The International Workshop on Selected Topics of Magnetospheric Physics

The International Magnetospheric Survey (IMS) is an international cooperative venture to study the magnetosphere. It is coordinated by the Scientific Committee for Solar-Terrestrial Physics (Scostep) of the International Council of Scientific Unions (ICSU). The program consists of many separate efforts by scientific groups and individual scientists to study simultaneously the diverse phenomena of the magnetosphere and then compare their results. This procedure has permitted scientists the freedom to pursue their individual programs and has also stimulated creativity, yet at the same time it has provided coordinated observations and studies of individual events from a wide variety of instrumentation.

The study of the magnetosphere consists of measurements taken with spacecraft at both low and high altitude and ground-based measurements taken with auroral cameras, magnetometers, radars, photometers, riometers and the like, as well as rocket and balloon flights. Together with these diverse measurements, there is a parallel effort by theoreticians to explain analytically and to model the observed behavior of the magnetosphere.

To bring together such a varied group, a series of IMS workshops have been scheduled. Some of these workshops have been regional, i.e., discussing measurements in one particular geographic region. Some have been narrowly topical, such as the ones on measurements of the magnetopause and bow shock using the ISEE (International Sun Earth Explorer) spacecraft. Others have been based on computer-aided data analysis, such as the December 1978 Coordinated Data Analysis Workshop (CDAW) held at the National Space Science Data Center at Goddard Space Flight Center. The most recent workshop held in Tokyo March 13 through 16 concentrated on reports of analyses performed on a wide variety of phenomena, but included two working group sessions where scientists compared original data records for the first time. These latter sessions are extremely important for they reveal what data are available for attacking specific problems, and they sow the seeds for cooperative ventures to solve those problems.

This workshop was attended by close to 150 scientists, including 50 overseas participants from 15 countries. Included in this number was a delegation of three scientists from the People's Republic of China. The delegation was led by Tschu Kang-Kun of the Institute of Geophysics Academia Sinica, Peking, who was once a student of Sidney Chapman. Tschu reported on a proposal he has made to his government for participation in the IMS. He emphasized that it is just a proposal and not an adopted program. However, due to our present ignorance about the present state of Chinese programs in this particular area, Tschu has granted permission to print the text of his address, which appears in an accompanying article.

Of perhaps greatest interest to the workshop participants were reports on the results of the four latest IMS satellites, three Japanese and one Russian. The first of the Japanese satellites Exos-A, also known as Kyokko (aurora), has as one of its principal aims the study of the dynamics of the aurora as seen from space. Its ultraviolet camera can see most of the auroral zone from its apogee of 4000-km altitude. Photographs are taken every 2 minutes alternately in low and high-sensitivity modes. The spacecraft is magnetically oriented about one axis about which is slowly rotates. Thus the aurora are not continually in view. However, the initial results shown at the workshop indicate that the detailed analysis of these images, which is about to begin, will be extremely fruitful.

The second Japanese spacecraft Exos-B, also known as Jikiken (magnetosphere), has an apogee of 30,000 km and is intended to study the middle magnetosphere. The variety of plasma wave emissions detected by this spacecraft is particularly impressive. The data are remarkably free from the interference tones which have plagued many previous investigations.

The third Japanese satellite ISS-b, Ionospheric Sounding Satellite, is a twin to the earlier ISS satellite which was the first IMS satellite launched, ISS-b has an apogee of 1220 km, perigee of 970 km, and an inclination of 69.4°. Its principal investigation is a study of the topside ionosphere.

The latest Russian magnetospheric spacecraft is Prognoz 7, in a highly elliptical polar orbit with an apogee of 200,000 km, much like the earlier European Heos-2 spacecraft. The main aim of Prognoz 7 is to study the polar cusp and boundary layer.

In addition to the results of these spacecraft, results of previous IMS spacecraft were discussed. While the majority of these satellites are still returning data, the scientists involved have had more time to digest the measurements, and the analyses are at a more mature state of investigation. Much progress has been made in understanding the source of magnetic pulsations. The control by the solar wind of the properties of pulsations observed on the ground has been known for some time. However, present studies of waves upstream of the bow shock, in the magnetosheath, and in the inner magnetosphere together with studies of the ground-based records are revealing how this control is exercised. Another important area of investigation is in dynamics of the 'cold' plasma in the ionosphere. Electric field instruments now are routinely measuring the transport of cold plasma across field lines, thus showing that earlier inferences from theoretical considerations and rocket and balloon measurements were correct. On the other hand, plasma analyzers studying the composition and three-dimensional flow properties of this cold plasma reveal that much of the cold plasma observed in the outer magnetosphere is flowing along field lines out of the ionosphere and contains large quantities of He⁺ and O⁺. Finally, measurements of the magnetopause and shock reveal them to be very dynamic entities moving irregularly and being capable of changing in character from minute to minute.

Not all the new information and understanding of the magnetosphere comes from satellite data. Very impor-
tant also are the many ground-based records. Irregular magnetic pulsations, known as Pi2, have long been known to be associated with substorm, but their source and behavior was the subject of much controversy. Extensive studies of the worldwide properties of Pi2's have now been undertaken, and most of these controversies have been resolved. We now know that some, but not all, Pi2 pulsations can propagate completely around the earth. However, most Pi2's are seen near the meridian of generation. Also the period of these pulsations depends on the latitude of generation and hence can be used as a substorm diagnostic. Furthermore, while the amplitude is a maximum in the auroral zone, there is a secondary maximum at lower latitudes at the plasma pause.

Another area of intensive study has been the response of ground-based indices of geomagnetic activity to the properties of the solar wind. As reflected in geomagnetic indices the magnetosphere appears to be effectively a half-wave rectifier of the north-south component of the interplanetary magnetic field not responding to northward fields. The solar wind velocity also plays a role, but not all geomagnetic indices respond in the same way. The AU index is linearly proportional to the velocity, but most other indices are proportional to the square of the velocity. Complicating these studies, the Al index appears to saturate at high solar wind velocities, and the mid-latitude $A_m$ index has a response due to the solar wind density.

The organizing committee of this workshop are to be complimented for their efforts in hosting an excellent and fruitful workshop. In addition they have set a new standard in the publishing of the proceedings of the conference. Summaries of all the talks were collected on the first day of the meeting, printed, and then distributed to the participants on the last day. This soft cover 400-page volume is available on request from A. Nishida, Institute of Space and Aeronautical Science, University of Tokyo, Komaba, Meguro, Tokyo, Japan.

C. T. Russell is with the Institute of Geophysics and Planetary Physics of the University of California at Los Angeles.

EOS, Vol. 60, Page 460
Copyright American Geophysical Union
0096-3941/79/6020-0460$01.00