larger issues than just the history of the Australian analogue of AAAS. The subject-by-subject chapters, however, will by and large have a more restricted appeal to those who have an interest in the narrative history of scientific institutions rather than ideas or their changing social contexts.

ROBERT M. MAY
Department of Zoology,
University of Oxford,
Oxford OX1 3PS, United Kingdom

Supraterrestrial Enterprises

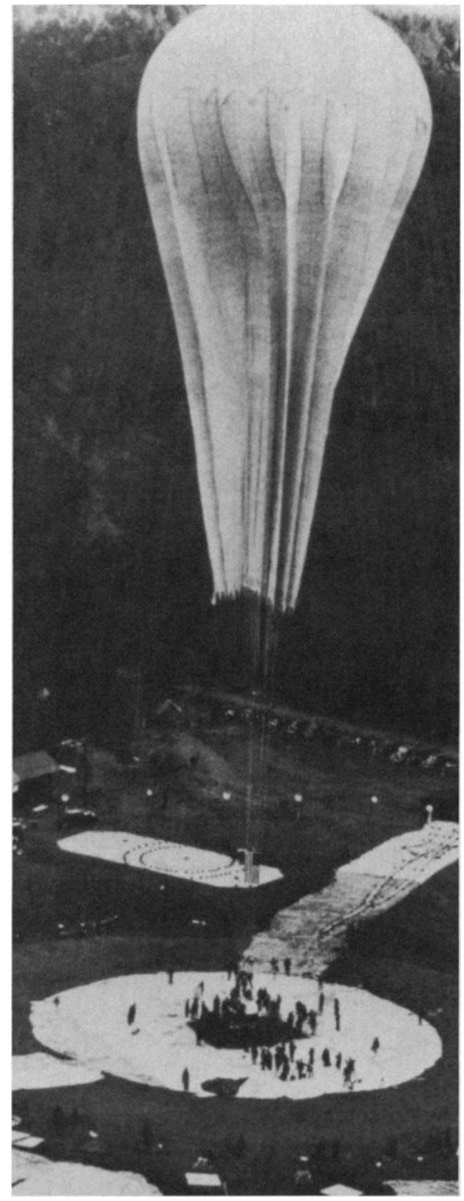
Race to the Stratosphere. Manned Scientific Ballooning in America. DAVID H. DEVORKIN. Springer-Verlag, New York, 1989. xiv, 406 pp., illus. $39.50.

Manned ballooning has been associated with science from its origins, as Charles Coulston Gillispie's *The Montgolfier Brothers and the Invention of Aviation* demonstrates. In the volume at hand, David DeVorkin has examined this association in the context of the manned stratospheric balloon flights of the 1930s. By a comparison with Project Apollo, he has illuminated patterns of politics and patronage characteristic of such scientific spectaculars.

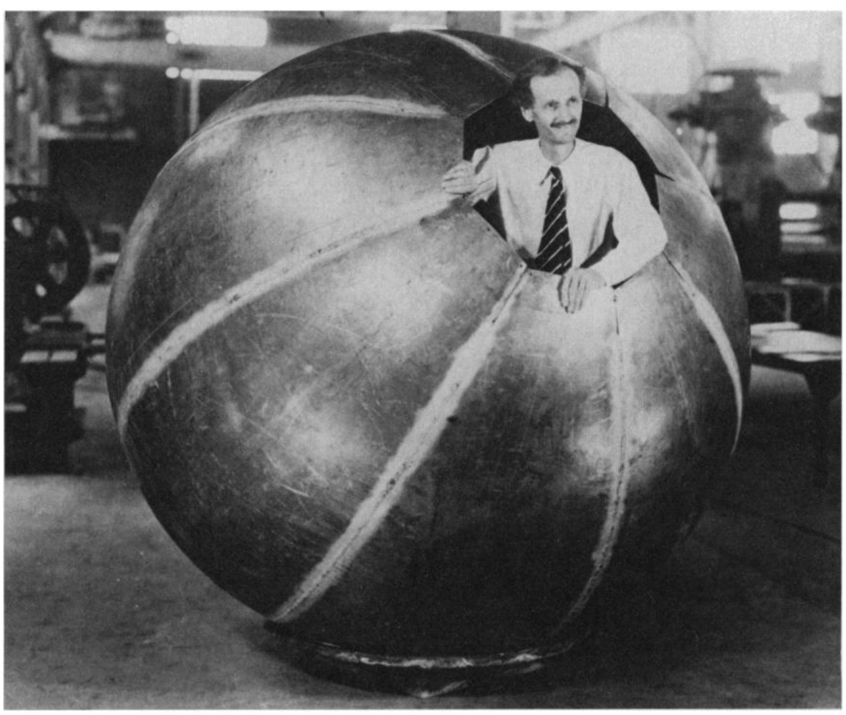
Auguste Piccard's penetration of the stratosphere in manned balloons in 1931 and 1932 stimulated Soviet and American emulation in the name of science and national prestige. DeVorkin traces in detail the American side of the story, which he calls a "synergistic social conditioning process [in which] science inevitably became a marketing tool." Science, however, got short shrift in the process, as the exigencies of manned flight, balloon technology, and patronage crowded out experiment.

