A Thin Cosmic Rain Michael W. Friedlander. 241 pp. Harvard UP, Cambridge, 2000.Price $29.95 (cloth) ISBN 0-674-00288-1. (Reviewed by Frank C. Jones)

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energy particles and the study of the effect of the geomagnetic field on the propagation and arrival at earth of these particles. In the 1950s the development of laboratory based particle accelerators shifted the former area away from cosmic rays leaving the field primarily concerned with the geophysical and astrophysical aspects of the phenomena.

The sweep of this book is broad and up to date; there are very few topics that are left out (shortly, I shall mention a couple of topics that I would like to have seen included but were not.) The latest information and understanding is included such as the detection of neutrinos from supernova 1987A and the ultra high energy particles that seem to defy the limits on energy and distance of travel implied when one considers the effect that the universal microwave background would have on such particles.

In this book the reader will find almost everything the educated layman would want to know about cosmic rays (well, almost everything); there are chapters on geomagnetic effects, high energy particles from the sun, the propagation of cosmic rays through the galaxy, origin theories and electrons, gamma rays and neutrinos. There is a chapter on the elementary particle physics done with cosmic rays as well as one on the role of cosmic rays in radiocarbon dating in archeology and biological effects. As one might imagine, organizing all of this material into a coherent whole is a daunting task. While this book does not flow like a novel I would say that the author has done an admirable job of putting it all together.

In a book that includes so much it is inevitable that questions of style and organization would arise. I found several digressions and detours that were disconcerting to me. For example in discussing the role of the geomagnetic field in the determination that cosmic rays were (mostly positive) charged particles, the narrative shifts into a

history of magnetic field research starting with Gilbert. At this point I found myself wanting to get on with the cosmic-ray story but, on second thought, I realized that the reader for whom this book was written might want just such an aside in order to gain a little perspective on the subject. There is nothing more frustrating than running into an unfamiliar and unexplained concept while valiantly trying to follow an argument. I suppose that in such a situation it is better for the author to err on the side of over completeness rather than incompleteness; after all, one can simply skip the parts that are already known.

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detectors, that are especially sensitive to the low energy nucleonic componenet, are operated by many universities and research organizations over a wide range of geomagnetic latitudes. As is explained in this book, the geomagnetic field makes detectors at different latitudes sensitive to different regions of the energy spectrum. Thus, studying the time variations of these detectors gives valuable information about how the solar wind effects cosmic rays at different energy. There is a wealth of information that could have been given here as well as stories of high adventure, such as the smuggling of data out from under the noses of rebel guerrillas in certain South American countries.

A second topic that I wish had been included is the acceleration of charged particles by plasma shocks. While the author does mention that a shock of this type does exist at the outer edges of supernova remnants he does not mention that the process of shock acceleration is now widely held to be the primary process that accelerates the bulk of the galactic cosmic rays. In fact, in the discussion of the anomalous cosmic rays that are accelerated by the solar wind from interstellar neutral atoms, the author states that they are accelerated by the solar wind by some means whereas the overwhelmingly accepted notion is that it is the solar wind termination shock at $\approx$80 - 100 AU that is responsible for the acceleration. I think that a process that plays such a central role in our understanding of the source of cosmic rays deserved some mention.

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