

comfortable with it. I myself (an observational astronomer) found it rather opaque.

The subject coverage is encyclopedic, going from dynamics to general relativity, with many exercises for the reader, some of them worked out. This coverage is designed to develop a theoretical toolkit for astrophysics in a self-contained manner. As the author says, any one of the major topics is fairly vast and often requires a full textbook to do them justice, whereas he devotes only ~60 pages to each. The author's treatment of polytrope theory, for example, takes three pages. This leads to a very steep learning curve! Perhaps an excellent instructor could ease the process?

Claud H. Sandberg Lacy

Arkansas–Oklahoma Center for
Space and Planetary Science
Department of Physics
University of Arkansas
Fayetteville, Arkansas 72701, USA



Tektites in the Geological Record: Showers of Glass from the Sky by Joe McCall. The Geological Society Publishing House, Bath, United Kingdom, 2001, 256 pp., £65.00 paper (ISBN 1-86239-085-1).

Tektites have been a geological puzzle that resisted clear, straightforward explanations for generations of geologists. Tektites are small, shiny and smooth glass objects of greenish, brownish, or grayish-black color, which have fascinated humans from early in our history. They seem to have been of great interest even to our early predecessors, as tektite fragments were found with fossils of primitive humanoids in Indochina. More recently, many mineral collectors proudly display their tektites, lured in part by the long-lasting debate about their origin. Tektites received their name from E. Suess in 1900 (in Vienna); the word is derived from the Greek term for "molten", indicating their glassy nature. At that time, their origin was not well understood. During most of the twentieth century, a widely held hypothesis postulated that tektites are glass that was ejected at high velocities from giant volcanoes on the Moon and thrown all the way to the Earth. For many years, this was a valid hypothesis, because not much was known about lunar rocks and craters on the Moon, and mineral collectors liked the idea that they owned an inexpensive piece of the Moon.

The recovery locations for tektites on Earth are not much help in figuring out their source because, unlike volcanic glasses that are tied to specific source volcanoes, tektites are found in geographically large areas around the world. Today, four such tektite strewn fields are known: the 35 Ma North American, the 15 Ma Central European, the 1.07 Ma Ivory Coast, and the 0.8 Ma Australasian strewn field. The last one covers about

one-tenth of the surface of the Earth. Around the time of the first landing on the Moon, by *Apollo 11* in 1969, the interpretation of the origin of tektites changed, as most researchers had come to the conclusion that most, if not all, craters visible on the surface of the Moon were formed by meteorite impact, and there was no credible evidence of recent violent and large-scale volcanic activity. In addition, studies of lunar rocks quickly showed that their chemical composition is completely unlike that of tektites. At that time, an alternative hypothesis gained ground, namely that tektites are, in fact, quenched fragments of melted rock that were ejected during the catastrophic impact of an asteroid or comet on the Earth. During the last 30 years, chemical and isotopic studies have left hardly any doubt that tektites have formed during catastrophic hypervelocity impact events, when many cubic kilometers of terrestrial rocks were vaporized and melted, and small glassy fragments were ejected halfway across the globe.

Joe McCall has written a book that summarizes the history of tektite research and lays out our current knowledge on the subject. He mostly succeeds in his task, which he defined for himself in the preface: "This volume does, I believe, present an up-to-date picture of what is known, what is likely, what is guessed at globally, and above what is still not known concerning these enigmatic glass bodies. My aim is to present an all encompassing view of tektites at a level that will attract as readers, geologists, geochemists, geophysicists, astronomers, planetologists and also the general reader with an interest in science." Thus, the present volume should not be mistaken as a highly technical treatise and comprehensive data repository on tektites. Rather, it provides an overview of the subject with a very detailed and comprehensive reference list, which should enable the interested reader to find whatever technical aspect they are looking for. There are nine chapters. The book begins with an "Historical perspective", which is followed by descriptive chapters on "The strewn fields", "Microtektites", and "Muong Nong-type tektites". An important chapter discusses the so-called "Age paradox". Next is a discussion that brings our current knowledge on "The source of tektites". Then McCall switches to a description of tektite-like glasses in "Glasses related to tektites: Darwin Glass and Libyan Desert Glass" and in "Other related occurrences of natural glass". The latter chapter only deals with impact-related glasses (not all sorts of natural glasses) and even includes a description of crystalline impact-related deposits, such as the Late Eocene clinopyroxene-bearing spherules and the Cretaceous–Tertiary boundary. A "Discussion" is the last chapter, which is followed by an appendix on "Applications of isotope geochemistry", a glossary, the excellent reference list, and a comprehensive and useful index.

