REVIEWS

Concepts from Tensor Analysis and Differential Geometry. Vol. I, *Mathematics in Science and Engineering Series.* **By T. Y. Thomas.** (Academic Press, New York and London), 1961. Pp 1–115. Price $ 5.00.

This is the first volume of the series of monographs and text-books on *Mathematics in Science and Engineering* edited by Richard Bellman. According to the Editor, many recent mathematical theories can be applied to a number of different scientific areas; many scientific areas of significance require a cross-section of mathematical theories for their successful treatment, and the purpose of this new series of monographs is to present the theory and application of these recent scientific and mathematical developments. This, purpose is admirably served by the volume before us which is the first in this new series. The monograph is suitable not only to students of pure mathematics, but also to those students whose primary interest is the study of certain aspects of applied mathematics including the theory of relativity, fluid mechanics, elasticity, and plasticity.

There are altogether 25 sections developed within the compass of 115 pages containing a wealth of topics, and although this entails strict brevity in dealing with each topic, no sacrifice is made either in clarity of presentation or in the logical development of the subject. Nor do we find the omission of any really important areas of interest, specially from the point of view of applications, for, the choice of topics has been made taking this also into consideration.

The first five sections and Section 12 might be considered to constitute the basic foundation on which the subject is developed. These sections deal with several types of co-ordinate manifolds, notions of scalars, vectors, and tensors defined on these manifolds. The notion of groups of transformations is considered briefly in the first section and amplified in Section 12 to the important particular cases of the affine group, the orthogonal group, and the Euclidean group leading respectively to the affine space, the Euclidean metric space, and the Euclidean space with the corresponding affine geometry, Euclidean metric geometry, and Euclidean geometry imbedded in them.

A succinct account of Riemann spaces is given in Section 6, and the next five sections are devoted to the generalisation of this to affinely connected spaces.

The remaining sections deal with classical differential geometry in a space of three dimensions, without rigidly adhering either to a Riemannian $\mathbf{R}_3$ or an Euclidean metric $\mathbf{E}_3$ only. Special mention may be made of Section 17 dealing with mixed surface and space tensors, co-ordinate extension and absolute extension wherein these topics, treated earlier for general affinely connected spaces, are explained in relation to a $\mathbf{R}_3$ and serve to clarify the tensorial significance of surfaces and curves in this space.

Another feature we notice in this monograph is that the treatment is not rigidly confined only to generalised n-dimensional spaces, and tensors of general orders, but special cases are considered wherever necessary for purposes of clarification. We have no hesitation in saying that this monograph admirably fulfils the purpose with which it has been prepared.

B. S. MADHAVARAO.

Discrete Variable Methods in Ordinary Differential Equations. By Peter Henrici (John Wiley and Sons, Inc., New York and London), 1962. Pp. xi + 407. Price $ 11.50.

Numerical Analysis is rapidly developing and playing an increasingly great part in Modern Mathematics. The book under review is concerned, as its title makes it clear, with particular methods of numerical approximations in Differential Equations. The solution of a differential equation of the form $y' = f(x, y)$ with initial condition at $x = a$ is discretely approximated when, within a certain margin of error, the values of y are obtained at a discrete set of points : $x_0 = a, x_1, \ldots . x_n$. A first method, called one-step method, is concerned with finding the approximate value of $y(x_i)$ knowing that of $y(x_{i-1})$. The second, called multi-step method, makes it possible to calculate $y(x_i)$ when the values of $y(x_j)$ are known for a number of values of $j < i$. The steps themselves call into play only elementary analysis. The most delicate part of the methods is however to obtain estimates of the errors made in applying them. One thinks naturally of resorting to classical analysis and obtaining certain inequalities. The result would be extremely rough estimates. It is therefore

necessary to consider the local round-off errors as random variables and apply general principles of statistics, a summary of which is given by the author. The most difficult, but the most useful, part of the book is that devoted to the statistical calculus of errors and the reviewer believes that it is the first time that such methods are explained in the form of a treatise.

