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Books and Multimedia Reviews

Our Universe: The Thrill of Extragalactic Exploration as Told by Leading Experts edited by S. Alan Stern. Cambridge University Press, New York, New York, USA, 2001, 152 pp., $19.95 softcover (ISBN 0-521-78907-9).

Our Universe tells nine true stories about why people do science and how science really gets done. This book is unusual because the tales are told from the heart about their authors' dearest subjects of study. The writers are all leading experts in extragalactic astrophysics, both junior and senior investigators on the frontiers of knowledge, yet their stories are easily understandable by a wide audience of readers.

The science conveyed in their stories is, of course, fascinating, but what is just as interesting is the insight they give into the sociology of science and the role personalities play in scientific revolutions. You want to know how science really gets done? Someone bets you a bottle of wine you're flat wrong and they're right. It's amazing how much effort you'll expend to win that bet!

Of course it is hard to overcome the inertia of conventional wisdom. As one of the authors relates, you may be "cast off into the wilderness" if you go against the mainstream. How you move your ideas from that position to widely accepted knowledge makes for a gripping yarn, and there are nine of them here. They include the observational discovery of gamma-ray bursting hypernovae, ghostly low surface-brightness galaxies, elusive dark matter, and theoretical supercomputer models of the large-scale universe.

Many of the authors include stories of the events early in their lives that led them into science. Each such case is, of course, unique, but I think it is important for those young adults who are considering science as a career to know that it can actually be done, though the path may have many unexpected twists and turns. Each of the articles includes as well suggested readings and web sites on the topics, also at a level understandable by a well-prepared high-school student.

These insiders' perspectives of the real world of astrophysical research make this a fascinating book for anyone to read, especially someone interested in science as a career. The highly personal accounts tell not only what scientists do, but also why they want to do it and how they achieved their current status in life. I highly recommend this book to all who are interested in our universe and the people who study it.

Claud H. Sandberg Lacy
Department of Physics
University of Arkansas
Fayetteville, Arkansas 72701, USA

Solar System Dynamics by C. D. Murray and S. F. Dermott. Cambridge University Press, Cambridge, United Kingdom, 1999, 575 pp., $39.95 softcover (ISBN 0-521-57597-4).

Solar System Dynamics is a textbook devoted to the dynamical exposition and understanding of the solar system. It is an ambitious book that covers a wide range of topics, tying together classical dynamical astronomy material with more recent research on all aspects of motion in the solar system. The authors have successfully knit these diverse topics into one coherent and authoritative text that brings recent developments in dynamical systems theory and the physics and geophysics of the solar system within the fold of dynamical astronomy. In fact, it represents a new breed of dynamical astronomy textbook.

I am certainly not alone in this opinion, as the back cover of the book is graced by strong endorsements from a number of leading researchers and authorities in the field of solar system dynamics. In fact, given the impressive list of endorsements, it would be very difficult to come to any other conclusion. So I will instead focus on its content and, perhaps more importantly, the shift in the field of dynamical astronomy that this textbook signifies.

The book is almost 600 pages and includes an extensive bibliography, numerous drawings, photographs, graphs, and plots distributed throughout. The style of writing is informal, and the discussions have many physical examples that motivate the mathematical developments. Even with this informal style, however, the level of mathematics covered in the text is sufficiently deep and detailed to convey the advanced theory, and can be used as a starting point for serious research. The book has an associated website (http://ssdbook.maths.qmw.ac.uk/) with more details about the book, an extensive collection of computer animations and programs highlighting various aspects of the theory, and a comprehensive list of corrections. It should be noted that the current list of corrections runs for 15 pages and is apparently still growing (the most recent entries date from November 2001); hopefully a future printing of the text will accommodate these. Each chapter also has a set of challenging and well thought out homework problems. This book is an excellent selection for use in a graduate solar system dynamics course, as a reference book for practitioners of dynamical astronomy, or as an introduction to a particular area of research. As the title advertises, this book deals specifically with the solar system in its current and relatively recent state; indeed, there is little discussion of the formation dynamics of the solar system or of extra-solar planetary systems.

