emissions from the stacks on the health, global motion of pollutants and their subsequent deposition at large distances from their place of origin, sudden release of toxic compounds into the atmosphere due to accidents, etc., are questions that bother the scientists, managers and planners alike. The basic ingredient that must go into any recipe that can provide the requisite answers is understanding of the atmospheric turbulence. Unfortunately, at the present, our knowledge of atmospheric turbulence is limited. What is more unfortunate is that even the existing knowledge is perhaps not effectively used by the industrial practitioners and air-pollution regulators.

The book under review is an attempt to trigger further improvements in air-pollution modelling as well as the use of such models, by 'elucidating today's understanding of the physics of the lower atmosphere and of dispersion within it, and demonstrating how this understanding can be used to solve practical problems'.

The first chapter is an overview of the structure of the planetary boundary layer (PBL). This forms the basis of the book and covers the stability and structure of PBL and its implications to air-pollution modelling. The next chapter reviews the field and laboratory-diffusion experiments and a critical analysis of the surface-layer similarity, convective scaling, and statistical theory approaches of interpretation of the data. The third chapter is about plume rise caused by buoyancy effects and the discussion is linked with the material presented in Chapter 1. The fourth and fifth chapters are about applications of the theory presented up to this point to dispersion calculations in the convective boundary layer and stable boundary layer, respectively. Both these chapters combine the practical approaches of calculation with the understanding developed earlier The sixth chapter develops further applications of air-pollution modelling to three topics; dispersion in the context of land-water boundary or coastal areas; dispersion in complex terrain; evaluation of models. The last two chapters are concerned with concentration fluctuations.

The articles are clearly written and despite the multiplicity of the authors, there is a coherence of presentation. The book will be of value to students and researchers as an up-to-date introduction to the topics covered from the view point of air-pollution modelling.

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Waste water technology—Origin, collection, treatment and analysis of waste water edited by W. Fresenius, W. Schneider, B. Bohke, K. Poppinghaus. Springer-Verlag GmbH and Co. KG, Postfach 105280, Tiergartenstraβe 17, D-6900 Heidelberg 1, 1989, pp. 1182, DM 178.

Waste-water treatment from the view point of eventual disposal or recovery is one of the major environmental problems faced by both the industrialised countries as well as those still on the threshold of development. This book deals with the formation, collection, analysis and treatment of waste waters from various sources. The main emphasis is on the municipal and industrial wastes in the urban locations since it is here that the major problems are faced. As a consequence this book does not address itself to low-cost and appropriate technologies relevant to small townships and villages in rural districts of developing countries.

The book is organised in ten chapters as follows: Chapter 1 is a brief introduction to classification, composition and effects of waste water on natural water bodies. Chapter 2 deals with the types and amounts of waste water from domestic, municipal and industrial sources. It is an exhaustive compilation of specific information on the average amount of waste generated and its composition in different industries. As many as 80 industrial wastes are listed. Chapter 3 on waste-water disposal in rural areas and small villages is just a statement and could have as well been omitted. Chapter 4 pertains to the collection and drainage of waste water. Different drainage methods, building components of drainage systems, and sewer construction, operation and maintenance aspects are dealt with in great detail. Various sewer layouts and design charts are also included. Chapter 5 lists the acceptable standards for various pollutants in waste waters. The general requirements and regulations for the direct and indirect discharge of industrial effluents are also discussed. Standards for sewerage systems are provided based on German, European and French experiences. Chapter 6 discusses the various physical, chemical and biological methods for waste-water treatment. Also included are techniques for handling and disposal of residues from waste-water treatment plants. Chapter 7 deals with some aspects of sampling, analysis and classification of waste water and sewage sludge. Experimental procedures and equipment requirements are covered very well. Topics included in this

chapter range from site inspection to chemical methods of estimating pollutants. Chapter 8 lists 195 references. However, most of these are reports from organizations such as WHO. Consequently unless the reader has ready access to these reports, the references will be of very limited use. Chapter 9 is a subject index, while Chapter 10 lists supplements. This section spells out the need and guidelines for planning and implementation of bilateral cooperative projects on water supply and sanitation in developing countries.

