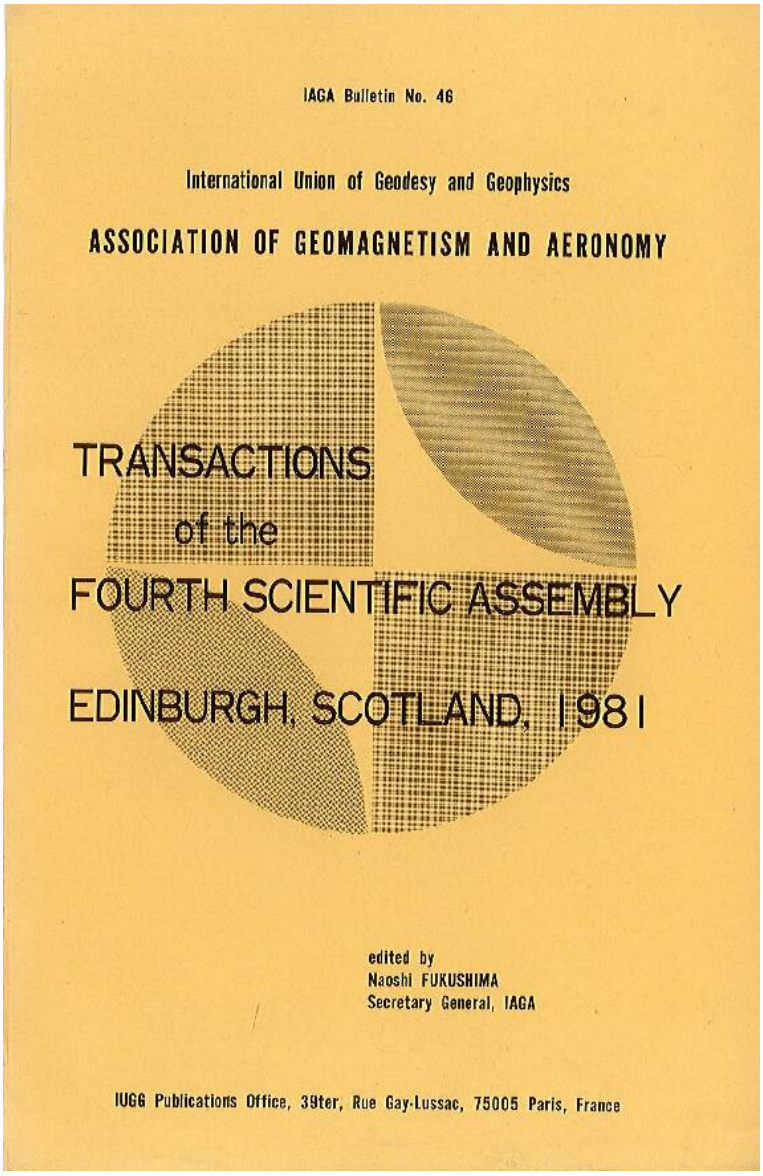


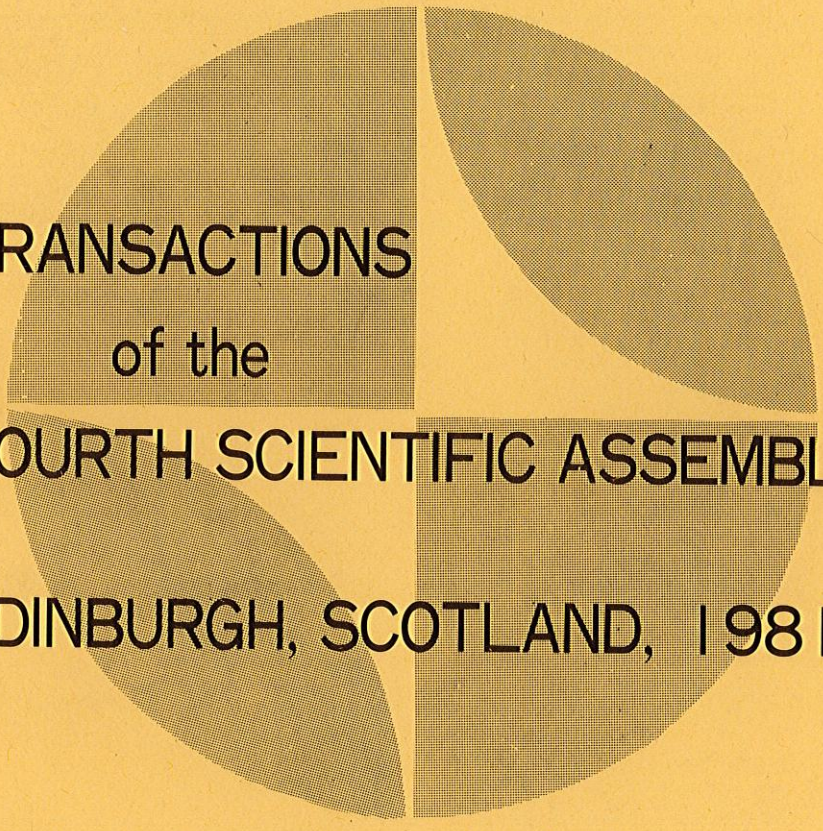
How to cite:

IAGA (1981). ***IAGA Bulletin No. 46, Transactions of the Fourth Scientific Assembly, Edinburgh, Scotland, 1981.*** **IUGG Publications Office. https://doi.org/10.25577/j85r-af95**

IAGA Bulletin No. 46

International Union of Geodesy and Geophysics

ASSOCIATION OF GEOMAGNETISM AND AERONOMY



TRANSACTIONS of the FOURTH SCIENTIFIC ASSEMBLY EDINBURGH, SCOTLAND, 1981

edited by
Naoshi FUKUSHIMA
Secretary General, IAGA

IUGG Publications Office, 39ter, Rue Gay-Lussac, 75005 Paris, France

The **INTERNATIONAL ASSOCIATION OF GEOMAGNETISM AND AERONOMY** (IAGA) is one of the seven Associations in the **International Union of Geodesy and Geophysics** (IUGG). The countries which adhere to the IUGG are members of IAGA and may participate in the activities of IAGA. Each Member Country is represented by a single body (called IAGA National Body), established in that country by the body that adheres to the IUGG.

The objectives of IAGA are:

a) to promote studies of magnetism and aeronomy of the Earth and other bodies of the solar system, and of the interplanetary medium and its interaction with these bodies, where such studies have international interest;

b) to encourage research in the above subjects by individual countries, institutions or persons and to facilitate its international coordination;

c) to provide an opportunity, on an international basis, for discussion and publication of the results of the research work indicated above;

d) to promote appropriate standardizations of observational programs, data acquisition systems, data analysis and publication.

At present, the components of IAGA are as follows.

Division I: Internal Magnetic Fields
Division II: Aeronomic Phenomena
Division III: Magnetospheric Phenomena
Division IV: Solar Wind and Interplanetary Magnetic Field
Division V: Observatories, Instruments, Indices and Data
Interdivisional Commission on Antarctic Research
Interdivisional Commission on History
Interdivisional Commission on the Middle Atmosphere
Interdivisional Working Group on Relations between External and Internal Magnetic Variations

Each Division (and some Interdivisional Commissions also) has Working Groups or Topic Groups for specific items of research.

IAGA holds its ordinary General Assembly every four years in connection with each ordinary General Assembly of IUGG. Between ordinary General Assemblies, IAGA holds a Scientific Assembly, so that IAGA meets every other year.

IAGA has two kinds of publications, i.e. **IAGA Bulletins** and the **IAGA News**. The IAGA Bulletins include

Transactions of the IAGA General or Scientific Assemblies
Program and Abstracts of Papers for IAGA General or Scientific Assemblies
Geomagnetic Indices and Data (published yearly)
Special Data Summary or Useful Information Booklet (published occasionally).

All the IAGA Bulletins are on sale at the IUGG Publications Office (39ter, rue Gay-Lussac, 75005 Paris, France). In 1960's some Proceedings of special IAGA symposia were also published from the IUGG Publications Office.

IAGA issues an internal publication called "IAGA News" which contains various information of general interest to the IAGA community. The IAGA News is usually published on a yearly basis, and is available free of charge on request from the Secretary General of IAGA.

N. Fukushima
Secretary General, IAGA
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IAGA Bulletin No. 46

International Union of Geodesy and Geophysics

ASSOCIATION OF GEOMAGNETISM AND AERONOMY

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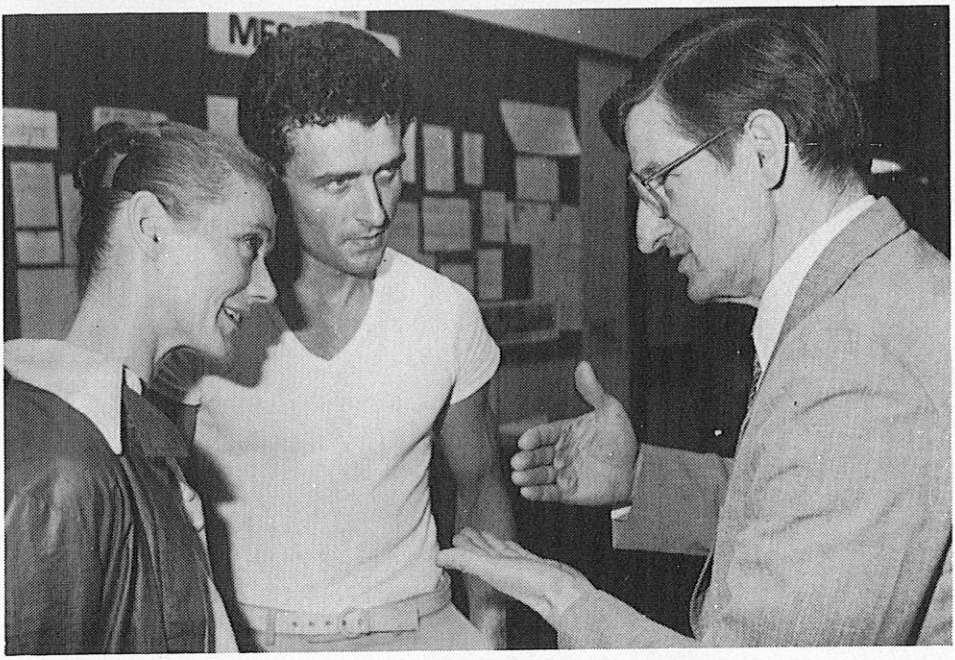
Appleton Tower

MEETING OF ARTS AND SCIENCES

Delegates to the 4th Scientific Assembly of Geomagnetism and Aeronomy in Edinburgh who attended The Scottish Ballet's performance at the King's Theatre in August were astounded to find Jack Carter's THE Kp INDEX on the programme.



Professor Keith Cole explains the Kp index to Elaine McDonald and Graham Bart, principal dancers with Scottish Ballet. Photo: Antonia Reeve, courtesy of Scottish Ballet.

Extract from Scottish Ballet Programme

THE Kp INDEX

Programmed Sound Charles Dodge
(Earth's Magnetic Field)
Choreography Jack Carter
Lighting Ian Irving

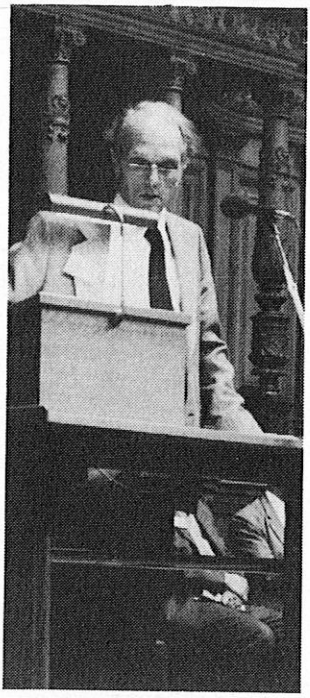
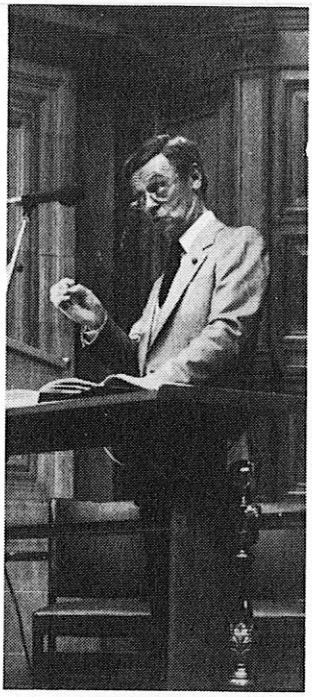
In the last decade, satellite experiments have established the existence of an electrically charged gas — a solar wind — continuously emanating from the nuclear furnace of the sun at speeds of several hundreds of miles an hour. The magnetic field of Earth is able to deflect this solar wind away at distances far greater than the extent of Earth's atmospheric layers, so preventing the wind from intermixing with the gases of our atmosphere.

The magnetic changes caused by the impact of the solar wind are measured every three hours on a scale known as the Kp index which, when displayed as a graph, looks somewhat like musical notation. The graphs of the Kp indices for the year 1971 were computer programmed into a form suitable for music synthesis and were played through an IBM/360 model 91 at Columbia University Computer Centre so, in a real sense, the sounds you hear are the sun playing on the magnetic field of Earth.

Elaine McDonald **Graham Bart**

The Kp Index has been recorded in Benesh Movement Notation by Grant Coyle.

The Kp Index is premiered by The Scottish Ballet on 4th August 1981 at the King's Theatre, Edinburgh.

The Opening Ceremony held in the McEwan Hall.
L to R, Sir Herman Bondi, Chairman of the Natural Environment Research Council, B R Leaton, Chairman of the Local Organising Committee and Mr Russell Hunter, who gave an amusing account of Scottish life and culture

Professor Cole addressing delegates and guests at the official reception by the University and the City of Edinburgh at the Royal Scottish Museum

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ACKNOWLEDGEMENTS

The International Association of Geomagnetism and Aeronomy held its Fourth Scientific Assembly in Edinburgh, Scotland, 3-15 August 1981, at the invitation of the Royal Society of London. The meeting in Edinburgh was the second one in the history of IAGA, the first being the Sixth General Assembly of IUGG in September 1936 with 65 participants from 17 countries. This time, the total number of registrants (excluding 110 accompanying members) was 747, indicating a great expansion of IAGA science in the past 45 years.

The Local Organising Committee members were:

Mr. B.R. Leaton (Chairman), Institute of Geological Sciences
Dr. S.R.C. Malin (Secretary), Institute of Geological Sciences
Mr. C.R. Argent, Royal Society of London
Prof. K.M. Creer, University of Edinburgh
Dr. M. Gadsden, University of Aberdeen
Dr. B.A. Hobbs, University of Edinburgh
Dr. V. Rosemary S. Hutton, University of Edinburgh
Mr. S.W.E. Davidson, City of Edinburgh Council
Dr. F.J. Lowes, University of Newcastle-upon-Tyne
Mr. W.H. Rutherford, Royal Society of Edinburgh
Dr. W.F. Stuart, Institute of Geological Sciences
Dr. P.C. Wraight, University of Aberdeen

The Organising Committee was able to have assistance from:

The City of Edinburgh District Council
The Institute of Geological Sciences
The Natural Environment Research Council
The Royal Society of Edinburgh
The Royal Society of London
The University of Edinburgh

and also from British Caledonian Airways, the Lothian Regional Council, the Royal Scottish Museum, Russell Hunter, Esq., the Scottish Tourist Board, and Shell U.K. Ltd. According to the report from the Local Organising Committee, donations were also made by Esso U.K., Mackay and Lynn, Phillips Petroleum, Baxters, BP Oil, Brooke Bond Oxo, Wallace Brown, Drambuie Liqueur Co., Kiltmaker, Royal Bank of Scotland, Thomas Tait, United Yeast, William Sanderson & Son, Joseph Walker, Whiteholme, and seven commercial exhibitors; equipment was loaned by the Church of Scotland, IBM U.K., and Rank Xerox.

The Local Organising Committee made excellent arrangements, with a number of helpers (including the spouses of some Organising Committee members), for

Assembly facilities (living accommodation, lecture and meeting rooms, catering, audio-visual aids),
Liaison with University departments and IGS Units (exhibitions, displays and assistance),
Transport to Edinburgh (air, rail and road),
Scientific Excursions (pre-assembly visits to exposures of geological and palaeomagnetic interest in Scotland; weekend tour to stone circles, castles and Aberdeen; Newcastle Palaeomagnetic Laboratory, and Eskdalemuir Geophysical Observatory, during the Assembly; Optical Calibration Workshop in Aberdeen after the Assembly),

Receptions (venues, hospitality from City and University),
Social Activities (ladies programme, excursions and other social activities, maps, guides and souvenirs),
Administration (Secretariat, registration, finance, cash handling, printing, circulars and documentation),
Services (banking, post, telephones and bussing),
Sponsorship (fund-raising, in-kind support, equipment loans and commercial exhibition),
Publicity,
Exhibition (exhibition in the Royal Scottish Museum of some British contributions to geomagnetism).

All the participants of the IAGA Assembly (as well as those MAP meetings arranged by the MAP-Steering Committee of SCOSTEP on 14-15 August) enjoyed the proceedings very much, and the meetings were very successful, thanks to the excellent arrangements made by the Local Organising Committee.

The Assembly itself was held in Appleton Tower, except for the Opening Ceremony on the first day followed by the Special Symposium on Saturn, and social events during the Assembly period. The facilities of the conference building were excellent and very convenient for the participants. At the registration area on the ground floor of Appleton Tower, the Organising Committee members and their assistants gave all kind of excellent service to the participants every day. The Secretariat Office was staffed by Miss J.L. Dunford, Mrs. G.L. Crichton (both from the Institute of Geological Sciences) and Mrs. E. Wilson.

After the Assembly, the Secretary General received many letters of appreciation for all the arrangements at the Edinburgh Assembly; all these words of appreciation are due entirely to the efforts of the Local Organising Committee, especially to Mr. B.R. Leaton (Chairman), Dr. S.R.C. Malin (Secretary), and Dr. V.R.S. Hutton (convener of the Organising Group for Social Activities). The Secretary General recently happened to see a summary report of the Local Organising Committee, and he fully recognized just how great the efforts of the Local Organising Committee were. On behalf of IAGA and all the participants of the Edinburgh Assembly, we would like to express our heartfelt thanks to them. It is interesting to note that the good weather during the Assembly is mentioned in the "Resolution of Thanks" adopted on the last day of the IAGA Edinburgh Assembly. The participants had the impression that the Gods had given us the good weather, after knowing of the earnest efforts of the Local Organising Committee towards the success of the Assembly.

The Programme-Abstracts booklet of the Fourth Scientific Assembly (IAGA Bulletin No.45) was printed in the University of Edinburgh, and the publication and distribution of the Transactions have also been arranged by our colleagues in Edinburgh. The contents of the Transactions were forwarded to the Secretary General from the leaders of IAGA Divisions and Interdivisional Bodies, the conveners and/or chairmen of all the scientific sessions. Mrs. B. Edwards helped in drafting the minutes of IAGA Executive Committee meetings. The preparations for compiling the Transactions manuscript were made in Tokyo with the assistance of Mrs. D. Hiscock (until June 1982) and Mrs. P. Tazawa (after June 1982).

October 1982

Naoshi Fukushima
Secretary General of IAGA

OPENING CEREMONY AND ADDRESSES

OPENING CEREMONY

August 3, 1000 - 1110, McEwan Hall

The opening ceremony was presided over by Mr. B.R. Leaton, chairman of the Local Organizing Committee. He introduced Sir Hermann Bondi (FRS, President of the Research Council for the Natural Environment), and Sir Hermann gave the opening speech for the Fourth Scientific Assembly of IAGA in Edinburgh.

After this opening speech, Mr. Leaton introduced Mr. Russell Hunter who gave an entertaining talk about Scotland.

Dr. V.R.S. Hutton was then asked to explain the Social Programme planned during the IAGA Edinburgh Assembly.

Finally, Professor A.A. Ashour (Past President of IUGG), representing the IUGG Bureau, gave the greeting for this IAGA Assembly.

SPEECH DELIVERED by PROF. A.A. ASHOUR

Sir Herman, President Cole, and Colleagues.

It is my pleasant duty to bring to you the greetings of the President and members of the Bureau of IUGG and to wish you a very successful scientific meeting and a very pleasant stay in the beautiful city of Edinburgh.

Mr. Chairman: I believe that IUGG is unique between the Scientific Unions in the fact that it comprises seven International Associations dealing with different disciplines of the physics and chemistry of the solid and liquid Earth and its atmosphere. Despite unavoidable differences and overlapping, this federation gives the Union strength. Some of these Associations are indeed larger than several of the other Unions. This is certainly true for IAGA.

Mr. President: The Executive of IUGG recognizes this fact about the size and diversity of activities of IAGA. It views with satisfaction the leading and coordinating role which IAGA plays in the organization and activities of ICSU Scientific and Inter-Union Committees such as SCOSTEP and COSPAR and in large international programs such as the IMS and its post data analysis and MAP and the coming Lithosphere Program to mention only a few. It also views with great interest the efforts of IAGA to help the Developing Countries.

It is very natural that we are meeting in Edinburgh today. Edinburgh is one of the strongest holds for IAGA in the World. Our colleagues here have contributed so much to our science. Nor is this the first meeting IAGA is holding in Edinburgh. Those of us who attended the First Workshop on Electromagnetic Induction in the Earth (which was held here in 1972) remember the excellent organization and warm hospitality provided by our colleagues. But of course the present meeting is much larger and the Local Organizing Committee is to be congratulated and thanked for the excellent job they are doing.

Another meeting which was held here in 1936 was the General Assembly of IUGG itself. At that Assembly the total number of participants was 285 and from this IAGA's share was 65 belonging to 17 countries. Comparing these numbers with the participants of the present IAGA Assembly shows how much our Union and Association has grown since then. A copy of the group photograph of the participants of the Assembly is displayed in the Registration Hall. It includes some of the pioneers of our science including Sydney Chapman, Julius Bartels, Harold Jeffreys and Vincent Ferraro.

Ladies and Gentlemen: Again I wish you a very successful meeting.

WELCOME ADDRESS at the Reception on 5 August 1981
by Prof. W. Cochran, FRS
(Dean of Faculty of Science, University of Edinburgh)

Ladies and Gentlemen, it is my pleasant duty to welcome conference delegates, and others who are here because of the IAGA Assembly, on behalf of the University of Edinburgh. I am a great believer in the value of conferences; the direction of my own research was completely changed by a chance meeting at a conference, and it was the beginning of a collaboration between departments in different countries which is still continuing now after 20 years, although the two people who met at that conference are no longer directly involved. And I may say I met my future wife, not actually at a conference, but while I was traveling back from one. That conference was in Stockholm, and we were welcomed I remember by the King of Sweden, who was himself something of a scientist and archaeologist. With all due deference to you Lord Provost, even jointly we fall somewhat short of Royalty. Our surroundings here, however, while very different from those we enjoyed at Drottningholm, are not less interesting. You will have seen the exhibition of British contributions to geomagnetism. I noticed that Sir James Clark Ross was referred to as a great Scottish explorer, although if I am not mistaken he was born in London. It reminds me that the Duke of Wellington, an important figure in British history, was told that he was not an Englishman because he had not been born in England, to which his reply was that a man could be born in a stable, but that would not make him a horse.

Geology has a long history in Edinburgh, and one thinks immediately of James Hutton, who was born in Edinburgh in 1726, and was a founder of the subject. Geophysics is a comparative young department, and Professor Creer is only the second person to have been Professor of Geophysics. There are 23 departments in the Faculty of Science, and Geophysics is one of the smaller ones. My file on it is a thin one which means that it has given me very few problems during my three years as Dean; they have been getting on with their teaching and research and we are proud to have a department which is so active in research. Some of you will have noticed that Geophysics is housed in the James Clerk Maxwell building and I would like to take a few more minutes of your time to tell the non-scientists present who JCM was. He was born in Edinburgh just 150 years ago this summer and went to school and university here.

I have just been reading a new biography of Maxwell by Ivan Tolstoy, who incidentally was a Professor of Geophysics. Maxwell's name is not well known to non-physicists, but there is an increasing realisation that his influence on physics was in the same class as that of Newton or Einstein. His work touches the interests of this Conference at three points at least, the kinetic theory of gases, the stability of Saturn's rings, and his theory of the electromagnetic field and EM waves. In his lifetime Maxwell was little honored in his native country and I regret to say that when he applied for a Professorship in this University in 1860 he was unsuccessful -- it may have been just as well on both sides as he was a poor lecturer and Edinburgh students had a reputation for noisy behaviour in lectures. As a man Maxwell was a saintly character but he had a good sense of humour and was addicted to writing humourous verse. Here are a few lines of what he wrote after a lecture by his colleague P.G. Tait at a conference of the British Association for the Advancement of Science.