The methods developed in the case of a simple equation can be extended to systems and differential equations of higher order. It is also possible to develop a method for an equation of the form $y'' = f(x, y)$ when the value of y is given at the extremities of the interval of variation of x.

In addition to results due to several Mathematicians, the book contains some original contributions due to the author. A rich set of exercises and problems enhances considerably the value of this text. The get-up is naturally excellent as this is a John Wiley and Sons book.

C. RACINE.

Cybernetics, 2nd Edition. By Norbert Wiener. (The M.I.T. Press and John Wiley & Sons, Inc., New York), 1961. Pp. xvi + 212. Price $ 6.50.

The original edition of this book, issued in 1948, was acclaimed as one of the most provocative works in recent scientific history. The new, revised second edition is indexed and contains two supplementary chapters.

The book is addressed to the intelligent layman and purports to explain the implications of the new science of Cybernetics and its possible effects on our society. However, little attempt is made to popularise the subject and many pages are filled with, what at first appears to be, abstract mathematics. The author glibly discusses his ideas in terms such as Newtonian time, Gibbsian statistics, erogodic theorems, Maxwell distributions, Gestalt, Brownian motion, non-Abelian groups and the like. These concepts are then employed to discuss developments in a wide variety of subjects ranging from computers to neuropsychology, from speed governing to homeostatic processes, from automation to heredity.

The word cybernetics is defined as control and communication in the animal and the machine—that is, the transmission of information to produce desired results. The essence of the method is the application of mathematical logic and probability theory to recognise the message being transmitted by filtering out the effects of the disturbing noise The cyberneticist conceives of man as a mechanism, the senses being merely means of transmitting information to the brain. These signals appear as pulses of current flowing along a complex network of neuron chains, producing different types of hormonal activity which give rise to our sensations and emotions. Tentative as it is, this theory has led the physiologist to new advances in sensory prosthesis, *i.e.*, in the replacement of a lost sense by developing the ability to recognise information received from another sense, *e.g.*, to read print by hearing. Also discussed is the hopeful possibility of restoring to artificial limbs the kinesthetic senses of position and velocity.

The author also explains ataxia, manic depression and homeostasis in terms of feedback and the oscillations observed in closed loop-control systems. In the new chapters he offers an explanation for brain waves and proves mathematically that these could be "organised" into a pattern by powerful external oscillations. Similarly, non-linear mechanisms could be forced into synchronism to form self-organizing systems. Considering reproduction, he describes machines that could be made to build other devices like themselves. He apprehends the dangers of these new ramifications of automation and points out the possibility of having these automata endowed with the ability to carry out, without human intervention, policies that may prove to be fatal to our civilization.

Mathematics apart, the main theme of the treatise is presented in a direct, absorbing manner and one is amazed at the manner in which the author rambles from communication engineering to physiology, from biology to automation, from economics to sociology, with the lucid competence of an expert. The going is heavy but the preserving reader is amply rewarded.

PREM J. BHATT.

Response of Metals to High Velocity Deformation, Metallurgical Society Conferences, Vol. 9, A.I.M.E. Edited by P. G. Shewmon and V. F. Zackay. (Interscience Publishers, New York and London), July 1960. Pp. xii + 491. Price $ 18.00.

This book, which covers the proceedings of the 8th Conference in the Technical series of the Metallurgical Society of the A.I.M.E. held in Colarado in July 1960, highlights the application and use of high strain rates for metal deformation, a field that has been attracting widespread interest. An international flavour is lent to the

subject and the book by the contributors from England, France, Canada and U.S.A.

The book has been conveniently divided into two main parts, the first consisting of some 6 papers and the discussions thereon and the second having 10 papers.

