liquid core, it will be necessary to write a successor to Lambeck in far less than two decades. Given the hoped-for time scale and the magnificent achievement evident in his first effort, one can only add the hope that Lambeck himself will take on the task.

D. E. SMYLIE
Earth and Environmental Science Programme, York University, Downsview, Ontario M3J 1P3, Canada

Solar Phenomena

Solar and Interplanetary Dynamics. Papers from a symposium, Cambridge, Mass., Aug. 1979. M. DRYER and E. TANDBERG-HANSSEN, Eds. Reidel, Boston, 1980 (distributor, Kluwer Boston, Hingham, Mass.). xx, 558 pp., illus. Cloth, $66; paper, $28.95. International Astronomical Union Symposium No. 91.

The study of the solar corona was revolutionized during the decade of the 1960's by in situ spacecraft observations of the coronal gas in the vicinity of 1 astronomical unit. Even the earliest spacecraft data revealed that the solar corona is not static but expands supersonically into interplanetary space. Observations of this "solar wind" confirmed the basic theoretical predictions made by E. N. Parker in the late 1950's, but it soon became apparent that the simple kinematic picture of Parker required modification. The observations revealed that the solar wind was highly structured over some six orders of magnitude of spatial scales, from a few hundred kilometers to a large fraction of an astronomical unit. Moreover, the solar wind was found to be highly variable in time, with temporal scales ranging from a few seconds to many months, and to even longer time scales associated with the solar cycle.

A similar revolution occurred in solar physics during the decade of the 1970's with the launching of sophisticated solar telescopes into space, most notably in the Skylab program. As a result of studies during this period it is now realized that the lower solar atmosphere is itself highly structured and dynamic. The structuring of the solar atmosphere occurs over a wide range of spatial scales, from a few hundred kilometers to about a solar radius. It has become apparent that the structuring is strongly controlled by the solar magnetic field, with the solar atmosphere being organized into loop-like structures that appear to follow magnetic field lines. Prominent exceptions to this rule are the "coronal holes," which have been shown to correspond to magnetic field lines that open out into the solar wind and contribute to some of the spatial and temporal structure of the wind. Moreover, the modern data reveal the lower solar atmosphere to be ever in a state of change and agitation on a wide variety of time scales.

As a result of these discoveries, the solar physics community has abandoned its quasi-static one-dimensional view of the solar atmosphere and solar wind. The solar physicist is now presented with a fascinating laboratory for exploring a great variety of nonlinear dynamic phenomena in a flowing plasma in the presence of gravity and a highly structured magnetic field. In addition, direct observations of the response of the solar wind to changes in the lower layers of the solar atmosphere demonstrated in a graphic way how closely the behavior of the solar wind is coupled to the underlying solar atmosphere. As a result, solar wind physics and solar physics have largely merged into one discipline.

This volume of proceedings consists of 12 invited review papers, 69 short contributed papers, and a brief summary by M. Kuperus. The overall approach is to consider what is known about the dynamic response of the solar atmosphere and solar wind to various changes occurring at some lower layer. A wide variety of phenomena are examined: spicules, surges, solar flares, coronal and chromospheric heating, filaments and prominences, solar wind streams, coronal and interplanetary shock waves, and related phenomena. However, two topics are recurring themes throughout the book. The first is the quasi-static response of the chromospheric, coronal, and interplanetary magnetic field structures to the dynamo activity in the subphotospheric solar layers. This topic is treated in several review papers; "Evolution of coronal and interplanetary magnetic fields" by R. Levine is particularly instructive. The second theme is the physical nature of the so-called "coronal transient"—a large-scale eruption of coronal mass (and perhaps magnetic field) into the solar wind. This topic is treated in several review papers; "MHD aspects of coronal transients" by U. Anzer stands out as a model of a critical review of the field. There are also several invited papers dealing with prospects for future developments.

The contributed papers are of varying quality. The editors have, however, restricted them to a nearly ideal length of two to three pages; more information is provided than in an abstract, but they do not substitute for publication in a properly refereed journal.