You British asses, who expect to hear
Ever some new thing,
I've nothing to tell, but what, I fear
May be a true thing.

For Tait comes with his plummet and his line
Quick to detect your old stuff,
Now dressed in what you call a fine
Popular lecture

Like Maxwell, you will know by now that you do not expect to enjoy everything that you hear at a Conference, but I hope and expect that you will enjoy most of it, and that you will all enjoy your stay in Edinburgh.

FIRST CONFERENCE OF DELEGATES

August 3, 1120 - 1210, McEwan Hall

President Cole presided over this First Conference of Delegates. A quorum for Chief Delegates was satisfied. The meeting had the following presentations :

1. A statement regarding the International Lithosphere Programme

   R. Van der Voo (chairman of the ICL Working Group on Phanerozoic Plate Motions and Orogenesis) gave a short talk.

2. Nomination of the Resolutions Committee

   The following names were recommended and approved by the Conference of Delegates.

   D.J. Williams (chairman, U.S.A.)
   M.-L.Chanin (France)
   B.A.Hobbs (U.K.)
   A. Nishida (Japan)
   O.M. Raspopov (U.S.S.R.)

3. New Chairman and Co-Chairman of IAGA Division IV

   President Cole announced that the IAGA Executive Committee had nominated

   L.F. Burlaga (U.S.A.) as the new chairman and
   F.M. Neubauer (F.R.G.) as an additional co-chairman,

   effective 1 January 1981.

4. Invitation from Czechoslovakia for the IAGA 1985 Assembly

   President Cole announced that IAGA had received a letter from the Czechoslovakian National Committee for IUGG inviting IAGA to hold the 1985 Assembly in Prague. He asked Chief Delegates to consider this invitation until the Closing Conference of Delegates.

5. Presidential Address by K.D. Cole. (see the following pages)

PRESIDENTIAL ADDRESS

Keith D. COLE

The Science

The sciences for which IAGA is a major international forum cover planetary magnetism and also solar-planetary physics (excluding meteorology). The scope of the programme here at Edinburgh and the attendance of over 750 (the largest ever in IAGA's history) is testimony to the great activity and high interest in this area of science.

There are essentiallly four large areas of physics involved, each of which is represented at the microscopic and macroscopic levels. A fifth smaller area is beginning to show itself. The areas are: -

1. Plasma Physics - from wave-particle interactions and wave-wave interactions to gross structures, such as interplanetary shocks and magnetospheric electric fields and currents.
   The outer atmospheres of the planets and interplanetary space provide a range of plasma processes far greater than man is able to produce in the laboratory. These plasmas compensate for our lack of control over them by their natural reproduceability. Moreover some of the processes can be observed 'clean' and clear of 'wall effects'. Though in magnetospheric physics, some phenomena of long duration do encounter geophysical 'walls' like the ionosphere or the plasmapause or the magnetopause.
2. Aeronomical Physics - from the quantum mechanics of particle-particle interaction to large scale phenomena like ionospheric storms or changes in the mesospheric electric field following energetic particle bombardment of the atmosphere.
3. Magnetism - from the physics of single domain grains to the classical problems of the origin and maintenance of planetary magnetic fields.
4. Solar-Terrestrial and solar-planetary relationships - In this area of science we are interested in the sequence and coupling of physical processes, starting with the emission of electromagnetic waves and particles by the sun, their transmission through interplanetary space and their interaction with the upper atmospheres of planets and their magnetic fields.
5. The fifth highly exciting yet embryonic field is that of biomagnetism, as, for example, in the relationship of the geomagnetic field to bird migration.

In reporting on our science, I shall commence with work on the solar wind and finish with that on the internal magnetic field.

Solar Wind

The large-scale characteristics of the solar wind are being investigated by Helios 1 and 2 (0.3 to 1AU), Voyager 1 and 2 (1 to >10AU), Pioneer 11 (1 to ≥25AU). Generally the magnetic field follows the pattern predicted

by Parker, but considerable variability about this pattern is observed by Voyager and in particular the nominal radial component of $\underline{B}$ is smaller than the fluctuations beyond $\sim$0.3AU. The sector structure was observed to disappear at heliographic latitude $\gtrsim 16°$ in 1976, which was interpreted in terms of a tilted solar dipole field, and Helios observations show directly that the sector boundary surface was close to the equatorial plane at that time. In 1978 the sector boundary surface as within ±15° of the solar equatorial plane and warped such as to produce a 4-sector pattern consistent with a solar dipole aligned along the spin axis and a 10 percent quadrupole contribution; the footprints of the sector boundary surface measured by Helios and IMP spacecraft may be inferred from the maximum brightness contour of the HAO white-light coronagraph data. The variation of the electron temperature with distance between 0.45 AU and 4.8AU was determined from Mariner 10 and Voyager data showing $T \sim R^{-1.175 \pm 0.03}$. The heliomagnetic latitudinal variations of the solar wind plasma were investigated using observations made in the ecliptic plane together with the fact that the solar magnetic field resembled a tilted dipole in 1974. Discontinuities in the interplanetary magnetic field have been observed at least out to 8.5AU and in to 0.46AU. Corotating shock pairs are found to be a general feature of the solar wind in the outer solar system and the interactions which produce these shocks have been developed in 3D and MHD models. The coalescence of two shock waves between 0.8AU and 1AU was observed by Helios and IMP spacecraft. The dependence of the thickness of collisionless interplanetary shocks on the plasma β and Mach number has been investigated. The magnetic structure of solar wind shocks between 1 and 2AU has been described, for example, a quasi-parallel shock in which elliptically polarised fluctuations with an apparent period of 20-25 sec, extended 500,000 km downstream from the shock.

Notable contributions to our understanding of solar activity and its effect on the solar wind are coming from SMM (Solar Maximum Mission), the U.S. Air Force, Satellite P 78-1, the radio wave experiment on ISEE (International Sun-Earth Explorer), and the white-light coronograph data that have been collected by the HAO group during the last cycle. Numerous observations of coronal mass ejection events and related solar phenomena have stimulated such study, both theoretical and experimental, giving a body of descriptive knowledge and a list of hypotheses concerning their dynamics. Interplanetary events called magnetic clouds may be interplanetary manifestation of coronal mass ejection events. These are regions with a radial extent $\gtrsim$0.25AU, a high field strength, anomalous but ordered field directions, and a low temperature; they are apparently expanding under the influence of a high internal magnetic field pressure. Another type of flow, corotating streams, has recently been shown to originate in coronal holes. The evolution of coronal holes during the last solar cycle was described recently based on white-light data. Solar flares are being intensively studied by SMM, and shock waves produced by flares can be followed almost continuously from the sun to 1AU using data from the radio wave experiment of ISEE. These data, together with in situ interplanetary measurements, promise to give definite knowlege of the propagation of shocks in the inner solar system.

Observations of He^+ behind an interplanetary shock have been reported indicating the presence of cool material, possibly even neutral matter, which might have been ejected by an eruptive prominence. Routine measurements of O^{+6}, O^{+7}, He_3^+, and charge states of iron are now being made on ISEE-C, opening the way to diagnose the coronal temperature as a function of time.

In the realm of solar physics of direct concern to IAGA is the question of what structures on the sun are related to geomagnetic storms. It has recently been discovered that in addition to coronal holes and solar flares, disappearing filaments create structures in interplanetary space which eventually cause geomagnetic storms on the earth, provided of course that the earth is in the 'line of fire'.

Planetary Physics

One of the most exciting events of space physics has been the exploration of the magnetospheres of the outer planets Jupiter and Saturn. The relative importance of the internal magnetic field rotation, atmospheric winds, and the solar wind and satellite action in determining gross magnetospheric properties varies from planet to planet. Comparative studies of the magnetospheres of the planets is most fundamental and earth scientists have much to learn from it. This afternoon we are to be treated to a Symposium devoted to the Saturn air system giving us up-to-the-minute results. IAGA takes special pride in providing this forum for this work.

Space probes of both USA and USSR have extended greatly our knowledge of the solar wind interactions with Venus.

Solar Wind Interaction with Venus

The pioneer Venus Mission, preliminary results from which are described in a special issue of the Journal of Geophysical Research (December 30, 1980) has greatly increased our understanding of the solar wind interaction with an unmagnetised planetary body which has an ionosphere. In particular, the Orbiter dips into the ionosphere near periapsis and travels to a distance of $\sim 2R_V$ at apoapsis, giving us the first extended data set on the boundary layer between a planetary ionosphere and the solar wind at a wide range of solar zenith angles. It has been observed that the interaction involved the transmission of incident solar wind dynamic pressure to magnetic pressure outside of the boundary layer. Inside the boundary, the ionospheric plasma pressure is approximately equal to the same value. There also appears to be a change in the interaction when the incident solar wind dynamic pressure exceeds the maximum ionospheric plasma pressure. On these occasions the solar wind with its frozen-in magnetic field may be pushed closer to the planet surface. It has also been determined that the loss of the planetary atmosphere via the solar wind interaction proceeds via photoionisation of neutrals located outside the boundary layer, charge exchange with solar wind protons in this outer region, detachment of ionospheric plasma from the boundary by yet undetermined forces near the terminater, and possibly by a tail wind in the antisolar direction that bears some similarities to Earth's polar wind. Finally the unexpected observed phenomenon of small scale magnetic structure ('flux ropes') within the undisturbed ionosphere has an as yet uncertain origin but is a ubiquitous phenomenon in the dayside ionosphere under quiet solar wind conditions.

The Terrestrial Magnetopause

Two very important discoveries about the behaviour of the magnetopause were made using ISEE 1 and 2 just prior to the Canberra assembly. The first is that steady reconnection as envisioned in most theroretical developments does exist on occasion and that patchy reconnection in the form of flux transfer events is often found to exist. A period of quiet solar wind conditions reconnection signatures were continuously present. In fact during one traversal the spacecraft remained in the magnetopause for about an hour.

Flux transfer events were somewhat a surprise in the ISEE data because high resolution magnetic measurements across the magnetopause have been made for almost two decades. Study of these phenomena since Canberra have shown that they have heat flux anomalies, that protons stream out of them into the solar wind and that they have higher pressure than the surrounding magnetosheath plasma. These signatures all suggest that the flux transfer event is the signature of a reconnection event isolated in time and in space.

The Foreshock

It has been known for some time that the foreshock region, upstream of but connected to the earth's bow shock, is characterised by particle fluxes travelling back upstream along the IMF from the shock and by a variety of waves. Recent measurements, made primarily by the ISEE-1 and 2 spacecraft have however provided a much more detailed portrait of the region than was available previously. This began with the early recognition that upstream ion populations varies in character. They range from reflected beams with narrow energy and pitch angle ranges through intermediate populations to fully diffuse distributions which appear isotropic in the spacecraft frame and were observed over the entire energy range of their instrument.

A second important observation was reported, and found that the large amplitude low frequency (.03Hz) waves which characterise much of the foreshock are uniquely associated with diffuse distributions. Another exciting contribution made by the ISEE mission has been the identification, using the unique dual spacecraft measurements, of upstream wave modes and rest frame frequencies. A great many more observations are presented in a special upstream Waves and Particles issue of the Journal of Geophysical Research which contains a comprehensive selection of articles representing data from most of the ISEE instruments.

Magnetospheric Physics

In recent times boundary layers of the magnetosphere have been further explored, particularly as regards the description of the low latitude boundary layer in which solar wind is found inside the magnetopause. Evidence is now being accumulated for reconnection of the interplanetary and geomagnetic field at various regions of the magnetopause. Investigations into hydromagnetic wave in space around the earth and geomagnetic pulsations at the surface of the earth are providing us with new information in several areas.

The first concerns hydromagnetic waves originating in interplanetary space which are registered at the earth's surface and the second area of increasing interest is geomagnetic pulsations on the polar caps inside the auroral oval. In the noon sector particularly, information comes from the boundary layer via hydromagnetic waves and much work remains to be done to understand the range of geomagnetic pulsations in this region.

Deeper in the magnetosphere, simultaneous observations from satellites is beginning to reveal the modal structure of hydromagnetic waves. Heavy ion effects on hydromagnetic waves in the magnetosphere are receving more attention. An area of geomagnetic pulsation research which needs further development is that in the equatorial regions.

A region of intense interest is that of the terrestrial kilometric radiation. A most exciting observation is that it can be stimulated by type-III solar bursts. The morphology of the source regions of this radiation above auroras is being delineated.

The SCOSTEP programme on the International Magnetospheric Study provided great impetus to magnetospheric research recently. At present the post-IMS Data Analysis Phase is being developed and we can expect our understanding of the magnetosphere to be improved over the next few years as a result of this effort. SCOSTEP is organising a sequence of co-ordinated data analysis workshops in this regard and there will be a major symposium in 1984 on results of the IMS. For this symposium SCOSTEP will approach COSPAR with the view of having it in association with COSPAR's 1984 meeting.

IONOSPHERIC PHYSICS

Incoherent scatter radar continues to prove its worth as a major tool for studying upper atmosphere dynamics. Optical interferometry has also been used to good effect to study the complicated night-time dynamics over Arecibo, and to study winds associated with polar cap convection. The thermosphere over Arecibo turns out to be surprisingly complicated, perhaps because it seems the midlatitude and equatorial regimes meet in this vicinity; but there may be a lesson that nowhere is the ionosphere simple if probed in sufficient detail. The observational and theroretical progress on equatorial ionospheric irregularities of various scales is a highlight of present-day aeronomy. Also in the euqatorial field, the counter-electrojet is receiving considerable attention.

Another promising topic is the role of ring current protons in depositing energy into the low latitude thermosphere.

At high latitudes the MPI heating experiment at Tromsö is entering service as a major new instrument for doing plasma physics; EISCAT transmissions were expected to start in late May 1981; the STARE and other radars are useful synoptic instruments for auroral work; whereas GEOS has continued to provide valuable data for studies of ionospheric-magnetospheric coupling. All this work exploits the ionosphere as a plasma physics laboratory, for both passive and active experiments. An example is the finding of evidence that plasma waves are generated in the auroral oval and play a role in the dissipation of energy there. The subject of the formation of irregularities in the ionosphere by the passage of hydromagnetic waves is now being advanced by using high resolution studies of the ionosphere employing phase path techniques and observations of geomagnetic pulsations.

The chemical modification of the ionosphere, particularly by space vehicle emissions, remains a field of interest and not without practical importance. It is interesting that the present solar cycle has given new results concerning the relationships between solar and thermospheric parameters, and between geomagnetic/interplanetary parameters and the ionosphere; to a large extent, these relationships are empirical or statistical but they pave the way to physical understanding.

The great advances in exploring the planets are now being followed up with interpretative and theroretical studies, that build on knowlege of the earth's thermosphere in order to investigate planetary aeronomy.

The Middle Atmosphere

The altitude distribution of some minor constituents of the atmosphere are being determined from satellite measurements of spectral radiance and the application of inversion techniqus.

IAGA scientists are very much involved in the Middle Atmosphere Programme of SCOSTEP. This programme comes into existance officially in 1982 and will last until 1985. Here in Edinburgh an important assembly of scientists interested in MAP will take place.

Internal Magnetic Field

Analysis of the main field and secular variations

The Magsat mission has provided data of unprecedented completeness which are being analysed by investigators in numerous countries. Secondly, three proposed models have been prepared for the update of the IGRF planned for the Edinburgh Assembly. Thirdly, efforts continue towards inversion of the main field and secular variation fields, to current distributions in the core. Two symposia in Edinburgh will be sponsored by WG I-1.

Electromagnetic induction and electrical conductivity (Earth and Moon)

The fifth Workshop of this WG was held at the University of Istanbul in August 1980, and was attended by 95 scientists from 17 countries. Papers covered a wide range of topics, many of which dealt with the problem of inversion of observed field to conductive structure.

Magnetic anomalies (Land and Sea)

There is good progress in the project to produce a Magnetic Anomaly Map of North America by 1988. An IGRF must be removed to eliminate the core field, so that the work on new IGRF's is vital to the Anomaly Map project.

Paleomagnetism

There are major advances in three areas. The first is the study of secular variation through lake sediments. The second is work on metamorphic paleomagnetism by the combination of accurate geothermometry and thermal blocking theory with remanent magnetism. The third area is that of studies of continental accretion, in some cases involving numerous small blocks now incorporated in one continent, notably in western North America.

Rock Magnetism

There are interesting developments in this subject in several directions. Several groups are active in biomagnetism in honey bees, butterflies and dolphins' heads. Multiple magnetisation in many rocks continues to attract much study, and limestones are becoming significant for paleomagnetism. (Single-domain grains of pyrrohotite show interesting metastable effects.) Finally, interesting results are emerging on the dependence of thermoremanent magnetisations on cooling rate. This last development may be important for work on paleointensity of the geomagnetic field.

Lithosphere Programme

IAGA is keen to take a very active role in the proposed lithosphere programme and is glad that Professor Van der Voo will address this conference of delegates on this important new initiative.

History

The history division in IAGA is flourishing and the papers in this area presented at Edinburgh are of great interest not only historically but scientifically. There appears to be a strong development of interest in this field manifesting itself not only in the writing of articles but also production of books and films and scripts for radio broadcasts. This signifies a great public interest in the contribution that IAGA is making to an understanding of our total environment.

World Data Centres

IAGA scientists depend heavily upon the services provided by World Data Centres in their field and I wish to acknowledge on their behalf, their gratitude for these services and also to thank all those countries and scientists involved who participate in supplying data to the World Data Centres. Our science depends in some areas on the availability of long time series of data and for data sets of many parameters measured simultaneously in different regions of space or in the earth. IAGA is most interested in the problem of data management.

IAGA and the Developing Countries

IAGA continues to take an interest in the problem of strengthening its sciences in the developing countries and following initiatives taken at earlier IAGA meetings, the Workshop on Strengthening IAGA Sciences in the Developing Countries will be held here at Edinburgh on the evenings of August 10 and 14 with the view to producing a working document to help a committee of IAGA (to be established) to take further steps in this area.

IAGA's Relation to other ICSU bodies

The spheres of interest of IAGA and IAMAP are more and more overlapping, especially as concerns the stratosphere and mesosphere of the earth and the atmospheres of other planets. These sister organisations within IUGG are collaborating closely on symposia and projects of mutual interest. IAGA scientists contribute very heavily to the programmes within the Scientific Committee on Solar-Terrestrial Physics such as the Solar Maximum Year, the Middle Atmosphere Programme, the Data Analysis Phase of the IMS, Solar and Interplanetary Programmes and the relationship of solar variability and meteorology. In addition IAGA is collaborating with COSPAR in terms of the contents of their scientific meetings which are held in the odd years, 1981, 1983 etc. by IAGA and even years, 1982, 1984 etc. by COSPAR.

In recent times URSI has stated its objective of not running scientific meetings of straight geophysical nature and this has resulted in significant rationalisation of scientific meetings on the international scene. However many scientists continue to have joint interests in URSI and IAGA and IAGA for its part has been intent on avoiding clashes of meeting dates.

Conclusion

The IAGA scientific meetings and the opportunities of interaction which these create are continuing to fulfil important functions of communication in science beyond that achieved by publication. As emphasised by Sir Hermann Bondi in his opening address here at Edinburgh, these opportunities are perhaps the most important when all is said and done.

Acknowledgement: I am indebted to many colleagues within IAGA for help in the preparation of this report, expecially L. Burlaga, R.L. Dowden, H.B. Garrett, D.I. Gough, H. Rishbeth and C.T. Russell.

CLOSING CONFERENCE OF DELEGATES

August 15, 0900 - 1100, Appleton Tower Lecture Theatre 1

President Cole presided over the Closing Conference of Delegates. The quorum was satisfied for the Conference of Delegates. The agenda was circulated in advance through the Daily News, and the draft of the Resolutions was available the day before. The items on the agenda and the results of reports and discussions are summarized below.

1. Opening Remarks and Fixing of Agenda

After fixing the agenda, President Cole pointed out the following.
(1) National Reports : In order to publicize the availability of special publications summarizing the national activities in the field of IAGA science (including the addresses of the organizations and personnel involved in the work, and bibliography of recent work), it was recommended that such useful information be sent to the Secretary General for inclusion in the IAGA News and if possible also in the IUGG Chronicle.
(2) IAGA Statutes : The present IAGA statutes may need some polishing to clarify some expressions and therefore avoid future ambiguity. All member countries are asked to pay attention to this matter, in order to discuss any amendments which may arise at the next General Assembly in Hamburg in August 1983.
(3) Cooperation of IAGA with Other international organizations : President Cole mentioned the good cooperative relationship of IAGA with IAMAP, IASPEI within IUGG, and with URSI, COSPAR, SCOSTEP, SCAR etc. in the ICSU family.

2. Report of the Resolution Committee and Adoption of Resolutions

Vice President Dessler (in place of the chairman of the Resolutions Committee, D.J. Williams) reported on the work of the Resolutions Committee during the Edinburgh Assembly and presented the draft of 15 Resolutions. They were discussed one by one, and all of them were adopted; some were modified after the open discussion. [The Resolutions with final wording are shown elsewhere in this publication. The last Resolution of Thanks was deferred to Item 8 later.

3. Reports from the Executive Committee

(1) Approval of Honorary Members : President Cole reported on the creation of "Honorary Members of IAGA" for those who have given outstanding service to IAGA (see IAGA News No. 19, Page 12, issued in December 1980). Drs. L.R. Alldredge and J.O. Cardus (past General Secretaries) were recommended by the IAGA Executive Committee to be the new Honorary Members, in addition to the four past Presidents (Drs. J. Coulomb, V. Laursen, M. Nicolet and T. Nagata). This was approved by all Delegates with their acclamation.

(2) Appreciation of Special Services : President Cole referred to the excellent service given by Miss J.V. Lincoln for many years as the director of World Data Center A for Solar-Terrestrial Physics. On the occasion of her retirement, the participants expressed their thanks to her by warm applause.

(3) Logo Competition Results : President Cole explained that he had

been given the power to select the winner for the new IAGA logo competition, but that it was impossible to reach a conclusion during this Edinburgh Assembly. Hence he proposed postponement of the final decision until the 1983 Hamburg Assembly, allowing modifications to the submitted entries and also new entries. [Remark: President Cole did not mention the reason behind his difficulty in selecting "one only" from the contributions of 10 designers. He heard a lot of opinions regarding the designs but they did not correspond. Some designs were very good and liked but even these had some points to be remedied to symbolize *geomagnetism* and *aeronomy* more explicitly.]

4. Celebration of the First and Second International Polar Years and International Geophysical Year

There are a number of plans in 1982-83 in IAGA/IUGG member countries for the celebration of the 100-year anniversary of the First Polar Year 1882-83, the 50-year anniversary of the Second Polar Year 1932-33, and the 25-year from the International Geophysical Year 1957-58. It was recommended that such information be compiled for the IAGA News, and the cooperation of member countries in providing information was solicited. Troitskaya (USSR) introduced a Soviet plan to make a 1 hour film, including the contributions of other countries. Dooley (Australia) drew attention to the Fourth International Symposium on Antarctic Earth Sciences (16-20 August 1982, at the University of Adelaide, South Australia, sponsored by SCAR, IUGS, etc.). Barsczus (France) pointed out that the Hamburg Assembly in 1983 will be a good chance to celebrate the ∿150 year of the "Magnetischer Verein" of C.F. Gauss as well as the ∿100 year of the first "World Magnetic Survey", organized by the French "Bureau de Longitudes" through the "Service Hydrographique de la Marine", which had sent out parties to South America, Africa and the Pacific, and even established temporaty magnetic observatories.

5. Results of Workshop on Strengthening IAGA Sciences in Developing Countries.

President Cole summarized the results from the successful meetings of this Workshop on the evenings of 10 and 14 August. The four major topics (education, research, institutional networks and individual initiatives) were discussed extensively in four groups, and the reports will be summarized later in the proceedings. It was announced that an Ad Hoc Committee (consisting of 2 representatives each from Africa, Central and South America, Asia; 1 each from USSR, UK, USA; 2 ex-officio members) was formed, and this committee would work out the outline of terms of reference as early as possible by correspondence.

6. Positive Steps from IAGA Scientists in Relation to WDC's

Since WDC's are very important and useful to all the IAGA community, Prsident Cole urged IAGA colleagues to justify our need for WDC's and to help WDC's to maintain their activities.

7. Future Assemblies in 1983 and 1985

The next IAGA Assembly is the XVIII General Assembly in connection with the General Assembly of IUGG, scheduled during 15-27 August 1983 in Hamburgh in the Federal Republic of Germany. As to the Fifth

Scientific Assembly of IAGA in 1985, the invitation from Czechoslovakia was accepted by this Conference of Delegates with Acclamation. The date for the 1985 Assembly is to be discussed in the near future.