One of the primary needs in any attempt to reduce the prevalence of water-borne diseases is an integrated approach linking the supply of hygeinic drinking water, sewage disposal and sanitation. For such a coordinated approach one requires detailed information on the prevailing waste-water treatment technology, design procedures and specific case histories in as comprehensive a manner as possible. The authors of this book achieved precisely this objective. The book does an excellent job of compiling data on the origin, collection, analysis and treatment of waste waters emanating from a variety of industrial operations. Though the technology of waste-water treatment is discussed rather superficially, it could not be otherwise considering the wide coverage the authors attempted. An in-depth treatment of the subject would perhaps have resulted in an additional volume, since the book as such contains more than 1100 pages. The book contains a wealth of information on waste-water treatment and should serve as a ready reference source for practising engineers. While it may have limited use as a class-room text book, it will be ideally suited as a guide to consultants, civil and environmental engineers, civic authorities, and statutory bodies involved in waste-water treatment and management.

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Flow injection atomic spectroscopy edited by Jos'e Luis Burguera. Marcell Dekker, 270, Madison Avenue, New York, NY 10016, 1989, pp. xii + 353, $150.

Flow-injection analysis, ever since its introduction in 1970, has grown at an unprecedented rate because of its simplicity, rapidity and versatility. More than 1400 research papers and reviews have appeared in analytical journals on the coupling of FIA with infrared, UV-VIS spectrophotometry, fluorescence, flame emission, chemiluminiscence, atomic absorption, thermochemical and electrochemical analysis. The author's efforts to present flow-injection atomic spectroscopy is most laudable since it is the first to deal with a selected field and also because atomic spectroscopy is one of the most elegant techniques for the direct and indirect assay of more than 70 elements in trace and ultratrace quantities.

When dealing with hyphanated techniques such as the above, usually there is the danger of more elaborate treatment of one technique at the expense of the other, depending upon the author's experience and preferences. This could be a serious handicap in the proper thematic development of the subject. Fortunately, this book avoids such a trap by dealing with adequate theoretical concepts of both the techniques coupled with instrumental aspects. The introductory first and second chapters deal with the basic FIA systems highlighting the common FIA problems and various modifications usually employed to overcome the same. Theoretical aspects of the various flow properties in FIA systems required for an adequate understanding of the technique are described in a concise manner. Chapters III, IV and V deal with the instrumentation, basic components and the design of FIA-AS systems including the automation possibilties. Specific details are provided for the preconcentration and isolation of the analyte elements. From analytical point of view, Chapter IV is the most rewarding

since actual interfacing of FIA to atomic-absorption spectrometers is described with special reference to sample introduction, dilution techniques and calibration procedures as applicable to flame, hydride generation, mercury cold-vapour technique and multielement analysis. The main advantage of this coupling appears to be in sample introduction and online treatment of the analyte. However, it fails to emphasize the potentiality of FIA-AS systems for methods development and separation techniques.

One of the criticisms levelled at FIA-AAS is the relatively low sensitivity as expressed by characteristic concentration. This aspect deserves to be more critically examined by adopting peak-area measurements of which several commercial instruments are capable of. Certainly a slight sacrifice in sensitivity is justified when compared with the advantages of increased sample throughput and high tolerence of salt content (*e.g.* determination of cadmium in 25% magnesium chloride solution and copper in 40% urea-potassium hydrogen phosphate samples: p. 112).

Chapter VI describes the application of FIA-AS for the analysis of sodium, potassium, calcium, magnesium, iron, aluminium, etc., in agricultural and environmental samples. The available literature on the potentialities of employing the partially overlapping zones for the wide-range determination of metals and elimination of interfaces is well presented.

Chapter VII is a comprehensive review of FIA–flame-atomic absorption spectroscopy to clinically relevant elements such as copper, zinc, iron, lithium, sodium, potassium, lead, cobalt, manganese, etc. It must, however, be admitted that in spite of the several advantages of such systems, clinical chemists seem to be reluctant to adopt this technique for routine analysis. It is hoped that this situation may change. An important feature of this chapter is the section on specialised applications of FIA with hydride generation, electrothermal atomization and inductively coupled plasma analysis. Undoubtedly future developments of FIA-AS will come from this direction.