The one objection I have to the volume is its division into eight primary sections. I have been able to find very little correspondence between the section titles and the contents of the sections and recommend that the reader ignore the section divisions and peruse the entire table of contents for papers that may be of interest to him or her. (An index is also provided.) I also recommend that the paper by Kuperus be read first as an introduction to the volume.

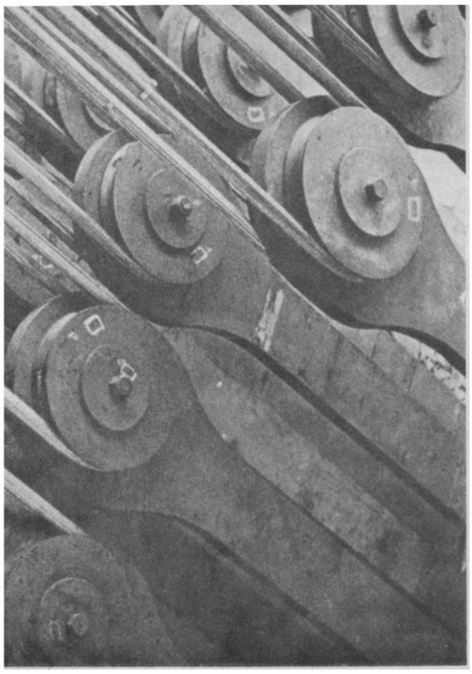
JOSEPH V. HOLLWEG
Space Science Center and *Department of Physics, University of New Hampshire, Durham 03824*

Bridges Past and Future

Long-Span Bridges. O. H. Ammann Centennial Conference, New York, Nov. 1979. EDWARD COHEN and BLAIR BIRDSELL, Eds. New York Academy of Sciences, New York, 1980. viii, 282 pp., illus. Cloth or paper, $54. *Annals of the New York Academy of Sciences*, vol. 352.

For many years, the United States was the leader in the design and construction of long-span bridges. However, after World War II, countries such as Germany, England, and Japan soon caught up. Appropriately, an international conference on long-span bridges was held in November 1979 in New York City to share ideas on the subject. The meeting commemorated the 100th anniversary of the birth of Othmar Hermann Ammann, a Swiss-born bridge engineer who practiced his profession in the United States and was the designer of the famed Verrazano suspension bridge across New York Harbor. Out of this conference came the present book. Although much of the information found in it is available elsewhere, the book does bring together in one package a considerable amount of useful material on long-span bridges.

Because of the wide range of subjects

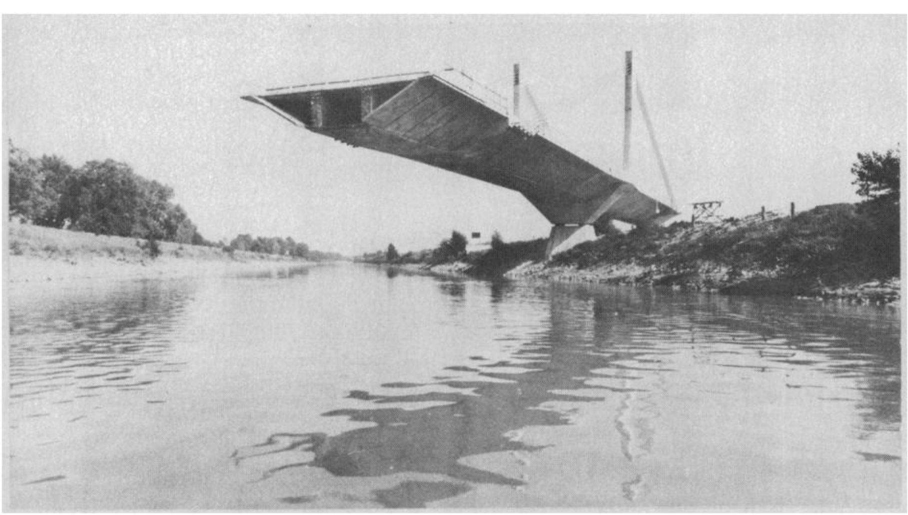


Anchorages for cables in a suspension bridge. "The anchorage resists the enormous pull of the cable, and eyebars or anchor bolts to support the parallel wire strand are used to anchor the cable to the anchorage. For a strand cable the ends of the strands may be socketed and the sockets held in place with anchor bolts or through pipe sleeves and adjustment made by means of shims under the sockets." [From A. I. Zuckerman's paper in *Long-Span Bridges*]