8. Thanks to the Local Organizing Committee

President Cole expressed his sincere thanks, on behalf of all the participants of this Assembly, to the Local Organizing Committee, for the excellent preparations and arrangements (including entertainment) made for this successful Fourth Scientific Assembly of IAGA in Edinburgh, Scotland. His speech was followed by long acclamation from all the attendants of the Final Conference of Delegates.

MINUTES OF THE IAGA EXECTIVE COMMITTEE MEETINGS

Edinburgh, Scotland, U.K.

August 1981

The IAGA Executive Committee (hereafter abbreviated to EC) Meetings were held before and during the Fourth Scientific Assembly in Edinburgh, Scotland, U.K. The meetings were held in a room in the Appleton Tower of the University of Edinburgh in the afternoon (14 - 18h) of 2 August and the lunch hours of 3, 4, 5, 6, 10, 11, 12 and 14 August. The Meetings on 3 and 10 August were with the Leaders of IAGA Divisions and Interdivisional Bodies, and the meeting on 14 August was with IAMAP representatives. All EC members were present but C.-G. Fälthammar had to miss the second week. The meetings were arranged with great efficiency by M. Gadsden with the support of the Local Organizing Committee. The following is a summary of discussions and conclusions reached during the EC meetings, without keeping to chronological order. The minutes of the meetings with the leaders of IAGA Divisions and Interdivisional Bodies and the IAMAP representatives are given separately.

I. Approval of the Agenda

It was agreed to follow the agenda proposed by Secretary General Fukushima, and some additional material for discussion was distributed at the meeting.

II. Minutes of the Previous Meeting, and Matters Arising from the Minutes

The minutes of the previous EC meeting (in Galveston, Texas, U.S.A., 22 - 24 October 1980) have been published in the IAGA News No. 19, pp. 10-22 (issued in December 1980). These minutes were approved. Some matters arising from the minutes were discussed under the appropriate items in the following minutes.

III. Reports on the IUGG Executive Committee Meeting, Including Information on the XVIII General Assembly of IUGG, Hamburg, August 1983.

President Cole and Secretary General Fukushima attended the IUGG Executive Committee Meeting held on 25 - 26 July 1981, in the University of Western Ontario, London, Canada, during the IASPEI Assembly. They presented a summary report of the activity of IAGA since the XVII IUGG Assembly (Canberra, December 1979) along with IAGA's wish for the IUGG Interdisciplinary Symposia at the XVIII General Assembly in Hamburg in August 1983.

The report covered the following items: IAGA publications, IAGA Finance in 1979 and 1980, Workshop on Electromagnetic Induction in the Earth and Moon, IAGA's attitude on IAGA/URSI Joint Working Groups, IAGA representation to the SCAR Working Group on Upper Atmosphere Physics, preparations for the Fifth International Symposium on Solar-Terrestrial Physics, IAGA cosponsorship to COSPAR symposia in 1982, and an outline of the IAGA Edinburgh Assembly.

Plans for the IUGG Interdisciplinary Symposia for the 1983 IUGG General Assembly were introduced and it was decided that they should be shown to the leaders of IAGA Divisions and Interdivisional Bodies in order for account to be taken during the discussion of the IAGA sessions of the next Hamburg Assembly.

The conclusions reached by the IUGG Finance Committee on the possible reduction to Association allocations in the coming two years were also reported. President Cole was authorized to write a letter to the IUGG President regarding the financial situation.

IV. Preparations for the IAGA Edinburgh Assembly and the Conference of Delegates

Secretary General Fukushima reported first on the admirable preparatory arrangements made by the Local Organizing Committee, including the publication of the Program-Abstracts booklet (614 pages, containing more than 1000 abstracts). He also mentioned that the IUGG Bureau representative at the IAGA Edinburgh Assembly was Prof. A.A. Ashour.

President Cole reported that Prof. M. Nicolet was unable to attend the Edinburgh Assembly, therefore his celebratory lecture on International Polar and Geophysical Years scheduled for the First Conference of Delegates had to be cancelled. However, Professor Nicolet will give such a talk as one of the IUGG Lectures at the 1983 IUGG General Assembly.

President Cole reported on his efforts since the last EC meeting for the Workshop on "Strengthening IAGA Sciences in Developing Countries", meetings are scheduled for the evenings of 10 and 14 August during the Edinburgh Assembly.

President Cole explained that the U.K. National Committee for IAGA agreed to postpone its proposal on the amendment of the present IAGA Statutes until the next General Assembly. He mentioned however the need to clarify some expressions in the Statutes to avoid possible ambiguity. Since only member countries are entitled to propose any change in the Statutes, it was agreed to ask the National Committees of IAGA member countries to pay attention to this problem.

It was agreed to report to the First Conference of Delegates the names of the Resolutions Committee (chairman: D.J. Williams; members: M.L. Chanin, B.A. Hobbs, A. Nishida and O.M. Raspopov) and the new Chairman of IAGA Division IV, L.F. Burlaga, and a new co-chairman F.M. Neubauer. A Preliminary invitation from the Czechoslovak National Committee for the IAGA 1985 Scientific Assembly was also to be presented to the First Conference of Delegates.

V. Review of the Activities of IAGA Internal Bodies

The EC noted with satisfaction the activities of all IAGA Divisions and Interdivisional Bodies under the new leaders elected at the Canberra Assembly. Detailed discussions were deferred until the meetings with these leaders (on 4 and 10 August).

VI. Liaison with IAGA National Bodies of Member Countries

Secretary General Fukushima reported that he contacts the IAGA National Correspondents (and Local Correspondents also) usually on a quarter-yearly basis, and he is very grateful to them for their cooperation in disseminating and collecting important information and also in updating the list of IAGA News recipients. The list of IAGA National Correspondents is revised every year and published in the IAGA News.

VII. Cooperation of IAGA with Other Associations or Inter-Association Bodies within IUGG

It was agreed to ask the Joint IAGA/IAMAP Advisory Board to continue their efforts towards future cooperation between IAGA and IAMAP. The approach of the Division I chairman to IASPEI regarding their participation in the study of electrical properties of the asthenosphere by means of input from seismologists and others working on physics of the upper mentle, heat flow etc. was noted with approval.

It was noted that IAGA had very effective joint assemblies with IASPEI in 1969 and with IAMAP in 1977. It was agreed that such joint assemblies could possibly occur again in the future. In the meantime, IAGA will use the opprtunity of the IUGG General Assembly to strengthen the close cooperation with sister associations of IUGG.

VIII. Cooperation of IAGA with URSI, COSPAR, SCOSTEP, IGL and other ICSU Bodies

URSI: There is a proposal for fusion of Commissions G (Ionospheric Radio and Propagation) and H (Waves in Plasmas) in the agenda of the URSI Council Meeting during the XX General Assembly of URSI. IAGA's attitude has been to support the Joint URSI/IAGA Working Groups (Structure and Dynamics of the Thermosphere, Ionosphere and Exosphere; Neutral and Ion Chemistry and Solar Fluxes; Passive Electromagnetic Probing of the Magnetosphere; Wave Instabilities in Space Plasmas) for as long as URSI wishes. The EC noted some strong support of JWG members for continuation for some JWG's, and now awaits the recommendation from URSI*. If URSI is going to

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* It was later known that the General Assembly of URSI recommended the continuation of URSI/IAGA Joint Working Groups on "Wave Instabilities in Space Plasmas" (with URSI Commissions G and H) and "Passive Electromagnetic Probing of the Magnetosphere" (with URSI Commission H).

entrust "geophysical research" to IAGA, IAGA would take over the work of the above JWGs in some way in the IAGA internal structure. It was recommended that the President write a letter to URSI to avoid the future clash of meetings, even though the next possible one will not be until 1987 (IUGG) or 1993 (IAGA).

COSPAR: Fukushima reported that IAGA failed to obtain the official cosponsorship of COSPAR to two sessions of the IAGA Edinburgh Assembly (i.e. the Special Symposium on Saturn and the session on Dynamics of the Thermosphere and Exospheres of the Earth and Planets), due to the lack of time needed for advance negotiation. The meetings were nevertheless organized satisfactorily.
As to the COSPAR's wish for IAGA cosponsorship of the Workshop on Comparison of Data with CIRA and Proposed Revisions, the EC decided to ask for the advice of the Division II chairman for the nomination of the IAGA representative (see also item IX).

SCOSTEP: President Cole explained some recent affairs of SCOSTEP (i.e., the change in the SCOSTEP Secretariat, the adoption of a new constitution, MAP activity, etc.). He explained the need for a change in IAGA representation in the SCOSTEP Bureau. It was agreed to recommend T. Obayashi (Japan) to replace J.G. Roederer (U.S.A.) at the end of the coming SCOSTEP General Meeting in Ottawa in May 1982. Roederer reported that the program of the Fifth International Symposium on Solar-Terrestrial Physics (scheduled for 17 - 22 May 1982, Ottawa) is ready for announcement, and he appreciated the cooperation of the IAGA representatives on the Program Committee.

ICL: It was reported that the IAGA Division I is trying to contribute as much as possible to the new international project "Dynamics and Evolution of the Lithosphere" which is now being conducted by the IUGG-IUGS Inter-Union Commission on the Lithosphere.

SCAR: Prof. T. Nagata (IUGG representative to SCAR) brought up the need for nomination of an IAGA representative to the SCAR Working Group on Upper Atmosphere Physics; the EC agreed to the nomination of Prof. T. Hirasawa (National Institute of Polar Research, Tokyo, Japan). The importance of IAGA's active participation in the SCAR Upper Atmosphere Physics Working Group was discussed, including ways of setting up more communication between SCAR and IAGA. It was suggested that perhaps a number of nominations for an IAGA representative to this group should be made and then the person considered to be the most active chosen. It was felt that a review of the science and planning should be initiated by IAGA and liaison set up with SCAR. Troitskaya volunteered to look into this problem, including means of getting money for support. Cole stated he would contact Prof. G.A. Knox in New Zealand on this matter. He felt that some progress toward organization and activities of the SCARUP should be made by the time of the Hamburg Assembly and asked everyone to give it some thought; in the meantime IAGA will give full support to Prof. T. Hirasawa .

IX. IAGA Cosponsorship of International Conferences

It was reported that the following meetings were held during January 1980 - July 1981, with IAGA cosponsorship.

COSPAR Symposium on Progress in Planetary Exploration
(Budapest, 2 - 4 June 1980)

COSPAR Symposium on Cosmic Rays in the Heliosphere
(Budapest, 3 - 4 June 1980)
COSPAR Symposium on Active Experiments in Space Plasmas
(Budapest, 11 - 13 June 1980)
Sixth International Symposium on Equatorial Aeronomy
(Puerto Rico, 17 - 24 July 1980)
International Symposium on Middle Atmosphere Dynamics and Transport
(Urbana, Illinois, U.S.A., 24 July - 1 August 1980)
Fifth Workshop on Electromagnetic Induction in the Earth and Moon
(Istanbul, 17 - 24 August 1980)

The proceedings of the above three COSPAR symposia were recently published by the Pergamon Press. Brief reports of the last three meetings have already been published in the IAGA News No. 19 (issued in December 1980).

Although the Workshop on Latin American Geomagnetic Observatory and Survey Practice was scheduled on 20 - 26 July 1980, in Rio de Janeiro (to which IAGA had given cosponsorship at the Canberra Assembly), this was cancelled due to financial difficulties.

The IAGA Working Group I-3 plans to hold its Sixth Workshop on Electromagnetic Induction in the Earth and Moon in Livermore, California, U.S.A., during 15 - 22 August 1982. It was agreed to ask IUGG for cosponsorship and financial support as in the previous meetings of this series.

According to the proposal from COSPAR, the EC agreed with cosponsorship of the Workshop on Comparison of Data with CIRA and Proposed Revisions (24 - 26 May 1982 during XXIV COSPAR Meeting), and it was decided to ask Prof. K. Hirao (Institute of Space and Astronautical Science, Tokyo, Japan) to be the IAGA representative on the Program Committee of this workshop, on the advice of IAGA Division II chairman Rishbeth.

X. IAGA Publications

IAGA Bulletin: No. 44 "Transactions of the XVII IAGA General Assembly in Canberra, Australia, December 1979" appeared in December 1980. No. 45 is the "Programme and Abstracts of the Fourth Scientific Assembly of IAGA, Edinburgh, Scotland, August 1981". No. 46 will be the "Transactions of the Fourth Scientific Assembly of IAGA, Edinburgh, Scotland, August, 1981". The IAGA Bulletin No. 32j "Geomagnetic Data 1979" appeared recently. It was also reported that the Bulletin 32-series will be published in the future despite the possible retirement of Dr. D. van Sabben as the Director of the International Service of Geomagnetic Indices in De Bilt, Netherlands.

IAGA News: No. 19 was published in December 1980. No. 20 will be published at the end of 1981, and this issue will contain a quick report on the IAGA Edinburgh Assembly and advance information on the 1983 IUGG/IAGA Hamburg Assembly.

XI. IAGA Finance

Fukushima reported that the Financial Report for 1980 (March-December 1980, shown in Appendix I, because the previous report was January 1979-February 1980) was sent to the IUGG Treasurer with the remarks concerning the great difference between the 1979 and 1980 reports. He explained that

all sales of publications had been reported in 1979; that only one entry of interest had been reported in 1980, whereas three appeared in 1979; that there were two IAGA News publications in 1980 as well as the Transactions of the Canberra Assembly, whereas no expenditure for publications in 1979; and so forth.

It was reported that the allocation from IUGG would be reduced by $5,000 for each of the next two years and ways to compensate for this loss were discussed. It was noted that IAGA's reserves should not fall below the level of one year's operation, that an equitable way for IUGG to make allocations to the various Associations would be to take into account their reserves. The President was asked to write to the Chairman of the IUGG Finance Committee to explain that IAGA had built up its reserves over the past years in anticipation of the Canberra Assembly but that now the reserves are at the proper one-year level.

Discussion was held on how to cut the costs of publications. One suggestion was to have smaller issues of IAGA News by discontinuing the short scientific articles and restrict the contents to results of Working Groups and general information of interest to the IAGA community.

XII. Resolutions of the Edinburgh Assembly

D.J. Williams (chairman of the Resolutions Committee) presented 16 resolutions received from the IAGA Divisions and Interdivisional Bodies and polished by the Resolutions Committee. All of these were approved, with some wording changes, with the exception that dealing with the overlapping of IAGA and URSI conference dates. It was decided that instead of a resolution the President should write an open letter to URSI expressing IAGA's concern over this unfortunate circumstance. This action is to be mentioned at the final Conference of Delegates. Vice President Dessler was asked to present the Resolutions to the final Conference of Delegates because of Williams' absence on that day. Williams was asked to prepare a note of appreciation to the Royal Societies of London and Edinburgh and the Local Organizing Committee for hosting this Fourth Scientific Assembly of IAGA.

XIII. Other Items

Logo of IAGA: Fukushima reported that 10 designers contributed to the contest for a new IAGA logo. The EC agreed to give the President the power to select the winner. [The result is described in the minutes of the Conference of Delegates: the final decision is to be postponed to the 1983 Hamburg Assembly for possible modification of the proposed ones and new entries].

Honorary Members of IAGA: Drs. L.R. Alldredge and J.O. Cardus were unanimously recommended to be the new Honorary Members, in addition to the four past Presidents (Drs. J. Coulomb, V. Laursen, M. Nicolet and T. Nagata). This designation was to be reported to the Final Conference of Delegates.

Next Meeting of the IAGA EC: It was agreed to hold the next EC meeting in connection with the 1982 COSPAR Meeting in Ottawa, Canada, i.e. on 16 May 1982 (Sunday, all day) and the evening of some following days.

Appendix I.

INTERNATIONAL ASSOCIATION OF GEOMAGNETISM AND AERONOMY

Financial Report for the Year 1980 (Mar. 1 - Dec. 31, 1980)

FORM 2

Amounts in USA dollars Exchange rate .....

RECEIPTS	IUGG	GRANTS & CONTRACTS
15. IUGG ALLOCATION	24,700.00	x
2. UNESCO GRANTS	x	0
3. OTHER GRANTS	x	0
4. CONTRACTS WITH UNESCO, etc.	x	0
5. SALES OF PUBLICATIONS	0	x
6. MISCELLANEOUS	283.43	x
7. TOTAL RECEIPTS	24,983.43	0
8. CASH ON HAND AND IN BANKS Mar. 1, 1980	25,190.19	0
9. INVESTMENTS & RESERVES Mar. 1, 1980	0	0
10. TOTAL	50,173.62	0

EXPENDITURE	IUGG	GRANTS & CONTRACTS
11. ADMINISTRATION	3,583.22	x
12. PUBLICATIONS	15,166.02	0
13. ASSEMBLIES	2,595.00	0
14. SYMPOSIA & SCIENTIFIC MEETINGS	9,680.55	0
16. GRANTS (Permanent Services, etc.)	0	0
17. CONTRACTS WITH UNESCO, etc.	0	0
18. MISCELLANEOUS	82.23	0
19. TOTAL EXPENDITURE	31,107.02	0
20. CASH ON HAND AND IN BANKS Dec. 31, 1980	19,066.60	0
21. INVESTMENTS & RESERVES Dec. 31, 1980	0	0
22. TOTAL	50,173.62	0

	Mar. 1, 1980		Dec. 31, 1980	
23. ACCOUNTS RECEIVABLE	0	0	0	0
24. ACCOUNTS PAYABLE	0	0	0	0

Breakdown of Item 6

Interest	283.43

Breakdown of Item 11

11.1 Personnel	1,200.00
11.2 Quarters	0
11.3 Supplies & Equipment	457.07
11.4 Communications	1,834.43
11.5 Travel (admin. only)	0
11.6 Miscellaneous	91.72
	3,583.22

Breakdown of Item 12

12.1 Transactions of the Canberra Assembly	6,774.78
12.2 Proceedings of Symposia	0
12.3 Periodicals: IAGA News No.18	3,233.54
IAGA News No.19	5,157.70
	15,166.02

Breakdown of Item 13

13.1 Organization	0	
13.2 Travel	2,595.00	

Breakdown of Item 14

14.1 Organization	3,912.68	
14.2 Travel	5,767.87	
		9,680.55

Date: 24 February 1981

N. Fukushima

N. Fukushima
Secretary General, IAGA

MINUTES OF THE MEETINGS OF IAGA EXECUTIVE COMMITTEE AND CHAIRMEN OF IAGA DIVISIONS AND INTERDIVISIONAL BODIES

3 August 1981 (1200 - 1400h)

Present: H. Rishbeth, G. Rostoker, C.G. Sucksdorff, H.B. Garrett, S.R.C. Malin and all EC members

A provisional list of proposed IUGG Interdisciplinary Symposia for the 1983 Hamburg Assembly was distributed and explained by Cole. Chairmen of IAGA Divisions and Interdivisional Bodies were asked to discuss this list at their Business Meetings and to suggest names of conveners or co-conveners for these IUGG Interdisciplinary Symposia which are the concern of IAGA. Troitskaya recommended approaching the co-sponsoring Associations with the suggested names of co-conveners. It was also requested that the IAGA convener names be reported to the Secretary General immediately after the Business Meeting, possibly with a short description defining their ideas concerning the symposia so that guidelines can be set up. Fukushima promised to distribute by noon of 4 August more detailed information on the availability of time slots during the 1983 IUGG Assembly. It was recommended not to plan too many sessions for Hamburg, in order to avoid clash between IUGG symposia and IAGA sessions.

As to the Resolutions, it was decided that the draft must be in the hands of D.J. Williams by Friday (7 August).

It was remarked that good geographical coverage as well as good scientists should be considered when selecting officers at the next General Assembly in 1983. Any ideas on the IAGA internal structure modifications, long-term goals, and what IAGA must do, should be turned in to the President.

10 August 1981 (1200 - 1400h)

Present: D.I. Gough, H. Rishbeth, M.H. Rees, A. Nishida, C.G. Sucksdorff, H.B. Garrett, T. Hirasawa, L.R. Megill, J. Taubenheim, S.R.C. Malin and all EC members except C.-G. Fälthammar

This meeting was devoted to exchange information on the outcome of the Business Meetings of IAGA Divisions and Interdivisional Bodies. Each Chairman reported on the draft of Resolutions, discussion and outcome regarding the sessions for the IAGA part of the 1983 IUGG Hamburg Assembly, and other important discussions. The Resolutions are shown elsewhere in this publication and the proposed IAGA sessions are listed later. Based on the comments and questions on the thrust of some IUGG Interdisciplinary Symposia, the Secretary General stated that he would write a summary of these comments and questions for the IUGG Executive Committee in order to avoid any ambiguities. Apart from the Resolutions and the 1983 scientific topics, the following information was introduced.

Two recommendations were presented from Division I: 1) that IAGA take appropriate action, in consultation with IASPEI, to replace the existing Ad Hoc Committee on the ELAS Project with an ELAS Committee, with a membership determined jointly by IAGA and IASPEI, and the support of IUGG be sought for the establishment of that Committee at the IUGG General Assembly in 1983 (Gough recommends U. Schmucker to be the chairman of this Committee); 2) that an informal Working Group be formed, consisting of no more than 3 representatives each from the IAGA Working Groups I-1, III-3 and V-5, to explore the possibility of providing a unified Geomagnetic Reference Field Model that would combine the fields due to the sources both inside the earth (excluding the lithosphere) and outside the earth (including the ionosphere and magnetosphere). Cole stated that there was already an Interdivisional Working Group on "Relations between External and Internal Magnetic Variations" and that it might be possible to expand the charter of that group to include the activity in the second recommendation. Gough said the suggestion had been made that Division I be subdivided because of the varied interests within the Division; however, no action was taken. As to the input from Division I for the Lithosphere Program, it would be handled by correspondence.

Division II feels there is no longer a need for the IAGA/URSI Joint Working Groups on "Structure and Dynamics of the Thermosphere, Ionosphere and Exosphere" and "Neutral and Ion Chemistry and Solar Fluxes"; however recommendations from URSI will be considered before any further action is taken. They feel the need to continue the Joint Working Group on Instabilities in Space Plasma.

Division V noted that it would be advantageous to have Working Group Meetings prior to Division Business Meetings (a similar comment was received by the Secretary General from Division III), and wondered if it would be possible to schedule a day for Working Group Meetings. It was felt that although it was a good idea, probably attendance would not be good enough to make it worthwhile. Cole suggested that business could be conducted partly by correspondence before meetings.

The Interdivisional Commission on History had been approached by the International Union of the History and the Philosophy of Science (IUHPS), Division of History of Science (DHS), to join them. It is felt that IAGA's group would provide input on "History of Space Physics" etc. Garrett asked for approval to do this and guidance in going about it etc. It was later recommended by the EC that the History Commission should go ahead and negotiate the possibility of forming a working group with IUHPS.

The Interdivisional Commission on the Middle Atmosphere questioned the separation of the "electrodynamics of the middle atmosphere" group within MAP from the group on the "electrodynamics of the upper atmosphere" within IAGA. The IAGA Working Group on UV Radiation in the Atmosphere should maintain close contact with the corresponding group in IAMAP. It was reaffirmed that the Interdivisional Commission on the Middle Atmosphere is IAGA's liaison with SCOSTEP/MAP.

MINUTES OF THE IAGA EXECUTIVE COMMITTEE WITH IAMAP REPRESENTATIVES

Date: August 14, 1981. 1230 - 1400

Present: S.A. Bowhill, J. London, L.R. Megill, J. Taubenheim, P.C. Simon, K.D. Cole, N. Fukushima, A.J. Dessler, M. Gadsden, J.G. Roederer, V. Bucha, V.A. Troitskaya, D.A. Valencio, D.J. Williams.

After a short welcome message, President Cole explained the status of the Interdivisional IUGG Symposia for the 1983 Hamburg Assembly, including the recommended titles, scope and conveners, which resulted from the business meetings of IAGA internal bodies. He also noted that IAGA wished to hold a symposium on "Cosmic Dust in Interplanetary Atmospheres" (which was proposed by IAGA but not adopted by an IUGG symposium) with IAMAP cosponsorship and input from COSPAR and IAU. London stated that IAMAP would be willing to support.

Cole noted that the principal interaction between IAMAP and IAGA concerned MAP and asked Bowhill to comment. Bowhill noted the differences between meteorologists and aeronomers and stated that a Workshop on Troposphere-Stratosphere coupling has been suggested; final plans will be discussed next week in Hamburg.

Megill spoke of IAGA/IAMAP relationship and noted that an IAGA Working Group on Electrodynamics of the Middle Atmosphere had been formed with H. Volland as co-chairman. Cole explained IAGA's strong feeling for the need of this Working Group and mentioned the possible cooperation of IAMAP on this topic to be arranged sometime in the future. Bowhill noted that there is a MAP Study Group on Electrodynamics of the Middle Atmosphere with H. Volland as Chairman and that they are concerned with the problems of the global electric circuits and indicated that this would be an area for IAGA/IAMAP coordination. The ground-based measurements of electric fields would also need the cooperation of IAGA and IAMAP. Bowhill also spoke of another subject of interest to both IAGA and IAMAP, i.e. circumpolar balloon flights in the Northern Hemisphere. He hoped that IAGA would take the initial steps to investigate this possibility and discover what scientific dividends might be gained.