The first part under the caption 'High Velocity Deformation deals with contributions on the effects of strain rates in thin specimens produced specifically by increasing the head speed, and the notation and symbols used herein are those standardised by Dr. Krafft. Instrumentation for high-speed strain measurement in a simple gas machine and a bar-block impact machine is described in the first paper. Then follows the observations of brittle behaviour produced by neutron irradiation on pure iron and a 0·21% C. steel. The increase in resistance of mild steel to the propagation of non-uniform yielding with increased dynamic rates of strain and low temperature is discussed next. The inapplicability of the elasto-plastic theory and the Malvern strain-rate theory to the comprehensive aspects of the strain-rate effects and the consequent use of the dislocation theory is described in an excellent paper by Prof. Dorn and his co-workers. This is followed by two papers on the structural changes in aluminium and copper single crystals and mild steel and crystallographic changes in aluminium single crystals, produced by high velocty deformation using explosive systems.

The various aspects of shock phenomena in metals are discussed in detail in Part II under some well-written ten papers. The first paper describes the shock wave concept, and some of its properties, the second the theory of moving dislocations, the third the dynamic shock properties of some alloys of iron and the fourth deals with the determination of the Hugoniot curves with a metallurgical technique. The value of metallurgical observations in studying the complex shock propagation phenomena is discussed next and then follows 5 papers dealing with the behaviour of iron and steel under impulsive loading, the nature of fractures, the production of Newmann bands, changes in microhardnees and microstruture and the changes in mechanical properties in austenitic manganese steels caused by the passage of plane compressional shock waves.

The 16 papers, covered in this book, very well establish the general hydrodynamics of shock motion and clearly bring out the fact that any change in the thermodynamic parameter must be associated with structural changes both in the macro and the micro scale.

The book is profusely illustrated by diagrams, graphs and photo-micrographs and is an indispensable guide book to all those working on shock phenomena in metals and alloys.

A. A. KRISHNAN.

The Fire of Life—An Introduction to Animal Energetics. By Max Kleiber. (John Wiley and Sons, Inc., New York and London), 1961. Pp. xxii + 454. Price $ 11.50.

The aim of this book is to give the reader an account of the fundamental concepts and basic relationship between rate of heat production and environmental temperature. The book consists of six parts. Part I deals with the subject of "The evolution of bioenergetics" which includes topics such as thermochemistry and source of animal heat. Part II deals with the subject of "Total starvation", Part III with "The physical aspect of metabolism", Part IV with "The metabolism of the starving animal", Part V "Food as fuel" and Part VI with "Food and population". These have been presented in simple language. The author has introduced simple principles of analytical geometry and calculus to show how generalisations, hypotheses and theories have been developed by applying mathematical analysis to observed data. The author has also critically examined the facts and figures presented. This book will prove highly useful to students of animal energetics.

M. SWAMINATHAN.

The Chemical and Biological Action of Radiations, *Vol. V. Edited by M. Haissinsky.* (Academic Press, London ; India : Asia Publishing House, Bombay-1), 1961. *Pp. xi + 278.* Price 63 *sh.*

The fifth volume in the series covers the following subjects: (I) Mechanism of the radiolysis of water by gamma rays or electrons, (II) Action des rayons alpha sur les solutions acqueses, (III) Diffusion kinetics in radiation chemistry, and (IV) Mass spectrometry and radiation chemistry.

The first paper gives a historical account of the development of radiation chemistry of aqueous solutions and emphasizes the fundamental contribution of Fricke to the subject. The criticism which was advanced against the radical theory in its early stages of its development and the arguments which have now finally brought the radical theory to prominence have been clearly put forward. The development and testing of the radical theory have been adequately described and the author

has also defined a number of problems that remain to be solved.

In the second article, which is in French, the radiation effects of alpha-particles on aqueous solution (which cannot be satisfactorily explained by the radical theory) have been accounted for, by postulating for intensely ionizing radiations, a zone of molecule-radical reactions, $H_2 + OH$, $H_2O_2 + OH$ and $H_2O_2 + H$, in the immediate vicinity of the trajectories of the alpha-particles. The relative importance of these reactions depends upon the nature and concentration of the solute. Several difficulties presented by this theory are pointed out and the author makes a few suggestions for improvement.

