International Journal of Astrobiology 2 (1): 75–77 (2003) Printed in the United Kingdom

Book reviews

The Sun: an introduction, second edition

M. Stix

Springer, Berlin (*2002*)
490 pages · Price Euros 79.95 · ISBN 3-540-42886-0 HB
10.1017/S1473550403211423

This is the second edition of the Stix textbook on Solar physics. The book is aimed at final year science undergraduates and research students. The preface to this edition clearly states the aims of the book as '… illustrating the application of the rules of physics to a star like the Sun' and to present a 'coherent yet more technical text on the whole Sun'. Judged against these stated aims this text is an undoubted success. All aspects of Solar physics are covered at a consistent level and the book is logically structured and well written. Since the whole of Solar physics is covered at an introductory level it is inevitable that some elements are given more detail than others. Overall the book is biased towards observational techniques and results as opposed to theoretical analysis. However, all of the essential theory is introduced in a clear and straightforward manner and here the emphasis is on pedagogical exposition rather than rigorous detail. Thus while some specialists may feel that their particular field hasn't been given enough space, or the balance favours some branches of Solar physics over others, this would be an unfair criticism. All books of this nature must involve an element of choice by the authors and I believe that here the overall balance is right. It covers material on Solar physics which is not available from another single source, is a valuable resource for advanced undergraduate courses and should be required reading for all postgraduate students with interests in Solar or stellar physics. The excellent bibliographical notes at the end of each chapter, and the reference list, easily compensate for any minor omissions in the text and ensure that this book could be safely used as a starting point for study of all aspects of Solar science. The questions posed throughout the book are excellent prompts for active study, although I thought these were often at a slightly higher level than the material in the text itself, and comprehensive answers are available online.

The fact that this book should become required reading for all postgraduate students studying the Sun, and those with a more general interest in stellar structure, also to some extent defines the limits of the usefulness of this book to a wider audience. For specialists in astrobiology this book probably is too focused on the important and fascinating physics of the Sun as a subject in itself. This does not mean that the book can only be read by Solar physics specialists, or those training to be specialists, merely that other more appropriate sources are available for those with a more casual interest in the subject. The excellent books, and web sites, which are now available on general stellar structure, formation and evolution would be a more appropriate starting point for non Solar physicists. If these resources still left the student unsatisfied on the details of 'our star' then this textbook would be a logical next step.

In summary, this is an excellent introduction to the whole of Solar physics at a consistent level of mathematics and assumed physics background. It would be suitable as a reference for some advance undergraduate courses and should be compulsory reading for postgraduate students studying the Sun. It could also be read with interest by anyone with a physics background wishing to learn more detail about the Sun than is available online or through general astrophysics books. For those students who must learn something about the Sun or stellar structure but are not intending to specialise in this field it would probably be better to start with other texts and turn to Stix's textbook only if these left important areas of Solar physics uncovered.

Tony Arber
University of Warwick, Coventry, UK

The Search for Life in the Universe, Third Edition

D. Goldsmith and T. Owen

University Science Books, Sausalito (*2001*)
573 pages · Price £48.99 · ISBN 1-891389-16-5
10.1017/S147355040322142X

In their book, *The Search for Life in the Universe, Third Edition*, Donald Goldsmith and Tobias Owen successfully detail the current state of the growing science of astrobiology in a logical and engaging manner. The authors explain each topic in such a way as to educate a reader from outside a particular discipline, while also providing enough detail to engage a specialist. *The Search for Life in the Universe* is quite possibly the best astrobiology text currently available.

Astrobiology students enter the field from many backgrounds – astronomy, biology, chemistry, geology, etc. – and astrobiology textbook authors must balance breadth and depth of the contributing subjects. Goldsmith and Tobias wrote their book at a level appropriate for advanced undergraduate or graduate students with a variety of science backgrounds. Each topic contains enough depth for meaningful learning, but also includes enough introductory explanation so that students from each field can understand the other fields. For example, a biology student would be able to understand the material on cosmology, while the

astronomy student would be able to understand the life science chapters.