As DeVorkin illustrates in the case of studies of cosmic rays, one of the more glamorous and adventurous fields of physics in the 1930s, manned balloon expeditions promised much but delivered less than unmanned balloon-sondes, which paid greater scientific dividends despite their comparative lack of appeal to patrons eager to shatter manned-flight altitude records as well as to acquire new scientific knowledge.

The adventures and misadventures of Auguste Piccard's American emulators, who included his brother Jean and Army Air Corps Captain Albert W. Stevens, are portrayed against a background of patronage



Preparation for the launch of the first Explorer balloon near Rapid City, South Dakota, 28 July 1934. The two Explorer flights resulted from an initiative by Army Captain Albert W. Stevens, an aerial reconnaissance specialist. Stevens solicited and obtained financial support from the National Geographic Society, which needed to provide "well-crafted and visually rich accounts of exploration and discovery [for] its vast and hungry market" while maintaining "the dignified vestiges of its origins as a patron of . . . research." He also sought scientific participation from, among others, Robert Millikan, whose concerns included not only cosmic ray research but strengthening of the Weather Bureau, and Lyman Briggs of the National Bureau of Standards, the status of which was in jeopardy owing to the Depression. The scientific agenda included cosmic-ray experiments and studies of the upper atmosphere and the solar ultraviolet spectrum. The Explorer flights received much publicity, but "the scientific return, although gratifying, did not compare with" that of contemporaneous unmanned flights. Moreover, the altitude reached, 24 kilometers, "was the practical limit set by [available] technology." [From *Race to the Stratosphere*; National Geographic Society]



Jean Piccard and the gondola under construction for ascent into the stratosphere at Chicago's 1933 Century of Progress exposition. Backed by the National Research Council and utilizing materials contributed by the Dow Chemical, Goodyear, and Union Carbide corporations, the expedition "was to be a showdown between two American titans of physics," Arthur Compton and Robert Millikan, who held divergent views about the origin of cosmic rays. The first flight of the balloon ended unintentionally in a nearby railroad yard, where the balloon was torn to bits by treasure hunters. After a second, more successful flight both Compton, who had been an enthusiast for the venture, and Millikan, a skeptic, "expressed some satisfaction with their results" but turned their attention to other enterprises, while Piccard, who had been excluded from the flight, characterized Compton as a "swindler." [From *Race to the Stratosphere*; Dow Chemical Company] and politics that will not be unfamiliar to the students of the history of physics in this period. DeVorkin links these patterns of patronage to earlier military sponsorship of scientific expeditions and to the postwar support of science by the military services. In the latter, he shows, the military mission and scientific programs tended to present a more problematic relationship for the scientists involved. Following the postwar fortunes of Project Helios, a manned ballooning program sponsored by the Office of Naval Research in which the indefatigable Jean Piccard was again a prominent actor, DeVorkin traces the evolution of military motives and missions to exploit new technological opportunities offered by improved materials and the scientific interest in cosmic rays and other stratospheric phenomena. In these enterprises the Navy ultimately disappointed Piccard and his colleagues by failing to support manned stratospheric flight.

In his concluding chapters, DeVorkin strives to erect historical parallels with the manned space flight programs of the 1960s, especially the Apollo program. The disparate scope of these programs, the bureaucratic formality of NASA, and the greater eminence of the scientific promoters of space science, however, make these parallels less striking. Though it is true that the Apollo program depended, like manned stratospheric flight, on the human presence for glamor and support, it is not clear that its scientific purposes were sincere self-delusions, stimulated solely to justify the funding of manned flight, as were those of the balloonist-savants. If the selling of manned ballooning was mission-oriented and short-sighted, as DeVorkin maintains, it involved a much smaller expenditure of the national treasure than the program Kennedy proposed. And if, like Apollo, manned stratospheric flights teamed the romantic drive to explore with the need to reestablish national pride, much more was at stake in the ICBM era.

Regardless of whether one agrees wholeheartedly with DeVorkin's comparisons of manned stratospheric flight and manned space flight, his book makes heuristic use of the parallels and sheds new light on a hitherto neglected area of the history of science and technology. By weaving patronage, politics, physics and aerostatics together in his narrative, DeVorkin makes what had previously been regarded as a sideshow in the history of American science an exemplar of the interactions of science and American Society.

