

Book Reviews

Advanced techniques in chromosome research edited by K. Kenneth Adolph. Marcel Dekker, Inc., 270, Madison Avenue, New York, NY 10016, 1991, pp 480, \$166.75.

Several developments in the area of molecular, cellular and developmental biology in recent years have contributed to a better understanding of the ultrastructural organization and functional aspects of eukaryotic chromosomes. The modern molecular techniques in the analysis of chromosomes have given valuable information regarding the functional aspects of human chromosomes both in the normal and diseased states. The molecular, cytological and genetic techniques have reached a stage where now one can embark on the mapping of total human genome which has already been initiated at several centres all over the world. In this context, the publication of this book is very timely.

The book is divided into three broad sections. The first deals with molecular techniques describing various methods developed for the analysis of chromosome and large DNA molecules. The first chapter describes the use of PCR techniques and RFLP in the diagnosis of various genetic diseases like sickle cell anemia, chronic granulocytic leukemia, hemophilia and cystic fibrosis. The second chapter describes in detail some of the recent techniques developed to clone and analyze large DNA molecules, particularly by the use of yeast artificial chromosomes. This section also contains chapters describing *in situ* hybridization of nonradioactive oligonucleotide probes to chromosomes which is becoming very popular in recent years and also on fine structure analysis of the human genome using flow-sorted chromosomes. The application of pulse-field gel electrophoresis to human and mouse sex determination has been dealt with very nicely in a chapter by Verga and Erickson.

The second section is devoted to recent developments in cytogenetics and linkage analysis of chromosomes. It is known for a long time that several solid tumors are associated with structural alterations in the chromosome. Such structural changes have been studied both by pFGE and by the use of linkage and jumping libraries. These techniques are summarised in the first chapter of this section. Rapid advances have also been made in the detection of fragile sites in the chromosomes, particularly the fragile X-syndrome-causing mental retardation which has been dealt with in the chapter by Sutherland. Use of antibodies to nuclear proteins and their application in the structure and function of chromosomes has been summarised in the chapter by Haaf and Schmid. The use of antibodies against BrdUrd, Z-DNA, 5 Methylcytosine and Triplex DNA is also described. The next three chapters discuss the linkage and gene-mapping techniques applied to mouse and human chromosomes.

The third section deals with cellular techniques and the first chapter in this section by Adolph describes the application of computer-aided image reconstruction technique to the analysis of human mitotic chromosomes. The techniques of transgenic animals and micromanipulation of gametes and embryos have advanced very much in the last few years and are yielding valuable information regarding gene therapy and regulation of gene expression. These techniques are discussed in the chapter by Jon Gordon.

Hsu and coworkers have discussed the effects of environmental mutagens on human chromosomes and the advantages of human and other mammalian cells in identifying chemicals that cause chromosomal aberrations. The final two chapters deal with karyotypic analysis of solid tumors and the use of microtubule poisons in the analysis of metaphase chromosomes.

The book on the whole is a good collection of all the modern techniques written by established scientists in the area and gives a very good description of the use of the molecular, cytogenetic and

cellular techniques in the analysis of chromosome structure and function. This is an excellent reference book to have in any library.

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Special analytical techniques in nutritional biochemistry edited by Gopal Krishna and S. K. Ranjhan. Kalyani Publishers, 1/1, Rajinder Nagar, Ludhiana 141 008, 1991, pp 292, Rs. 90.

The word *special* in the title prompted me to look for modern or newly introduced analytical methods. I was disappointed to see that this is a collection of old methods apparently used in colleges of agricultural or veterinary education. The book consists of 14 chapters and 33 appendices. The chapters describe the methodologies such as spectrophotometry and vitamin assays. The appendices give the details of analysis such as ascorbic acid in blood more like a notes in a laboratory. These will help in carrying out such experiments as the authors claimed in the preface. This purpose the book serves well. It is, however, disconcerting to note the methods are outdated in some cases, and the references, are invariably to publications earlier to 60s/70s. The authors should have taken greater care in proof-reading to reduce errors in printing. The authors hoped that 'this manual will challenge the mind of a student'. On the contrary, after following the methods described herein, the student will have nothing to exercise the mind about the basis of the reaction or about the limitations. If it is in a library of scientific research institutions, I wonder whether any one will use it. At the best, the book will serve the purpose of laboratory manual, where such methods continue to be used.

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Journal of Spacecraft Technology, ISRO Satellite Centre, Bangalore 560 017, India.

One measure of the level and vigour of scientific and technological activities of a society is the number of professional journals it publishes. On this score, India is steadily improving its position. The *Journal of Spacecraft Technology*, the first issue of which has been brought out in August 1991, is a recent addition to the growing number of specialized professional journals published in India.

There has been a definite need for a journal in this area. Aerospace-related activities in India have grown in quantity and quality in recent decades. Large national programmes have been initiated, and some of these have begun bearing fruit. Although the scale of Indian aerospace activities does not yet match that of the big four or five powers of the world, it has come to be highly diversified and broad-based, covering the research, development, and manufacture of aircraft, missiles, rockets and spacecraft. The *Journal of the Aeronautical Society of India* does cover good ground, but its coverage is naturally more aircraft oriented. The *Journal of Spacecraft Technology* would thus fill a definite void in the coverage of aerospace activities of the country.