Bucha noted that another STP Symposium would be an opportunity for coordination between some IAGA and IAMAP groups. It was mentioned that the SCOSTEP Committee on STP-Meteorology chaired by J.W. King, plans to meet next week and perhaps formulate plans for a symposium in 1982 in the U.S.S.R. Cole noted the desirability of joint IAGA/IAMAP Assembly in the future. Simon spoke of the UV Working Group and the difficulties of organizing two meetings on the same subject without overlapping material.

President Cole thanked IAMAP for its invitation to the IAMAP Assembly during the next two weeks in Hamburg but because of his inability to attend he asked P.C. Simon to represent IAGA at the IAMAP Hamburg Assembly. J. London kindly offered to convey the results of the discussion of this meeting to the IAMAP leaders next week.

REPORTS OF IAGA ORGANIZATIONAL UNITS

DIVISION I ON INTERNAL MAGNETIC FIELDS

Scientific Sessions at the Edinburgh Assembly

Thirteen sessions were sponsored by Division I. Working Group I-1 organized two sessions, one on "Scientific results from the MAGSAT missions: main field" (3 half-days) and another on "Mathematical modelling of the main geomagnetic field" (A.N. Pushkov memorial session, 2 half-days). WG I-2 held one session on "The magnetohydrodynamics of planetary interiors" (2 half-days). WG I-3 was responsible for three sessions, on "Electromagnetic induction studies in the oceans and their implications for sub-oceanic layers" (1 half-day), on "Audiofrequency magnetotellurics and crustal studies using ELF wave propagation" (1 half-day) and on "Regional electromagnetic induction studies" (3 half-days). WG I-4 held one session on "Physical parameters related to geomagnetic anomalies (permanent and time-dependent)" (2 half-days). WG I-5 organized three sessions, on "Time scales of geomagnetic secular variation" (2 half-days), on "Paleomagnetic aspects of the evolution of the Mediterranean and North Atlantic region" (2 half-days) and on "Magnetic reversal stratigraphy, including studies of polarity transition" (3 half-days). WG I-6 held three sessions, on "Properties of natural and synthetic titanomagnetites" (2 half-days), on "Physical and chemical processes of magnetic overprinting in relation to geological events" (2.5 half-days) and on "Effects of stress on the magnetic properties of rocks and minerals" (1.5 days).

All of the above sessions were well-attended and bore witness to the enthusiasm of the scientific communities involved. The organization of the sessions was superb, and the participants owe a debt of gratitude to the Organizing Committee. The above sessions of Division I could be arranged with minimal overlap of related sessions.

The conveners are named in the Programme and Abstracts book, which gives full details of the papers. The great majority of those listed in the Programme were given.

IAGA Scientific Sessions proposed for the IUGG Assembly in Hamburg

The Working Groups proposed seven Scientific Sessions for the Hamburg Assembly, and these were accepted by the Business Meeting of Division I on August 7, 1981, and transmitted to the IAGA Executive. They are:

From WG I-1: Mathematical modelling of the geomagnetic main field and secular variation, and its applications. Conveners: Barraclough and Mundt. 3 half-days.

From WG I-2: Origin of main fields and secular changes of the earth and planets. Convener: E.R. Benton.

From WG I-3: Electromagnetic studies of the Earth. Conveners: V. Haak and O. Praus. 3 half-days.

From WG I-4: The origin and significance of regional geomagnetic anomalies. Conveners: A.G. Hahn and P.J. Hood. 3 half-days.

From WG I-5: Megaplates and microplates. Conveners; D. Stone and A.N. Khramov. 3 half-days.
From WG I-6: Basic theory and experiments on the magnetic properties of oxides and sulphides. Conveners: S.K. Banerjee and V.S. Shcherbakov. 3 half-days.
From WG's I-5 and I-2: Palaeomagnetism and dynamo theory. Conveners: R. Merrill and D.J. Stevenson. 2 half-days.

Resolutions

Four proposed IAGA Resolutions were submitted to the Executive by the Business Meeting of Division I. They are:

Resolution 1 (from WG I-1) (Peddie/Barraclough)

IAGA, recognizing the continuing need for an International Geomagnetic Reference Field, recommends that:

1. IGRF 1980 be used for the interval 1980 to 1985.
2. DGRF 1965, DGRF 1970, and DGRF 1975 be used, with linear interpolation for applications requiring definitive values for the interval 1965 to 1975.
3. PGRF 1975 (i.e. DGRF 1975 and IGRF 1980 interpolated linearly) be used for the interval 1975 to 1980 until DGRF 1980 is produced.
4. This pattern be maintained in future updates.

Resolution 2 (from WG I-1 and WG I-4) (Peddie/Barraclough)

IAGA recognizing the usefulness of Magsat satellite vector magnetic data in defining IGRF 1980; noting the nonlinearity of secular variation; and further recognizing the value of such data in mapping intermediate-wavelength anomalies; attaches great importance to the acquisition of such data by magnatic satellites at an altitude less than 200 km; and resolves to give full support to the launching of such satellites at regular intervals.

Resolution 3 (from WG I-4) (Hood/Harrison)

IAGA, recognizing the great contributions that detailed aeromagnetic surveys would make in understanding the structure and geologic history of Antarctic and its surrounding oceanic areas, strong urges the acquisition of aeromagnetic data from those regions.

Resolution 4 (from WG I-5) (Briden/Barton)

IAGA, noting the need to extend our knowledge of the geomagnetic secular variation beyond the limited range of historical and observatory records, and recognizing the large increase during the past decade in secular variation records from a worldwide network of sites obtained from archaeomagnetic studies of sedimentary sequences, urges that a data bank be established and lodged at a World Data Centre to enable all workers to gain ready access to the available data.

Recommendations

Two recommendations were transmitted by Division I to the Executive Committee:

i) The following recommendation was moved by Dr. M. Zhdanov and seconded by Dr. B.A. Hobbs. It was carried with one dissentient.

Division I of IAGA, noting that the ELAS Project (Electrical Conductivity of the Asthenosphere) was launched in 1977 by Resolution of IAGA, for the study of the physical properties and lateral distribution of the asthenosphere, in the depth range 50 to 200 km, and that the asthenospheric layer is characterized by changes in electrical resistivity and seismic velocities, and recognizing that the necessary data acquisition and interpretation requires collaboration with seismologists and geothermal and mathematical geophysicists, recommends to the Executive Committee of IAGA that appropriate action be taken, in consultation with IASPEI, to replace the existing Ad Hoc Committee on the ELAS Project with an ELAS Committee with a membership determined jointly by IAGA and IASPEI, and that the support of IUGG be sought for the establishment of that Committee at the IUGG General Assembly in 1983.

ii) (Peddie/Olson). Division I recommends to the IAGA Executive that an informal Working Group be formed, consisting of no more than 3 representatives from each of the three Working Groups: I-1, II-5, and III-3, to explore the possibility of providing an unified Reference Field Model that would combine the fields due to sources both inside the Earth (excluding the lithosphere) and outside the Earth (including the ionosphere and magnetosphere).

Working Groups

All six WG's held well-attended Business Meetings during the Edinburgh Assembly. In every case, a lively discussion bore witness to active and productive work.

Two WG's changed officers. In WG I-2 Prof. I.A. Eltayeb was elected Chairman and Dr. D.E. Loper Vice-Chairman. In WG I-5 Prof. D.A. Valencio was elected Chairman and Dr. C.E. Barton Vice-Chairman.

MAGSAT had recently yielded data in the form of new estimates of the spherical harmonics of a reference field. WG I-1 devoted much of its Business Meeting at Edinburgh to the definition of a series of reference fields covering the period 1965 to 1980, with provision for adjustment to a definitive reference field (DGRF) after each five-year period from a current provisional reference field (PGRF) used during that period. The scheme is set out in Resolution 1 and the various reference fields will be given in forthcoming publications in geophysical journals.

During the last two years WG I-2 has organized three workshops on topics related to the thermal conditions, motions in the Earth's core and dynamo theory. Further details of these conferences, and of other developments in this field of science, are given in the Report of WG I-2.

WG I-3 has held its Fifth Workshop on Electromagnetic Induction in the Earth and Moon, at the University of Istanbul, in August 1980. Details will be found in the WG Report (Appendix A). The WG is also active in work on the ELAS Project on which further notes are given later in this Report. The Sixth Workshop on EM Induction will be held in Livermore, California, U.S.A. in August 1982 (the venue was later changed to Victoria, B.C., Canada).

WG I-4, in its work on Magnetic Anomalies on land and sea, is much concerned with the deduction from observations of the best possible IGRF: that is, the IGRF best representing the core field. Members of this WG therefore were active in the discussion of reference fields in WG I-1 and in related Sessions. WG I-4 is also involved in the compilation of the forthcoming magnetic anomaly map of North America, and in preparations for a similar map of Africa. At its Business Meeting this WG generated part of Resolution 2 above, and Resolution 3.

WG I-5 in the Sessions it organized in Edinburgh reflected the renewed activity of paleomagnetists in study of the geomagnetic field, its secular changes, reversals and excursions, as well as continuing work on motions and tectonic interactions of lithosphere blocks. A proposal, developed at the Business Meeting of this WG, resulted in Resolution 4 to support the creation of a bank of data from archeomagnetic and recent sediment studies to promote knowledge of the secular variation. Other topics discussed at the Business Meeting of WG I-5 may be found in the WG report.

WG I-6 both at its Sessions and its Business Meeting continued to show evidence of the activity of rock magnetists in relation to problems of magnetic overprinting which complicate contemporary paleomagnetic research. Other, older problems of single-domain and pseudo-single-domain magnetizations, physical and chemical processes of magnetization, and stress effects, continue to generate active work.

The ELAS Project

The study of the Electrical Conductivity of the Asthenosphere is approachable only through electromagnetic induction studies. Consequently the ELAS Project is of close concern to WG I-3. An Ad Hoc Committee on the ELAS Project was set up at the Canberra Assembly of 1979 under the chairmanship of Professor U. Schmucker, with Dr. L.L. Vanyan as Vice-Chairman, and has already gathered and disseminated a Report (attached as Appendix B) on related work in many parts of the world. At the Edinburgh Assembly Division I recommended to the Executive Committee of IAGA that this Ad Hoc Committee be replaced by an ELAS Committee with a membership determined jointly by IAGA and IASPEI. The new ELAS Committee would take office at the 1983 IUGG Assembly, provided the necessary support arises from IAGA, IASPEI and IUGG. The full Recommendation is given earlier in this Report. At the request of the Ad Hoc Committee I have already corresponded with Professor Bolt, President of IASPEI, and secured suggestions from him of suitable seismologists to be invited to the next Workshop of WG I-3, where ELAS will form part of the proceedings.

The International Lithosphere Project

Various Working Groups of Division I will certainly wish to interact with the Inter-Union Commission on the Lithosphere Project and with National Committees. I shall shortly write to the Chairmen of WG's inviting and making suggestions on the best ways for Division I, and IAGA as a whole, to become involved in this Project.

(D.I. Gough, Chairman of Division I)

WORKING GROUP I-1 ON ANALYSIS OF THE MAIN FIELD AND SECULAR VARIATIONS

The form of the next generation of IGRF was specified at the Canberra Assembly. Geomagnetic modelers were invited to propose models satisfying the requirements. Groups at the Institute of Geological Sciences (UK), the National Aeronautics and Space Administration (USA), and the U.S. Geological Survey responded by submitting models. All persons expressing interest in evaluating the models were given copies of them, and were invited to report their findings to the Working Group at the Edinburgh Assembly.

Business Meeting

The Working Group met on August 6, 1981 under chairman N.W. Peddie. Twenty-seven delegates, including six members of the Working Group, were present.

D.E. Winch, E. Dawson, F.S. Barker, R.L. Coles, R.A. Langel, D.R. Barraclough, and N.W. Peddie reported the results of their evaluations of the proposed models. About 14 nonmenber delegates were invited to participate in the decisions. After debating the merits of the proposed models, the electorate decided that the new IGRF would be defined as a weighted mean of the proposed models, the weights being chosen according to the apparent strengths and weaknesses of the proposed models.

The new IGRF consists of the following:

1. For 1980-85, an international geomagnetic reference field (IGRF 1980), consisting of a 10th degree and order spherical harmonic model of the main field at 1980 and an 8th degree and order secular variation model for extending the main field model up to 1985.

2. For 1965-75, a definitive international geomagnetic reference field, consisting of 10th degree and order spherical harmonic models of the main field at 1965 (DGRF 1965), 1970 (DGRF 1970), and 1975 (DGRF 1975), with linear interpolation specified for intervening dates.

3. For 1975-80, a provisional international geomagnetic reference field ("PGRF 1975"), defined as the linear interpolation of DGRF 1975 and IGRF 1980 (main field).

(N.W. Peddie, Chairman)

WORKING GROUP I-2 ON THEORY OF PLANETARY MAGNETIC FIELDS AND GEOMAGNETIC SECULAR VARIATION

This report spans the period between two general Assemblies of IAGA, those at Canberra in 1979 and Edinburgh in 1981. An account of the former has already appeared in IAGA News, as has a report on the activities of the Working Group in the two years perior to that meeting. During the Canberra assembly, Prof. I.A. Eltayed of the University of Khartoum took

over the duties of Vice Chairman from Dr. D. Gubbins of Cambridge University. At the Working Group meeting in Edinburgh (at which the attendance was 23), Prof. Eltayed succeeded Prof. P.H. Roberts of the University of Newcastle upon Tyne as Chairman, and Dr. D.E. Loper was voted Vice-Chairman.

The Working Group at Edinburgh welcomed a suggestion by Working Group I-5 to Co-sponsor a session on "Palaeomagnetism and Dynamo Tyeory" for the forthcoming Hamburg Assembly, and asked the Chairman of Division I to make a formal request for such a session. Dr. D.J. Stevenson from the California Institute of Technology agreed to be co-convenor, jointly with a co-convenor from WG I-5, if such a session were authorized.

The Group discussed at length what the principal thrust should be at Hamburg for the session usually sponsored by WG I-2 at IAGA assemblies. It was felt that, as usual, all papers should be wolcomed that threw light on magnetohydrodynamic processes in planetary cores, but (bearing in mind the possibility of a palaeomagnetic-cynamo theory session) the Working Group considered that the principal thrusts of their session should (because of the abundent satellite observations) be on the synthesis of core surface motions in the Earth, and on inferences about planetary magnetism. To bring out the second of these themes, the Group decided to recommend the Session be entitled "The Origin of the Main Fields and Secular Changes of Planets". Dr. E.R. Benton of the University of Colorado at Boulder accepted the nomination for Convenor. The Group felt two half-day sessions would be required at Hamburg, as in past Assemblies.

During the two years covered by this report there have been three international meetings of significance to Working Group members. Prof. H. Stiller organized a Workshop on 'Comparative Studies of Planetary Interiors' during the COSPAR General Assembly in Budapest (2-14 June, 1980). Drs. C. Jones and L. Knopoff ran a conference on 'The Thermal Regime of the Earth's Interior' at Lake Arrowhead, California (27 July - 4 August 1980). Drs. G. Barta and P.H. Roberts organized a COSPAR/EGS Workshop on 'Stellar and Planetary Magnetism' at Budapest during the EGS Congress (25-29 August 1980). Papers from the first of these were published in Advances in Space Research. EOS reported on the second. Proceedings of the third will appear in 1982 in a Gordon & Breach volume edited by Dr. A.M. Soward. A Pergamon book by F. Krause and K.-H. Radler on 'Mean Field Magnetohydrodynamics and Dynamo Theory' has also appeared recently. It nicely complements related books by Moffatt and by Parker that were mentioned in previous Working Group reports.

Of course, papers too numerous to mention here but of interest to Working Group members have appeared in the last two years. In an effort to provide a guide to recent literature, the Chairman of the Working Group initiated what is hoped will be a series of Newsletters. This contained information about registration for two of the conferences mentioned above- and a bibliography of Some 70 recent papers written mainly by Working Group members, who also received copies of the Newsletter. They were invited to keep the Chairman of the Working Group abreast of developments and publications that would be useful to Working Group members if circulated in later Newsletters.

The theoretical questions raised by the origin and behaviour of planetary magnetic fields are generally acknowledged to be difficult to answer, and progress has been slow. There is no doubt, however, about

the interest in these questions - the attendance at Session I-3 at Edinburgh was even better than at corresponding sessions at Grenoble, Seattle and Canberra - nor about the high level of scientific activity of the members of WG I-2. Sessions like I-3 serve a very useful role, and we are grateful to IAGA for their continued support and encouragement for this subject.

P.H. Roberts
(Chairman WG I-2, 1977-1981)

WORKING GROUP I-3 ON ELECTROMAGNETIC INDUCTION IN THE EARTH AND MOON

IAGA Working Group I-3 held its Fifth Workshop at the Department of Geophysics, University of Istanbul, August 17-24, 1980. The Workshop was co-sponsored by IUGG, IAGA and the Faculty of Earth Sciences, University of Istanbul. The Workshop programme focused on the following topics: Electrical properties of minerals and rocks in relation to crustal and upper mantle conditions; Geophysical prospecting with electromagnetic methods: Observational techniques on land and sea; Forward and inverse problems in electromagnetic studies; Electrical conductivity structure in the lower crust; Electromagnetic induction in the oceans; Time dependent transfer functions (Seismo-magnetic and vulcano-magnetic effects).

Electromagnetic field measurements made on the surface of the earth can in principle be used to determine conductivity within the Earth to a depth of a few hundred kilometres. To interpret these conductivity estimates data on the conductivity of specific rocks ar various temperatures and pressures are required. For studies of the crust and upper mantle this raises the vexed question of the electrical conductivity of basalt. It was well known that conductivity depends on composition, water content, chemical activity and of much importance, oxygen fungacity. At a time when laboratory experiments were isolating these effect and producing an abundance of conductivity relations with various parameters, the Workshop discussed new results related to the stability of the experiments with time. The results indicate that when kept at high temperatures for 2-3 weeks, a sample may change its conductivity by 3 orders of magnitude. Indeed in some cases, equilibrium may never have been reached. Clearly a reassessment of the previously published data is now necessary.

Before geological or structural interpretation can be made, the conductivity of the Earth has to be estimated from surface measurements. For electromagnetic methods, several significant advances in data acquisition of processing were reported. The established Magnetotelluric (MT) method (variation periods $1 - 10^4$ s) has now been enhanced by Audio-Magnetotellurics (AMT), (periods $10^{-4} - 1$ s) and many examples of the use of these techniques, together and separately, were presented. In this connection several groups reported development of their in-field data processing capabilities. In general these provided for data acquisition and processing and in some cases inverted the data to ptoduce conductivity estimates. The advantages of the system are that data quality is readily

determined and that informed decisions on further measurements can be made on site. In the MT method impedance tensor elements required for interpretation are generally deter-ined from auto and cross power spectra of orthogonal components of magnetic and electric field variations. The noise power in these spectra can lead to erroneous impedance tensor estimates. The recently introduced Remote Reference method makes use of observations at a site distant from the field investigation to reduce the noise power and improve the auto and cross power estimates. The importance of the technique was demonstrated by several applications. It was noted that Squid magnetometers reduced instrumental noise to an extremely low level and that any further enhancement of the signal/noise ratio must stem from further studies of source characteristics and global induction models.

Between data acquisition and geological interpretation lies the stage of conductivity modelling of processed data. This modelling is traditionally accomplished by forward or inverse procedures. No major new theoretical ideas were presented at the Workshop but the results of an enterprising study COPROD were made available and discu-sed at length. In this study the same processed data had been supplied to a number of research groups and 9 independently produced conductivity models using their normal, but individual, methods. A highly conducting layer was apparent and was reasonably consistent amongst the models, but other parameters varied quite widely. There is a clear need for further studies of this nature and for caution in individual interpretations. The results of a number of MT investigations around the world indicated the variability of the electrical conductivity of the lower crust. A controversial topic in this connection is the concept of current channeling whereby induction need no longer be considered solely on a local basis, but may have a regional component stemming from a global system of currents, part of which flow through the local region. The regional current gives rise to derived quantities (transfer functions) independent of frequency in agreement with observations. However, others will argue that these observations can be explained by local induction alone. Further observational and theoretical studies were made of induction in the oceans, and it was noted that no MT investigations of mide-oceanic ridges were reported.

The time-dependence of transfer functions was discussed with a view to earthquake prediction and tectonic activity. Clearly noise reduction, in the manner suggested above, is necessary in order to provide sufficient accuracy of the transfer functions for significant time variations to be observed. Even then it was felt that a close cooperation with other disciplines of the solid earth sciences was the way forward. Earthquake prediction was further discussed at a special session in which geophysicists from Turkey detailed their methods applied to the Anatolian fracture zone and to Southern Europe. More generally, in global tectonics the asthenosphere represents that boundary on which move the lithospheric plates. The determination of its characteristics is of great importance in the tectonic history and recent activity of the Earth. The special IAGA project for this research, named ELAS (Electrical conductivity of the Asthenosphere, IAGA resolution No.6, Seattle 1977) also formed part of the Workshop and aspects of international co-ordination were discussed.

The Sixth Workshop will be held in Livermore, California, U.S.A. at the end of August, 1982. (Remark: The venue was later changed to Victoria, B.C., Canada).

(A. Adam, B.A. Hobbs)

WORKING GROUP I-4 ON MAGNETIC ANOMALIES (LAND AND SEA)

The IAGA Working Group I-4 met on the evening of Thursday, 6 August, during the Edinburgh Assembly. At this business meeting, the Working Group decided to submit draft resolutions on (1) the usefulness of MAGSAT data and the future need of such low-altitude magnetic survey satellites, and (2) the need of the detailed aeromagnetic surveys in the Antarctic and surrounding oceans. [These were adopted as IAGA Edinburgh Resolutions Nos. 15 and 12, respectively, at the Closing Conference of Delegates.]

Another matter discussed at the business meeting was the selection of the scientific session during the next Hamburg Assembly. It was decided to recommend "The Origin and Significance of Regional Geomagnetic Anomalies", possibly for 3 half-days, with the conveners being A.G. Hahn and P.J. Hood.

In the past two years, since the Canberra Assembly, the Working Group members have concentrated their efforts on the compilation of magnetic anomaly maps for various regions of the world. Since the accuracy of these maps depends on the utilization of an accurate reference field, the IGRF has been a great concern for the Working Group members, and we appreciated very much the work of WG I-1, which proposed the IGRF 1980, taking the recent MAGSAT observations into account. WG I-4 was responsible for arranging the session on "Physical Parameters Related to Geomagnetic Anomalies (Permanent and Time-Dependent)" which was convened to discuss problems such as the theoretical and practical aspects of the geophysical and geological interpretation of geomagnetic anomalies; the correlation between magnetic anomalies and other geophysical, geodetic or geological parameters; and local and regional secular variation anomalies in tectonically active zones. The Working Group members contributed also to some other sessions of the Edinburgh Assembly, such as "Scientific Results from the MAGSAT Mission".

(P.J. Hood, Vice-Chairman)

WORKING GROUP I-5 ON PALAEOMAGNETISM

1. Sessions on the 4th IAGA Scientific Assembly

The WG organized four scientific sessions on aspects of palaeomagnetism which attracted a very large numbers of scientists. 121 papers were submitted, representing 40% of the total contribution to Division I. The title of these sessions were

i. Time scale of geomagnetic secular variation
ii. Palaeomagnetic aspects of the evolution of the Mediterranean and North Atlantic region
iii. Magnetic reversal stratigraphy, including studies of polarity transitions
iv. Physical and chemical processes of magnetic overprinting in relation to geological events (supporting WG I-6)

2. Business meeting

WG I-5 held its business meeting in the J.C. Maxwell Building on 4 August. Seventy-nine scientists attended.

- It was agreed to circulate a letter to all the palaeomagnetic laboratories and equipment manufacturers with a view to improving communication between each other. Scientists were invited to send to the WG chairman any complaints and fevourable opinions regarding commercial palaeomagnetic equipment.
- A resolution to establish an archaeomagnetic and palaeomagnetic data bank for geomagnetic secular variation records was approved and submitted to the Chairman of Division I.
- D.A. Valencio was confirmed as Chairman and C.E. Barton was elected Vice Chairman of the WG.
- It was agreed to circulate a notice concerning the University of Hawai project for compiling a computerized bibliography of palaeomagnetism and geomagnetism. The notice will be published in the next IAGA News.
- Two symposia were approved for the IUGG Assembly in Hamburg, 1983:

i. Palaeomagnetism and dynamo theory; Convenors: R. Merrill and D. Stevenson (two half-day sessions).
ii. Magaplates and microplates; Convenors: D. Stone and A.N. Khramov (three half-day sessions).