dealt with, there is in this volume something for everybody, from the casual bridge buff to the serious bridge designer. If one wants history, there are several historical papers. If one wants aerodynamics or fracture mechanics, there are several papers on those subjects. Case studies of the performance of several bridges, including the Golden Gate Bridge in San Francisco and the George Washington Bridge in New York, are also presented. Perhaps of greatest general interest are the papers on the latest ideas relating to new long-span bridge forms. Two new types, originating in Europe and only now beginning to be seen in the United States, are the cable-stayed bridge and the concrete segmental bridge.

Cable-stayed bridges have towers and roadway superstructures much like those of suspension bridges, but have straight cables directly joining the roadway structure to the towers. From this design, a totally new esthetic is had, made even more interesting by the many different shapes of towers and arrangements of cables possible. The cables can all fan out from the top of the tower or spread out, harp-like, spaced along the height of the tower. Such bridges have even been built with only one tower, eccentrically positioned. Typical free spans of present-day cable-stayed bridges range from 135 meters (as on the Sitka Harbor Bridge in Alaska) to 450 meters (as on the new Hooghly River Bridge in Calcutta). Cable-stayed bridges with concrete girders have somewhat lesser spans than those with steel girders, but nevertheless extend up to about 300 meters. Although spans of this type of bridge are expected to go well beyond these limits in the future, the suspension bridge is still, and probably will remain, the long-distance "champ." Suspension bridges exceeding 1500 meters are currently under design in Japan, for example.

Segmental bridges have hollow, box-shaped girders of prestressed concrete spanning between piers and are entirely self-supporting. The special feature of this bridge type is the manner of construction. As the name implies, the box girders are built in segments, with the segments either precast or cast in place. Unlike old concrete bridges, which had to have extensive ground-supported form work to carry them during construction, segmental construction can be done without such forms. If the girder units are precast (in size about 3 meters in length and the full dimension of the roadway in width) they are simply placed in position and post-tensioned to the bridge, unit by unit. Construction usually starts at the piers and cantilevers outward toward the center of the span. If the segments are cast in place, they are field cast in a sliding form temporarily attached to the bridge. When these concrete segments become hard, they are post-tensioned to the bridge as in the case of precast units. The sliding form then cantilevers outward another increment and the operation continues until the structure is complete.



Strallato Bridge, near Vienna, a cable-stayed bridge under construction May 1979. Though the columns seem like cantilevers supported at the bottom, they are "actually elastically supported by the cables at the top. This elastic support not only restricts longitudinal movement of the column top, but also reduces the lateral buckling effect. This action has enabled designers to omit the expensive braces between the columns." [L'Industria Italiana del Cemento; from Lin and Redfield's paper in *Long-Span Bridges*]

As is bound to happen, new bridge types push out old types. The losers at this time in history are the arch bridge and the truss bridge, configurations popular earlier in this century. It is significant that none of the papers deal with these bridges as viable bridge types for today. In comparison with other types, they have generally become too expensive.

Several of the papers hint of possible future developments, such as suspension bridges 3300 meters in length across the Messina Straits between Italy and Sicily, or a ribbon of cable-stayed bridges across the Bering Strait between Alaska and the Soviet Union. It is the opinion of many that most of the dramatic long-span bridges in the future will be in the relatively undeveloped areas of the world, opening up vast new territories for mankind. This reviewer has little doubt that many exciting new developments in long-span bridges are yet to be seen, as he himself is researching the possibility of using actively controlled tendons to control the dangerous dynamic movements of long-span structures, much as muscle tendons control arm or leg movements. Other researchers are working in such areas as high-strength materials, sophisticated analysis, and automated construction, all of which point toward continued development in bridges to come.

WILLIAM ZUK

School of Architecture,
University of Virginia,
Charlottesville 22903