At this time, only the first issue of the *Journal* is available. Going through this issue, one gets the impression of thorough planning and professional execution of the publication process. As this is the beginning of the series, the first article of the issue is, appropriately, a review of the evolution of spacecraft technology in ISRO by the Director of the ISAC. With the authority of a person who has been involved in senior capacities in every Indian satellite program, the author provides a fairly detailed and integrated view of the growth of the Indian satellite program, covering systems as well as major

subsystems and technologies. For Indian scientists, intelligent laypersons and administrators who wish to do a quick catching up, this is good material.

The remaining articles of the issue are technical. There are five full articles and two short communications. This two-level organization is becoming more popular globally, and the publishers have done well to adopt it. The subject-wise distribution of the articles is quite broad, giving the issue a healthy degree of diversity. A positive feature of the selection of the articles is their generally applied nature. Also, most of the articles relate directly to the Indian satellite program. The inclusion of an article reviewing three years of mission performance of the IRS 1A satellite lends a touch of authority, as expected from an organization actually conducting space missions.

The editor sets forth in his note in the first issue the considerations leading to the publication of the *Journal*. He has referred to the teething problems, which are all too common in our environment. Perhaps that partially explains the relatively low frequency envisaged for the publication: twice a year. Given the vigour and volume of the spacecraft-related activities in India, one is sure that a more frequent publication schedule is technically sustainable provided, of course, that the publishers are ready for it. Also, based on this first issue, the exact nature of the *Journal* is not fully clear. Is it more of an in-house journal essentially reporting to the world the developments within ISAC, or is it an open forum for dissemination of spacecraft technologies from and to the members of a broader community? From the Foreword written by the Chairman of ISRO, the first of these would appear to be the nature of the journal. Also, in the first issue, nearly all the authors (all first authors) are from ISAC. However, in the brief declaration 'About the *Journal*', contributions to the *Journal* are 'invited', giving the impression of a more open nature. Perhaps this point will be clearer as more issues are published.

The layout of the *Journal* is quite professional, and printing and paper quality are about as good as one finds in India. The final look is not quite international, but that may have more to do with the cost and availability of the proper grade of paper in the country than intentions or expertise. The printing could generally have been a little more compact, and figure printing could have been of a little finer quality. A few more variations of the typeface should improve text presentation. The cover page should perhaps be a tougher grade of paper to stand mailing and also archiving and repeated use, as in libraries. However, on the whole, the production is of high quality in the Indian context.

In summary, the *Journal of Spacecraft Technology* is a fine attempt at filling a definite void in Indian aerospace information scenario and a welcome window to peep into an area of our national effort. One hopes it acquires more momentum as it rolls on over the coming years.

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Nonlinear fracture mechanics – Volume I: Time-dependent fracture edited by A. Saxena *et al.*, and **Volume II: Elastic-plastic fracture** edited by J. D. Landes *et al.* ASTM, 1916, Race Street, Philadelphia, Pennsylvania 19103, 1989, pp Vol. I: 471 and Vol. II: 625, \$130 (2 volumes).

The International Symposium on Nonlinear Fracture Mechanics is the third in the series of meetings organised by ASTM on this subject. Earlier symposia covered elastic-plastic fracture mechanics (EPPM) with the third symposium laying emphasis on wider interests in nonlinear fracture mechanics. The topics covered here include time-dependent fracture dealing with creep-crack growth, dynamic fracture and cyclic loading, fracture of non-metals in Volume I and elastic-plastic fracture dealing with analytical aspects, toughness measurements, applications to practical structures and models and mechanisms in Volume II. The research in this area is to assist structural integrity assessment of high technology industrial structures which are being designed today to operate far beyond the linear range.

Nonlinear fracture mechanics is an emerging field with the development of new materials with extensive ductility and high-fracture toughness. Under conditions of small-scale yielding, the procedures developed by ASTM earlier, based on linear elastic fracture mechanics (LEFM) are found to be adequate. However, modern trends in structural design, qualification and life assessment and extension procedures, requiring highly fracture-resistant materials, demand development of methods and techniques using concepts of EPFM. Today, the stringent standards to meet safety requirements in power generation, aerospace, chemical and heavy mechanical industries demand a total understanding of structural integrity assessment. The proceedings of this Conference and the subsequent publication of ASTM STP 995 focussed attention on almost all aspects which require attention by analytical and experimental researchers. ASTM standards are expected to evolve soon to cater to the EPFM methods and procedures to meet various design conditions in industrial structures.

The major demands on the study of EPFM have emanated from nuclear power industry where safety and reliability are of paramount significance. Various studies earlier brought out that structural integrity assessment could be carried out using J-integral, CTOD or other energy-based parameters. Definitive need in this area is to standardise the test methods to determine these characterizing parameters with a sense of reliability so that they could be confidently used in major technological problems. In a parallel effort, the work on nonlinear mechanics also attracted the curiosity of scientists to study time-dependent fracture problems at elevated temperature.

Volume I: Time-dependent fracture

A significant part of the papers published in this volume dealt with problems related to research topics on creep-crack growth. The papers presented time-dependent fracture in various steel alloy components for high-temperature applications such as gas turbines to assess their structural integrity. As early as 1974, energy-based parameter C^* which is analogous to J-integral in EPFM was proposed to characterize fracture in dominantly secondary stage creep conditions. Recently proposed C_c parameter, a variant of C^* parameter, has much wider applicability in the range of small-scale creep to extensive creep conditions. This parameter is evaluated normally by finite element methods and most of the experimental work attempted to correlate creep-crack growth rate (da/dt) to C_c raised to a power of n to establish its usefulness. Such correlation can easily be seen in a logarithmic plot between da/dt and C_c .