The reviewer is not aware of any current research work in India on FIA-atomic spectroscopy. However, it is expected that scientific community will appreciate the importance of FIA-AS in continuous environmental pollution monitoring, metallurgical, geological, food industries and several other related fields. This book is certainly useful as an introductory reference material for entrants in this field.

A glossary of terms provided at the end of the book will be helpful to follow the text. References to original work are given at the end of each chapter and suggestions for further reading are given in the bibliography. The book is complete with author and subject indices. A few typographical errors remain but they are few and far between. The book is a valuable addition to the library as a reference material. The cost appears to be reasonable.

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Guidance and control 1989 (Volume 68 of Advances in the Astronautical Sciences) edited by Robert D. Culp and Robert A. Lewis. American Astronautical Society, 1989, pp. 708, $85. Orders to Univelt, Inc., P.O. Box 28130, San Diego, CA 92128.

For over a decade now, the Annual Rocky Mountain Guidance and Control Conference has provided an authentic forum for exchange of notes on the recent advances in research and technology of astronautical guidance and control amongst some of the most active groups in the United States. Volume 68, edited by Robert D. Culp and Robert A. Lewis comprises the technical papers presented at the 1989 Conference—twelfth in this line, held at Keystone, Colorado. The choice of the papers and

their organisation seem to have been done with perfection. Persons who are familiar with the current trends in space research are sure to find this volume a true window to the directions in scientific, military and commercial exploitation of space. This is in spite of the fact that the technical content of some of the papers is not necessarily appearing for the first time in the open literature.

Astronautical research spans several actively pursued missions in the United States. These include manned space stations, control of a constellation of satellites for voice and data communication and earth observations and the accurate pointing and tracking systems for the well-advertised Starwar type of military and scientific exploits. All these missions, both at component technology and systems levels, have been dealt with in this volume which is organised in five sections with the tutorial lectures appended.

The first section is devoted to the recent advances in satellite autonomy and component technology and consists of seven papers. With simple and straightforward modifications to existing hardware on board for attitude determination, it is shown that it is possible to realise a low-cost autonomous navigation system with a 3-sigma position accuracies of 100 m to 1.5 km. Using an all-sky database of 4100 locations of stars, simulation indicates that a star-referenced attitude determination can give accuracies of the order of 8 arcsec. However, the papers in this and other sections that purport to demonstrate the use of the recent advances in knowledge engineering in developing expert systems for space missions are more in the nature of popular lectures lacking in specifics. This amply indicates that the topic of application of artificial intelligence to aerospace problems is still fertile for research with many concepts yet to be tested. The increasing size of space vehicles demands attitude actuators with long life and higher torque and momentum capability. The level of precision that is required for the fabrication of single- and double-gimbal-mounted control moment gyros is truly astounding. The design and fabrication aspects of these actuators form the theme of two papers. Space-based monitoring of sea-surface elevations is critical to global weather and climate prediction programs. TOPEX is planned as a joint venture between NASA and CNES. The design of the earth-pointing system for TOPEX presented in one of the papers shows the level of technology required for such missions.

The second section comprises the ever-popular 'Story Board' displays. The recent trends in the use of optics for accurate and agile-ranging systems and the zero-lock laser gyro developments are discussed in clear detail. These developments are offshoots of the Starwar program. The control of large flexible space structures requires accurate and fast monitoring of arc-second motions. Suppression of base motion will directly determine the pointing accuracies of IR and laser-based SDI missions. The design and the performance of the prototype optical remote sensor for this purpose are elucidated. The orbital configuration for a constellation of satellites planned to be deployed for mapping oceanic mesoscale is examined.