The authors start their book with a brief introduction to astrobiology, which includes some of the reasons why the field of astrobiology is gaining so much interest (e.g., its interdisciplinary nature, past and present studies of Mars, possible subsurface oceans on Europa). Following the introductory chapter, the next section reviews the current state of cosmology and prevalent theories of how matter, stars, galaxies and the universe formed. As a biologist, I found this section to be particularly enlightening as well as being very accessible.

In the third section of their book, the authors provide a good overview of biology. In the same manner as they used for the section on cosmology, Goldsmith and Owen make the life sciences accessible to the non-biologists without oversimplifying the concepts. Included in this section are some descriptions of the nature of life, as well as an overview of primordial evolution and current theories on the origin of life. Additional chapters describe the evolution of intelligence, and also explore the extreme limits of life.

The book's fourth section merges the physical and life sciences to look for life in the solar system. Here, the authors explore the astrobiologically interesting worlds of our solar system – Venus, Earth, Mars, and the satellites of Jupiter and Saturn. The evolutionary history and present environment of each of these planets are discussed in the context of how life might have evolved, or why it might not. Special attention is given to Mars, including the results of the Viking Project's biology experiments and to the microfossil-like formations within Martian meteorite ALH84001.

Finally, in the fifth section, the authors write extensively on the search for extraterrestrial intelligence. Not only do they provide an update on the current state of the search, but the authors explain how one-way and two-communication between worlds might be accomplished. Included in their discussion are chapters on interstellar space flight and on the likelihood (or not) of extraterrestrial visitors to Earth. Throughout the book, but especially in this section, the authors make distinctions between science and pseudo- or non-science.

This is a very well-conceived and well-written textbook. As one might expect with a third edition book, typographical and topical errors are practically nonexistent. The authors' writing style is clear, interesting and captivating. I highly recommend *The Search for Life in the Universe* to anyone with a serious interest in astrobiology.

David J. Thomas
Lyon College, Science Division,
Batesville, USA

Geological and biological effects of impact events

E. Buffetaut and C. Korberl (Eds.)

Springer (*2002*)
295 pages · Price €69.95 · ISBN 3-540-42286-2 HB
10.1017/S1473550403231426

It took the dinosaurs 120 million years to find out. We have managed to find out in 2 million years – asteroids and comets can kill you. In this, the first volume of a new interdisciplinary series on 'Impact Studies' by Springer-Verlag, the two editors take us on an ambitious, but excellent tour of some of the major connections between past biological changes and the collision of asteroids and comet impacts with the Earth.

Let me start out by re-assuring the reader that asteroid and comets really do kill things. There is still some great debate about whether an asteroid was really responsible for killing the dinosaurs and 75% of life at the Cretaceous-Tertiary boundary or whether other factors, such as volcanoes, could also have been involved. However, there are now over 150 impact craters that have been identified on Earth and even though global mass extinctions caused by asteroid and comet impacts arouse controversy, there is no doubt that all of these events would have caused ecological disruption at the local level at the very least. In this book we find out how paleontologists go about looking at the effects of impact events and determining their roles in biological changes.

The first chapter tells us about how ostracods can be used to examine mass extinctions. About 75% went extinct 365 million years ago at the Frasnian/Famennian boundary and the extinction was very abrupt. Nowhere in the chapter does it tell me what an ostracod is, but the web tells me they are 'tiny marine and freshwater crustaceans with a shrimp-like body enclosed in a bivalve shell'. The chapter isn't directly related to impact events, but brings the reader into the picture of how the remains of organisms can be used to examine past extinctions.