The papers in this section cover a wide range of steel alloys on which the creep-crack growth relation is established. A470-class 8-steam turbine rotor steels, 316 L steel, corrosion-resistance 800H alloy, A387 Grade II and A182 F11 steels and 304H stainless steel were some of the materials used in these studies. The experimental correlations using C_c parameter are found to be very encouraging. In conditions of steady-state creep excellent correlations were shown between creep-crack growth rate and C^* parameter. One of the impressive results here is the consolidation of $da/dt - C^*$ data for alloy 800H in three different recrystallized states at two temperatures in the range when the crack growth varied by three orders of magnitude.

The evaluation of C_c parameter in various materials under various conditions would continue for some more years in future research. In laboratory specimens, existence of extensive creep conditions lead to simple correlations to C^* parameter. In practical structures, operations over larger duration demand the need to establish the correlations in wide range of conditions. The acceptability of a parameter such as C_c would be very valuable for such requirements. In one of the papers, finite element creep analysis was carried out from small scale to extensive creep conditions. It was found that the C_c parameter does not, in general, characterize HRR crack tip singularity. Only under extensive creep conditions, $C_c = C^*$ and it characterizes HRR singularity. The physical explanation provided is that C_c parameter represents accumulation of history-dependent creep damage in the vicinity of the crack tip and reflects the compliance change due to creep zone.

The second set of papers published in the first volume deals with aspects related to dynamic fracture. The work in this area is on the applicability of J-based approach to fracture characterization under dynamic loading conditions. Finite element studies are reported to estimate the domain integral in transient conditions. Improved methods to obtain J-R curve from drop-tower tests are presented using

analytical key curve based on test data of a single full-size fracture mechanics specimen. Influence of high rate of loading on ductile fracture was a subject of investigation. It was, however, found that in A533B steels the influence of loading rate on crack-growth resistance curves was marginal.

Work of significance, but a small number of papers were presented in the next part on the effect of cyclic loading on crack growth in EPFM regime. Primary aspect of this work is the correlation between delta J and fatigue crack-growth rate (FCGR). Excellent correlations were reported between FCGR and effective delta J range bringing in the crack-closure behaviour. Extensive experiments were conducted with constant delta J , J -increasing and J -decreasing mode of fatigue tests. Crack-closure measurements were carried out which shows that crack-closure load was always compressive in EPFM conditions. Mixed-mode loading which has always been a problem area for FCGR has been studied with reference to the type of loading in a turbine generator. Various single- and mixed-mode testings provided ample information regarding the dependence of FCGR on the mode of crack propagation. The section ends with two papers on the use of Moiré interferometry to study crack-tip behaviour and the presentation of a dislocation-free zone modes for fracture.

With the increased use of non-metals for structural applications, study of fracture behaviour in these materials which is often nonlinear, assumes special importance. This volume, however, provides two, but significant, papers on fracture toughness testing of polyethylene and fracture study of concrete and ceramics. ASTM J_{IC} test was conducted on polyethylene and these results were correlated with fractographic studies. It is apparent that a lot more needs to be studied in this area and extensive research in non-metals is likely to form the subject matter in a different forum after a few more years.

Volume II: Elastic-plastic fracture

This volume concentrates on analytical methods for fracture growth studies, experimental methods for fracture toughness measurements and engineering applications of EPFM-based methods and procedures for practical structures.

The commonly used methods earlier are based on global criteria in EPFM such as J -integral or CTOD to characterize crack initiation and growth. Recently, local criteria have gained recognition. These could be based on local cleavage criterion using the concept of critical fracture stress or local ductile criterion using cavity growth models. Papers on analytical methods in this volume presented validation of the local criteria and also made a systematic comparison between local and global criteria.

The study of damage growth in surface cracks is one of the most complex experimental programs. A comparison between analytical estimation and experimental measurement of crack growth is presented with a view to study the validity of the J -based criteria. This part on analytical methods also presented papers on the use of key-curve method for an engineering analysis of crack growth, weld integrity analysis, plasticity effects near a blunt flaw and dislocation modelling of crack tip fields.

The second part of this volume presents fracture toughness measurements so that the sequence is set to examine application of all the methods to practical structures in the next section. Significant aspect in EPFM regime is the geometry dependence on the R -curve considered as the elastic-plastic fracture toughness. Studies showed that R -curve is geometry independent for CT, SEN and DEN specimens and is geometry dependent only in CCT specimens. The geometry independence is achieved mainly due to the use of modified J -integral (J_M). Other studies included evaluation of steel toughness through correlation between J , CTOD and T -parameters and elastic-plastic fracture mechanics tests on welded joints. Two more interesting papers are presented on the study of large crack growth from small specimen laboratory tests and the effect of pre-strain on J -resistance curve for HY-100 steel.

Fracture mechanics-based design has now become mandatory in a wide variety of high-technology structures. Unlike conventional design, the method of applying these principles based on EPFM vary based on the design and the operational requirements of different structural components. These proceedings brought out a significant number of practical examples in the third section focussing attention on this aspect. Methods of using failure assessment diagrams, local failure criteria based on cavity growth, ductile-tearing instability procedures and leak-before-break criterion received considerable attention. Structures

of major interest to power industry such as piping systems and welded components were analysed with special reference to determination of J-R curves and critical acceptable flaw depths.

Simple engineering procedures to interpret and handle the failure assessment diagram are presented. One paper deals with the Universal Calibration Curve and the second with self-equilibrating secondary stresses. Two other papers dealing with the development of procedures refer to the application of local approach based on cavity growth and coalescence and to assess the occurrence of under-clad crack during manufacturing in reactor vessels. They have observed that the local approach brings out the effect of large range of nonlinearities and heterogeneities which are ignored in global approach based on J or K criteria.