The acquisition, agile pointing and tracking technology of relevance to SDI forms the main focus of Section III. Systems offering submicroradian-pointing jitter-like Hubble Space Telescope (HST) and space infrared telescope sensors with extremely quiet structures and virtually no base motion are now well known. The present SDI programs demand performances for Shuttle and ground-based acquisition agility, retargeting and the isolation of SDI payload from 'noisy' spacecraft that far exceed those of the earlier missions. Several papers are devoted to the future direction in achieving these improvements in acquisition and tracking systems. An interesting paper describes the challenges involved and the feasibility of designing control system for Zenith Star which demands two order of magnitude faster precision pointing speeds than HST.

The National Aero-Space Plane (NASP), anticipated to achieve Mach 25 and the air-launched orbital Pegasus booster and Space Shuttle-related Satellite Servicer System are discussed in Section Four and this gives a glimpse of the future trends in complex-space missions and their endurance

levels, currently receiving attention in the USA. Two of the papers are devoted to the hypervelocity intercept guidance at terminal phase using certainty control. The performance improvement over other guidance schemes is illustrated.

The section on recent experiences reports the results of several of NASA's missions and is highly educative and valuable in dictating directions for future endeavours in astronautical research world over. The experiences of Delta 181 mission for phenomenology data support for SDI has given critical inputs in the tracking of plumes and ground-launched rocket against various backgrounds. It has brought out the high and low points of the pointing and tracking systems in actual flight. The impact of the Shuttle disaster has resulted in changed mission requirements for Galileo. The resultant changes in attitude control system form the major thrust of one of the papers. Instability of gravity gradient experienced with the satellite is exposed to the full Sun condition in orbit has been engaging attention of NASA to find out the possible perturbation sources. Simulations are carried out to give possible recommendations for avoidance of this instability.

The tutorial lectures appended to the volume are of high utility for a general graduate course in state space analysis of spacecraft dynamics, estimation and control. The use of MATLAB and the inclusion of several routines in MATLAB make this appendix more valuable and in tune with modern teaching techniques and the large-scale usage of personal computers for problem solving.

In summary, it can be said that Volume 68 has maintained and improved upon the tradition set by earlier volumes in this series as an important media for disseminating the wide spectrum of the current and the top of the deck research and development efforts in the USA in the areas of guidance, control and navigation and other related disciplines. It certainly adds significantly to our understanding of the scientific and engineering challenges of space exploration. The challenges are too tempting for the mankind to be deterred by temporary failures.

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Digital electronics and microprocessors -- Problems and solutions edited by R. P. Jain. Tata McGraw-Hill Publishing Company Ltd, 4/12, Asaf Ali Road, New Delhi 110002, 1987, pp. 524, Rs. 69.

This is an unusual book, in the sense that it contains only problems and solutions on a wide range of topics in digital electronics and microprocessors, which field has been expanding at a rapid rate in the last few years. The author has started off with the fundamental concepts of digital electronics in Chapter 1 in which many problems covering the basics, simple logic analysis and design have been solved from first principles. This is followed by a number of supplementary problems of similar type which the student can attempt on his own, and a large number of review questions on the subject with answers, in the same chapter. The same trend of presentation is continued in the remaining eleven chapters. The topics covered include switching-mode operation of semiconductor devices, digital logic families, number systems and codes, combinational logic design, combinational logic design using MSI, flipflops, sequential logic design, timing circuits, ADCs and DACs, semiconductor memories and microprocessors, in that order. In each chapter, solved problems are first taken up, followed by supplementary problems and then review questions with answers. Answers to all the supplementary problems in the book have been given at the end of the book (Appendix H). A very large number of multiple choice questions on the whole subject of digital electronics and microprocessors have also

been included in the book (Appendix E), together with their answers. A number of additional appendices are included in the book to provide useful data/information on the topics included in the book in problem/question form. These appendices cover summary of logic gate operation, Boolean algebraic theorems, digital ICs, summary of 8085 CPU instructions, glossary of terms and bibliography.