(D.A. Valencio, C.E. Barton)

WORKING GROUP I-6 ON ROCK MAGNETISM

The IAGA Working Group I-6 held its business meeting in the James Clark Maxwell Building on the evening of Tuesday, 4 August, jointly with WG I-5 on Palaeomagnetism. The joint meeting was very effective because of common subjects on palaeomagnetism and rock magnetism. At this meeting, the topics for the next Hamburg Assembly were discussed, and WG I-6 decided to propose a session on "Basic Theory and Experiments on the Magnetic Properties of Oxides and Sulphides" for 3 half-days, if possible, with the conveners being S.K. Banerjee and V.P. Shcherbakov.

In the past two years, since the Canberra Assembly, WG I-6 members have contributed to the basic study of rock magnetism and its implications. Results were presented during the Edinburgh Assembly to the three specified sessions organized by the Working Group, i.e. "Properties of Natural and Synthetic Titanomagetites" (12 August), "Physical and Chemical Processes of Magnetic Overprinting in Relation to Geological Events" (4-5 August), and "Effects of Stress on the Magnetic Properties of Rocks and Minerals" (5 August). Each of these three sessions was successful and well attended. A number of new important experimental results were introduced at these scientific sessions.

(D.J. Dunlop, Chairman)

DIVISION II ON AERONOMIC PHENOMENA

The Business Meeting of IAGA Division II during the Edinburgh Assembly was held on 4 August 1981, from 1600-1730.

The Chairman reported that the proceedings of the previous meeting, held in Canberra on 4 December 1979, had been published in IAGA Bulletin No.44 and circulated.

Joint Working Groups with URSI

The Chairman recalled that there were two groups involving Division II, namely "Structure and Dynamics of the Thermosphere, Ionosphere and Exosphere" (SD), Chairman J.V. Evans, and "Neutral and Ion Chemistry and Solar Fluxes" (NI), Chairman L. Thomas. Both groups had met at Canberra in December 1979, but there had not appeared to be any compelling reason to continue the groups in being after August 1981. Neither Chairman wished to continue. The NI Chairman had written that he considered that group to be more of value to URSI than to IAGA, since in view of URSI's declared intention of withdrawing from 'geophysical' activities the group could, in principle, provide to URSI the scientific input needed for URSI's 'communications' interests. The meeting noted that the Secretary General of IAGA had suggested that IAGA should leave to URSI the decision on the future of the SD and NI groups (which were subsequently disbanded).

Division II Structure

The Chairman reviewed the present structure comprising nine 'topics'; each with three reporters, but no purely Division II working groups. After discussion, it was agreed that Topic II-9 should include the aeronomy of comets as well as planets. There was discussion of the question of cosmic dust, it being concluded that the topic 'Effects of cosmic dust in planetary atmospheres' would be appropriate to IAGA. (Topic II-9 and/or II-7.)

The Chairman reminded the meeting that a completely new set of Division officers and reporters would have to be appointed at the Hamburg IUGG meeting in 1983. All interested scientists were urged to make suitable nominations (of themselves or others) privately to the Chairman.

There appeared to be a consensus in favour of continuing Reporter Reviews in Division II, in spite of the problems associated with such reviews.

Division II Programme at IUGG Hamburg 1983

The Chairman presented an outline programme comprising the following proposals from IUGG (of which some modifications were proposed by Division II):

- Interim Results of MAP (with IAMAP, SCOSTEP)
- Electrodynamics of Polar Upper Atmosphere (with SCAR)
  (possibly as part of IUGG symposium 'Geophysics of polar regions')
- Management of Geophysical Data
  (IUGG is requested to reinstate 'geophysical' in title, instead of 'earth sciences')

- Comparative Studies of Planetary Atmospheres (IAU, COSPAR cosponsorship to be sought). One aspect of the subject, 'Cosmic dust in planetary atmosphere', may be organized as a small Division II session.

Other proposed sessions for Division II:

- Reporter Reviews and Business Meeting
- Equatorial Ionospheric Irregularities (proposal from India)
- Cold Plasma in Magnetosphere (proposed by Cole)
- Ionospheric Modification by High Power Radio Waves (proposed by FRG) (suggested extension to other modifications, e.g. chemical)
- General Contributions (might be numerous, in view of the number of topics at Edinburgh not otherwise catered for in the Hamburg programme)

A proposal from the FRG for a session on 'Ionospheric scatter observations high latitudes by VHF and UHF radio waves' was not favoured by Division II. This technique-based approach was seen as more appropriate to URSI, while the science would be covered by the above mentioned 'Electrodynamics ...' symposium.

The Chairman would work out a proposed distribution of the 17 half days available during the period 16-26 August 1983, and submit the proposals to the IAGA Executive Committee.

Proposal for Chapman Memorial Lecture

M.H. Rees introduced the proposal that IAGA should sponsor a suitable lecture. After discussion, the proposal was remitted to the IAGA Executive Committee without any strong recommendation. The Chairman took the opportunity of announcing that a public lecture by S.-I. Akasofu would be presented the following Tuesday evening (11 August 1981) under the auspices of the British Astronomical Association.

Division II Mailing List

The Chairman enquired whether there was any need for a Division II mailing list, he having abandoned the lengthy and rapidly aging list inherited in 1979. It appeared that sufficient communication was provided by (a) IAGA News and other IAGA information, (b) the Division II Officers' mailing list - with some augmentations - as used by the Chairman for Division II Circulars, (c) some other individuals in particular countries.

Approved Draft Resolutions for transmission to the IAGA Resolutions Committee

1. Re Design study for Southern Hemisphere Incoherent Scatter Radar (proposed by J.A. Gledhill, and approved).

2. Re Consultation with other ICSU bodies on dates of future meetings (proposed by S.A. Bowhill, and approved).

(H. Rishbeth, Chairman of Division II)

DIVISION III ON MAGNETOSPHERIC PHENOMENA

The Business Meeting of Division III was held at 1600-1800h on 5 August (Wednesday) 1981 during the Edinburgh Assembly. The Chairman proposed the agenda as below.

1. Review of method of selection of reporters
2. Proposed symposia for 1983 IUGG Assembly in Hamburg
3. Resolutions
4. Other business
5. Adjournments

Professor A.J. Dessler moved a proposal for the approval of the agenda, the motion was seconded by Dr. V.A. Troitskaya and was approved by the assembly of members present.

The Chairman pointed to the by-law which has empowered the executives of the Division to select the reporters. He then tabled four different suggested methods for the selection of reporters and asked the members for their opinions of the preferred method to be used in the future.

Dr. J.O. Cardús pointed out that the by-laws were framed to ensure that proper geographical distribution is maintained in the selection of the office-bearers of the Divisions. Dr. C.-G. Fälthammar cautioned that we should not lose the participation of the active scientists in the handling of the Division.

Dr. M.G. Kivelson moved that "The executive should solicit the membership before the business meeting and additional nominations may be presented by the floor during the meeting. The final selection should be made based on the voting by the members present at the meeting". The motion was seconded by Dr. D.J. Williams. The result of the voting was unanimous, without any dissention, and thus approved.

The Chairman described the symposia suggested by the inter-divisional meeting and the time available to Division III for their symposia at the 1983 meeting at Hamburg. The Chairman listed the symposium titles suggested to him by the members of the Division. After some discussion, it was suggested by the Chairman that each member should write on a piece of paper his or her list of priorities for the nine symposia suggested. On the basis of the popularity of each subject, and on the basis of available time, the Chairman decided that the symposia subjects for the 1983 assembly would be as shown below.

Priority for Symposia		Comments
1. Comparative aspects of magnetospheric structure and dynamics	2 half-days	Joint with Division II Recommended convener, T. Hill (USA)
2. Electrodynamics of the magnetosphere-ionosphere system	2 half-days	Joint with Division III Recommended convener, R.A. Greenwald (USA)
3. Role of ionospheric plasma in physics of the plasmasphere and trough regions	2 half-days	Joint with Division II Recommended convener, C.R. Chappell (USA)
4. Theory and modeling of hydromagnetic waves	2 half-days	Recommended convener, A.D.M. Walker (R.S.A.)

Priority for Symposia		Comments
Reporter reviews	2 half-days	G. Rostoker
General contributions	3 half-days	A. Nishida
Other Division III Assignments		
Results of Magsat	1 half-day	Recommended Co-convener, T.A. Potemra (USA)
Geophysical Data Management	1 half-day	
Ionospheric Scatter Observations	2 half-days	
Total:	17 half-days	

N.B. We do not believe that the Geophysical Data Management Symposium should last longer than one full day. We further believe that the Interdisciplinary Symposium "Geophysics in Polar Regions" should be extended to 5 full half-days of which 2 should be assigned to Division III. Our Priority 2. Symposium would be contained within this interdisciplinary symposium. (Dr. Rishbeth of Division II will also assign 2 half-days to this symposium.) If this is not possible, we do not want to commit Division III to participate in "Geophysics in Polar Regions".

The Chairman proposed two resolutions; one regarding the importance of the continuation of the World Data Centers, and the second regarding the importance of the reporters attending the IAGA meetings and presenting their reports. It was generally approved that the Chairman may draft the appropriate resolutions for presentation to the IAGA Resolutions Committee.

(G. Rostoker, Chairman)

WORKING GROUP III-1 ON ULF PULSATIONS

A business meeting of the Working Group was held on Thursday, August 6, 1981 and attended by about 50 scientists from 15 countries. The following agenda items were considered:

(i) Chairmanship of Working Group. The present Co-chairmen indicated that they would resign their positions at the next IAGA Meeting in Hamburg in 1983. It was decided to solicit by mail nominations for a Chairman (or Chairmen) for four years beginning in August 1983.

(ii) Symposia for Hamburg

Prior to the Division III Business Meeting, at the WG Meeting proposals for symposia were prepared by the Co-chairmen and the

Convener of the Edinburgh Pulsation Symposia, W.J. Hughes, which were submitted to the Division III Business Meeting. The final recommendation from Division III is to plan a two half-day session on "Theory and Modelling of Hydromagnetic Waves", so long as WG III-1 is concerned.

Since the allocated time will not cover all pulsation work expected to be presented at Hamburg; it was, therefore, decided to recommend contributors to submit papers on the topics of ULF pulsations to the General Contributions of Division III, where they would later be grouped accordingly. The possibility for invited papers in the contributed sessions will also be considered.

With the success of the last two IAGA meetings there has been a great resurgence of interest in ULF pulsations. For example, at Edinburgh 90 papers were submitted to the pulsation symposia. Should the G3 sessions prove unable to carry all contributed papers, then the possibility exists for running specific sessions under the title of WG III-1 Meetings. Poster sessions may be presented and the decision on this will be made later by the pulsation symposia convening committee.

It was decided that abstracts of all papers submitted on pulsations should be sent to the pulsation symposia convener or one of the WG Co-chairmen as well as the convener of the symposium to which the paper is being submitted and the IAGA Secretary General. This will ensure that the WG is aware of all contributions made in the pulsation field and, therefore, have the ability to participate in the organization of the G3 sessions as well as possible WG sessions.

The following convening committee was proposed and accepted for Hamburg. Tentative symposia responsibilities are indicated but the final organization will be at the discretion of the Convener.

Convener: A.D.M. Walker (R.S.A.)
Committee: O. Rospopov (USSR), T. Bosinger (Finland), H. Singer (USA), E.W. Greenstadt (USA), S. Kokubun (Japan).
Ex Officio: B.J. Fraser (Australia), F. Glangeaud (France)

(iii) Cooperative Pulsation Research

There now exists a number of working groups or similar groups studying specific events on a workshop basis. Currently active groups, with a contact name, were provided for information at the meeting.

(a) ISEE Pulsation Working Group
(W.J. Hughes - see Newsletter No.9)

(b) Air Force Cambridge Geophysical Laboratory (AFGL) Workshop
(P. Fougere/R. Sagalyn - see Newsletter No.9)

(c) Coordinated Data Analysis Workshop 6 (CDAW-6)
(W.J. Hughes)

(iv) Pulsations and Related Wave Phenomena

Discussion was initiated on the close relationship between ULF pulsations and VLF phenomena, e.g. quasi-periodic VLF emissions. One view was that the WG should be expanded to include similar and associated wave phenomena at ELF-VLF frequencies. A counter view

was that the WG was already large enough and should remain with interests only in ULF. It was suggested that the ULF-VLF topic may be more suitable for studying the joint IAGA-URSI WG on Passive Electromagnetic Probing of the Magnetosphere.

It is recognised that furthering understanding on ULF pulsations may also involve other disciplines such as particle and ionospheric studies. The place of interdisciplinary studies in the framework of the WG is a topic which may require considerable discussion in the future.

(B.J. Fraser & F. Glangeaud, Co-Chairmen)

WORKING GROUP III-2 ON COMPOSITION OF THE HOT MAGNETOSPHERIC PLASMA

The Working Group III-2 met on the evening of Friday, 11 August during the Edinburgh Assembly. The activities of the past two years were discussed, including the analysis efforts for coordinated satellite data on plasma composition. It was a great pleasure for the Working Group that, in Edinburgh, 21 papers were presented to session 3-I, "Role of Ion Composition in Understanding Magnetospheric Processes", which was, in practice, organized by WG III-2. In addition to the papers in this session, there were many other important results on the magnetospheric plasma composition in other sessions of Division III, such as "Quantitative Comparisons of Magnetospheric Event Data and Models", and "General Contributions to IAGA Division III on Magnetospheric Phenomena".

Working Group III-2 has a great interest in the activities of CDAW (Coordinated Data Analysis Workshop) with the satellite data for plasma compositions. It is expected that a number of new important results will come out of future CDAW meetings. The Hamburg Assembly of IAGA will give us a good opportunity to review the recent progress in the study of the magnetospheric composition.

(R.G. Johnson, Chairman)

WORKING GROUP III-3 ON QUANTITATIVE MAGNETOSPHERIC MODELS

During the IAGA Edinburgh Assembly, Working Group III-3 met on the morning of 13 August (Thursday). Since the Working Group meeting was scheduled in the second week, and the Business Meeting of Division III in the first week, it was inconvenient for Working Group members to reflect their opinions at the Business Meeting of the parent Division. In order to cover this disadvantage, the Chairman had circulated, in advance, a newsletter explaining the situation regarding the program constraints, and asked for members' comments, especially on the subject of topics for the Hamburg Assembly. Despite the Chairman's advance notice, however, the Working Group resolved that, in future Assemblies, it would be desirable to have the Working Group meeting before the Division III Business Meeting, if a room and time-slot should be available in the early part of the Assembly. This opinion was forwarded to the Division III Chairman, and, with the support of all the other Working Groups in Division III, he wrote a letter to the Secretary General asking for his serious consideration of this matter for the Hamburg Assembly.

The Working Group noted with satisfaction the papers presented at the 3-Q session, "Quantitative Comparisons of Magnetospheric Event Data and Models", which was arranged by the Working Group on Wednesday, 12 August, the day before the Working Group meeting. Some papers were very useful in considering the future activities of the Working Group. The successful results of CDAW (Coordinated Data Analysis Workshops) series were also worth noting, and the Working Group expects further success in the coming CDAW conferences.

As to the scientific sessions for the next Hamburg Assembly, the Working Group decided to cooperate with other groups in planning the IAGA sessions, rather than insisting on holding its own sessions. A typical session will be,

"Separation of the Observed Magnetic Field into Main, Ionospheric and Magnetospheric Contributions",

for which the Interdivisional Working Group on Relations between External and Internal Magnetic Variations will have the main responsibility. Working Group III-3 will contribute also to other sessions such as,

"Electrodynamics of the Polar Atmosphere and Ionosphere", and
"Theory and Modelling of Hydromagnetic Waves".

(W.P. Olson, Chairman)

DIVISION IV ON SOLAR WIND AND INTERPLANETARY MAGNETIC FIELD

Business Meeting of Division IV

The Business Meeting of IAGA Division IV was held at 4.00 p.m. on August 7, 1981, presided over by the Chairman, L.F. Burlaga. The main results of the meeting were as follows:

1. Leadership

The following changes in leadership were noted:

i. H. Rosenbauer (FRG) resigned as Chairman, and L.F. Burlaga (USA) was appointed Chairman by the IAGA Executive Committee;

ii. F.M. Neubauer (FRG) was appointed Co-Chairman of Division IV;

iii. F.M. Neubauer resigned as reporter of Topic IV-2, and no replacement is planned;

iv. There will be no replacement for the late Dr. Mansurov, reporter for Topic IV-4.

2. Proposed Sessions for the Hamburg Assembly

In addition to the Reporter Review Session (1 half-day) and the General Contributions Session and Business Meeting (1 half-day), the following sessions were proposed for the next IAGA Assembly in Hamburg:

1) Large-scale Solar-interplanetary Relations (2 half-days; conveners: R. Schwenn and N.R. Sheeley).

2) Turbulence and Kinetic Physics in the Solar Wind (2 half-days; conveners: W.C. Feldman and E. Marsch).

3) Solar Maximum Transition (1 half-day; conveners: F.M. Neubauer and D.M. Rust).

4) Problems Related to Solar Wind Composition (1 half-day; conveners: K. Ogilvie and O. Vaisberg).

3. Division IV supports the IAGA "Symposium on Collisionless Shocks in Space", which was proposed by Dr. Lange-Hesse. It was suggested that at least one day be given to the Symposium with approximately half the time being given to a discussion of interplanetary shocks, and it was suggested that the Division IV representatives (conveners) be E. Smith and A. Galeev. (However, it became clear later that, due to a shortage of time available during the Hamburg Assembly, this plan could not be realized.)

4. Regarding the proposed IUGG Symposia:

1) Gringauz was proposed as the Division IV representative for the Symposium on Geophysics in Polar Regions, if Division IV is requested to participate. Among other things, this symposium might discuss polar activity (geomagnetism, aurorae, energetic particles, etc.) in response to changing interplanetary conditions;

2) It was decided that no representative would be appointed for the "Symposium on Management on Earth-Sciences Data" until more is known about the symposium, but it was suggested that someone from the NSSDC in the U.S.A. might be considered as a candidate.

5. Two resolutions were adopted and forwarded to the Resolutions Committee.

6. The importance of continuous monitoring of interplanetary conditions with changing solar activity was strongly emphasized, and persons involved in spacecraft mission planning and operations are urged to consider this in any decisions they might make concerning spacecraft and instruments measuring the solar wind and interplanetary magnetic field.

(L.F. Burlaga, Chairman)

DIVISION V ON OBSERVATORIES, INSTRUMENTS, INDICES AND DATA

During the 4th IAGA Scientific Assembly, Edinburgh, August 13-15, 1981, Division V had the following activities:

All Working Groups held their business meetings.
Reporter Review Session,
Business Meeting of Division V, chaired by C. Sucksdorff,
Session GV, General Contributions to IAGA Division V, chaired by C. Sucksdorff.
Session VM, Production of Regional Magnetic Charts using Recent Satellite Data, chaired by A. Hahn.
Session VC, Comparisons of Analytical Techniques for National and Regional Magnetic Charts, chaired by E. Dawson.
Session VW, Workshop on observatory and Repeat Station Practice, chaired by G. Fischer.

REPORTER REVIEWS

(6 August 1981, a.m. and p.m. Room: LT5)

All Working Groups gave their reports. In addition special reports, referred to below, were given under WG-1 report. Only WG reports differing essentially from the Minutes of the business meeting of the WG are given below. The Minutes of the business meetings are given later in this Transactions.

Working Group V-1. Magnetic Observatories
- General Report from WG (W.F. Stuart, Chairman)
- Report on magnetic operations in West Africa (K.L. Svendsen, Cochairman)
- Service of comparisons of magnetic standards (E. Kring-Lauridsen)
- Nordic geomagnetic collaboration (E. Kring-Lauridsen)
- Comparison of standards between Mozambique, USSR, Portugal, South Africa and IAGA (L.M. Pereira)
- Comparison of night hour values in Europe (W.F. Stuart)
- Rating of observatories using scalar change (D.R. Barraclough)

Working Group V-2. Meteor observatories (W.G. Elford, Chairman)
Working Group V-4. Optical Calibration standards (M.R. Torr, Chairperson)
Working Group V-5. Magnetic Surveys and Charts (D.R. Barraclough, Cochairman)
Working Group V-6. Geophysical Indices (J.V. Lincoln, Chairperson)
Working Group V-7. Collection and Dissemination of Data (J.H. Allen, Cochairman)
Working Group V.10. Ground-Based Measurements for Satellite Geomagnetic surveys (H.G. Barsczus, Cochairman)

BUSINESS MEETING OF DIVISION V

The meeting on the morning of 7th August 1981, was chaired by C. Sucksdorff. 55 people attended.

1. Statement of WDC for STP

Mr. J.H. Allen described the situation at WDC for Solar Terrestrial Physics. Thanks to a very severe reaction from all over the world, the closing of the WDC for STP was avoided and the main programs seem to be safe. IAGA Division V noted with satisfaction that there is a possibility that no severe reductions will occur in the near future.

2. Statement on Service of Indices

Dr. Van Sabben's change of position in his institute has led to his resignation from the post of Director of the ISGI. Div. V noted with gratitude the willingness of Dr. As from the same institute (Royal Netherlands Meteorological Institute) to continue Dr. Van Sabben's work, and decided to propose to IAGA that IAGA should ask that Institute to continue the ISGI. Div. V expressed its thanks to Dr. Van Sabben for his many years of excellent work for the ISGI and for the whole scientific community utilizing geophysical indices.

3. Service on Observatory Annual Means

The situation in the Service on Observatory Annual Mean Values was discussed due to the early and unexpected death of Prof. Pushkov, the key person in the Service. Urgent need for continuation of the Service was noted, as well as a need for more rapid publication of the annual mean values. The Chairman was given the task of writing to IZMIRAN, Moscow, to find out about the possibilities of the continuation and speeding up of the service. Final decisions will be made in Hamburg.

4. Division V programmes in Developing Countries

At President Cole's request, the programs of Div. V to help Developing Countries were discussed. Five suggestions came up and were forwarded to the Seminar on Developing Countries i.e. (i) Developing countries in interchange programs, (2) workshops to be arranged in Developing Countries, (3) help in repeat measurements, (4) formation of a subcommittee in IAGA for Developing Countries, and (5) publishing guides on data production and usefulness of data.

5. Articles to IAGA News

Division V noted with gratitude the publication of short practical articles in IAGA News and hoped that more articles in this line would appear in the future. Especially there should be: -one article about the importance of scaling with the K-indices manually. This article should include the arguments against the use of machine production of K-indices, - articles about instruments and improvements in measurements, -summaries of results of intercomparisons of observatory standards.

6. Project GLOBMET

Prof. Kasheyev descibed Project GLOBMET, a universal project to standardize and utilize radio methods in tracking meteors, which is the most profitable way to monitor the winds in the middle atmosphere. Div. V decided to support this project with a resolution.

7. Division V Organization in Hamburg

Div. V discussed the possible need for changes in its organization. No changes were found necessary at the moment. The Chairmen, however, will be cahnged at the Hamburg meeting, as recommended by IAGA to be done in connection with every IUGG Assembly.

8. Program for the next Hamburg Assembly

As to the IAGA programs for Hamburg there were the following suggestions, one of which was forwarded to the Executive Committee:

- Workshop on observatory and survey practice
- WG 2 proposed a symposium on "The dynamics of the mesosphere and lower thermosphere" to be sponsored together with IAMAP. Union symposia were, however, already decided upon, so this proposal has not been forwarded.
- See also (Other matters 11).

In addition, Division V decided to express its willingness to cosponsor the session on Cosmic Dust, if needed.

9. Quality of Observatories

Dr. Sugiura had, in his work on D_{ST} indices, found that the quality of several observatories is declining. Div. V decided to ask WG 1 to consider the quality problem and try to find methods to improve the quality of magnetic observatories.

10. Resolutions

Proposals for 8 resolutions came from different Working Groups. They were all adopted and forwarded to the Resolutions Committee. The resolutions dealt with the following matters:

- Three resolutions supported observatories (Paramaribo, Nairobi and Nampula).
- Digitizing of AE observatories was urged
- Project GLOBMET was supported
- Assistance for repeat measurements in Developing Countries was requested.
- Support for workshops to train technicians for magnetic operations was asked for.
- Support for the production of AE indices was requested.

11. Other Matters

1) From WG V-5 it was pointed out that the objective of the World Magnetic Survey Board was to obtain a global geomagnetic data set at a track spacing of 250 km. Over three decades of survey efforts culminating in MAGSAT have produced such a data set and it is now necessary to formulate new survey plans. These should integrate near-surface surveys and repeat station observations with magnetic observatories. Final plans should be adopted in 1983 at the IUGG meeting in Hamburg.

2) Importance of having a collection of solar wind data was discussed and stressed. Actions by IAGA were asked for founding such a data service.

3) It was decided that Working Groups in their meetings should nominate candidates for a Div. V representative to the possible Working Group for Developing Countries.

