



Book review: *Scientific Debates in Space Science* by Warren David Cummings and Louis J. Lanzorotti

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Debates in science are essential as they challenge existing theories and push the boundaries of our understanding, potentially leading to new discoveries. Witnessing debates in real time is exciting, but looking back on them in historical context offers a more complete story and deeper insight. This book serves exactly this purpose. It describes eight historical debates in the recent history of space science, starting in the 1950s: solar wind or solar breeze, an open or closed magnetosphere, influx of small comets into Earth's atmosphere, the origin of the Moon, lunar dust, the Chicxulub impact on Cretaceous extinctions, the size of the solar system, and sources of Gamma ray bursts.

The authors detail how each debate started, evolved, and settled along with many historical materials from archives. They also assess the scientists involved in the debates by applying Eddington's guidelines. Readers can feel the dynamic and evolving nature of space science and gain insights into how scientific consensus is built and the role of diverse perspectives in shaping the trajectory of space exploration.

Scientific debates can be roughly divided into two types: debates among researchers from the same field (which occur more often) and debates among researchers from different fields (rare). The book includes both types, revealing interesting differences. For instance, the debates related to solar wind and magnetosphere involved only space physicists, while the debates on lunar dust and the Chicxulub impact involved space physicists, geologists, cosmochemists, paleobiologists, and astrophysicists. Debates of the former type are much more focused and may evolve more rapidly. Debates of the latter type understandably evolve slowly, as the different

parties involved often have completely different observation tools, methods, and ways of reasoning. This makes it difficult for the debates to benefit one another, leading to slower convergence, as seen in the chapter on Cretaceous extinctions. This type of debate strongly demonstrates the difficulties in and need for multidisciplinary research.

In addition to learning the history of space science and the role of debate, readers can enjoy reading about the scientists behind the debates. The authors, leveraging their role as long-time leaders in the space science community, provide rich historical information, photos, and anecdotes by citing research papers, conference recordings, and personal communications. Such descriptions remind us that, although science is objective and about facts, scientists, as emotional human beings, bring their subjective experiences, backgrounds, and training to their work, together with their passion and pride. This is seen vividly in several chapters, especially those on the Chicxulub impact and the lunar dust. Though different in nature, these debates remind me of the famous movie *Rashomon*, where different characters have completely different impressions and interpretations of the same crime. The book emphasizes the delicate balance between being confident and being objective and flexible, stating that "There is a fine line between maintaining a position, and objectively maintaining a scientific position after contrary data become evident". I cannot agree more.

The book caters to a broad audience. Firstly, echoing Thomas Zurbuchen in the foreword of this book, it is highly recommended for early-career scientists. By offering a historical perspective on scientific debates, it helps young researchers develop the right attitude towards controversies and disagreements. I personally find this to be particularly necessary for those who grew up in Asian cultures like myself, where harmony is emphasized and conflicts are avoided. Secondly, for senior researchers, the book serves as a reminder to

remain objective during controversies. By recognizing various sources of scientific disputes, senior researchers can act more openly and flexibly to foster a constructive environment in the science community. Finally, teachers and professors in space science will find this book to be a valuable resource for enriching their lectures. By introducing these stories to the classroom, educators can convey the message that many seemingly basic rules in the field were not set in stone from the beginning but took time to form and be accepted. In this way, they can inspire their students to view different opinions positively, considering conflicts to be opportunities for growth instead of personal attacks.

This book is published by Springer as part of the book series on astronomy and planetary sciences. It has two editions, hardcover and ebook.