find this book interesting and enlightening. It will be a valuable reference material for students taking courses on the history of mathematics. All in all, a worthwhile addition to mathematical libraries.

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Mysterious Motions and other Intriguing Phenomena in Physics. G. S. Ranganath. Universities Press India Ltd, 3-5-819. Hyderguda, Hyderabad 500 029. 2001. 149 pp. Price: Rs 195.

Matter and motion are two of the most significant factors of the universe. Starting from macroscopic objects like the galaxies to microscopic entities like the atoms, everywhere the presence of matter and motion is seen. The motions exhibited by the material entities are the subject of man's quest in understanding. The entire domain of science in general and physics in particular, deals with the detailed study and understanding of the motions. A large variety of motions fall under the direct focus of the basic laws of physics. However in many situations, we come across motions which do not apparently fall under the normal laws of physics. They appear mysterious, somewhat paradoxical and often appear to be exceptions to the basic laws. In this remarkably lucid presentation, Ranganath clearly points out how the mysterious motions can be understood by a proper scientific application of the established postulates of physics.

The mysterious motions described in the book belong to a variety of situations. Why was solar probe *Ulysses* launched towards Jupiter, although the objective was for it to circle around the sun? Why do tides not occur when the moon is directly above or below the sea? What are chaotic motions? Are they repeatable or not repeatable? What are the unusual features in the flow of grains like sand grains? Why does the Tippe-top toy jump upside down while spinning? Similar questions come in a variety of other areas like elasticity, motions involving heat, light, oscillations and electrodynamics. Ranganath illustrates the mysterious motions encountered in all these areas and brings out the scientific principles involved.

The style of the book is clear and lucid. It is a reader-friendly approach that the author has employed with practically no mathematical equations, but still keeping faithful representations of scientific principles and their applications. The objective of the book is to attract the young students into many classical domains of physics. But, it does much more than that. It illustrates many physics principles with applications which are not often cited.

I would unhesitatingly recommend the book to all students of physics, whether undergraduate student or a research student and also to all practising physicists, whether physics teacher or researcher who wants to enjoy physics.

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Origin of Inertia – Extended Mach's Principle and Cosmological Consequences. Amitabha Ghosh. Affiliated East-West Press Pvt Ltd, 105 Nirmal Tower, 26 Barakhamba Road, New Delhi 110 001. 147 pp. Price: Rs 135.

The idea that 'inertial properties of an object are determined by the presence and distribution of mass–energy throughout all space' is one way of expressing the principle given by Ernst Mach, the Austrian philosopher–scientist. Einstein thought that the general theory of relativity (GTR) given by him in 1915 incorporated this principle. However, the first solution of the theory discovered by Schwarzschild in 1916, described an isolated massive object which seemed to violate Mach's principle. Wheeler used the Mach's principle as a boundary or initial condition to rule out single mass solutions, unless they are embedded in the rest of the universe. Many others, including Hoyle and Narlikar, have attempted to incorporate the Mach's principle in their theories.

Among various proposals, there is one due to D. W. Sciama, given in 1953, which adds another term to the well-known Newtonian expression for gravitational attraction between two massive objects. This additional term is proportional to the acceleration between the objects. When the interaction between one object and the rest of the universe is considered, we have to integrate over all the masses in the universe. The normal term vanishes as matter is distributed symmetrically all around, while the new term makes a contribution proportional to the acceleration (which breaks the symmetry). This acceleration is with respect to the mean rest frame of the universe. It gives rise to an expression similar to the second law of Newton. As the term is due to gravitational mass, its equivalence to the inertial mass term in the second law of Newton follows in a natural fashion. Sciama had also discussed the possibility of a term dependent on velocity, but did not pursue it. The author of the book under review, Amitabha Ghosh, postulates a velocity-dependent force in the gravitational interaction of two particles and discusses its consequences in some astrophysical and cosmological contexts. Ghosh who teaches at IIT Kanpur, has also served as the Director of IIT, Kharagpur.

The main effect of the new term introduced is to slow and stop motion and thus act as a drag force. The author seems to have a fascination for the Aristotilean idea that motion must decrease, and the object must come to a stop in course of time. The Galilean idea incorporated in the first law of Newton, postulating non-stop uniform velocity, is certainly non intutive and many students in schools have lots of problems getting used to the idea.

Before going into some of the details presented in the book, I have to express my unhappiness with total absence in the book of a discussion of broader frameworks and principles of physics like Lorentz invariance and general relativity. It is unclear how the modification of Newton's law of gravitation suggested in the book, will fit into the time-tested framework of physics. The postulated term is proportional to square of the velocity. One might have thought that this is the first post-Newtonian correction of the

order of square of (v/c), where v is the velocity of the object and c is the velocity of light. But the author applies this term to photons by taking v to be equal to c! So the additional term cannot be viewed as a small correction.