An in-depth examination is provided in two papers on the ductile-tearing instability and conditions of arrest of unstable crack extension. Crack velocities during this process and rate sensitivity of the material significantly affect this instability criteria. Ductile-tearing instability procedures were also used to establish pressure temperature limit curves with a specific view of application to nuclear power industry.

As a general approach, the modified J-integral (J_M) is presented in a paper to appropriately define the plastic and elastic part and to examine the adequacy of J in the presence of irreversible processes. Two other practical procedures are presented in different papers relating to (i) the estimation of critical depth of an internal or an external flaw in a pressurized tube using finite element analysis and experimental results, and (ii) a criteria related to leak-before-break in piping systems under complex loading such as inputs from earthquakes.

Welded structures pose a very critical problem for structural integrity assessment. The methods and procedures in various forms presented by several workers based on J-R curves were used extensively to generate the assessment of cracks in welded joints. Though most of the problems relate to the requirements in power-generation industry, the techniques developed have much wider applications. The section on applications ends with an interesting contribution on the comparison between rectangular and square-CTOD fracture specimens on A36 steel. The conclusions show little effect of the geometric change and that specimens can be interchanged for testing.

The last section of the volume deals with papers on the metallurgical and microstructural aspects of fracture. Several features of crack growth in EPFM range can easily be explained by a careful examination of the microstructure. These aspects, though do not influence the design process, have great potential to understand the material behaviour. One of the papers could explain that the fracture toughness J_{IC} of ASTM A710 steel is twice that of HY-80 steel because fracture occurs in the former due to void coalescence between reduced inclusion content. Similarly, in another paper, it was possible to explain the decrease in crack-growth resistance (slope of J-R curve) in irradiated zirconium alloy due to shear localization behaviour. Other papers deal with a microscopic examination of fatigue crack propagation in Fe-3Si steel which revealed extensive damage zone consisting of slip bands surrounding the propagating crack, a new model to explain CTOD ductile-brittle transition curves and an attempt to separate elastic and plastic components of energy from the load-displacement record of a CTS specimen. Though this section is small and deals with topics which are different in their objectives from other sections, it brings out important projections in terms of future research areas in fracture mechanics from materials view point.

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Hypersonics, Vol. 1: Defining the hypersonic environment, Vol. 2: Computation and measurement of hypersonic flows edited by John J. Bertin, Roland Glowinski and Jacques Periaux. Birkhauser Verlag, CH-4010, Basel, Switzerland, 1989, pp 547 and 459, SFr 218. Indian orders to Springer Books (India) Pvt Ltd, 67, Community Centre, Panchsheel Park, New Delhi 110 017.

These two volumes contain the lectures presented at the First Joint Europe/US Short Course in Hypersonics that was held in Paris in December 1987. This course was hosted by the European Space Agency and presented by

Groupe pour L' Avancement des Methodes Numeriques de L'Ingenieur-Societe de Mathematiques Appliquees et Industrielles (GAMMI-SMAI) and Centre of Excellence for Hypersonic Training and Research at University of Texas at Austin.

In Volume 1, the first paper by John J. Bertin on General characterization of hypersonic flows gives a good overview of the subject. It brings out the need to interrelate computational fluid dynamics (CFD), ground and flight test data to make a headway in this complex field.

The next four papers deal with the broad design methodologies for hypersonic vehicles. Trella's paper on 'Introduction to hypersonic phenomena of Hermes' deals with its design problems. The paper by Pernier on industrial methodologies for the design of hypersonic vehicles is rather too general. A lacuna of these two papers is that they do not give a list of references. The paper by Neumann on 'Defining the aerothermodynamic methodology' is very good and gives valuable insight into specific aerothermodynamic topics of value in the design of orbital lifting entry vehicles. Hunt's paper on 'Hypersonic airbreathing vehicle design (focus on aerospace plane)' is an excellent review on a topic of current interest all over the world.

The paper by Clarke on 'Physico-chemical gas dynamics and its relation to hypersonic flow' deals effectively with how the basic flow phenomena, like, for example, shock waves, get affected due to relaxation effects that come into play at high-stagnation temperatures of hypersonic flow. The paper by Bruno on 'Real gas effects' deals very well with the modelling of the real gas effects needed in the prediction of hypersonic flow fields. The paper by Scott on 'Effects of thermochemistry, non-equilibrium, and surface catalysis on the design of hypersonic vehicles' reviews the state of the art that has been applied to determination of non-equilibrium flow field of hypersonic reentry of the Space Shuttle Orbiter. The paper by Brun 'Non-equilibrium effects in high speed flows: Modelling and experimentation' deals with the same subject matter as those of the papers by Clarke and by Bruno, but the treatment is different and the flow fields considered are those obtained in experimental facilities like nozzles, shock tubes and shock tunnels. The paper by Warnatz on 'Air dissociation thermochemistry and problems resulting from coupling of flow and chemistry' points that the effects of chemical reaction of flow fields in hypersonic flow can be considerable and gives examples of taking chemistry into account in treating simple flow problems.

The last two papers in Volume 1 deal with rarefied gas dynamics. The paper by Harvey examines some of the fundamental concepts of rarefied gas dynamics. The paper by Koppenwallner goes further and covers the analysis of aerodynamic behaviour of simple bodies in the complete range of continuum to molecular flow, and brings out the effects of the rarefaction phenomena.