The third paper deals with the competition between the recombination of the radical and their diffusion away from one another by quantitatively describing it in terms of the macroscopic reaction rates and diffusion laws. The resulting equations which in general have no analytical solutions can now be solved by high speed electronic computors. In addition to the general formulation and criticism of the diffusion kinetic model, there are several analytical and numerical treatments of one radical model. The two-radical model, the effect of dose rate and the comparison with experiments are also given in some detail. The numerical calculations clearly show the extent to which the diffusion model explains the experimental results in the radiolysis of aqueous solutions.

The final article describes the principles, the apparatus and the technique of mass spectrometry as applied to radiation chemistry. It also contains a section dealing with ion-molecule reactions.

In general, all the articles have been written in a competent manner by distinguished experts in their respective fields. Each article has a list of valuable references for supplementary study. This book can be consulted with confidence.

H. B. Mathur.

Galen on Anatomical Procedures. (The Later Books: A Translation by the late W. H. L. Duckworth.) Edited by Lyons and Towers (Cambridge University Press), 1962. Pp. xix + 279. Price 40 *sh.*

Galen's *Anatomical Procedures* published in the final form, just a few years before his death, embodies the result of a lifetime of practical research. Only the first eight and a half books out of the 15 volumes have survived in the original Greek and have been translated into English by the late Charles Singer. However, on the basis of an Arabic translation of the entire work, which was available, the last six and a half books have now been translated and presented in this volume.

The volume starts with the sixth chapter in the ninth book which deals with the dissection of the brain and experiments in brain surgery. The anatomy of the eyes, tongue, lips and movements of deglutition are surveyed in Book X. The Larynx and associated structures in apes and swine are described in Book XI. The generative organs and fœtal development, dissection of veins and arteries, the anatomy of nerves arising from the brain and the spinal cord are the subject-matters of Books 12 to 15.

The volume while bringing to completion the entire *Anatomical Procedures* in English has also achieved its objective in focusing the attention of scholars and scientists on one of Galen's greatest works.

M. Sirsi.

Soil Micro-organisms and Higher Plants. By Prof. N. A. Krasil'nikov. (Published for the National Science Foundation, Washington D.C. and the Department of Agriculture, U.S.A., by the Israel Programme for Scientific Translation, 1961. Available from the Office of Technical Services, U.S. Department of Commerce, Washington D.C.) Pp. 474. Price 4.5 U.S. Dollars.

This book brings together most of the aspects of interaction between soil micro-organisms and higher plants which is engaging the attention of soil microbiologists. The subject-matter which is presented in a clear, readable style covers fundamental details of the structure, development, variability and classification of bacteria, actinomycetes and fungi in the light of recent research. Information is given at length on the importance of micro-organisms in plant nutrition, the role of microbial activities in the complementary nutrition of plants, the effect of microbes on the vitamin content of plants, their importance in plant growth and the part played by them in soil fertility.

The book is divided into four parts, namely, (1) Fundamentals of the structure and development of micro-organisms including the variability and classification of Actinomycetes, bacteria and phages. (2) The soil as an environment for micro-organisms: This deals with soil structure, soil respiration, thermal regime of the soil, soil insolation, organic matter and radioactive substances in the soil, the absorption capacity of

the soils and the ecological and geographical distribution of soil microbes. (3) Biological factors of soil fertility: Here is discussed mainly the effect of humus on plant development, and rôle of biotic substances of the soil and the effect of bacteria on the assimilation of nutrients by plants. (4) Interaction between soil micro-organisms and plants: This deals with most of the advances made in the study of rhizosphere microbiology with a note at the end on the epiphytic microflora.

Much of the material on soil microbiology, published in recent years by Russian investigators, is comprehensively discussed. The points of view on the subject that are considered to be of major importance in soil microbiology by the Russian scientists should be very useful indeed to workers in this field elsewhere. The book ends with a bibliography of 641 Russian titles (some of which are Russian translations of non-Russian material) and 829 titles by foreign authors, which, I think, is by no means complete. Omission of an Index at the end of the treatise makes reference rather difficult.

In view of the recent increased interest in the study of soil micro-organisms in relation to plant well-being, the book will be a good reference work for microbiologists, plant physiologists, soil specialists, plant pathologists, agrobiologists and agronomists alike.