The author deserves full complements for conceiving of a new approach to preparing a book, organizing the various chapters and appendices in a lucid way, framing interesting and educative problems/questions and solving them in the book. In addition, the inclusion of a large number of multiple choice questions (*i.e.*, 465) in the book deserves special commendation. The problems and questions included pertain to real-life and practical situations, which any electronics engineer is likely to face in the present-day world. While the author has attempted to be as comprehensive and updated as possible, the reviewer found a few lacunae in the topics included. For example, switching behaviour of JFET, depletion MOS FET and CMOS circuit have not found place in Chapter 2. Also, newer TTL ICs like LSTTL, FTTL, etc., have not figured anywhere in Chapter 3. In combinational logic design (Chapters 5–6), ROM-based design does not seem to have received the attention it merits. Similarly, in timing circuits (Chapter 9), the role of n-MOS and CMOS ICs has hardly figured. While DACs have been covered well through problems in Chapter 10, the emphasis on ADCs seems to be rather low. The microprocessors chapter has been well treated; but, there seems to be over emphasis on 8085. But for these few shortcomings, the problems and questions included in the book are up to date and well conceived. The reviewer is convinced that the book will be a useful guide for supplementary reading and problem solving to all the undergraduate engineering students specializing in electronics, communications or computers. This can also be a good help for students preparing for GATE and other competitive examinations in the country.

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Proceedings of the 35th International Technical Communication Conference, Philadelphia, 1988. American Astronautical Society, 1988, $180. Orders to Univelt, Inc., P.O. Box 28130, San Diego, CA 92128.

It is forbidding to review the proceedings of a large-scale, multi-focus conference like the International Technical Communication Conference. The papers number above 300 and cover a wide range of topics from good old-fashioned psychology of reading to state-of-the-art 'hypertext'. A large number of the papers and reports on workshops are represented by mere thematic outlines which are more suggestive than definitive about their content. Add to this the common experience of all who attend such big conferences or attempt to read their proceedings, *viz.*, the proportion of chaff and grain heavily in favour of the former, and you get a fairly clear idea of the odds stacked against the reviewer. Yet I shall try to recover for those interested, a few worthwhile notions and practices currently holding sway in the field of technical communication.

With the widening of the concerns of, and approaches to technical communication has taken place a weakening of the near-monopolistic hold of university academics in general, and language departments in particular, over the field. Engineers and scientists actively pursuing technical communication either as a career in its own right or as part of their professional work have come to enjoy a majority status among workers in this area. The institutional affiliations and occupations of

the contributors to the volume under review clearly indicate this particular direction of development in the discipline. This holds two important implications in the Indian context. First, practising engineers and engineering educators need to pay more serious attention to the communicational aspects of their work. Secondly, teachers of technical communication in Indian institutions have to consider the views, opinions, and experience of professional engineers and scientists while formulating communication courses for student engineers.

The first section of the volume, titled ATA stem—Advanced Technology Application Stem—comprises contributions that illustrate points of entry into technical communication for technical personnel with professional competence in electronic communication, computer science, and artificial intelligence. The paper by Steven Jong (Principal Software Writer at DEC) (pp ATA 30–32) deals with the technological challenges offered to technical communicators by the new information tool called 'hypertext' defined as "a means of connecting information in a non-linear manner with a computer automating the process of moving from one piece of information to another". Another paper in the same section (pp ATA 43–46) represents a specialist's attempt at removing misconceptions about the characteristics and possibilities of on-line documentation. Those, as well as the contributions on 'Interactive interfaces' by IBM staff writers (pp ATA 59–64) are interesting, informative and accessible to non-specialists. The case studies on 'Andrew Help System', concerned as they are with refining meta-level information pertaining to systems being used at Carnegie-Mellon University are of limited use to an Indian reader. Desk top publishing is a high-tech growth area in technical communication, which Indian information engineers, following the lead of the contributors to this volume may turn to explaining and popularising for the benefit of science and technology students and technical communication teachers in our country.

The RET stem, which follows the section dealing with the development of local chapters of the Society of Technical Communicators, concerns itself with the second of the implications I mentioned earlier, *viz.*, the pedagogic. There is much here that an enterprising teacher of English for Science and Technology can exploit to her benefit. Though some of the papers deal with courses leading to specialist qualifications in technical communication, there are others that present considerations, concerns and methodologies that all teachers of technical communication in science and technology institutions should work with. Some also deal with the special features of in-service technical communication courses for professionals in government and industry. One aspect of the courses shared by most of the ones described here, and that appears particularly interesting is the practice of internship for technical communication students. As the name suggests, this has to do with attaching a student to the technical writing department of an organization, which affords her an opportunity for 'learning by doing'. This, of course, seems only a dream in our country, where industrial apprenticeship is taken lightly and sometimes wholly discarded even in the case of hardcore engineering subjects.