In Volume 2, the first paper by Bertin, 'State-of-the-art engineering approaches to flow field computations' deals with the subject matter extremely well and gives an overview. The next paper by Cousteix and Aupoix gives a detailed account of the calculation on hypersonic laminar boundary layers taking into account real gas effects. The paper by Alziary de Roquefort on 'Leading edge transition in hypersonic flows' deals with a particular type of transition, *viz.*, attachment line contamination and gives some experimental results for the same. The next four papers: a) Computational methods for hypersonic flows, special techniques and real gas effects by Hollanders, Marraffa, Montagne, Morice and Viviani, b) Computation of hypersonic flow by finite-volume methods by Rizzi, c) Computation of hypersonic flow fields by Chien Peng Li and d) On the computation of hypersonic viscous flows by Hanel and Schwane, all deal with the same subject matter and consequently there is considerable commonality in the contents of these papers in spite of their treatment being different. Taken together, all aspects of the computation of hypersonic flows is covered in a thorough manner. The last paper in Volume 2 on 'Hypersonic flight testing' by Williamson Jr gives a brief overview of this important subject.

On the whole, these two volumes on hypersonics, which contain the state-of-the-art papers on many aspects of hypersonic flow, the emphasis being on theoretical and computational aspects, would be very valuable to the research workers in this field, particularly in view of the programmes on hypersonic plane taken up in many countries of the world.

Composite media and homogenization theory (Progress in Nonlinear Differential Equations and Their Applications, No. 5) edited by G. Dal Maso and G.F. Dell'Antonio. Birkhauser Verlag AG, Ringstrasse, 39, CH-4106, Therwil, Switzerland, 1991, pp 259, SFr. 74. Indian orders to Springer Books (India) Pvt Ltd, 6, Community Centre, Panchasheel Park, New Delhi 110 017.

Homogenization theory is used to describe the relevant macroscopic properties of a system which has a complicated microscopic structure. As a simple example, consider a beam made up of some particular material but reinforced by means of rods of another material. If we wish to study the torsion of this beam, the angle of torsion satisfies a second-order elliptic equation whose coefficients are functions. These coefficient functions assume different values at different points of the medium depending upon the material the point lies. As the reinforcements increase, these coefficients become highly oscillatory and consequently the numerical solution of the equation becomes very difficult. Hence, it is desirable to replace this composite medium by means of a fictitious homogeneous medium so that the coefficients are now simpler. In other words, we wish to average the equation in some suitable way.

In mathematical terms, we have a family of differential equations parametrized suitably so that the coefficients become more and more oscillatory as the parameter approaches zero. We wish to identify a differential operator of the same type, but with smooth coefficients, called the homogenized operator, which, suitably interpreted, will be the 'limit' of the given family of operators. Various parallel theories are available for this under the names H-convergence, G-convergence, Γ -convergence, etc. One of the earliest approaches was to study the convergence of the 'energy' associated with the system.

The present volume is a collection of articles on the theory of homogenization and its applications to the study of composite media, based on the proceedings of the symposium held on this subject at the International Centre for Theoretical Physics, Trieste, Italy, in January 1990. It covers a broad range of topics on this subject. Specific areas of focus are the homogenization of periodic and non-periodic structures, porous media, optimal bounds for effective modulus, waves in composite media, etc. Asymptotic analysis for linear and nonlinear problems, optimal design and relaxation and composite random media are also considered.

The papers are varied in nature. Some are purely mathematical in context, like those on integral representations of functionals on Sobolev spaces, nonlinear unilateral problems, Γ -convergence and the least-squares method, Dirichlet forms and stochastic differential equations. Others present models of practical situations like the study of a linearly elastic structure and also the study of miscible displacement in unsaturated soils. Others are in between, presenting a mathematical study of a potentially applicable situation.

The articles contained in this book should be of interest both to mathematicians working in this area as well as to applied mathematicians and engineers interested in modelling the behaviour of composite and random media.

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Composite materials: Fatigue and fracture (STP 1012) edited by Paul A. Legace. ASTM, 1916, Race Street, Philadelphia, PA 19103, 1989, pp 418, \$ 64.

This volume consists of 23 papers divided into four groups: fatigue and damage growth, models and analysis, delamination and application to structures.

Most of the presentations deal with various types of experimental results and an attempt is made to develop models of damage. In most of the experimental methods, a measurable reduction in stiffness due to accumulated fatigue damage is considered. The damage is measured using advanced non-destructive evaluation techniques like acoustic emission, radiography and ultrasonic scanning, etc.

In modelling, analytical prediction is developed using fatigue modulus degradations and fatigue life equation. Setting a criterion like maximum strain to failure is a useful concept. The phenomenon of delamination which is applicable only to composites was discovered and the interest and importance of this is reflected in a large number of papers dealing with this aspect which has necessitated a separate section. The application of knowledge of fracture mechanics to fatigue to composite structures is demonstrated in the section on application to practical structures.

Most of the work is done on thermosetting resins, though a small amount of work in thermoplastics is also presented. This volume contains information of importance to those employing conventional thermosetting epoxies as well as to those using the new thermoplastic.

The papers represent the state-of-the-art work and is a very good source material for practising engineers and researchers in this difficult and important field of fatigue and fracture in composites.

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Static and dynamic analyses of plates and shells by H.C. Huang. Springer-Verlag GmbH & Co., KG, Postfach 105280, Tiergartenstr. 17, 6900 Heidelberg 1, 1988, pp 194, DM 295.