4) The desirability of continuation of the publication by NOAA of the special report for magnetic observatories was stressed.

5) A new satellite measuring magnetic and gravity fields from low altitudes (160 km) during 6 months in 1987-1988 was reported.

6) Div. V decided to suggest that Mr. J.H. Allen should be nominated new Chairman of Working Goup V-6, Geophysical Indices, after J.V. Lincoln who desired to resign from this position because of her retirement.

7) Division V expressed its gratitude to Virginia Lincoln for her excellent work in chairing the WG on Geophysical Indices and for conducting the difficult matters in the production of the numerous indices.

8) Division V noted with concern that several magnetic observatories are in danger of being closed down and expressed concern that the research community within IAGA takes the existence of magnetic observatories for granted. It is essential that IAGA recognizes the importance of its

influence on the funding agencies in developed and developing countries. This is directly related to the quality of the data which are collected.

9) Finally, Division V decided to suggest to IAGA, that in the coming 1983 Assembly there should be a special day reserved for Working Group Meetings before the Business Meeting of the Division. This would facilitate the handling of matters and make it possible for scientists in Division V to participate more in the scientific sessions. Also the pure scientists might attend more to the Working Group activity in Division V, which would be most desirable because Division V tries to supply scientists in other Divisions with data.

(C.G. Sucksdorff, Chairman)

WORKING GROUP V-1: OBSERVATORIES, INSTRUMENTS AND STANDARDS

WGV-1 held its meeting on Aug. 13, 1981. 25 people from 16 countries representing 18 institutions and observatories attended. The following items were discussed and decided upon. (It was noted with extreme regret that the WG meeting took place after the business meeting of Division V and because of this some important issues could not be brought to the attention of the IAGA EC through the Division).

1. The closure and imminent closure of several geomagnetic observatories and the general deterioration of data quality: This is mainly a low latitude phenomenon (but not exclusively) and the WG expressed concern that observatory operations were taken for granted by the geophysical research community. Several practical steps were discussed which might apply to specific cases, but it was agreed that if we are to slow down or halt the closing of geomagnetic observatories and the deterioration of data quality, an important first step would be to work through IAGA to try to marshall the forces of the research community into supporting the maintenance of observatories, which will indicate to national and international funding agencies that geomagnetic observatories and surveys must be given a much higher priority than at present.

2. Assistance to observatories in maintaining standards: Dr. Wienert's book was again commended as a basic training manual which each observatory should have (not in the headquarters library), because it was felt that although some scientists have opportunities to exchange visits between institutions, the technicians who operate the instruments do not. This was felt to be a matter for attention, because there are many cases where technicians are not trained thoroughly enough and not properly supervised. Several representatives of the large institutions offered to look into the possiblity of accepting technicians from less experienced observatories for training. Fund and hard currency were identified as the main problems. Dr. W.F. Stuart was asked to act as an intermediary between those institutions or individuals who have a need for staff training and those institutions which may be able to offer training facilities. It was emphasized that any request for the training of staff should be sent or at least endorsed by the highest possible academic or governmental body

of the requesting country. It was reiterated that WGV-1 regards collaboration between observatories on a regional scale as of paramount importance and that yearbooks should be published promptly. In the yearbooks it was recommended that short technical papers be included and that the present widespread policy of anonymity of observers should be abolished by listing their names and responsibilities.

3. It was recognised that some geomagnetic observatories and institutions have instruments which have been retired and which might be lent or sold at an economical, or even nomimal, price to institutions which are short of basic equipment. Also, it was suggested that some less than fully equipped observatories would be capable of building instruments and acessory electronic equipment if they could be provided with appropriate drawings, circuit diagrams and instructions. It was felt that WG V-1 should take the initiative in this matter and Dr. E. Kring-Lauridsen was asked to act as the intermediary. Several individuals offered to look into the possibility of supplying the necessary diagrams. It was agreed that these two "new" services should be advertised in the IAGA News and WG V-1 reiterated its conviction that IAGA News should be sent directly to each observatory.

It was proposed that Drs Sucksdorff and Stuart collaborate in producing an article for IAGA News on the subject "Why and where we need magnetic observatories", describing in detail the predicament with regard to magnetic observatory support. A suggestion was adopted that an International Panel should be appointed to examine the problems and to formulate solutions where possible.

Dr. Sucksdorff remind the chairman that WG V-1 had begun preparation of a pamphlet with articles on several aspects of geomagnetic observatory operation and the use to which data are put. In discussion it was clear that such a pamphlet was desirable (it in no way replaced Dr. Wiener's book "Notes on Geomagnetic Observatory and Survey Practice") and Dr. Stuart was asked to solicit contributions and act as coordinating editor.

(W.F. Stuart, Chairman)

WORKING GROUP V-2: METEOR OBSERVATORIES

The meeting was held on Friday, 14th August 1981 and was attended by seven members of the Working Group and three observers, with Dr. W.G. Elford in the chair.

Written reports were received from workers at the following locations: Adelaide (Australia); Christchurch (New Zealand); Kyoto and Tokyo (Japan); Ondrejov (Czechoslovakia); Atlanta and Urbana (USA); Kazan, Kharkov and Obninsk (USSR). Verbal reports were given with regard to the work at Sheffield (UK) and Bologna (Italy).

It was noted that the radar meteor wind work in France had ceased, and that meteor wind work at Trivandrum and Waltair (India), and Kühlungsborn (GDR) were not represented in the Working Group. Also the partial reflection drift work at Saskatoon was not represented. It was agreed that the co-chairmen invite new members in to the Working Group to represent these additional stations.

The Chairman stated that a copy of the edited reports would be sent to all members and interested participants. Highlights of the reports included the following.

Observational schedules - The majority of the stations making wind measurements have made observations during periods designated by the Co-ordinated Tidal Observation Program (CTOP). The USSR stations have been operating according to the calendar for the Global Radio Meteor Wind Station Project (GRMWSP). Some stations are now operating on a continuous basis and others have increased the length of their operating runs. As a result planetary waves with periods up to two weeks are being detected and their characteristics measured.

Zonal wind reversals - The changeover from winter to the summer circulation at 90 km has been observed to occur simultaneously at three stations in the USSR.

Two-day wave - This phenomenon has been shown to dominate the meridional winds for a few weeks in late summer in both hemispheres, and it has been the subject of co-ordinated observations from several stations.

Tidal winds - Simultaneous observations at different latitudes have been used to deduce tidal modes, while interhemispherical comparisons have been carried out at the conjugate stations, Adelaide and Kyoto.

The Chairman reported that an increasing number of stations are archiving wind data on magnetic tape, and that all meteor wind data recorded in the USSR during 1980 is now in WDC-B2. It was noted that draft proposals for archiving meteor wind data according to standard formats had been circulated by Drs. Roper and Kashcheyev. It was agreed that this matter should be resolved as soon as possible and Drs. Kashcheyev, Kingsley and Roper were asked to prepare and circulate a final draft to all observing stations.

Dr. Roper reported that the Co-ordinated Tidal Observation Program (CTOP) was being incorporated into the MAP calendar. A proposal for mid-summer and mid-winter observing campaigns in 1982 was accepted.

The Working Group noted that a proposal for a Global Meteor Observation System (GLOBMET) had been circulated by Dr. Kashcheyev. The proposal highlights the need for co-ordinated wind observations at stations distributed along prescribed lines of latitude and longitude, using radio systems that have been standardized and calibrated, and employing analysis techniques that have been agreed upon internationally. To provide a more effective geographical distribution of stations it was suggested that existing groups may need to sponsor new stations at specific locations.

Dr. R.A. Vincent stated that the scientific aims of GLOBMET applied to all wind measuring systems, and not only meteor systems. *Dr. Kashcheyev* tabled a document summarising comments on the proposal by a number of workers.

It was agreed to accept the GLOBMET proposal in principle and to endorse the following draft resolution already agreed to by the general Business Meeting of WG-5:

Reaffirming: IAGA Resolutions 5 and 6 of the Canberra Assembly,

Noting: that most radar systems are now automated,

Considering: the need for a more effective geographical distribution of radar meteor stations and recognizing the high degree of co-ordination necessary to undertake simultaneous world-wide observations,

Recommends that:

(1) IAGA member countries be encouraged to support and extend the radar meteor network,

(2) International co-ordination be undertaken through a Global Meteor Observation System (GLOBMET); co-ordination to be effected in the immediate future through the Middle Atmosphere Program,
(3) An *ad hoc* committee to be formed within SCOSTEP with representatives from IAGA, IAMAP, IAU, and URSI, to produce a GLOBMET planning document.

The following were proposed as IAGA representatives on the *ad hoc* committee: *Dr. Kashcheyev* (convener),*Dr. Elford, Dr. Mueller, Dr. Roper* and one representative from another geographical area. Dr. V.A. Nechitailenko was nominated as Secretary of the Committee.

The following changes to the membership of Working Group V-2 were recommended: Add G.J. Fraser (New Zealand), T. Hirasawa (Japan), A.H. Manson (Canada), V.A. Nechitailenko (USSR) and C.A. Reddy (India); delete M. Blanc, M. Glass and G.M. Teptin.

(W.G. Elford, Chairman)

WORKING GROUP V-4: OPTICAL CALIBRATION STANDARDS

The WG met on 17 August, 1981, in Aberdeen, Scotland. In the absence of Chairman M. Torr, the meeting was convened by P.C. Wraight.

1) Review of workshop

The workshop held in Aberdeen in connection with the fourth scientific assembly of IAGA at Edinburgh was proposed by M. Gadsden at Canberra in 1979. Reports and invitations were circulated by M. Torr early in 1980, and information was included in the 2nd IAGA circular late 1980. In March 1981, a wider circulation list was sent information and a reply form to indicate interest, by P. Wraight.

M. Torr attended the Edinburgh assembly and brought the calibration photometer, and a recently acquired low brightness source, to be used as a transfer standard, but was unable to come to Aberdeen. The photometer is described in detail in 'Intercalibration of Instrumentation used in the Observation of Atmospheric Emissions: A progress report 1976-1979' by Marsha R. Torr, Center for Atmospheric and Space Sciences, Utah State University, UMC 41, Logan, Utah 84322, U.S.A.

Preliminary measurements made in Aberdeen before the Workshop revealed certain problems; in addition experience during the workshop itself suggested other difficulties; these are collected here.

a) The transfer source had too small an aperture (it should fill the field of view of the photometer); it was too weak for convenience, and was spectrally inadequate, in that the emission at two of the test wavelengths was negligible.

b) An infra-red leak on channel 7, uncovered previously, was confirmed; it was not overcome by the extra filter supplied. A similar problem, though smaller, appears to be present on channel 8.

c) The LED display was found to emit at wavelengths transmitted by channel 7; this, together with the need for extra lighting to record results gives great difficulty with tungsten filament sources where ambient light can usually get into the phtometer.

d) To overcome this problem, because a printer was not available, the pulses were amplified and counted remotely. The preamplifier appears to have increased the dead-time so that non-linearity in the count-rate was suspected above 50,000 cps. Since the full-scale count rate on the photometer read out at 10s integration is 100,000 cps, it was difficult to be sure of the origin of this dead-time problem; the pulses present at the output from the photometer were too short and weak to propagate down a cable.
e) There was no easy method of locating either test or transfer sources precisely in front of the phtometer.
f) When the phtometer was dis-assembled at the end of the workshop, visual inspection cast doubt on the integrity of the 5577Å filter (channel 3).
g) Mistakes were made by several observers in the direction of rotation of the filter wheel.

The workshop was attended by 28 scientists, who brought 30 sources. On Monday 17 August the radioactively excited phosphor sources were tested. We found that 45 mins per source was an adequate time allocation. We used a radioactively excited phosphor - actually the 'original Fritz Peak' source used in a calibration exercise around 1970 - as the transfer source throughout. The aperture of the photometer was cut down to 3/4" diameter - within the area of uniform response according to previous measurements - so that when smaller apertures had to be used for brighter sources, the count-rate could be assumed proportional to area. On Tuesday 18 August we calibrated first the sealed tungsten sources, and finally bare tungsten filament lamps illuminating a barium sulphate screen at about 20m. We allowed one hour per source; because of time taken for setting-up and stabilization this was inadequate.

2) Recommendations for future calibration

a) use of calibration photometer

1) transmission of filters must be remeasured over whole range of interest.
2) remote or automatic recording (eg by printer) is highly desirable to allow one operator to work in dark.
3) fitment for accurate location and relocation of sources in front of photometer is desirable; accurate and locateable apertures are needed.
4) a ratchet, to give one direction of filter wheel rotation, or a Geneva drive to give better positioning, were suggested.

b) facilities available

1) for tungsten sources, >2 power supplies in dark room to allow warming up required.
2) a cooled darkroom (20C) requested.
3) a standard holder for the common sizes of radioactively excited sources would be valuable.
4) Power supplies at 230VAC, 115VAC, and DC power supplies (eg 7V, 6.5A; 12V,2A; 3V,1A) required.

c) Requirements for calibration

1) There were requests for calibration at 3914 and 8500Å.
2) in general it was felt that calibration with a single instrument from 3000 to 9000Å was feasible and desirable, but a reference source covering that range may not be possible.
3) 1.27μ calibration was requested, but would require a different detector.

d) Ideas for new calibration instrument.

1) Wider range of filers as above.
2) automatic operation, eg microprocessor or microcomputer controlled.

3) automatic recording, definitely including a printed output, and possibly including recording in computer readable form, eg cassette or paper tape.
4) possible use of calibrated photo-diode detector instead of calibrated source.

e) Recommendations.

1) that the calibration photometer, with transmission of filters checked, should continue to be used and circulated
2) IUGG Hamburg 1983: It is possible that the M.P.I. for Aeronomy, Lindau, may extend an invitation to aeronomers to bring their sources to Hamburg; these sources would be collected and calibrated, and returned after the first week.

During the second week of IUGG, we recommend that a meeting on calibration be held; at this meeting we would discuss both the design of an ideal calibration photometer, and also the possibility of holding a calibration workshop in connection with the IAGA meeting in Vancouver 1987.

The possibility of holding a calibration workshop in Prague in connection with the IAGA assembly, 1985, was raised. We do not know of local aeronomical research or suitable facilities; these and other logistic difficulties, meant that the suggestion did not meet with approval.

(P.C. Wraight, Co-chairman)

WORKING GROUP V-5: MAGNETIC SURVEYS AND CHARTS

The WG met on 13 August, 1981. In the absence of the Chairman, Peter McGregor, the Co-Chairman, David Barraclough took the chair. 13 others were present, including the following WG members: F.S. Barker, H.G. Barsczus and E. Dawson.

Ed Dawson summarized a paper by himself and *L.R. Newitt* on 'The reduction of repeat station data to a quiet magnetic level.' In this paper two methods of deriving a quiet magnetic reference level are tested using data from three Canadian magnetic observatories. Both methods use data from observatories in and around the survey area to define the reference level. One uses observations spanning an interval of about a a year and the other uses several years of data. The latter method is shown to be rather better at defining the correct level to be used. Some other methods of reducing repeat station observations were also discussed.

There was some discussion of a draft resolution which had been submitted to the Business Meeting of Division V. Because of the timing of this meeting (it took place nearly a week before the Working Group V-5 Business Meeting) it had not been possible to discuss the draft resolution fully with Working Group members. Perhaps because of this, its wording was not deemed, by the division V Business Meeting, to be suitable for a Resolution. Working Group V-5, however, wish it to be recorded (in a slightly amended form) as a recommendation of the Working Group. The recommendation is as follows:

The objective of the World Magnetic Survey Board was to obtain a global geomagnetic vector data-set at a track spacing of 250 km.

Over three decades of survey work, culminating in the Magsat project, have produced such a data-set and it is now necessary to formulate new survey plans to optimize the longevity and enhance the quality of the present global data-set. These plans should aim to integrate near-surface surveys and repeat station observations with magnetic observatory observations and should be finalized ready for consideration in Hamburg.

Changes in the membership of the WG were discussed. Since the Canberra meeting, F.S. Barker had replaced N.J.O'Neill as a member of the WG and the Working Group has lost one of its members through the untimely death of A.N. Pushkov. It was decided that V.N. Lugovenko should be asked to become a member in the place of A.N. pushkov. It was noted that the WG has no member from China and it was decided to ask Liu Quing-Ling to become a member. Another area not covered by the WG membership was South Africa. It was decided to ask D. Kuhn to suggest a suitable member from the Republic of South Africa.

Hans Barsczus requested that a letter be sent from the Chairman of Division V to those agencies from which he had received no replies concerning the compilation of references to magnetic observations in the Pacific region. This was agreed. There being no other business the meeting was closed.

(D. Barraclough, Co-chairman)

WORKING GROUP V-6: GEOPHYSICAL INDICES

The meeting was held on 4 August, 1981, chaired by Virginia Lincoln. Thirty representatives from fourteen countries attended.

Dr. Van Sabben reported that the International Service of Geophysical Indices (ISGI) at De Bilt had continued issuing monthly bulletins. The IAGA Bulletin 32i "Geomagnetic Data 1978" containing "A Report on Km Observatory Visits" by P.N. Mayaud and M. Menvielle was published in July 1980. Bulletin 32j for 1979 data will appear this summer. A questionnaire on the use of Bulletin 32 was sent to 300 recipients. Replies from 122 indicated use of all portions with times of international quiet and disturbed days, Kp or Ap, and times of SSC, the most heavily used. Dr. Van Sabben has retired as Director. The WG proposed that De Bilt continue to operate the ISGI under Dr. Jo As. Discussion indicated that many scientists do not know of the Bulletin 32. It was decided to advertise its existence in the footnote under the monthly table of indices in the Journal of Geophysical Research. Other publications were encouraged to do the same.

Dr. M. Menvielle reported that the Km, Kn, Ke, am, an, as and "aa" indices are routinely prepared by the Institut de Physique du Globe, Paris. The indices are provisional until the Antarctic magnetograms are available. Close quantity control has kept the indices reliable. Until a long series of magnetograms are compared between Canberra and Toolangi, the "aa" indices from 1st January, 1981 onward will be provisional. Canberra is now used for the southern hemisphere station in "aa". Southern hemisphere Ks are now prepared from a four region grouping of the stations rather than three regions.

Dr. Siebert stated that the Institut für Geophysik, Göttingen, was prepared to continue the derivation of Kp, Ap, Cp and the international quiet and disturbed days.

Mr. Joe H. Allen reported that World Data Center A for Solar-Terrestrial Physics (WDC-A for STP), of which he is now Director, will continue. A questionnaire has been prepared by the IAGA Secretariat, and he urged that attendees complete it. WDC-A for STP will be unable to prepare auroral electrojet (AE) indices in the future without outside contract support. WDC-C2 (Kyoto, Japan) was thanked for preparing the first half of 1978 AE and plans to prepare the AE indices through 1979. WDC-C2 is urged to continue such calculations. To aid in preparing indices in the future, all countries (the USSR, Sweden and Iceland in particular) were urged to convert to digital magnetometers. A resolution on this need was proposed.

Dr. M. Sugiura of NASA/Goddard, USA, was not present, but he continues to publish the Dst values. However, he is concerned with the quality of data being received from the Dst Observatories. This problem was referred to the WG V-1.

Dr. Cardus, Observatorio del Ebro, Spain, reported there are too few stations reporting sfe - only 25 with poor geographical distribution. The new classification of sfe (using letters and numbers) has been satifactory and has helped in solving several doubtful cases. There is the question of whether knowing of related phenomena, observers have found something on the magnetograms. Furthermore, observatories have consistently reported very clear sfe during local night hours. No answer has been received from Tamanrasset as replacement for M'Bow for magnetogram copies to be used to identify ssc. Perhaps Bangui, Tatuoca, Maputo, Tananarive or Mauritius might be able to assist. Dr. Romañá has been forced to retire by ill health. The Working Group proposed Dr. Cardús, the present Director, to continue the work at Ebro, and he accepted.

Miss J. Virginia Lincoln reported on the transition from Zurich sunspot numbers to the international prepared by Belgium. The homogenity of the new numbers should be studied. Dr. Henry Garrett, President of the Interdivision History Commission, indicated their interest in long-term indices.

Considerable discussion followed on the need for physical meanings of the proliferating indices. WDC-A for STP hopes to prepare such a Handbook.

Dr. T. Saito (Japan) reported on the Magnetic Pulsation Index C3 available at the Onogawa Observatory, Japan. The need for other geophysical indices for the solar wind and interplanetary space should be a project for the future. The demand for such indices is great.

Discussion of the article by Rangarayan and Murty("Scaling K-indices without subjectivity") in the IAGA News No.19 led to the request that Dr. M. Menvielle of France prepare for IAGA News publication critique of the article, presenting opposing views.

The WG proposed that Joe Allen of WDC-A for STP become Chairman replacing J. Virginia Lincoln who has retired. Dr. Saito will continue as Vice Chairman. Other proposed membership changes were Mr. J. As replacing Dr. Van Sabben and Dr. J.O. Cardús replacing Dr. Romañá. New members proposed are Dr. Voppel (FRG), Dr. Murayama (Japan), Dr. Joan Feynman (USA) and Dr. L.T. Afanasyeva (USSR).

The Working Group closed expressing their special thanks to Dr. Van Sabben, Dr. Romana and Miss Lincoln for their many years of service to the Working Group.

(J.V. Lincoln, Chairman)

WORKING GROUP V-7: COLLECTION AND DISSEMINATION OF DATA

The WG met on August 7, 1981. Some 15 participants from 10 countries signed the attendance record. There were 8 items on the agenda:

1. Status of WDC-A for Solar Terrestrial Physics and the continuation or elimination of STP data services by the National Oceanic & Atmospheric Administration (NOAA).
2. Catalog of IMS data collection established at WDC-A for STP.
3. Need for digital data from ground-based magnetic observatories.
4. Status of AE and Dst magnetic activity indices for the IMS.
5. Experience with IMS data exchange.
6. Need for standardized digital data formats for international data exchange vs. local digital data formats.
7. Archaeomagnetic data and lake sediment magnetic data - need for srandardized format and collection at WDCs.
8. Need for timely solar wind and IMF data.

Summary

1. NOAA Acting Administrator Mr. J.P. Walsh sent a letter announcing that NOAA will continue a "core program" of STP data services, including operation of WDC-A for Solar Terrestrial Physics for STP at the National Geophysical & Solar Terrestrial Data Center (NGSDC), Boulder, Colorado. Programs prviously done at NGSDC were divided into three categories, those to be continued at minimum level, to be continued at a greatly reduced level, and to be discontinued. To some extent, desirable programs in the latter two categories can be continued at the Boulder facility if their costs and personnel requirements are covered by other groups.

I. Programs to continue at minimum level:
   - "Solar Geophysical Data" publication and related data services
   - Ionospheric data services except for ionosonde operations
   - Satellite and large digital data base services
   - WDC-A for STP

II. Programs to be reduced:
   - UAG Reports publications
   - Special analyses and event data collections
   - Active data search and purchase programs
   - Data product development

III. Programs to be discontinued:
   - Ionosonde station operations (Wallops, Boulder, & Maui)
   - International newsletters (IMS, SMY, MAP)
   - De rivation of AE indices
   - STP related editorial functions.

We emphasize that the reduced and discontinued programs may be maintained at previous levels or increased if it is possible for other agencies to join NOAA in sharing the effort elsewhere or at the Boulder facility. For example, the Middle Atmosphere Program, (MAP) Newsletter is now being produced at the US MAP Coordinator's office in Washington, DC.

2. At WDC-A for STP (in the former IMSCIE Office), a computer-accessible IMS data collection file has been created on a local mini-computer. At this time, only 83 data collection projects are detailed in the listing. Each entry gives full information about the principal person to contact with regard to the data or for details about the experimental program, the location of the experiment, the "platform" for data collection (e.g. satellite rocket, balloon, surface, or multi), and the days for which data are available (1976-1979). The file may be searched at WDC-A or remotely for any combination of one or more items:

"Last name of principal scientific contact";
"Country";
"Experiment name";
"Experiment platform"; and
"Time interval for which data was collected (by day)".

It is intended to complete this collection for all known IMS experiments and to publish the result. Anyone wishing to use the system may enquire to WDC-A for STP about the possibility of direct access or of selected searches run on-site.

3. *Prof. H. Maeda* (Kyoto) wrote to stress the importance of the direct recording of digital geomagnetic and other types of geophysical data either at observatories or by their sponsoring institutions. Also, the need for conversion of analog records into digital format is increasing (e.g. the AE observatories for 1976-1979 and continuing until digital recording is implemented). Persons attending told about the existence of digital geomagnetic data sometimes prepared from analog records, from: USSR Antarctic IMS stations; Sodankyla and Nurmijaarvi (1-min); Bangui, M'Bour, and Pamatai (1/2-min); Ivalo; Australia - Toolangi, Gnangara, Port Moresby, Mawson, and MacQuarrie Island (hourly means); UK (hourly means); France (hourly means); India (hourly means); Canada (1-min); US (standard observatories, 1-min); American IMS Chains (10-s).