The second chapter takes us to the most profound mass extinction – the end-Permian extinction during which approximately 95% of species went extinct. We learn about changes in organic materials found at the boundary, which the authors tentatively ascribe to the acidic emissions from the vast Siberian volcanic Traps. Nowadays some authors are claiming to have found evidence for the influence of an asteroid or comet impact at the boundary, showing how the controversy between volcanoes and impacts continues.

In our continuing tour of extinctions, the next chapter investigates a link between the buried Morokweng impact structure in South Africa and possible impact materials found in Bosso River Gorge, Italy and it links these impact-induced effects to the Jurassic-Cretaceous Boundary. Now we begin to get a feel for the global effects these types of events can potentially cause.

Impact events are not all bad news and the following chapter tells us of the way in which impact-induced tsunamis may have churned up water and nutrients resulting in blooms of algae that took advantage of the improved marine conditions for growth after the Mjolnir impact event close to the Jurassic-Cretaceous boundary and north of what is now Norway. This nice chapter gives us a little mid-book cause for celebration and hope. But that is quickly crushed by the tidal wave of post-impact evidence that is now presented.

The data that has been gathered on extinction boundaries is extensive, so much so that we are then treated to a

description of a new database being developed that contains data about the K/T boundary – the extinction horizon of dinosaur fame. The purpose of the database is to gather all the literature and new information about changes that occurred at the boundary and their timing – maybe then the causes of the extinction could be better constrained and the controversy will be more successfully tackled.

This won't give much hope to bony fishes though, because in the next chapter we find out that 19% of all their families went extinct at the K/T boundary. Most of them were marine and not freshwater and the available evidence suggests that their extinction is best explained by a collapse of their food webs based on plankton. The authors suggest this was caused by the darkened skies of the post-impact world.

Ammonites will also find little to celebrate in the new database as we next find out how they also went extinct. The chapter presents some evidence that their decline was not very gradual, but very sudden. Why? The next chapter provides us with the insight we need to understand how a catastrophic impact event could have wrought changes sufficient to cause global extinctions. Bringing together a wide diversity of geological and geochemical evidence, the chapter argues persuasively for a rapid, catastrophic event occurring at the K/T boundary.

The evidence for impact is not easy to interpret as burrowing animals and chemical diffusion can influence the distribution of chemical signatures associated with impact, particularly important elements like Iridium, whose post-impact increases are thought to be extraterrestrial in origin. We discover how these influences can be examined and what their importance might be in trying to interpret the record of impacts.

Away from global effects and back to local effects, the next chapter considers the Ries and Stenheim impact craters in Germany that were formed 15 million years ago and the effects that these impacts might have had on the local ecology. It is suggested that the local ecosystems returned to normal within 100 years. This chapter is powerful alongside the other chapters – it gives us a feel for the importance of the size of the impactor on subsequent biological effects. We go from global mass extinction to small impact events when ecosystems can recover in 100 years. Energy is everything.

Our excursion into local impacts is soon rudely interrupted by a chapter about global fires caused by impacts – and we are back to tales of global horror. The plume from the impact could ignite 3–10% of the Earth's surface and the authors are keen to leave us in no doubt that barbeques were the order of the day following the K/T impact. We get some idea of how global fires might be caused when we delve into the next chapter that tells us about how material is ejected from a crater and distributed widely across the globe.

In our final chapter we learn about some unusual impact physics that is rarely considered. Electric charges formed by the impactor, thermoluminescent emissions and magnetization of the soils around the point of an explosion are all suggested as possible effects.

The book is a fascinating one. Don't read it if global extinction gives you nightmares, but it provides a diverse, but at the same time coherent view of impacts. I would say that the book is very much for people how have a little background knowledge in the subject, as inevitably, being a multi-author volume, the chapters are quite specialist and not designed to give a general overview. The book is an outstanding vindication of the European Science Foundations' IMPACT programme and if they produce things like this, long may this programme continue.

Charles Cockrell
British Antarctic Survey

https://doi.org/10.1017/S1473550403231426 Published online by Cambridge University Press