ROBERT SEIDEL
Bradbury Science Museum,
Los Alamos National Laboratory,
Los Alamos, NM 87545

Planetary Science

Origin and Evolution of Planetary and Satellite Atmospheres. S. K. ATREYA, J. B. POLLACK, and M. S. MATTHEWS, Eds. University of Arizona Press, Tucson, 1989. xii, 881 pp., illus. $45. Space Science Series.

In one way or another, more people study planetary atmospheres than any other aspect of planets. Accessibility of information could be part of the reason, but the richness of phenomena is a better explanation since it acknowledges the large number of disciplinary niches that scientists occupy in this area. There is one aspect of atmospheres, however, that commands the attention of all scientists who like to know how things came to be (and shouldn't that be all of us?). This aspect, origin and evolution, is amply covered in this new contribution to the University of Arizona's Space Science Series, a collection of books that threatens to overwhelm the bookshelves of planetary scientists everywhere.

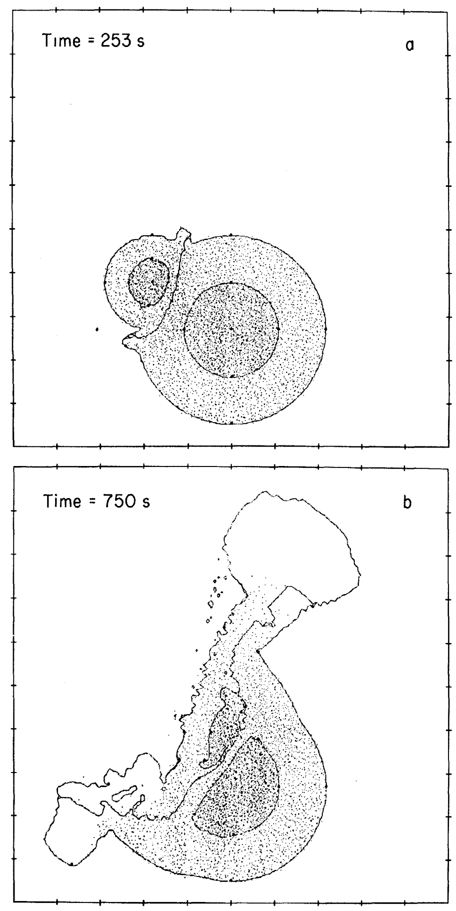
How can such a small fraction of a planet be so important? Three prominent reasons are the ability of an atmosphere to regulate the thermal regime of the planetary surface or even interior, the tendency of an atmosphere to store information about the dynamic and chemical history of the planet by being a repository for volatile species, and the likelihood that an atmosphere's composition can tell us about the material from which the planet formed, perhaps even how it formed. This book demonstrates the progress on these issues as well as the distance we have yet to cover.

The genesis of the book was a conference, some 50 of whose participants wrote the 22 review chapters making up the final text. Not only is scattered information well collected, many authors organized their thoughts in accordance with the theme, sometimes in collaborations that might otherwise not have occurred. I would judge that about half of the chapters are successful in telling a story that is not just a rehash of stories previously told.

I see three big stories in this area, each well developed but with much more research required. One is the growing sophistication of efforts to understand climate evolution on Venus, Earth, and Mars. Particularly in the chapter by Kasting and Toon, but also in related chapters, we see the growing awareness of the complex interplay of volatile abundances, impacts, volcanism, weathering, liquid water, and biology (at least on Earth, perhaps even on Mars). Why is Venus so different from Earth? For how long did Mars have a warm, wet climate? How much carbonate is there on Mars? When did Earth become habitable? Some of these questions are old, but satisfying or at least provocative answers are only beginning to crystallize. It is notable that some of the best work on the early climate of Earth is being done by people who approach the problem from a planetary perspective.

Another developing yet long-standing story concerns noble gases and their isotopic patterns in the atmospheres of Earth, Venus, and Mars. In the chapters by Pepin and by Hunten and others, we see the approach toward a quantitative understanding of the partitioning of gas species and isotopes during hydrodynamic escape from the ultraviolet-irradiated atmospheres of protoplanets. No unique story emerges, but the existence of any physically plausible story for the xenon isotope pattern (for example) is a major advance.

The third story concerns the newest information: The abundance patterns in the atmospheres of giant planets (chapters by



Computer simulation by Kipp and Melosh (1986) of the impact of a Mars-sized planetesimal on the proto-Earth 253 seconds (a) and 750 seconds (b) after contact. "Any primordial atmosphere that had evolved up until the point of the impact would be expected to be blown away, and a substantial amount of new outgassing would result." [From P. R. Weissman's chapter in *Origin and Evolution of Planetary and Satellite Atmospheres*]