4. AE indices for 1978 have been derived and published by WDC-C2 (Geomagnetism) Kyoto, Japan. Tables and plots of the 1-min indices were published in two reports, each for half of 1978. A magnetic tape for Jan-June 1978, is now available at WDC-A for STP. The tape for July - Dec 1978, should be available in late 1981. WDC-C2 is now working on derivation of AE indices for 1979 as a part of Japan's contribution to the IMS. WDC-A for STP produced preliminary AE indices for Jan-April 1976, and published them in the UAG Report series. For selected intervals of interest, AE(5) indices were also produced for times in 1976-1979 and published in the IAGA Bulletin 32 series and SGD. Dst indices produced by Dr. M. Sugiura (NASA/GSFC) are available for the entire IMS period (1976-1979) and will be available for 1980 before the end of 1981. Dr. R. McPherron (UCLA) has the American IMS Chain mid-latitude data (Eusebio, Brazil to Guam) which may be com bined with digital data from other suitably located stations to derive Dst and Assymmetry indices for higher time resolutions. The most complete data base begins in April 1978 although some IMS data is available as early as July 1977.

5. *Dr. B. Theile* (U. Braunschweig) has depostied a copy of his 58-tape collection of digital IMS magnetometer data with WDC-A for STP. This data was acquired along a 5-station meridional array in Scandinavia during the IMS. Copies of the American IMS tapes and plots on 35mm microfilm were supplied to each experimenter for the period 1977-1979. Guest workers at WDC-A have used the IMS digital data there. The NASA-sponsored Cooperative Data Analysis Workshops(CDAWs) have been a major contribution to IMS data exchange and use. In Europe and Japan, regional IMS workshops have provided a forum for presentation of results and definition of new studies of IMS data.

6. *Dr. D. Winch* (Australia) wrote to raise the issue of standard digital data formats. The formats adopted in Kyoto and modified in Australia have caused problems for some groups. The 1973 format called for BCD coded tapes which are necessarily 7-track but now most groups use 9-track drives and cannot produce or read BCD. Dr. C. Sucksdorff (Finland) presented the magnetic data format for 1-min and higher resolution data and for hourly data. Dr. Friis-Christiansen (Denmark) shared a copy of their digital magnetic data format for high resolution data. WDC-A for STP has

both a binary format that is optional for their computer environment and a simpler, coded international exchange format. No resolution was proposed in this meeting but the consensus was that each institution will probably develop a local format suited to their computer and special needs (frequency of accession, type of data display most commonly used, and analysis performed on the data). To the greatest possible extent, data formats for international exchange should be simple, machine independent, and flexible. They should not require considerable computer expertise to usefully extract the data for one station and one element for display and analysis.

7. A representative of WG I-5 shared their recommendation that standard data formats for archaeomagnetic and lake sediments data should be adopted and that collections now held by individuals and institutions should be placed in the WDC system.

8. A request was shared from WG V-6 that Solar Wind and Interplanetary Magnetic Field data are needed with greater timeliness than is now generally possible. Some index of energy transfer between solar activity and the earth is needed and it will almost surely involve the solar wind velocity and IMF. A description was given of the real-time availability of some interplanetary parameters from the ISEE-3 spacecraft through the NOAA/SELDADS (Space Environment Laboratory Data Acquisition and Display System). These values are now made available to experimenters having real-time needs and are used in the Space Environment Forecast Center. However, they are not retained for later use. Each ISEE-4 experimenter has access to the data pool tape and special arrangements may be made on a case-by-case basis for access to this. Efforts will be made to encourage sharing of summary data plots for publication in WDC-A for STP's monthly publication Solar Geophysical Data.

The meeting closed with a general expression of hope that it will be possible to have all the Working Group meetings ahead of the Division Meetings at the next IUGG General Assembly (Hamburg, 1983). WG V-7 met in Edinburgh after the Division V meeting so that there was no opportunity to pass on business or resolutions considered by the entire group.

(J.H. Allen, Co-chairman)

WORKING GROUP V-10: GROUND-BASED MEASUREMENTS FOR SATELLITE GEOMAGNETIC SURVEYS

WG V-10 met on 6 August, 1981, attended by 9 scientists and chaired by Co-Chairman H.G. Barsczus in the absence of Chairman, E. Fabiano. After recalling the WG's assignment (promotion of magnetic secular variation observations at selected repeat and variation recording stations performed at short intervals - as ground-based complementation to satellite surveys of the geomagnetic field), the Working Group agreed upon an agenda which was discussed as follows:

1. How to obtain information on the actual status of the project
   Previously, various countries have expressed their willingness to support these activities in various ways. However, very few status

reports have thus far been received (E. Dawson/Canada, E. Fabiano/ USA, G. J. Kuhn/South Africa, P. McGregor/Australia, H.G. Barsczus/ French Polynesia). H.G. Barsczus, as the acting chairman of the WG was asked to carry out an investigation on the question and to report at the next meeting.

2. How to organize collection of data

It was agreed that it is not necessary to put the data into a particular format prior to transmission to WDC-A. The latter is requested to open a special file for these data, and to report on their availability. However, it has to be understood that all data - in order to be useful - should be accompanied by basic information like the following: station identification, period of observation, time used, indication of reduction procedures in case these have been used, instrumentation. In the case of recording station data, only monthly or annual means should be transmitted for this project, accompanied by clear indication of any procedure of reduction, etc.

3. Actual and future requirements for data

R.A. Langel/NASA stressed once more (a) the particular need for data acquired in oceanic and other remote regions, especially in the Pacific and in Africa, (b) the data sets for each station should consist of at least three series of observations, carried out at intervals of 18 to 24 months, and (c) that all data collected and transmitted until December, 1984 will be of direct use to the present Magsat investigations and to the derivation of SV models. He further informed the WG that the NASA presently considers the prospect of launching, about the year 1987, another satellite for the performance of gravity and magnetic measurements - the satellite "Gravsat/Magsat-A".

4. Changes in the WG membership

It was agreed that T. Bergmark (Sweden) should join the WG, and that a representative for South America and China respectively, should be nominated.

5. Other matters

Considering the need for data especially from the developing parts of the world, ways and means to assist countries in the latter parts were under discussion. The WG expects that models for appropriate solutions might emerge based on the conclusions of the Seminar for Developing Countries, to be held at the IAGA meeting in Edinburgh.

(H.G. Barsczus, Co-chairman)

INTERDIVISIONAL COMMISSION ON ANTARCTIC RESEARCH

The following is the report of the Business Meeting held during the 4th Scientific Assembly, Edinburgh, 11 August 1981, 19.30h.

1. The Co-Chairman, Prof. J.A. Gledhill, welcomed those present and referred to the loss which the Commission had sustained by the untimely death of Co-Chairman Aleksander N. Pushkov. As a result, no progress had been made with proposals for the restructuring of the Commission. The main effort had been in the arrangement of the session on "Recent Results from Magnetic and Aeronomic Research in the Antarctic", which had taken place in the afternoon of 11 August. The session had been arranged by the Co-Chairman, the Secretary (Dr. T. Hirasawa) and much help had been received from others, in particular from Dr. A.N. Zaitzev in connection with contributions from the USSR.

2. Dr. A.N. Zaitzev was unanimously elected as the new Co-Chairman.

3. The meeting referred to the Committee, consisting of the Co-Chairman and the Secretary, the matter of restructuring of the Commission and asked them to report at the Hamburg General Assembly in 1983.

4. MAP Regional Definition Group. Dr. T. Nagata asked the Commission to nominate suitable persons who could present a report on MAP activities in Antarctica and the Southern Hemisphere and form a "Regional Definition Group" for that area. It appeared that there is very little MAP activity in the Southern Hemisphere countries that were represented at the meeting. Dr. A.V. Shirochkov and Dr. T. Hirasawa were nominated to prepare the report for the MAP Committee.

5. Dr. M.H. Rycroft proposed that ways should be sought to improve the participation of members of the Commission in the activities of SCAR. He suggested that a number of people might be asked to take an interest in the activities of the SCAR Working Group on Upper Atmospheric Physics. Names suggested were: Keith Cole (Australia), J.J. Berthelier (France), J.A. Gledhill (South Africa), M.H. Rycroft (UK), T.J. Rosenberg (USA), A.N. Zaitzev (USSR), and a representative of Japan, possibly T. Nagata or T. Hirasawa. Prof. Nagata, who is the Chairman of the SCAR Working Group on UAP, welcomed the suggestion that such cooperation should be encouraged in this way. It was agreed that the Co-Chairman, Prof. Gledhill, should write to the Secretary General of SCAR, Dr. G. Hemmen, reporting the discussion in an informal way and asking for SCAR's reaction to the proposal and the best way to put it into operation.

6. Hamburg General Assembly, 1983. The Co-Chairman drew the attention of members of the Commission to three symposia that were proposed for the Hamburg Assembly.

1. Geophysics in Polar Regions. It was noted that Division II was proposing to contribute a section on "Electrodynamics of the Polar Atmosphere and Magnetosphere" to this symposium, and Division III one on the plasmapause and Trough.
2. Data Management.
3. Interim Results of MAP.

It was proposed that the Commission on Antarctic Research would contribute to these symposia, but that the Commission would not press for a special section of its own, in view of the great pressure from all Commissions and Divisions for time on the programme.

7. Mr. J.C. Dooley (Australia) drew the attention of members to an international symposium on "Antarctic Earth Sciences" being organized in Adelaide, Australia, for August 1982.

8. MAP in Antarctica. Dr. T. Hirasawa presented a document on Japanese proposals for a MAP programme in Antarctica. This includes ground-based observations by lidar, spectroscopy, VHF radar, photometry, EM wave recording and magnetometry; balloon observations of aerosols, composition, ionization, electric fields and X-rays; rocket observations of ozone, NO_x, electron density and temperature, energy spectra of charged particles, electric and magnetic fields; aircraft measurements of minor species and aerosols; reception of data from satellites, including EXOS-C; and cooperative balloon observations in the northern and southern polar regions.

RESOLUTION. The meeting resolved to welcome these proposals for a Japanese MAP programme in Antarctica and to bring to the notice of all its members the possibilities for international cooperation that it offers; and draws the attention of IAGA to the differences between the northern and southern polar regions which are so well exploited in these proposals.

9. SHISCAT. Prof. J.A. Gledhill explained the proposal for a feasibility study of a transportable Southern Hemisphere Incoherent Scatter Facility and pointed out that the possibility existed that such a device, if it was built, could be operated in the Antarctic, to explore the atmosphere there in considerable detail.
The meeting resolved as follows:
RESOLUTION. The Commission notes that a proposal is being considered by URSI, that a feasibility study be made of the possibility of building a transportable incoherent scatter facility (SHISCAT), which could be used in the Antarctic and neighbouring regions and endorses the proposal as one which may lead to scientific results of great importance to this Commission, to IAGA and to atmospheric science in general.

10. Dr. A. Valenzuela presented a document on an experiment on the imaging of the upper atmosphere in the UV radiation from magnesium ions. He explained that the Max-Planck Institut für Extraterrestrial Physics in Garching, FRG, proposed to fly balloons in Antarctica to explore this technique, and would welcome approaches from interested people to participate, especially in telemetry reception as the balloons drift round the Antarctic. The meeting welcomed this imaginative experiment and drew the attention of all its members to the international cooperation which it offers.

11. The Co-Chairman thanked members for attending and asked them to check the mailing list which was displayed on the table.

(J.A. Gledhill, Chairman)

INTERDIVISIONAL COMMISSION ON HISTORY

At the IAGA Edinburgh Assembly, the Interdivisional Commission on History held a scientific session, "Geomagnetism and Aeronomy - The Historical Perspective", in the afternoon of Friday, 7 August 1981. This session was attended by over 200 people. The list of presented papers is shown elsewhere in this publication. The Business Meeting followed the scientific session with 25 people attending.

At the beginning of the business meeting, Dr. E.C. Forbes, representing the International Union of the History and Philosophy of Science (IUHPS), Division of History of Science (DHS), described his organization and requested that we join them. It was unanimously agreed to form a working group to work out the details of such a union. The content of the Hamburg meeting was discussed at the business meeting and at several splinter group meetings. It is hoped to hold 2 sessions: 1) "Historical Events or People": 2) "The Use of Historical Records in the Study of Geomagnetism and Aeronomy".

The first topic has drawn great interest with several names being suggested: A.V. Humbolt, Gauss, Lamont, Koenigsberger and A. Schmit and their contributions to geomagnetism, and finally, E. Wiechert, as the first Professor of Geophysics in the world. Prof. W. Kertz of the Institute of Geophysics and Meteorology, Technical University of Braunschweig has agreed to give a talk on: "From the Göttingen Magnetic Union to the First International Polar Year". Dr. W. Schröder was requested to prepare papers on E. Wiechert and the anniversary of the explosion of Krakatoa. Interdivisional and Inter-association support of Prof. Kertz's talk is being sought so that it may be scheduled as a separate evening talk at IUGG.

The second session is of both scientific and historical interest so that interdivisional support is being sought. As the number of sessions at IUGG will be severely limited, it is hoped that this session can be co-sponsored. As there may also be a related IUGG session, Inter-association sponsorship may also be obtained.

At present the possibility of a day trip to Göttingen under History Commission sponsorship is being investigated. Finally, it was noted that the 1983 Assembly falls near the anniversary of the First (1882-83) and Second (1932-33) International Polar Years and the IGY (1957-58).

(H.B. Garrett, Chairman)

INTERDIVISIONAL COMMISSION ON THE MIDDLE ATMOSPHERE

The main task of this Intervidisional Commission after the last Canberra Assembly has been to encourage various kinds of research connected with the Middle Atmosphere Program, which is now being carried out under the auspices of SCOSTEP. It was very advantageous for middle atmosphere scientists that SCOSTEP convened its meetings for MAP towards the end of the IAGA Assembly in Edinburgh on 14 and 15 August 1981, so that we could learn of the plans for MAP observations in the participating countries over the world. This arrangement by SCOSTEP gave some key IAMAP persons an opportunity to participate in the "Middle Atmosphere Scientific Symposia" held during 10-13 August.

At the Canberra Assembly, IAGA and IAMAP agreed to hold the above symposia in two parts, the first part in Edinburgh during the second week of the IAGA Assembly, and the second part in Hamburg during the week following the IAMAP Assembly. It was later reported that 22 IAGA registrants participated also in the IAMAP Assembly in Hamburg.

During the IAGA Scientific Assembly in Edinburgh, the Interdivisional Commission on the Middle Atmosphere held its Business Meeting on 11 August 1981, on Tuesday evening, from 7;00 p.m.. The meeting was so arranged that the general business meeting was held in one room, followed by two separate working meetings, i.e. on "middle atmosphere electrodynamics" and the other on "solar UV irradiance".

At the beginning of the business meeting, the chairman reported that at the IUGG Executive Committee meeting held in July 1981 it was decided to hold the interdisciplinary symposium on the "Interim Results of the Middle Atmosphere Program" during the next IUGG General Assembly in Hamburg in August 1983, with L.R. Megill as the chief convener. Since the time allocated for this interdisciplinary symposium is only 1.5 days, it was agreed to present only review papers during the IUGG symposium, and to plan some IAGA/IAMAP joint sessions to welcome a number of contributed papers on various subdivisions of the middle atmosphere sciences.

The Interdivisional Commission on the Middle Atmosphere had a working group on "Solar UV Irradiance". At the Edinburgh Assembly a second working group on "Electrodynamics of the Middle Atmosphere", was organized. The minutes of this new working group meeting, which were written by Dr. R.A. Goldberg, are attached below.

(L.R. Megill, Chairman)

Minutes of the Working Group on Electrodynamics of the Middle Atmosphere

On the evening of 11 August 1981 (7.45 - 9.30 pm), a meeting was convened at the 4th IAGA Scientific Assembly in Edinburgh, Scotland, for the purpose of organizing a working group on Electrodynamics of the Middle Atmosphere. This group was organized under the auspices of the Interdivisional Commission on the Middle Atmosphere. The attendees included ten participants from four countries, representing many of the disciplines thought to be important in this newly emerging field.

Agenda

1. Define the need for this working group
2. Establish a series of goals and objectives for the working group
3. Review current state of field; show its relationship to IAGA sponsored disciplines
4. Elect a chairman and organize the group
5. Make recommendations regarding sessions for the next IAGA meeting

1. It was immediately agreed that there is a definitive need for this group, to provide a platform for exchange of scientific information in this new field at an international level. It was felt that the current working group on Electrodynamics in Division III of IAGA is orientated toward magnetospheric research, and does not normally address this discipline. IAMAP has the International Commission on Atmospheric Electricity, which is mainly concerned with tropospheric phenomena. It was recommended by L.J. Lanzerotti, and agreed upon by the group, that this discipline could best the served by entry into Division II of IAGA, with an investigation for future affiliation with IAMAP.

2. It was decided that the Objectives of this working group would be:

To make recommendations for IAGA conference sessions.
To review current experimental techniques and recommend future repeatability and intercomparison approaches.
To consider the feasibility of a geoelectric index by definition of need and through the evaluation of meaningful parameters to be measured, including their use in (or as) an index

The last goals would be accomplished through organization of study groups and canvassing of the scientific community. It was decided that an irregular newsletter (1-2/year) might be published to inform the community of progress in the field.

3. It was decided that the field of Middle Atmospheric Electrodynamics is well suited for inclusion in IAGA.

4. Elections were held to elect a Chairman and two Vice Chairmen. Dr. R.A. Goldberg (U.S.A.) was elected unanimously as Chairman of the Working Group. Drs. A. Brekke (Norway) and H. Volland (F.R. Germany) were selected as Vice Chairmen.

The Working Group is currently composed of the ten attendees, plus two delegates of the Assembly (A. Brekke and J.A. Holtet of Norway) who where unable to attend. Earlier, a letter by Dr. L.R. Megill was sent out to a representative list of scientists throughout the world, to establish interest in this field. More than 40% responded, many of whom encouraged the formation of this Working Group in spite of their inability to attend the IAGA Assembly. It is anticipated that additional members of the Working Group will be selected from this list, and from recommendations of current members.

Two immediate goals were established for the group. The first was to petition with IAGA for early entry into Division II. The second was to develop an international mailing list for dissemination of information. Drs. Kato and Few agreed to assist in the organization of such a list.

(R.A. Goldberg, Chairman)

INTERDIVISIONAL WORKING GROUP ON RELATIONS BETWEEN EXTERNAL AND INTERNAL MAGNETIC VARIATIONS

The business meeting of this Working Group was held on Thursday, 9 August at 1930-2045. It was attended by 22 delegates.

The chairman congratulated the conveners on their efficient organisation of 4 scientific sessions for this Assembly, all of which are well-subscribed with papers. Indeed, it is interesting to note from the Programme and Abstracts book that there are more abstracts submitted to the External/Internal sessions than to all but Divisions I, II and III, and that their number exceeds the sum of those submitted to Division V plus all the Interdivisional Commissions. The content of the sessions will be summarised elsewhere, by the respective conveners.

The meeting then discussed the Interdisciplinary Symposia proposed for the 1983 meeting of IUGG in Hamburg. It was not considered that any of them was sufficiently specific to this Working Group for it to be appropriate for us to suggest conveners.

For our own contribution to the Hamburg meeting, the following 5 topics for half-day interdivisional scientific sessions were proposed (with conveners in parenthesis):

1) Origin and comparison of Sq and L variations (Matsushita, Winch, Gupta)
2) Modelling the magnetic field from core to magnetosphere (Olson, Matsushita, Singh)
3) Special Sq effects near the equatorial electrojet (Rastogi, Oni)
4) External/internal results from studies of IMS data (Campbell, Tschu)
5) General contributions on external/internal effects (Malin, Gupta)

The second topic is a new departure for this Working Group. The need for communication between modellers of the main field, ionospheric field and magnetospheric field has been noted elsewhere. At the request of the President, this sugject is now included (with S and L) as part of the remit of the External/Internal Working Group. The objective towards which we should work is the adoption of a comprehensive model of the geomagnetic field from the surface of the Earth's core to beyond the magnetosphere. The model should be included in a subroutine that will supply magnetic field components for specified date, time, position, activity level, etc. It is hoped that some of tne contributors to Session 2 will present candidate models.

The following resolutions were submitted for consideration by the IAGA Resolutions Committee:

1. Recognising the valuable contribution of the World Data Centres to the scientific community throughout the world, the IAGA urges that these Data Centres should be maintained and, if possible, expanded, during the coming years.
2. Recognizing the success of MAGSAT for improving out knowledge of the Earth's magnetic field, the IAGA suggests that a second such satellite be flown that would sample the field at all hours of local time rather than only dusk and dawn.

(S.R.C. Malin, Chairman)

WORKING GROUP BETWEEN DIVISIONS II AND III ON THE AURORAL OVAL AND ITS EXTENSION INTO SPACE (WGAO)

The business meeting at the Edinburgh Assembly of IAGA covered two main topics: the future meetings of interest to the Working Group and future projects in magnetospheric and auroral physics. The following table summarizes the results of our discussions on the latter topic.

Present and Future Projects with Spacecraft

Agency	Spacecraft	Orbit	Status	Instrumentation
USA/NASA	ISEE-1, 2	Coordinated pair in high altitude elliptical orbits, apogee $21R_E$	operating until ?	Magnetospheric fields and particles
USA/NASA	ISEE-3*	Heliocentric near libration point	operating until?	Interplanetary fields and particles, solar
ESA	GEOS-2	Geosynchronous	operating until mid-1982	Magnetospheric fields and particles
ESA	METEOSAT F-2	Geosynchronous	operating	Low energy electron detectors as environmental monitors
USA/NASA	Dynamics Explorer 1, 2	Coplanar orbits 1 - high altitude elliptical, polar apogee $4R_E$ 2 - low altitude, polar	operating	Atmospheric, ionospheric & magnetospheric instrumentation
USSR/ FRANCE	AUREOL-3	Low altitude, polar	operating	Atmospheric, ionospheric, magnetospheric
USA/NASA GERMANY UK	AMPTE CCE IRM UKS	CCE elliptical, low latitude $7R_E$ apogee IRM/UKS coordinated pair in low latitude elliptical orbit with apogee $20R_E$	launch planned Aug. 1984	Active experiments in solar wind & magnetosphere using Ba & Li releases, fields, particles & composition instrumentation
SWEDEN	VIKING	Polar, elliptical 800 km x 15000 km altitude	launch planned May 1984	Auroral, ionospheric fields and particles and imaging

* *In July 1982, ISEE-3's orbit was changed so that it drifted out of the libration point orbit and into a highly elliptic orbit about the earth. In the near term lunar flyby trajectories will be used to maintain the line of apsides in the geomagnetic tail. In 1984 the orbit will be changed once more to send ISEE-3 to intercept comet Giaccobini-Zinner.*

Agency	Spacecraft	Orbit	Status	Instrumentation
USA/DOD	DMSP	Two satellites in low altitude, circular polar orbit, one dawn-dusk, the other noon-midnight	launched as required	Particles with E & B field from flight F9
USA/DOD	RADSAT	Low-latitude, elliptical $1.2R_E \times 8R_E$	launch planned late 1985	Magnetospheric radiation environment B field
USSR	-	Polar orbit 6000 kms apogee	planned 1984/5	Magnetospheric
USSR	Prognoz	Elliptical, high-altitude	planned 1984/5	Magnetospheric
USA/NASA	OPEN programme	4 spacecraft in coordinated high altitude orbits	proposed late 1980's	Magnetospheric, interplanetary
USA/DOD	DMSP/OPEN	2 in low altitude polar orbit coordinated with NASA OPEN	as above	Ionospheric, magnetospheric
JAPAN	OPEN - J	High altitude, elliptical, coordinated with NASA OPEN	as above	Magnetospheric

Ground Based Facilities

Agency	Name	Status	Description
Germany Norway Finland	STARE	Operational	Twin auroral radar covering northern Scandinavia. Measures two dimensional distribution of reflection intensity and two dimensional drifts.
UK Germany	SABRE	Operational	Same as above, covering sector equatorward from STARE.
Norway, Sweden Finland, UK France, Germany	EISCAT	Operational	Incoherent scatter at UHF, VHF transmitters at Tromsö UHF, VHF receiver at Tromsö UHF receivers at Kiruna, Sodankylä
USA	Chatanika radar	To be moved to Greenland	Incoherent scatter

(C.T. Russell, Chairman)

JOINT IAGA/URSI WORKING GROUPS

General Remarks: Since the XIX General Assembly of URSI in Helsinki in July/August 1978, IAGA has had Joint Working Groups with URSI on the following four subjects:

- Structure and Dynamics of the Thermosphere, Ionosphere and Exosphere,
- Neutral and Ion Chemistry and Solar Fluxes,
- Passive Electromagnetic Probing of the Magnetosphere,
- Wave Instabilities in Space Plasmas.