It is always possible to quibble with an author's choice of the order in which he presents his subject, and I probably would have chosen a different way to present the material, but this is not really the point. In the end, McCall presents most of what is important on tektites. His approach is a more historic one, in

many cases detailing the discoveries in the order they were made. There is the odd typographical or factual error, but, overall, the book is well written and produced. For a paperback of ~250 pages, however, the price is a bit steep, which is a pity, because it should/would be of interest to a wide community. Nevertheless, I do recommend this book for students in geo- and cosmochemistry, anybody who is interested in impacts and tektites, serious collectors, and, of course, for all science (not just geology) libraries.

Christian Koeberl
Institute of Geochemistry
University of Vienna
Althanstrasse 14
A-1090 Vienna, Austria



Astrobiology: Origins from the Big-Bang to Civilisation

edited by Julián Chela-Flores, Guillermo A. Lemarchand and John Oró. Kluwer Academic Publishers, The Netherlands, 2000, 336 pp., \$154 hardcover (ISBN 0-7923-6587-9).

The fields of exobiology and its younger cousin astrobiology are rooted in the early twentieth century writings of Aleksandr Oparin, a Russian, and John Burdon Sanderson Haldane, an Englishman. Now, nearly a century after the publications by these pioneers, we have an edited volume dealing with these fields that is totally a contribution from Spanish speaking scientists (the one exception is a short chapter by Frank Drake to whom the volume is dedicated to commemorate his seventieth birthday). The volume is derived from the first Iberoamerican School of Astrobiology, which was held in Caracas, Venezuela, 1999 November 28 to December 8. It is not surprising that most of the contributions are by scientists from Latin American countries.

The first four sections deal with more or less standard exobiology/astrobiology topics: extrasolar planets, prebiotic syntheses and evolution, extraterrestrial life and the universal tree of extant life. Notable chapters are ones by Sabatino Sofia ("New developments in astronomy relevant to astrobiology"), Rafael Navarro-González ("Nitrogen fixation in planetary environments: A comparison between mildly reducing and

neutral atmospheres"), A. Becerra *et al.* ("Molecular biology and the reconstruction of microbial phylogenies: *des liaisons dangereuses?*") and Humberto Campins ("The chemical composition of comets"). Much of what is covered in these sections has been published in the peer-reviewed literature, but it is nice to have a good collection of these exobiology/astrobiology articles all in one volume.

The next two sections deal the origin of cognitive systems and the philosophical implications of the search for extraterrestrial life. The cognitive chapters discuss the origins of the neuron, synapses, and language. These topics are obviously relevant only to advanced multicellular life that has evolved to the point of reasoning and thinking. The chapters are very much biased by the example of the Earth's genus *Homo*, which is most likely a unique form of advanced, intelligent life in the Universe. The philosophical chapters consist of one on "Astrophysics and Meta-Technics," which I found to be incomprehensible and another on "darwinian evolution in the solar system," which is mainly a rambling discussion of man's place among the creatures on Earth and the microbes in the solar system (where are they except on Earth?).

The last section contains short contributions (extended abstracts) from participants and the topics covered range from the typical ones ("Condensed matter surfaces in prebiotic chemistry" by S. Ramos-Bernal and A. Negrón-Mendoza; "RNA-binding peptides as early molecular fossils" by Luis Delaye and Antonio Lazcano; "Experimental simulation of volcanic lightning on Early Mars" by Antígona Segura and Rafael Navarro-González) to ones much less typical ("Do wormholes exist?" by Diego F. Torres and Gustavo E. Romero; "Ultimate paradoxes of time travel" by Gustavo E. Romero and Diego F. Torres).

Overall, this is not a remarkable volume. Its main merit is that it demonstrates that scientists from Latin America are active contributors to exobiology/astrobiology research. Also, it helps introduce students and other scientists to individuals in Latin American countries carrying out research in these areas.

Jeffrey L. Bada
Director, NASA Specialized Center
of Research and Training in Exobiology
Scripps Institution of Oceanography
University of California at San Diego
La Jolla, California 92093-0212, USA