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Editor

The STEREO Mission

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Cover illustration: The image shows STEREO performing stereoscopic observations.

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Foreword

C.T. Russell

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The Sun-Earth Connection is now an accepted fact. It has a significant impact on our daily lives, and its underpinnings are being pursued vigorously with missions such as the Solar TERrestrial RELations Observatory, commonly known as STEREO. This was not always so. It was not until the middle of the nineteenth century that Edward Sabine connected the 11-year geomagnetic cycle with Heinrich Schwabe's deduction of a like periodicity in the sunspot record. The clincher for many was Richard Carrington's sighting of a great white-light flare on the Sun, on September 1, 1859, followed by a great geomagnetic storm 18 hours later. But was the Sun-Earth Connection significant to terrestrial denizens? Perhaps in 1859 it was not, but a century later it became so. Beginning in the 1930's, as electrical power grids grew in size, power companies began to realize that they occasionally had power blackouts during periods of intense geomagnetic activity. This correlation did not appear to be sufficiently significant to bring to the attention of the public but during the International Geophysical Year (IGY), when geomagnetic activity was being scrutinized intensely, the occurrence of a large North American power blackout during a great magnetic storm was impossible to ignore. By this time it was also known that ionospheric storms could disrupt communications, and late in the IGY the first orbiting spacecraft were launched and the radiation belts were discovered. The Sun, the magnetosphere, solar wind, and coronal mass ejections became the topic of news articles of interest to the public as well as to the scientific community.

Space, or at least near-Earth space, was no longer a frontier, it became a terrestrial workplace. Astronauts occupied it. Communication satellites, weather satellites, and navigation satellites depended on it, but these space systems proved to be sensitive to solar variability. Further our power grids continued to prove to be fragile. We learned quickly what the Sun was doing but we learned only slowly why and how the Sun behaved that way. Early missions such as Skylab, Solwind and later SOHO showed us the tremendous ejections from the Sun. HELIOS, ISEE and Ulysses revealed the interior structure of these ejections once they

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left the vicinity of the Sun. Unfortunately, as valuable as these missions were they provided only either projections on the plane of the sky or single cuts through the structure. A stereoscopic view of the Sun was needed, as was a multipoint in situ measurement of the material ejected from the Sun. Thus was born the concept of the STEREO mission, twin spacecraft, separated at launch, that slowly drift further and further ahead and behind the Earth near 1 AU, both triangulating with an optical suite of instruments on solar disturbances, and sounding these same disturbances when they reach the STEREO spacecraft and their suites of in situ devices.

This collection of articles describes the STEREO mission, its spacecraft, instrument and operations. The paper by M.L. Kaiser and colleagues describes the history of the project and its objectives and the article by A. Driesman and colleagues the observatory itself. A unique feature of this space-weather mission is its beacon mode that transmits a low rate data stream comprised of both in situ samples and solar image snapshots to Earth continually to help geomagnetic forecasters. The operation of this system is described by D.A. Biesecker, D.F. Webb and O.C. St. Cyr. The largest investment of the scientific payload is in the Sun-earth Connection Coronal and Heliospheric Investigation (SECCHI) whose acronym invokes the memory of a pioneering solar scientist. This suite of optical instruments includes coronagraphs and heliospheric imagers that can follow disturbances from the Sun until they pass 1 AU. This article is followed by a series of papers covering the elements of the payload that measure the plasma, energetic particles and magnetic and electric fields at the spacecraft. In many senses the radio system too is a remote sensor with direction finding capability that follows the solar disturbances. The first nine of these papers are devoted to the IMPACT investigation, starting with a detailed overview by J.G. Luhmann et al. and followed by discussions of the boom by Ullrich et al., of the magnetometer by M.H. Acuña et al., of the solar wind electron analyzer by J.-A. Sauvaud et al., of the suprathermal electron detector by R.P. Lin et al., of the suprathermal ion detector by G.M. Mason et al., of the low-energy telescope by R.A. Mewaldt et al., of the solar electron and proton telescope by R. Müller-Mellin et al., and the high energy telescope by T.T. von Rosenvinge et al.

The solar wind ion instrument is separate from the IMPACT suite as is the plasma waves investigation. The former instrument named the Plasma and Suprathermal Ion Composition Investigation (PLASTIC) is described by A.B. Galvin et al. The radio and plasma waves investigation has been dubbed the STEREO/Waves or S/WAVES investigation. It is described in an overview article by J.L. Bougeret et al., followed by articles on the electric antennas by S.D. Bale et al. and the direction finding mode by B. Cecconi et al.

The collection of articles closes with topics that cross all discipline areas. The first of these articles by M.J. Aschwanden et al. describes the theory and modeling effort supporting the STEREO mission. The next by J. Eichstedt, W.T. Thompson and O.C. St. Cyr describes the operations and data archive and the last led by L.M. Peticolas describes the education and public outreach program.

The success of this volume is due to the efforts of many people. The editor is extremely grateful for the assistance he received in assembling this volume. First of all he is grateful to the authors themselves who responded well to the comments of the referees. He is also grateful to the many referees who assisted by spending their time improving the contents of this volume. These referees include J.-L. Bougeret, S.R. Cranmer, A. Cummings, A. Davis, W. Farrell, J. Gosling, E. Grayzeck, S. Gulkis, S.R. Habbal, D. Haggerty, R.C. Harten, T. Horbury, R. Howard, M.-B. Kallenrode, W.S. Kurth, P. Lamy, L.J. Lanzerotti, J.G. Luhmann, W. Magnes, G. Mason, J. McCarthy, L.A. McFadden, B. McKibben, R. Mewaldt, R. Mueller-Mellin, M. Neugebauer, D. Reames, B. Reinisch, H.O. Rucker, R. Schwenn, A.C. Stewart, J. Wise, T. Zurbuchen. The editor also wishes to thank Markus J. Aschwanden

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