The second section (Rotation-Activity-Cycle-Age Connection: Observations) deals with observations of stellar rotation and with activity thought to be caused by magnetic fields. Here we find an excellent study of the time variability of solar differential rotation and also exciting new results on the rotation of a large number of sunlike stars. Unfortunately, differential rotation, thought to be critical in models of magnetic activity, remains beyond current observational capabilities, although some upper limits are given. A number of papers discuss measurements of spectral emissions from stars that, on the basis of solar observations, indicate the existence of magnetic activity similar, for example, to the well-known sunspot cycle. Observations from the space mission's International Ultraviolet Explorer and Einstein Observatory have been particularly fruitful. We can expect even greater advances when more sophisticated stellar observatories such as the Space Telescope, Advanced X-Ray Astronomy Facility, and Extreme Ultraviolet Explorer start operating from space.

The remainder of the book consists largely of papers on theory and modeling. The third section (Theory of Stellar Magnetic Field Generation) is mainly a discussion of dynamo generation of magnetic fields. In three excellent review papers we learn that the dynamo mechanism is widely accepted and has been remarkably adaptable to new observational results over the last couple of decades. Nevertheless, there is concern over some weak points in the theory, particularly the large number of degrees of freedom in existing models. The freedom to adjust models to fit observations is being reduced by extending dynamo models to stars having different parameters from the sun. It will be a surprise if our present ideas about dynamos escape major changes when these stellar and new solar results become available.

The next section (The Role of Magnetic Fields in the Structure and Energy Balance of Stellar Atmospheres) deals with how magnetic fields act to produce heating in the atmospheres of the sun and stars. The papers in this section demonstrate that a lot of phenomenology has been learned but that a physical understanding of how magnetic fields work to heat stellar atmospheres is still elusive. A promising mechanism for coronal heating involves resonant electrodynamic heating and is discussed in several papers. The sad fact is that although this and other mechanisms are very plausible we do not know if they actually work on the sun and stars.

The penultimate section (Stellar Winds and Spindown in Late-Type Stars) addresses mass and momentum loss in evolving stars. The basic idea considered is that the rotation of stars is reduced as they age owing to loss of angular momentum blown away by stellar winds. We learn in this section that hot winds are very hard to observe on stars other than the sun and that we cannot probe a large enough range of parameters in the sun itself to understand how winds actually carry away angular momentum as functions of age, magnetic activity, rotation, and so on. This subject is clearly in its infancy.

The final section contains four "provocative" summaries and an excellent broad summary of the entire symposium. These papers look at prospects for advances in the physics of solar-stellar magnetic activity and paint a picture of potential progress as exciting as any in astrophysics.

The book consists of camera-ready manuscripts that are well reproduced and in a generally uniform, easy-to-read format. In addition, extensive and lively (one participant said he was nearly moved to tears) discussions follow nearly every paper. This book should be in the library of every observatory and astronomy department. The relatively low price makes it attractive for the personal libraries of many active researchers interested in the physics of stellar activity and magnetic fields.

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An Era in Rocketry

Prelude to the Space Age. The Rocket Societies: 1924–1940. FRANK H. WINTER. Published for the National Air and Space Museum by the Smithsonian Institution Press, Washington, D.C., 1983. 208 pp., illus., + index. Paper, $15.

Frank Winter's book, *Prelude to the Space Age*, presents the history of the rocket societies that formed the core of the astronautical movement in the 1920's and 1930's. This era witnessed the birth of the space age, with the publication of works that laid the theoretical foundation of rocketry and spaceflight, the coining of the very word "astronautics," the invention of the first rudimentary liquid fuel rockets, and the initial training of future spaceship designers. At the center of these developments were the rocket societies, which Winter labels educators and motivators and to which he credits the creation of a space "lobby," a generation prepared to accept space flight.

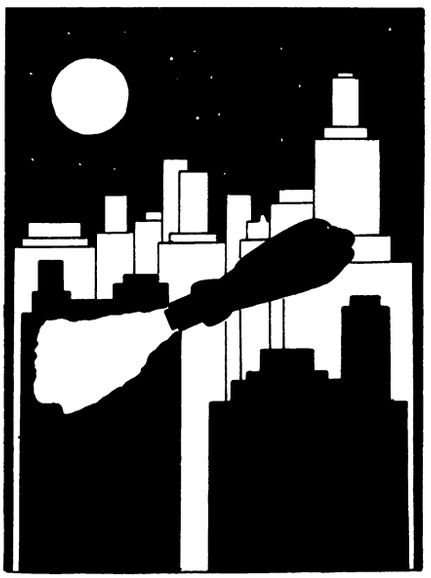
After discussing the background of science fiction, of individual pioneers and publicists of the space flight movement, and forerunners of the rocket societies, Winter concentrates on the major rocket societies in Germany, Russia, and the United States. He explains in detail the rise and decline of the preeminent German Rocket Society, whose legacy was the practical training of members like Wernher von Braun, who later served at the German Army's rocket center at Peenemuende. Although Winter devotes little discussion to military developments, the importance of the Germany Army in rocket development, especially after the Nazi regime's ban on private experimentation, is evident.