The sections on Visual Communication, and Writing and Editing can be scanned profitably by teachers and students of Technical Communication as well as by practising professionals. Here again, some of the papers underscore the technical communicators' need to be familiar with rather complex software in order to exploit the possibilities of computer graphics in increasing the visual appeal of technical documents and presentations. These sections are rich in details regarding the relative merits and demerits of existing software packages like 'MacDraw', 'Adobe Illustrator', 'Aldus Page Maker', etc. Some among the numerous first-person accounts—"autobiographical case studies" if you will—present interesting experiments in solving communication problems. These problems, though idiosyncratic in some cases may prove valuable to a number of readers faced with similar situations in their professional life.

The single dominant impression left by even a quick glance through the volume is that academic

concerns in technical communication are intimately intertwined with industrial and business concerns. Engineering educators in India, who have been voicing their enthusiasm to bring about greater interaction between industry and institution need to be aware of the communication dimension of such interaction as well—a fact that clearly emerges from the tone and content of the present volume.

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The social construction of technological systems: New directions in the sociology and history of technology edited by Wiebe E. Bijker, Thomas P. Hughes and Trevor F. Pinch. The MIT Press, 55, Hayward Street, Cambridge, Massachusetts 02142, USA, 1989, pp. 425, $12.95. Indian orders to: Affiliated East-West Press Pvt Ltd, 25, Dr. Muniappa Road, Kilpauk, Madras 600010.

Man is a social animal. He lives in a society. His life is greatly influenced by the technical innovations. In the recent past, there is a concerted effort to understand the social nature of technological innovations. The workshop held at the University of Twente, The Netherlands, in July 1984, marks one such attempt. Thirteen papers were presented by scholars in their chosen areas.

These papers have been divided into four groups: (a) common themes in sociological and historical studies of technology, (b) simplifying the complexity, (c) strategic research sites, and (d) technology and beyond.

There are three papers in the first group, three in the second, five in the third and two in the fourth. A noteworthy aspect of these contributions is an introduction to each group of papers wherein the common themes in the groups as well as their relation to other groups have been brought out.

Based on the case study of the bicycle, Trevor Pinch and Wiebe Bijker present their social constructivist approach. With a variety of illustrative examples, Thomas Hughes describes his approach to technological systems. In the third and last paper in the first group, Micheal Callon calls engineers as practising sociologists. It is argued that both science and technology are socially constructed cultures.

In the second group, the first paper is by John Law. He uses the system-building approach to explain the association of forces by which the heterogeneous elements, which range from people to artifacts, are built into durable networks. Henk Vanden Belt and Arie Rip propose an evolutionary model of technological change by extending sociological themes. Wiebe Bijker, based on the social constructivist approach, outlines a typology of different sorts of technological changes. These three papers show similarities in the models.

The third group is titled 'Strategic research sites'. Donald Mackenzie's report is on the development of strategic missile technology. Edward Constant states that the organisation as well as the system and engineers involved should be studied. Henk Bodewitz, Henk Buurma and Gerard de Vries analyse the various aspects of drug-regulatory processes in different nations. Ruth Schwartz Cowan gives prime importance to the consumer and states that consumer behaviour can lead to successes or failures of domestic technologies In the final paper in this group, Edward Yoxen describes the history of ultrasound imaging.

Artificial intelligence is a field of growing importance. Steve Woolgar takes the basis of AI research

program to be 'Cognitivism'. Any attempt to replace cognitivism by a systematic sociological understanding of human behaviour makes little difference to the AI task. The last paper by Collins points out that the goal of AI of building knowledge-based systems, so as to replace human skills is possible only by taking into account the social nature of technical skills.

This book, in summary, can be said to be unique, in the sense that it can be a text for students of industrial sociology, a reference for teachers and a source of information for researchers.

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