sink to the sea floor, singly or in aggregates. Just how this happens and what is coming down is being investigated by means of sediment trapping. The system acts as a trap not only for nutrients and carbon, but also for dust and mud introduced from land: terrigenous matter is filtered out and deposited in feces. The geochemistry of sediments produced by coastal upwelling has a peculiar character: such sediments are rich in diatom silica, planktonic organic material, and phosphorite (Calvert and Price). The odd observation that phosphorites tend to be concentrated at the upper and lower boundaries of the O_2 minimum off Peru may be related to bioturbation. Where bioturbation is absent, incipient phosphorite concretions may be readily buried. The relationship between the rates of accumulation of organic matter and certain heavy metals may hold the clue to distinguishing between open ocean sapropels and truly euxinic ones (Brumsack). The nature of the preserved organic matter similarly may hold clues to the depositional environment. The interactions of metals and organic matter during early diagenesis may bear importantly both on metal enrichment and on organic-matter preservation (Ittekkot and Degens).

G. N. Baturin leads off the second volume with a brief overview of the geochemistry of upwelling sediments. This is followed by an extensive review of the sedimentation of organic matter in upwelling regimes (Summerhayes). Massive, short-period production may be more important in providing organic accumulation than is steady-state high productivity. Other papers concentrate on the sedimentary signature of specific areas. Fütterer searches for upwelling clues in sediment properties other than chemistry and paleontology; he finds present-day conditions off northwest Africa not conducive to the preservation of such clues. Trace fossils may indicate the intensity of upwelling (Wetzel).

The historical part of the work starts one-third of the way into the second volume. There are four papers on Holocene changes, five on Pleistocene variations, and seven on pre-Pleistocene episodes. The Holocene data show, not surprisingly, that upwelling intensity varies. Increases in productivity can be dated rather exactly in places and correlated with climatic events (cool, dry periods in the case of California). Off Peru, the occurrence of hiatuses in Wisconsin to Holocene sediments tends to interfere with stratigraphic-climatic interpretations. The Pleistocene records in general confirm that coastal upwelling tends to be more intense during glacial intervals than during interglacial ones (Müller *et al.*, for example).

The Deep Sea Drilling Project is represented by two multiauthored papers, one showing increased productivity of the Benguela Current at the beginning of the Pliocene, the other presenting downcore carbon analyses from off northwest Africa and elsewhere. Onshore upwelling-related sediments are explored in the remaining 100 pages of the volume. The most comprehensive of the pre-Pleistocene papers is one on Paleozoic upwelling (Parrish *et al.*) featuring the striking global reconstructions of Ziegler's group at Chicago.

In summary, the book delivers what it promises: a collection of useful papers setting forth our current understanding of the subject. Part A is the stronger volume, for old hands are more concentrated among its authors and the rules of interpretation are better defined. In part B, about half of the material is of regional rather than general interest. Also, there is an air of rather painful groping in a confusing stratigraphic record. Those bold enough to try to reconstruct the history of still poorly understood phenomena clearly pay a price. In showing where we are, the book lays the groundwork for where we need to go: toward a greater integration of oceanography into the geologic record (as distinct from present-day sedimentation) and toward an effort to tackle such global issues as primary production, isotopes, extinctions, and the evolution of the atmosphere, as H. Tappan urged 16 years ago. The task is immense; it will be a while until a treatise with similar scope and comparable advancement will be presented.

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The Physics of Stars

Solar and Stellar Magnetic Fields. Origins and Coronal Effects. J. O. STENFLO, Ed. Reidel, Boston, 1983 (distributor, Kluwer Boston, Hingham, Mass.). x, 564 pp., illus. $67.50; paper, $32.50. International Astronomical Union Symposium no. 102. From a symposium, Zurich, Aug. 1982.

The study of stars was once the central topic of astrophysics. However, the advent of large telescopes with efficient detectors plus the ability to observe nonoptical radiation have made the present time the golden age of extragalactic astrophysics. Now these same advances are being applied to stars, with the result that a renaissance of stellar research is under way and this field is one of the most rapidly growing in astrophysics.

The present volume is a good indication of current research on the physics of stars, specifically on activity that is thought to be caused by magnetic fields generated within stars. The book is the proceedings of a symposium that was cosponsored by no fewer than six commissions of the International Astronomical Union. Such broad sponsorship indicates the wide interest in the subject. The organizing committee of the symposium chose to limit oral presentations to 17 invited reviews, 36 papers selected from submitted abstracts, and five summaries. An additional 56 papers were presented as posters. The book follows this organization by including all of the oral presentations save one. Poster papers are listed by title and author only. The result is the first IAU symposium volume that includes only half of the contributions. One hopes this is not the start of a new trend. The value of the book would have been greatly enhanced if at least the abstracts of the other papers had been included. The papers that are included fairly represent the symposium as a whole with one major exception: only five papers on solar observations, of the some 29 such papers presented at the symposium, are included. Thus the reader seeking recent observational results about the sun will not find much of interest in this volume. On the other hand, the book is a good collection of papers on recent stellar observational results and the theory and modeling of magnetic processes on both the sun and other stars.

The major theme of the book is magnetic activity on stars and its effects on their atmospheres. The emphasis is on combining results from the sun and stars not too different from the sun to obtain a better understanding of the basic physics than observations of either alone could provide. In the first section (Magnetic Fields in Stellar Photospheres) we learn that the difficult observations of magnetic fields on sunlike stars are advancing rapidly. The remarkably intermittent spatial character of the photospheric magnetic field seems to be reasonably well understood according to theoretical and modeling results presented here. This happy state is probably a temporary one that will be shattered once spaceborne observations of the sun's magnetic field with the Solar Optical Telescope allow us to actually resolve the magnetic structures.

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