In the Soviet Union the author concentrates on the GIRD's (Groups for the Study of Reaction Motion) in Moscow and Leningrad, whose members included Sergei Korolev, the most famous of the early Soviet rocket designers. Once again Winter devotes less space to purely military organizations like the Gas Dynamics Laboratory, and he encounters the dilemma that the GIRD's, if not initially militarily inclined, developed under a paramilitary umbrella organization, were later funded by the Soviet army, and ultimately, in the case of the Moscow group, merged with the Gas Dynamics Laboratory.

Winter cogently draws the parallels between Soviet and German pioneers like von Braun and Korolev: their beginnings as idealists concerned with space; the army's diversion of their paths to militaristic aims by the mid 1930's; and ultimately their leadership of space programs in the post-1945 era. He thus shows the legacy of the societies as "schools for the future," and his evidence indicates that Soviet strides after 1945 came from native, not captured German, talent.

Winter indicates that publicists dominated the American Rocket Society, which did number among its ranks J. H. Wyld, whose regenerative motor made the liquid fuel rocket practicable. Yet one concludes that the aloofness of scientists and experimenters like the pioneer Robert Goddard rendered the American group less productive and significant than its German and Russian counterparts.

After examining lesser groups like the British Interplanetary Society, the author concludes that the societies constituted an international movement that made enthusiasm for space travel an



"Futuristic spaceship designed by Cleator was winning design in contest for first cover [January 1934] of *Journal of the British Interplanetary Society*." [From *Prelude to the Space Age*; Smithsonian Institution Negative No. 77-14787]

international phenomenon, and that they established a certain public acceptance of and infectious enthusiasm for space travel where there had been none before. He thus agrees with an earlier study by the sociologist William Bainbridge, *The Spaceflight Revolution* (1976), that these early space travel societies created an intellectual revolution. At the same time he rejects Bainbridge's contention that von Braun manipulated the German war machine into paying for the development of space vehicles. Winter makes it amply clear not only that the army was interested in liquid fuel rockets before it approached von Braun but that von Braun, as did Korolev, subordinated his interest in space flight to the development of rocket hardware for the military.

Though this book will certainly be an essential reference document on the rocket societies of the interwar era, it does have some problems. The artificiality of Winter's distinction between the military and civilian societies results in the rather arbitrary omission of some military developments. The civil-military dichotomy is reasonable for the Western countries, where the army was not linked to the societies. It is somewhat artificial for Germany, where the army had gained control of the remains of the societies by the early 1930's, and totally so for the Soviet Union, where the army was indirectly involved in the societies from their beginnings.

Occasional lapses of style and spelling detract from the work, though they are not serious in the great majority of cases. At two crucial points in the conclusion, however, incorrect word usage gives the author's remarks exactly the opposite meaning to that he had intended. "The perfection of the rocket became subordinated to the spaceflight idea" (p. 114) clearly reverses the author's intended meaning, and the statement "Very early the spaceflight idea was subordinated or given lip service in lieu of weaponry or other military applications" (p. 115) must mean that "Very early the spaceflight idea was subordinated to weaponry or other military applications."

Finally, Winter's use of the term "lobby" to describe a generation prepared to accept space flight is vague and problematic. If "generation" refers to the societies' members, the term "lobby" is in order. Otherwise, the book does not adduce sufficient evidence to show the effect of the societies' efforts on the wider public's interest. In fact, it gives the impression that the wider public usually showed limited interest in spaceflight and less in rocket experiments.

Despite such problems, the book presents a thorough and interesting discussion of the rocket societies. Winter's research is solidly based on the journals of the societies, the correspondence and personal papers of the participants, and interviews with them. It further contains valuable appendixes and excellent illustrations of the rocketeers, their inventions, and of the literature of the era. It is a most informative addition to the material on the origins of the space age.

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"By 1930 . . . Germans had their *Raketenflugplatz* (Rocket Flying Place) in Berlin where the VfR [German Rocket Society, Verein für Raumschiffahrt] planned, built and flew most of their early rockets." [From *Prelude to the Space Age*; Smithsonian Institution Negative No. 77-4214]

Biological Theorists

The Philosophical Naturalists. Themes in Early Nineteenth-Century British Biology. PHILIP F. REHBOCK. University of Wisconsin Press, Madison, 1983. xvi, 281 pp., illus. $30. Wisconsin Publications in the History of Sciences and Medicine, no. 3.

Early-19th-century naturalists did more than accumulate descriptive information about plants and animals; they also developed a body of theory. In Britain, where empirical traditions were especially strong, the theoretically minded sought to distinguish their special activity by calling themselves "philosophical naturalists." Philip Rehbock has written a history of the two principal groups among them: comparative anatomists, who promoted idealist concepts, and biogeographers, who began to adopt historical theories.

Although Britain produced a highly original biological idealist in William Sharp Macleay, most British idealists owed a great deal to Continental thinkers. Rehbock has devoted special attention to Robert Knox, the Edinburgh anatomist who introduced Continental