V. AGNIHOTHRUDU.

Mechanisms in Radiobiology. Edited by M. Errera and A. Forssberg. Volume I. General Principles. (Academic Press, New York and London; India: Asia Publishing House, Bombay-1), 1961. Pp. 534. Price $ 16.00.

All those who have read the papers in Volume II of this series (see *Curr. Sci.*, 1961, **30**, 238), which for some unknown reason appeared a year earlier than Volume I, would be happy that this long-awaited publication has come out of the Press. It is no fault of the authors that much new knowledge particularly in the field of free radical measurements has become available since the papers of the current volume were written. Progress in radiobiological research, as in all other branches of science related to atomic energy, is so fast that any review paper is likely to become outdated even before it is published. Nevertheless, the basic facts do not change so fast—only views pertaining to the relative importance of the numerous pathways of radiation action on cells undergo periodic reassessment—and hence this volume dealing largely with general principles is of great value, despite its belated publication. Research workers interested in radiobiology will welcome this excellent compilation of the basic facts concerning the action of radiations on cells, organs and organisms.

The volume begins appropriately with a paper on the physical principles of radiation action by F. Hutchinson and E. Pollard. Radiobiologists will find the discussion on radiation dosimetry and description of radioactive sources particularly useful. In a second part of the article, the same authors deal with the target theory of radiation action. They discuss the nature of radiation damage on molecules of various kinds and the relation of this damage to cell function. They rightly conclude that the simple biophysical theories built around statistical considerations are not wholly adequate to explain the effects of radiation on cells and that the physical changes which cause the loss of specific biological function are yet to be identified.

In the next paper, E. J. Hart and R. L. Platzman, describe the history and nature of Radiation Chemistry. The ionic yields in the radiolysis of inorganic gases, gaseous hydrocarbons, organic liquids and water are presented in well-constructed tables. The data from biochemical studies carried out in irradiated *in vivo* and *in vitro* systems are summarised by M G. Ord and L. A. Stocken in the third chapter. They have incorporated in an addendum results from some recent studies on the effects of radiations on nucleic acids.

The cytological effects of ionizing radiation, particularly as observed by electron microscopy, are discussed in the fourth chapter by T. N. Tahmisian. With the aid of a few striking illustrations, the author has shown that the steps intervening between a small physicochemical change and a striking morphological result may have a topological basis, and that studies to bridge the gap between molecular configuration and ecology and those changes now readily observed by the electron microscopist are urgently needed. T. Alper describes the effects of radiation on subcellular units and free living cells From a consideration of the possible mechanism of lethal and genetic effects on cells, the author concludes that either (*a*) it is a structure other than the "gene" which frequently acts as a target for cell killing, and even for the induction of mutation or (b) the gene as functionally defined must include chemical substances other than DNA.

The last two chapters on "Radiation Genetics" and "The Induction of Mutations as a Method of Plant Breeding" by S. Wolff and Å. Gustafs-

son respectively are masterpieces of condensation of the available knowledge on these topics. Those enthusiastic about the economic possibilities of mutation breeding would do well to note that Gustafsson, who more than any other living scientist is familiar with the possibilities of this technique, stresses that to achieve success the plant breeder should "study his crop plant carefully and learn to know its genes and linkage conditions, as well as its mutation spectrum, both under spontaneous conditions and after the application of different radiations and chemical mutagens". There is thus no hope of quick success for those who wish to add mutation research as an additional item to their already overloaded programme of research.

The Academic Press deserves both our gratitude and congratulations for providing this excellent source of authoritative information in a field of science characterised by explosive progress.

M. S. SWAMINATHAN.

Books Received

Drugs, Medicines and Man. By H. Burn (George Allen & Unwin Ltd., London W.C. 1), 1962. Pp. 232. Price 25 *sh.*

Nutritive Values of Fruits, Vegetables, Nuts and Food Cures. By Shaukat Usmani. (Shaukat Usmani, Y.M.C.A., Woodhouse Road, Bombay), 1962, Pp. ix + 192. Price Rs. 6·50.