There are detailed calculations of predictions in a few cases for which observations are available. The areas where this term has been applied include cosmological redshift, gravitational redshift of light emitted by the sun and white dwarfs, redshift of photons grazing the sun, secular retardation of planets and satellites, transfer of angular momentum from centre to periphery due to differential drag, and matter distribution in spiral galaxies. Some of the applications are qualitative and in some cases, there are just hand-waving arguments given. One glaring omission is the application to bending of light by the sun, where Newtonian theory predicts half the value observed while general relativity predicts the correct value.

The first application is to the photon. The drag on it leads to a formula for cosmological redshift. It is concluded that expansion of the universe is not needed and we are in a static universe. The cosmic background radiation is attributed to cosmic rays and other vague ideas. The derived redshift increases (exponentially) faster than the distance. This does not agree with the recent observations using supernovae, which seem to indicate the opposite; it is distance which is increasing faster than redshift.

The corrections are significant for the sun and galaxies, but get smaller for objects smaller than the sun or larger than the galaxies. This is because the velocity term falls-off like the square of the distance. So the redshift due to drag is not a small correction for the sun, it is an addition of about two-thirds of the Einstein value. The observation of the gravitational redshift of the sun is complicated due to Doppler shift caused by motion of gases at high temperatures. The author claims a good fit to the data for his predicted value. Whereas J. M. Beckers (*Astrophys. J.*, 1977, **213**, 900) found that at dark spots in the sun, where the temperature is low, making convective effects of gases negligible, the exact Einstein value is obtained. A result which leaves no room for the effect of drag. The other predictions made in the book are also not completely convincing, and are masked by other competing effects.

The book is written in a clear and lucid style, and the author's enthusiasm for the discovery is quite evident. I find it difficult to get excited or even convinced by the idea. The book may be of interest to persons with a liking for unconventional ideas in science, but will have only a limited appeal to others.

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Annual Review of Biomedical Engineering, 2001. M. L. Yarmush *et al.* (eds). Annual Reviews, 4139 El Camino Way, P.O. Box 10139, Palo Alto, CA 94303-0139, USA. 2001. vol. 3, 483 pp.

Biomedical engineering, an interdisciplinary field, has emerged as one of the major contributors to health care. It has received inputs from various branches of science, engineering and medicine. It is in this context that the *Annual Review of Biomedical Engineering, 2001* with its 16 reviews gains its relevance by providing a comprehensive review of significant developments.

To honour the memory of Thomas McMahon, a pioneer in the field of cardiac-assist devices and orthopaedic biomechanics, a prefactory chapter is added, which is followed by reviews related to his speciality. The cardiac-vascular development involves a dynamic interaction of genetic and environmental factors. The various features of development of chick-embryo heart are explained based on modelling of growth and microstructural adaption. The moulding (morphogenesis) of tissues, as controlled by micromechanical and chemical signals, contributes to the growth of the inner and outer walls. The radial growth of the blood vessels depends on shear stress due to blood flow. According to Taber, remodelling of the cardiovascular tissues takes place in diseases. The review by Grotberg on respiratory fluid mechanics and transport process presents the contributions from pulmonary and critical-care medicine, surgery, physiology, environmental health sciences and engineering. Through modelling and experimental studies the changes in air flow, starting from nasal area to alveoli are presented. The various processes such as transport of non-respiratory gases, aerosol transport, airway stability, etc. associated with health and disease conditions are well elaborated.

In order to understand the occurrence of increasing number of injuries, especially related to abdomen, pelvis and lower extremities due to car accidents, the fundamentals of impact biomechanics are presented. Based on large data, King has reviewed the prevention aspects of these injuries. Osteoporosis could dramatically reduce failure load, which occurs after tolerance limit is exceeded. The micro- and nanomechanics of outer hair cells associated with electromobility is crucial for amplification, sharp frequency selectivity and nonlinearities of mammalian cochlea. The review by Maynard explains the features to achieve narrower mechanical tuning through electromobility modelling, based on phenomenological description, molecular level modelling and membrane bending. The review on trabecular bone by Keaveny *et al.* presents the theoretical and micro-level imaging developments in this field. A unique tool for analysis of multiaxial loading, time-dependent failure and damage accumulation of this spongy bone, the micro-structural class of 'high resolution' finite element method is discussed. Through this the relation between bone anisotrophy and underlying architecture with reference to aging, disease and drug treatment is analysed. The interaction of nervous and muscle systems to produce coordinated movements of body parts, by computer modelling and simulation procedures, are analysed. This review by Pandy also includes schematics of the coordination activities of various systems applied to analyse jumping, pedalling and walking of human subjects. The data on the networks of biochemical, genetic and biophysical processes of cellular behaviour and their failure, consisting of hundreds to thousands of interacting chemical species and structures, as analysed by forward engineering and modelling, are reviewed.

The development of vascular tissues considering endothelial cells as base material, is reviewed by Nerem and