This book is in the specialized area of finite-element analyses of plates and shells. It develops the basics of Mindlin-type elements along with their advantages and disadvantages. An approach to overcome the defects of these types of elements is also proposed. Its main strength lies in the strong problem-oriented approach. Both static and dynamic situations are handled without too much of mathematics. Two computer programs are provided with their source codes. These are also made available on floppy discs with sample problems. The chapter headings, which give a clear idea of the contents of the book, are: Degenerations of three-dimensional theory, Defects of Mindlin-plate and degenerated shell elements, Assumed strain finite element plate formulation, Linear benchmark tests for plate elements, Assumed strain finite element shell formulation, Linear benchmark tests for shell elements, Formulation and applications of elasto-plastic shell analyses, Formulations and application of elasto-plastic dynamic shell analyses. Two Appendices deal with software description for elasto-plastic static transient analyses.

The book is useful to the nonspecialists also, particularly those interested in the response of shell structures under blast loadings.

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Elementary structural analysis by A.K. Jain. Nem Chand and Bros, Civil Lines, Roorkee 247 667, 1990, pp 624, Rs. 65.

This is a book meant for undergraduate engineering students in Indian universities. It is yet another addition to the long list of such books available in the Indian market. It contains a large number of worked examples and also problems for further solution. The objective-type questions given in Chapter 17 could be useful for students appearing for entrance tests, like GATE. The main weakness of the book is that it caters only to the examination needs of the students. It does not provide the reader with any insight into the connection between engineering mechanics and structural engineering; nor does it make the reader inquisitive to know more. Another shortcoming is the total absence of any discussion on buckling. Any modern book on static structural analysis is incomplete without a chapter on beam columns

and buckling. There are also several loose statements throughout the text. For example, on page 17 a deterministic load is defined to have exactly known direction and position. 'Magnitude' of the load should also have been included into this statement. In the introduction of Chapter 7, a statement about the limitation of combining the bending and direct axial stress, when the beam deflections are large and the P- Δ contribution becomes significant, should have been incorporated. On Page 545 in the statement "Its analysis depends....", geometrical properties are also wrongly clubbed under elastic properties. Some of the objective questions in Chapter 17 and the answers provided are of doubtful validity. For example, on page 571, Q 12 and its answer are both improper.

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Building construction before mechanization by John Fitchen. The MIT Press, 55, Hayward Street, Cambridge, Mass. 02142, USA, 1988, pp 326, \$11.95. Indian orders to Affiliated East-West Press Pvt Ltd, 25, Muniappa Road, Kilpauk, Madras 600 010.

The book by John Fitchen is a timely addition to the scanty literature on traditional construction. There is, indeed, a wealth of literature on ancient architecture discussing building forms, while the technologies associated with these forms are often ignored. This book attempts to fill this gap by looking into construction devices used in earlier times.

The most significant portion of the book deals with use of devices like pulleys, gins, windlasses and other devices used in lifting heavy building blocks. Fitchen also dwells in some detail on arch construction, Gothic cathedrals and domes. It is, however, surprising that he does not touch upon the now famous work of Hassan Fathy in resurrecting the traditional catenary vaults of the Middle East. The reader also becomes acutely aware that this book is essentially limited to the European experience with the exception of the Pyramids of Egypt.

The author speculates on the mode of construction in building the Cheop's Pyramid. It would, perhaps, have been interesting if he could compare the somewhat similar tasks of lifting massive stones in South Indian temples. It must, however, be admitted that in an area where there are hardly any publications this book makes an interesting beginning.

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De Stijl: The formative years (1917-1922) by Carel Blotkamp *et al.* The MIT Press, 55, Hayward Street, Cambridge, MA 02142, USA, 1982, pp 284, \$45. Indian orders to Affiliated East-West Press Pvt Ltd, 25, Dr. Muniappa Road, Kilpauk, Madras 600 010.

Most students of arts would have heard of *De Stijl* as one of the avant-garde movements of the early part of this century. The popular image of the De Stijl movement is that its adherents ardently believed in the use of only vertical and horizontal lines and solid colours in blocks in painting and in architecture. Movements of this nature flourished in Europe during the beginning of this century. Art students will think immediately of cubism, dadaism, impressionism and students of architecture of the Bauhaus school. Even students of science find a parallel case in the Bourbaki group of mathematicians. The general understanding of such movements (at any rate of the non-specialists) is that the creativity of the individual is subservient to the ideals embodied in the movements.

The aim of this book is to show that, contrary to the popular belief, there were distinctive individual traits in the De Stijl group and that they did not always agree among themselves. The group consisted

of four painters, Theo van Doesburg, Piet Mondrian, Vilmos Huszar and Bart van der Leek and four architects, J.J.P. Oud, Jan Wils, Robert van't Hoff and Gerrit Reitveld and the sculptor Georges Vantongerloo. Although all of them were not members of De Stijl while it lasted (1917-1928), they contributed to the journal *De Stijl* some time or the other. Theo van Doesburg was the founder and key figure in the movement and much of the information presented in this book is obtained from his letters and estate which is now under the Dutch government. While most of the existing literature emphasizes the general and common characteristics, this book emphasizes the specific and the individual. It is a pleasure to learn that the book is the outcome of eight graduate students in art history at the Rijksuniversiteit in Utrecht, each of whom researched on the life and work of one of the artists (two of them wrote jointly about Jan Wils). The pattern of reporting adopted by the authors was to follow through the education and development before the De Stijl movement and to trace the various influences on their work. Charlotte I. Loeb and Arthur L. Loeb translated the work into English so elegantly that it is difficult to believe that the book is the work of eight distinct authors, much less of graduate students. The book is not only fascinating to read but serves as a good example to students in our universities to show how they can all focus their dissertations on a single theme and illuminate it.