The Indian Ephemeris and Nautical Almanac for the Year 1963. (The Manager of Pubications, Government of India, New Delhi), 1961. Pp. xxvi + 462. Price Rs. 14.

A Bibliography of Indology. (Vol. 2)—*Indian Botany* Part I, A-J Compiled. by V. Narayanaswami. (The Librarian, National Library, Belvedere, Calcutta-27), 1961. Pp. xlii +370. Price Rs. 8.

Soil Microorganisms and Higher Plants. By N. A. Krasil'nikov. (Academy of Sciences of the USSR, Moscow), 1958. Pp. 474. Price $ 4.75.

Polarised Light Production and Use. By W. A. *Shurcliff.* (*Harvard University Press, Cambridge*, Massachusetts; India: Oxford University Press, Mount Road, Madras-2), 1962. Pp. ix + 207. Price Rs. 31·25.

Fusarial Wilt (Panama Disease) of Bananas and other Musa Species. By R. H. Stover. (The Commonwealth Mycological Institute, Ferry Lane, Kew, Surrey), 1962. Pp. vi +117. Price 20 *sh.*

Essay on Atomism: From Democritus to 1960. By Lancelot Law Whyte. (Thomas Nelson & Sons Ltd., 36 park Street, London W.1), 1962. Pp. 107. Price 16 *sh.*

Acharya Prafulla Chandra Ray—Birth Centenary Souvenir Volume. (The Publication Committee, Calcutta University, Calcutta-19), 1962. Pp. x + 310.

The Adrenal Cortex—British Medical Bulletin, Vol. 18, No. 2, May 1962. (The Medical Department, The British Council, 65 Davies Street, London W. 1), Pp. 89–178. Price 20 *sh.*

Proceedings of the Summer School of Botany. Edited by P. Maheshwari, B. M. Johri and I. K. Vasil. (Ministry of Scientific Research and Cultural Affairs, Government of India, New Delhi), 1962. Pp. viii + 522. Price Rs. 25.

Eighth Symposium (International) on Combustion—Held at the California Institute of Technology, Pasadena, August 28 to September 3, 1960. (The William and Wilkins Co., Baltimore-2, Maryland, U.S.A.), 1962. Pp. xxviii + 1164. Price $ 31.00.

U.P. Scientific Research Committee Monographs —Ultrasonics and Colloids. By Satya Prakash and A. K Ghosh. (The Scientific Research Committee, U.P. Allahabad), 1961. Pp. 142. Price Rs. 8.

The Origin of Science. By E. H. Hutten. (George Allen & Unwin Ltd., Ruskin House, London W.C. 1), 1962. Pp. 241. Price 28 *sh.*

Natural Organic Macromolecules. By Bruno Jirgensons. (Pergamon Press, London), 1962. Pp. x + 464. Price 63 *sh.*

The Chemistry of Flavonoid Compounds. Edited by T. A. Geissman. (Pergamon Press, London), 1962. Pp. viii + 666. Price £ 7 10 *sh.*

Role of Bluegreen Algæ in Nitrogen Economy of Indian Agriculture. By R. N. Singh (Indian Council of Agricultural Research, New Delhi), 1962. Pp. 175. Price not given.

Errors of Observation and their Treatment (3rd Edn.). By J. Topping (Chapman & Hall, London W.C. 2), 1962. Pp. 119. Price 7 *sh.* 6 *d.*

Physics of the Nucleus. By M. A. Preston. (Addison Wesley Pub., London W. 1), 1962. Pp. x + 661. Price $ 15.00.

Handbuch der Kolorimetrie (Vol 1)—*Kolorimetrie in Der Pharmazie.* By B. Kakac and Z. J. Vejdelek (VEB Gustav Fischer Verlag, JENA). Pp. xv + 1139. Price 79·20 DM.

Advances in Astronomy and Astrophysics (Vol. I). Edited by Zdenek Kopal. (Academic Press Inc., New York-3, N.Y.), 1962. Pp. x + 366. Price $ 10.00.