For those who are familiar with the standard texts in dynamical astronomy with a solar system emphasis, such as the books by Roy, Danby, or Brouwer and Clemence (to name the most recent examples), the current text incorporates important new material that has been developed in the time

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since those books were written. Specifically, it includes detailed discussions on tidal heating, spin-orbit coupling, planetary rings, resonances, chaotic dynamics, and symplectic integrators to name just a few topics. These are in addition to standard topics such as the two-body problem, the restricted three-body problem, disturbing functions, and secular perturbations. In all of these topics the authors take a perspective not found in the classical texts, emphasizing physics and *in situ* observations in addition to the mathematics of the dynamics. The chapter on the restricted three-body problem is a case in point, as it nicely ties together the basic facts of this model, advanced mathematical analysis of the problem, and physical examples of how this model is used (in conjunction with additional physical models in some situations) to understand a number of dynamical phenomena in the solar system.

In the preface, the authors state that this book should be seen as an extension of Roy's "Orbital Motion", and indeed this is an appropriate way to view the text. Comparing the content of these two books highlights some significant shifts that have occurred in the field of dynamical astronomy. Roy's book (as with most classic texts on dynamical astronomy) has chapters on observational geometry, orbit determination, and the theory of the motion of the Moon in addition to a number of basic and special topics. These traditional topics do not appear in Murray and Dermott's book, probably a first for a dynamical astronomy textbook, and instead they cover topics that involve physical processes at a fundamental level—topics that often were not even broached in the classical dynamical astronomy texts. The reason why this shift has occurred can be easily understood, given the vigorous exploration of the solar system that has occurred in the last few decades, yielding observations and measurements of such high accuracy that the ideal mathematical models of classical dynamical astronomy often no longer apply and must be augmented. Thus, the current text does not replace the classic texts but, instead, shows how the field of dynamical astronomy has expanded to the point where a new species of textbook has become necessary. Indeed, *Solar System Dynamics* represents this new species of textbooks in dynamical astronomy—and as the first in this new class it will surely be a classic for many decades to come.

D. J. Scheeres
Department of Aerospace Engineering
The University of Michigan
Ann Arbor, Michigan 48109, USA

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Astrobiology by Monica Grady. Smithsonian Institution Press, Washington, D.C., USA, 2001, 91pp., $14.95 paperback (ISBN 1-56098-849-5).

From an unimposing artistic interpretation of the Big Bang, to a photograph of an unidentified man leaning against fossilized algal stromalotites, to an explanation of optical chirality, Monica Grady presents a wide range of ideas with clear and concise language as an introduction to the field which shares a title with her book. Grady meticulously describes the mission of astrobiologists to understand extremophiles found across the globe and propose plans to search for similar life forms beyond the Earth. Her consistently fact-based approach, however, lacks development of potentially inspiring speculation about the implications of the ultimate goal of the astrobiologist's mission. Grady briefly mentions in the preface "the philosophers and theologians who are captivated by the range and depth of the subject matter" and, while the range and depth of the subject is carefully laid before the reader, discussion of why these studies should captivate a philosopher or a theologian is absent.

Grady admirably recognizes the line between knowledge and speculation unsupported by current understanding. The result is a clear presentation of the facts for a reader with little background in the subject upon which further questions and opinions may be formulated. At the same time, she offers a unique perspective as an expert in the study of meteorites. This perspective is most prevalent in the section regarding the origins of life on Earth, which may have been significantly aided by the contribution of organic material in meteorites. She also employs the very current knowledge of the Earth's diverse families of extremophiles while remarking that the extremes of conditions in which life is found on Earth may not represent the limits to conditions in which life has developed elsewhere. Similarly, Grady applies cosmology and astronomy to explain all known possibilities for extraterrestrial life, evidenced in her careful noting even of the indication that water-ice may exist on Mercury in areas of impact craters permanently shadowed from the Sun. Grady's approach to the subject, though its strengths are clear, sacrifices an invaluable opportunity to profoundly inspire the nonscientist reader by avoiding development of any ideas beyond the support of particular discoveries through telescopes, microscopes, and space missions. Two pages are devoted to the history of the naming of space missions and another to an exhaustive list of space missions to Mars, but the equally relevant issue regarding the social implications for a society that discovers extraterrestrial life is not addressed. The unique depth of the subject's social implications and the invaluable perspective a scientist with a career devoted to the subject might offer effects a risk of stepping beyond scientific expertise that is well worth taking.

Grady insures ease of understanding and enjoyment for a readership of diverse backgrounds with multiple diagrams, tables, and graphs and beautiful photographs on nearly every page. Assurance, however, of continued discourse when the book is set aside between an inspired reader and any willing ear is sacrificed in avoiding some of the deepest questions we can ask ourselves about the uniqueness of our role in the universe. Offering these questions and some related speculation in introductory books such as this one can assure