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Clusters of galaxies and extragalactic radio sources edited by A.D. Kuz'min. Nova Science Publishers, Inc., 283, Commack Road, Suite 300, Commack, NY 11725-3401, 1989, pp 326, \$95.

If the fifties were the decade of biology and the sixties the decade of astronomy, then more restrictively, the current decade is the decade of galaxies. Indeed, the most challenging observational and theoretical work in the last several years has been in the area of extragalactic astronomy. This volume is thus a valuable addition to the growing literature in this rapidly developing field of our knowledge. It is also of special value because it brings to the wider attention the work done in this area by scientists in the Soviet Union. The book is a compendium of nine review articles covering almost all aspects of clusters of galaxies and extragalactic radio sources. In the latter area, it has three important articles on the structure of radio sources at metre and decametre wavelengths which would be of great relevance to Indian radio-astronomers as these are the wavelengths at which some of the major Indian facilities operate. Quite appropriately, there is also an article on interplanetary scintillation observations of metre-wavelength radio emission from galaxies.

The first three articles deal with clusters of galaxies. In the first, Dagkesamanskii and Konyukov review the observational data on clusters of galaxies and discuss the current models for the galactic component, plasma component and relativistic component in them. This is followed by a review of metre-wavelength observations of Abell clusters by Gubanov and Dagkesamanskii. They discuss radio observations of approximately 150 rich clusters that are then used to construct the radio luminosity function at meter wavelengths. Classifications and spectra of forty-seven radio sources in nearby Abell clusters have been described by Vatrushin and Gubanov.

Konyukov has written two superb theoretical reviews, the first on dynamical models of relaxed rich clusters of galaxies and the second on the galactic wind and the outflow of gas from clusters. Besides these, the article by Dogel and Uryson discusses diffuse emission from galaxies.

On the whole, these proceedings cover a considerable amount of observational and theoretical work and provide great insights into many of the current problems that need solution. I am sure the extragalactic astronomers will greatly benefit from reading this book.

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Local area networks—An introduction to the technology by John E. McNamara, originally published in USA by Digital Press (1985) and reproduced in India by Prentice-Hall of India Pvt Ltd, New Delhi, 1991, pp 165 Rs. 39.

Over the years, a traditional approach to cater to the computational needs of users in large organizations (e.g., educational & research institutions, industrial concerns or commercial undertakings) has been based on timesharing concepts, i.e., establish a data processing centre; install a large computer, centrally situated and provide a number of timesharing terminals at the various work spots/offices of the potential users. This scheme has been operationally quite successful for many years and reflected the Groch's law relating the economics of scales and the computing power. An analysis of the events in the computer arena during the past two decades reflects that the most significant factor which influenced the way people use computers has been the continuously decreasing cost of computing hardware. Timesharing was developed to provide users with the power of a large interactive computer system during an era when such systems were much too expensive to dedicate to a single user. The traditional timesharing is now no longer a cost-effective way to meet the increasing demands. The tremendous advancements in VLSI technology, coupled with steadily decreasing cost of computing hardware, have now made available personal computers which could meet the needs of average jobs within easy reach. Thus contemporary technology provides a person with a powerful personal computer equipped with a high-resolution graphics at almost the same cost which he is to pay to have a slice of timeshared system through a CRT terminal. Further, using the proven data-communication technologies of cable TV or base-band transmission and fiber optics, it is possible to connect these personal computers into a network and derive the benefits of sharing information, inter-user communication and access to expensive peripherals on demand.

The book is timely and is well written. It explains the technology of local area networks and is a useful source of basic information for any person interested in this field. The book comprises 12 chapters. Chapter 1 introduces the basic concepts, attributes, applications and cost-performance benefits of local area networks, tracing the history of evolution of computing systems, the mode of their utilization and access of computing resources to the users, highlighting the distinction between wide area and local area networks. In Chapter 2, various topologies, namely, star, ring bus, etc., for interconnecting computers and other H/W units into a network are described and various media-access control schemes are explained, highlighting their respective merits and shortcomings *vis-a-vis* the network topology. Chapter 3 traces the history of development of PBXs, time and space division multiplexing, circuit and packet switching techniques and discusses the potential use of PABX in local area computer networks and the bandwidth requirement *vis-a-vis* the type of user services to be supported. Chapter 4 describes the physical properties of various transmission media like twisted pair, coaxial cable, optical fibers, identifying their unique advantages and disadvantages and suitability for local area networks. Chapter 5 focusses attention on issues pertaining to physical planning, installation and testing of local area networks. Chapter 6 discusses the hardware/software, the complexities and tradeoffs in design and implementation of network interface controllers. Chapter 7 discusses the issues pertaining to network economy, availability and reliability. Chapter 8 describes the protocols needed for data communication between nodes in a computer network, highlighting the ISO-layered model for OSI. The role of various servers and the hardware and software aspects which provide shared access to expensive resources in a network are discussed in Chapter 9. Chapter 10 describes the schemes for extending local area networks using repeaters, bridges and gateways. The problems associated with administering large networks comprising different types of local area networks are discussed in Chapter 11. The last chapter, Chapter 12, describes briefly the efforts made by various agencies, e.g., IEEE, ISO and ARPA for developing standards for computer networking.

While the book is well written and easily understandable, it would have been helpful if a chapter on network operating systems had been included to complete the picture. However, it gives an introductory overview of the current state of art in computer networking and is a useful starting point for planners, designers and managers of LANs.

Allianz handbook of loss prevention by Allianz Versicherungs AG. Allianz Versicherungs AG, Vertrieb-Redaktion/TI, Postfach 440124, D-8000, München 44 (VDI Verlag), 1987, pp xvi+900, DM 198.

Today's global markets operate in a highly competitive situation where each country and the business enterprises in them try to attain satisfactory economic positions. Knowledge is being converted to processes and products at increasing rapidity. These developments are now directed to meet increasing concerns for energy conservation, environment and ecology. In this context, careful planning, erection, commissioning and operation of industrial plants assume great relevance. Any disruption of industrial production due to breakdown of plants, equipment or components, damage due to fire or floods or injuries to industrial workers or general public invariably threatens the public image and economic well being of the affected enterprise. Thus, loss prevention and risk management have become prime concerns of every industrial manager. Each enterprise can only draw on its operating experience in factoring the risks involved. However, specialized risk services, which have built up extensive knowledge in this area due to their operation in diverse branches of industry, can offer integrated services covering all aspects of loss prevention and risk management at reasonable cost.

One such company is the Allianz Risk Service with its headquarters at Munich, Germany. It was founded in 1890 and has just completed 100 years of service. It organizes specialized seminars, conferences, etc., and provides documents on loss prevention for its clients. The book under review has been brought out by the Engineering Division of the company in enlightened public interest supported by the conviction that loss prevention is better than (subsequent) compensation. The Division also publishes a house journal *Der Maschenschaden* (available at the Indian Institute of Science Library) to disseminate valuable information gained in its operations.

The book is divided into 20 chapters and covers a wide range of equipment and components used in industrial operations. A distinguishing feature of it is that, in each chapter, there are a large number of photographs and other illustrations showing actual damage in industrial installations resulting from inadequate attention to good practices for loss prevention. Also, references to a large number of papers, reports, surveys and recommendations are made in the text to help the reader to obtain additional information. While it is evidently not possible in a review to give details of the extensive coverage of topics in the book, an overview of the contents will be of help to the reader.

The structure and organization of the Allianz group and, in particular, the Engineering Insurance Division are briefly presented in Chapter 1. Then, the general principles and methods of loss prevention are outlined. Electrical energy is utilized in almost all industrial operations and involves a variety of electrical machines — turbogenerators, 3-phase induction and synchronous motors, direct current motors and transformers — distribution systems involving power cables, power electronics and devices for measurement, control and protection. Chapter 2 deals with all of them; useful hints on equipment design, commissioning, operation, preventive maintenance, overhaul and repair with the objective of loss prevention are given. Electronic data processing is now accepted as the key for greater productivity in all segments of industry. An introduction to the planning of buildings to house these systems with particular reference to prevention of loss due to fire, moisture and flooding by rain water is presented in Chapter 3. Problems in data media and master file integrity are also covered very briefly. A small section deals with similar problems in telephone installations.

Steam is used in many industrial processes and for power generation. Steam generators are complex systems. Chapter 4 deals mainly with water-tube boilers, their layout, design, manufacture and commissioning, water chemistry, pressure parts, air and flue gas-side components and apparatus and emphasizes the importance of proper attention to loss prevention. A small section also deals with shell boilers. Other important parts of steam generator installations are the pipework and vessels and loss prevention aspects in them are also fully covered. Steam turbines are used in industry as prime movers for electrical generators, pumps and compressors. As these turbines are very complex, great attention should be paid to loss prevention during planning, design, manufacture, assembly, commissioning, operation and repair. These aspects are well covered in Chapter 5 which also gives details of various possible abnormal conditions and outlines possibilities of loss prevention by regular inspection and overhaul. A related subsystem

is the condensing plant which is covered in Chapter 6. Various types of damage due to corrosion and erosion are described and guidelines for loss prevention have been given.

Gas turbines using light fuel oils or natural gas are increasingly being used in industries as prime movers for emergency power supply and compressors. Chapter 7 deals with loss prevention in these sophisticated systems starting from the planning stage to that of operation. Turbo-compressors and blowers are used in mining and chemical industries as well as in steel works. Water turbines, centrifugal pumps (used as boiler feed or cooling water pumps) and diesel engines are used widely in industries. Guidelines for loss prevention in these systems are briefly covered in Chapters 8 to 11.

Lifting and loading appliances are used in almost all industries. However, many accidents involving them are also common; this is mostly due to lack of attention to engineering principles as well as loss prevention measures. Chapter 12 deals with these aspects in respect of loading bridges and cranes of three types — slewing, tower and mobile. A principal item in all these appliances is the wire rope. Its proper use and care ensures its long life as well as safety. This matter is covered in considerable detail at the end of the chapter. Loss prevention aspects of certain specialized machines and equipment — earth-moving machinery, industrial furnaces, hot presses for particle boards, wood-working machines and printing presses form the topics of Chapters 13 to 17, respectively. Chapter 18 deals with components and assemblies. Short sections on loss prevention in bolted joints, shafts and spindles, bearings, shaft couplings, stationary gears as well as oil and lubrication supply systems for machine installations have been presented. The last two chapters are concerned with general aspects of construction of chemical plants and fire protection in industry. Valuable information on these aspects has been provided in these chapters.

This book will be of great value and use to all engineers engaged in planning, design, manufacture, testing, erection, commissioning, operation, overhaul and repair of industrial plant and equipment as well as those involved in engineering insurance and loss prevention. By its comprehensive coverage of all aspects of loss prevention in various segments of the industry, the book is bound to occupy a prominent place in the literature in the field. 'An ounce of prudence is worth a pound of gold' says an old adage. Loss prevention requires a lot of prudence and this book has at least a ton of it within its covers.

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