At the IUGG/IAGA General Assembly in Canberra in December 1979, IAGA endorsed the continuation of these four Joint Working Groups as long as URSI wished to maintain them.

In September 1981, both URSI and IAGA had their Assemblies; unfortunately, the venues were across the Atlantic, and, furthermore, the period of the respective meetings had an overlap of one week. Although both URSI and IAGA tried to arrange their scientific meetings to avoid clashing as much as possible, it was still inconvenient for those scientists who are active in both organizations, especially the members of the Joint Working Groups between URSI and IAGA.

The activities of the above Joint Working Groups were reviewed, and the necessity of their continuation was discussed at the meetings of both URSI and IAGA. IAGA maintained its attitude to leave the decision of continuing up to URSI. According to a recommendation from URSI (which was made known after the IAGA Edinburgh Assembly), the former two Joint Working Groups were disbanded. Hence, after September 1981, IAGA maintains the following two Joint Working Groups with URSI on

- Passive Electromagnetic Probing of the Magnetosphere (with URSI Commission H),
- Wave Instabilities in Space Plasmas (with URSI Commissions G and H).

The following two reports have been received from the leaders of the IAGA/URSI Joint Working Groups; the first one is a reproduction of the report presented to the XX URSI General Assembly.

(N. Fukushima)

IAGA/URSI JOINT WORKING GROUP ON 'NEUTRAL AND ION CHEMISTRY AND SOLAR FLUXES'

The main business of the Working Group during this period (1979-81), was conducted prior to and during the IUGG General Assembly held in Canberra, December 1979. In addition, informal meetings were held at the time of the URSI General Assembly in Helsinki, August 1978, and other business has been carried out by correspondence.

At Canberra, the Working Group helped to organise the IAGA Scientific Symposium on Thermospheric Chemistry. As expected, results derived from the successful series of Atmospheric Explorer (AE) satellites featured strongly in the programme.

The meeting of the Working Group at Canberra was chiefly concerned with future plans in the areas of AE satellite data exploration, solar flux measurements, rocket and ground-based measurements and the Middle Atmosphere Programme. It was suggested that Professor D.G. Torr should serve as the second Vice Chairman of the Working Group following the untimely death of Professor T. Tohmatsu in November 1977. During the discussion of the future of the Working Group it was considered that it is, perhaps, of particular value to URSI because, with the reduced emphasis on Geophysics within the Union, the Group enables URSI to maintain an interest in, and to take advantage of, developments in our understanding of the ionized regions for exploitation in radio communications.

It was agreed that the future of the Working Group should be raised at the General Assembly of URSI to be held in Washington, August 1981. In this discussion consideration could, perhaps, be given to a re-naming of the Working Group to reflect the objective outlined above.

(L. Thomas, Chairman)

IAGA/URSI JOINT WORKING GROUP ON PASSIVE ELECTROMAGNETIC PROBING OF THE MAGNETOSPHERE

A meeting of the Working Group was held during the Fourth IAGA Scientific Assembly in Edinburgh on the morning of 7 August 1981. The following were present: F. Glangeaud (France), N.G. Kleimenova (USSR), O.M. Raspopov (USSR), M.J. Rycroft (Co-Chairman, U.K.), M.W.J. Scourfield (South Africa), A.J. Smith (UK). There was a rather low attendance at the meeting due possibly to the clashing URSI Assembly. There was, regrettably, no representative from Stanford able to be present, nor a representative from the Japanese groups.

Introduction

Rycroft stated that he wished to relinquish his position as co-Chairman, as did D.L. Carpenter. They had suggested that A.J. Smith should be the new co-Chairman on behalf of IAGA, and that K. Tsuruda should be the new co-Chairman of URSI. The meeting accepted these suggestions which should be put into effect if URSI at its Twentieth General Assembly in Washington, D.C., agrees to maintain the existence of the Joint Working Group. If it does not agree to do so, the meeting considered that there was a definite need to maintain the group as a recognizable entity within Division III of IAGA.

It was agreed that a copy of the Joint Working Group mailing list, built up by Carpenter should be sent with a copy of the Working Group report to each scientist on the list. Additions to the list, and deletions from it, could then be suggested by the membership. At the same time, the membership would be reminded of the activities and scientific objectives of the group; changes to these could also be suggested by correspondence with Smith. It would also be helpful to send out advance notification of meetings of the group together with an agenda.

Reports of activities since the last meeting (Canberra) and future activities.

Kleimenova and Raspopov for the USSR reported that in Antarctica VLF observations at Mirny and Druzhnaya were continuing. Also there had been a Japanese-Soviet collaboration on VLF emissions and pulsations using data from Syowa and Molodezhnaya, and this was planned to continue. The analysis of the large ammounts of data accumulated was a problem, with a limited number of analysers available. VLF emissions and ULF pulsations at high latitudes should be studied together since they were closely related phenomena having similar generation regions. Observations were now being made near Tbilisi, Borok, Murmansk, Ny Alesund (Spitzbergen), and at the antarctic stations Molodezhnaya and Vostock. Interference problems were sometimes encountered. Records on paper charts were obtained from Yakutsk, Kamchatka and Tixie Island. Experiments were being conducted on horizontal magnetic and vertical electric wavefields. The relationships between VLF signals and geomagnetic pulsations were also being investigated.

Progress in VLF research in the Natal group had, according to Scourfield, slowed down somewhat owing to research staff taking sabbaticals and thus becoming involved in other projects. However, ground-based VLF observations were now in progress at the new Sanae station, running on a continuous or one minute in five schedule. The Stanford type tracker-d.f. system, which had been tried at Sanae had not worked satisfactorily. The ISIS satellite receiver formerly at Sanae had now been removed to Durban and was in use for receiving low latitude data from the satellite. A field mill had been installed at Sanae for the measurement of the atmospheric electric field.

On the analysis side, an on-line minicomputer was in use to speed up data processing. Work had been done on pulsating auroras and VLF hiss, with cross-spectral analysis being used to indicate the location of source regions for auroral electrons and VLF hiss. VLF hiss seen on ISIS was being used to determine ion densities. A 24-hour period, with high whistler rates at Sanae, had been selected for the purpose of measuring $\underline{E} \times \underline{B}$ plasma drifts by tracking whistler duct motions over an extended time period such as the 24-hour period studied previously. Continuous recordings in periods of high whistler activity were necessary for this work. Information on periods for which VLF data were available had now been computerised, and this would greatly assist in identifying IMS periods for which comparisons of data from the L=4 Antarctic chain would be desirable.

Smith reported for the BAS/Sheffield University group that the VLF goniometer receiver had continued in operation at Halley, Antarctica in 1980, and would continue in the future. Although the IMS observational phase was now over, a coordinated observing programme for the L=4 chain of Antarctic stations had been organised by Carpenter in 1980, but not 1981, since Siple had ceased operating for a year. A large and good set of VLF recordings had been gathered during IMS and this was now beginning to be used for investigating scientific problems, e.g. the study of longitudinal plasmapause structure from simultaneous whistler data at Halley and Siple. It was now important to identify periods of interest, e.g. with continuous high whistler rates for drift studies, and to undertake analysis of data from several stations. This view was also expressed by other participants.

In 1980 a temporary goniometer station had been operated at Ryvingen (200 km south of Sanae) for triangulation work with Halley, and two goniometer stations in Newfoundland, conjugate to Halley, had also been operated for 16 days in June 1980. Smith also reported important developments in data analysis techniques, where the addition of a PDP-11 minicomputer to the

existing whistler analyser at Sheffield University had considerably eased the task of processing VLF goniometer recordings; a system for the storage, manipulation and display of spectral data in digital form was now being developed.

Glangeaud described the work of the French groups in the field. Garnier's group in Paris was involved with active experiments using a power line in Norway as a VLF transmitting aerial. Corcuff's group at Poitiers was continuing VLF recordings at Kerguelen and General Belgrano, and studying the magnetospheric convection electric field using whistlers. Gendrin's group had a mobile station for ULF, VLF and optical observations, which was currently operating at Skibodn in northern Norway. In view of the close relationship between VLF emissions and ULF pulsations, members of the Joint Working Group were urged to be aware of the activities of the ULF working group and to exchange information with it.

Other matters

In selecting periods for case studies, it was agreed that it would be most useful to have available a list of what ground-based VLF recordings had been made by the different participating groups, at least over the IMS period. Smith undertook to attempt to assemble such a list, in conjunction with Carpenter. It would be also helpful to circulate lists of periods which were currently being analysed; one example was 10 July 1978 for which whistler duct drifts at Halley and Siple were being studied. Spaced-station observations, direction finding recordings and liaisons planned with other experiments (such as the recently launched Dynamics Explorer satellites) were discussed. Smith and Scourfield agreed that, in connection with DE, it would be valuable for Sanae and Halley to make simultaneous observations, both continuous and one minute in five during June and July 1982. Scourfield suggested that Sanae and Halley should keep in touch via HF radio and inform each other about the occurrence of good whistler reception; this would help to optimise simultaneous recordings at the two stations. The question of possibly operating a Sheffield type goniometer at Sanae was raised and Smith would look into this. Rycroft recommended that special attention be given to making recordings on Regular World Geophysical Days (Wednesdays), particularly June 16 and July 14, 1982.

Glangeaud drew attention to new methods of signal processing which were being developed, notably by Sanson, which may be of interest to members of the Joint Working Group. A 1.5 day session on signal processing methods for geophysics would take place during the 1982 European Geophysical Society meeting at Leeds (England).

Selected days for study by the pulsation community had been identified by W.J. Hughes and P.F. Fougere.

Scourfield mentioned that Mattern (FRG) planned VLF measurements aboard a ship crossing the North Atlantic, going near the geomagnetic conjugate of Sanae, and also at a remote station on the Filchner ice shelf, Antarctica.

(M.J. Rycroft, A.J. Smith)

WORKSHOP ON STRENGTHENING IAGA SCIENCES IN DEVELOPING COUNTRIES

During the Fourth Scientific Assembly of IAGA in Edinburgh, the Workshop on Strengthening IAGA Sciences in Developing Countries was held in the evenings of 10 and 14 August 1981. The Proceedings and Recommendations from this Workshop were compiled by the President of IAGA, K.D. Cole, and this report is now available from him on request. The following is an extract from the Proceedings of the successful meetings held in Edinburgh.

FOREWORD (by K.D. Cole, Convener)

A workshop on 'Strengthening IAGA Sciences in the Developing Countries' was held at the Fourth Scientific Assembly of IAGA at Edinburgh on the evenings of 10th and 14th August 1981. This was a sequel to the Symposium on 'Opportunities in Geomagnetism and Aeronomy in Developing Countries' held at the IAGA/IAMAP Joint Scientific Assembly at Seattle, August 1977, which was convened by A.A. Ashour and co-convened by J.G. Roederer.

The aim of the workshop was to evolve a plan of action for Strengthening IAGA Sciences in Developing Countries, following a discussion of,

(1) The present status of education and research in Geomagnetism and Aeronomy in the Developing Countries;
(2) The role of education and research in Geomagnetism and Aeronomy in the technological progress of a developing country;
(3) Entrepreneurial steps which must be taken at the personal, institutional, governmental and international level to strengthen IAGA sciences;
(4) Identification of institutions interested in this problem;
(5) Identification of persons prepared to devote considerable time to do work involved in implementing this plan.

The workshop was attended by about 80 persons who formed four groups to discuss topics which the meeting considered significant. These were:

Group 1: Education
Group 2: Research and Geomagnetic Observatories
Group 3: Institutional networks; Government agreements
Group 4: Individual initiatives.

Reports of each group were produced and have been collated, together with some individual comments received at the workshop and since then. No editing has been done on this material in the interest of fast dissemination.

On the final evening of the workshop, an ad hoc committee of IAGA was formed to take the next steps in promoting the aims of the workshop, drawing upon the reports of the working groups and any other sources, e.g., the proceedings of the previous Seattle symposium. The committee should define its terms of reference which can be confirmed in due course by the Executive Committee of IAGA.

MAIN POINTS IN THE REPORTS FROM WORKING GROUP PARTIES

No.1 EDUCATION (by G. Rajaram)

Educational requirements were discussed in detail for (1) High School and Pre-University (A-level) stage, (2) University Undergraduate, (3) University Postgraduate, and (4) Advanced Level Research and Training. Then the urgent needs and immediately appreciable plans were summarized as follows.

1. Setting up of a central IAGA organization to act as a liaison and clearing house for audiovisual aids, apparatus, equipment, books, journals, posters and documentary movies. This organization could keep itself informed about material required by developing countries, as well as material which can be spared by developed countries, and then arrange for interchange.
2. IAGA News could possibly reserve a page for exchange of information on the above, so as to keep scientists all over the world informed.
3. IAGA could recommend to governments, scientific ogranizations, research and educational institutions of various countries, certain points that are relevant to enhancing the standard of education, research and experimentation in developing countries. A typical example is the necessity of treating the pure and applied aspects of the sciences in an integrated manner. This will ensure better exchange of vital information, and active encouragement of local governments towards these sciences, once they realise that material prosperity can ensue from such studies.
4. IAGA could nominate local people in developing countries and developed countries, who can act as liaison between IAGA and the respective countries, as regards various necessities of COGADEC.
5. IAGA could set about establishing international centres for Geomagnetism and Aeronomy. This aspect will be dealt with in some detail as it was recommended by many scientists at the Edinburgh workshop. A typical example would be a Centre for Geomagnetism with facilities for advanced level and training, including a data-bank with say magnetic survey data (ground, ocean, air and satellite surveys). Scientists from developed countries would stay at this centre for suitable periods of time, and in addition to being exposed to various aspects of Geomagnetism, would be trained to use survey data for pure (Geophysical Science) and applied (say, location of natural resources) purposes. These scientists on returning to their native lands, could remain in contact with this Centre, while developing Geomagnetism in their respective countries.
   Such a project will need large-scale funds for which the UN would be a potential source. Some contribution could come from the developing countries themselves, following the principle that it is best for these countries to join hands in lifting up their own science and technology.
6. IAGA could recommend that personnel from developing countries who come to developed countries for training, should build their own equipment or data base, take it back home, and actively work on it to improve it and innovate on it.
7. IAGA could recommend to developing countries quick action in selecting qualified people to write good, lucid text books in Geomagnetism and Aeronomy for various levels. Such text books published within the respective countries would be low-priced and rather effective in disseminating knowledge on these subjects. IAGA could help towards scrutiny of the written matter, and funds for publishing.
8. IAGA could actively contribute towards the twin tasks of (a) motivating young students, (b) spreading the scientific temperament amongst the public in developing countries. These aspects have a high priority in developing countries.

Medium and Long-term plans

IAGA probably does not have to worry too much about this, except to raise the level of communication in pace with rise in scientific ability. Certainly some of these short-term plans, e.g. (a) treating Pure and Applied Geophysics in an integrated manner, (b) establishing centres for training personnel in Geomagnetism and Aeronomy, (c) encouraging availability of low-priced text books written by qualified scientists of developing countries, (d) motivating young students, and taking science to the common man in developing countries, are in themselves re-generative. These schemes will automatically lead Geomagnetism and Aeronomy into newer and better avenues, and there may even be major breakthroughs in these sciences, as a consequence.

No.2 RESEARCH AND MAGNETIC OBSERVATORY PROGRAMS (by K.L. Svendsen)

It is the belief of this working group that research in pure and applied geophysics is contributory and important to the development of countries. In as much as local magnetic observatories are a major source of data supply for local research, operation of magnetic observatories is an important factor in this reasearch and the health of their operation should be assured.

At the present time, the institutions in developing countries which are engaged in this research and are operating magnetic observatories are experiencing a variety of serious problems, some as serious as to threaten cessation of operation. In a poll of geophysical representatives from more than a dozen developing countries, the following problems were considered to be the most serious:

(1) Lack of trained scientists and technicians
(2) Lack of financial support or understanding by management
(3) Lack of research tradition (and low production of papers)
(4) Lack of opportunities for personal contact with foreign colleagues (including attendance at international meetings)
(5) Few graduate students (now lured away by higher paying positions)
(6) Lack of exchangeable currency for purchase of instruments and supplies
(7) Lack of opportunities for experiments

In general it was felt that those actions should be favoured which are designed to get at the core of the problems (not those which provide only temporary relief) and develop independence of the countries, although it was recognized that for some important scientific programs such as IMS and Magsat, some temporary action might be indicated. It was also recognized that most of the developing countries are in the equatorial and low latitude regions, and that therefore, programs including phenomena of those regions should receive special consideration.

It was the consensus that these problems are not easily solved and will, therefore, require some years of effort at correction. Accordingly, the working group urges IAGA to create a permanent committee to work on these problems. This committee would operate not only at the biennial meetings of IAGA, but on a continuing basis. It was noted that the present Working Group on Magnetic Observatories, Instruments, and Standards has been operating as a clearing house for solutions of urgent instrumental problems.

The following specific items are recommended for immediate action by IAGA:

(1) Creation of an IAGA Committee on Assistance to Developing Countries (CADC)

(2) Agreement of IAGA to send letters urging support of magnetic programs to those institutions requesting such assistance (currently, Kenya and Nigeria)
(3) Approach by IAGA to certain international bodies for establishment of regional training centres in geophysics: For Africa, to ECA for an International Center for Pure and Applied Geophysics in Africa (ECA is already supporting such a centre for geodesy); For Asia, to ASEAN; For Latin America, to OAS. Alternatively, one could consider one international center such as the one for physics in Trieste.
(4) Expression of intent by IAGA to consider endorsement of future proposals to UNESCO, UNDP, COSTED, AGID or other international bodies for grants for study abroad and other items mentioned above.
(5) Application by IAGA for funds from UNESCO to support travel of a specialist in magnetic operations through the regions of developing countries for upgrading magnetic observatory and field programs.

The following items are to be studied by the CADC for possible future action:
(1) How to promote visits of foreign scientists and technicians
(2) How to effect the donation of instruments
(3) The formation of regional workshops.
(4) The promotion of bilateral agreements for training technicians and for cooperative research projects (It is noted that India already has a national program of assistance to other developing countries in training of technicians)
(5) Justification for magnetic programs
(6) Preparation of a periodic newsletter giving information on activities of the CADC
(7) The promotion of the teaching of geophysics in the universities of the developing countries
(8) How to improve libraries of geophysics

No.3 INSTITUTIONAL NETWORKS (by H.G. Barsczus)

The meeting of this group was attended by few participants having immediate interest in that field. This low attendance was probably caused by a bad definition of the goal of that group which failed to identify a significant list of institutions able to become active in contributing to the advancement of geomagnetism and aeronomy in developing countries - if this was the assignment of the group. Such institutions are, for example, ORSTOM and CRG Garchy, both of France (having long experience with working in developing countries and/or training of scientists and technicians from and for developing countries), and WDC-A from Boulder/USA. A short report was also given on INAG activities.

However an immediate agreement was obtained concerning the need for appointing a special IAGA Committee for Developing Countries, and the group agreed to submit to SDC the following proposal essentially written by C.A. Onwumechili, followed by a list of suggestions for solutions relative to each specific field.

Committee on Geomagnetism and Aeronomy in Developing Countries (COGADEC)

Realising that the cheapest and most efficient approach to geophysics is through a global effort in which, as far as possible, each country studies its own environment and contributes to the world data bank and the steady growth of geophysical knowledge.

The objective of the exercise is the stengthening of the indigenous capability of the developing countries in the areas of geophysics, and more particularly in geomagnetism and aeronomy.

To focus attention and effort on this objective, it is proposed that a standing committee on Geomagnetism and Aeronomy in Developing Countries (COGADEC) be formed. Such a committee should be a vehicle for launching some of the recommendations that may come from the ad hoc groups formed on August 10, 1981, discussing:

a. educational and training programmes;
b. research and technical programmes;
c. institutional and international arrangements; and
d. individual initiative

Membership of the Committee should reflect as many areas of geomagnetism and aeronomy as possible as well as ensure a large geographical distribution, comprising both developed and developing countries. (Refer to existing IAGA discussions and working groups). If it becomes necessary, appropriate recommendations could be made in due time to IUGG to ensure that other areas of geophysics are covered and that a similar Committee of the Union might be set up.

While reporting periodically to its parent body, in order to ensure fast and unbureaucratic action, this Committee should enjoy a large measure of freedom of action, depending on its ability to find funds for its activities. Among these activities, the Committee may possibly through action of some of its proper ad-hoc working groups to be formed:

FUNDING: Attract funds from funding agencies and elsewhere in order to ensure its action capability;

EDUCATION: Organize workshops, study, scientific and technical training groups, symposia, seminars etc in liaison with existing national or international organizations on various aspects of geomagnetism and aeronomy in developing countries, and as far as possible with the venues in developing countries;

RESEARCH: Organize cooperative studies of geomagnetic and aeronomical phenomena of particular interest to developing countries and encourage the active participation of developing countries;

ADVICE: Encourage permanent observations of important geomagnetic and aeronomical phenomena in appropriate developing countries;

INFORMATION AND EXCHANGE: Serve as a clearing-house on information and linkages between scientists and institutions in developed and developing countries;

INDIVIDUAL INITIATIVES: Encourage participation of scientists from developing countries in international activities as well as visits of scientists and technicians from developed countries to developing countries and vice-versa, on an individual basis, and other individual initiatives with regard to collection and of donation and transport of spare equipment, other supplies, technical information (such as blueprints of instrumentation), books, journals etc for and to developing countries.

Experience has shown that such committees have been able to find funds and have contributed significantly to the achievement of the objective for which they were formed, for example - Committee on Space Research (COSPAR), Scientific Committee on Antarctic Research (SCAR), International Scientific Committee on Equatorial Aeronomy, INAG, and so on.

No.4 INDIVIDUAL INITIATIVES (by N.J. Skinner)

It was felt that there were a number of areas in which immediate progress could be made in strengthening IAGA sciences in developing countries for the expenditure of relatively small sums of money. The group considered the following three topics, and the recommended actions are also mentioned in the original report.

1. Visiting Scientists

(a) Short-term visits: Scientists in developing countries have relatively little opportunity for personal communication with other scientists. On the other hand, scientists travelling to conferences or on sabbatical leave could frequently make short stopovers in developing countries if the necessary contacts could be made in advance. The group recommends the establishment of a visitors' registry (along the lines originally suggested by Dr. M.J. Moravcsik at the Seattle Assembly). One scientist would act as coordinator. He would receive travel details from scientists who over the next few months would be travelling through or near some developing area, and would fill in an information card. Xerox copies of this card would then be sent to institutions who have indicated a general interest in receiving visiting scientists working in the fields of IAGA interest. If the host institution is interested in receiving a particular visitor it would make direct contact with the visitor and arrange all the necessary details. The cost to IAGA of implementing this scheme would be quite small and would consist mainly of postage costs.

(b) Longer-term visits: Longer working visits of scientists to or from developing countries could also be arranged through the coordinator of the visitors' registry.

2. Strengthening of Library Material in IAGA Disciplines

(a) Back sets of journals: Many newly established libraries in universities in developing countries cannot afford to buy back sets of scientific journals necessary for effective research in IAGA based fields, especially as payment would normally have to be in hard currency. At the same time many older scientists can no longer afford the shelf space required to accommodate long runs or journals which are now seldom consulted by them. Again it would seem that a coordinator is required to collect information from both donor scientists and potential receptor libraries (in consultation with local scientists) in order to facilitate the appropriate 'match'. The receptor library should be prepared to pay the transport costs of the material although it is sometimes possible to make special transport arrangements through, for example, the embassies of the donor's country, or through UNESCO (who have paid transport costs for this type of operation in the past).

Another method which should be considered is to supply back files of journals in micro-film form.

Gifts of books and book collections could also be handled through the coordinator.

(b) Current journals: The shortage of hard currency frequently restricts the range of current science journals subscribed to in developing countries. Many of these journals are published by learned societies operated by the scientists themselves, who thereby are in a position to influence the policy of the societies.

(c) Access to computer 'on-line' bibliographic databases in the geosciences: Scientists in developing countries with limited library facilities have difficulty in doing the necessary bibliographic research for their projects. Many libraries in Europe, North America and elsewhere have access to on-line bibliographic databases in the geosciences. Many scientists in developing countries are not even aware of the scope of this type of information system.

3. The Transfer of 'Idle" Equipment: Most scientists in developing countries suffer from the shortage of both specialised equipment for undertaking particular types of research investigation and more basic equipment in the test and monitoring categories (e.g., oscilloscopies, power supply units, etc.). In developed countries a considerable quantity of such equipment is becoming surplus to requirements. For example, many networks are currently shifting to digital magnetometers and sophisticated ionosonde models, and older machines (often with a useful lifetime) are being discarded. This is another case where IAGA could play a valuable 'broker's' role. Conditions of transfer whether by gift, indefinite loan or token payment, and transport costs, would have to be arranged directly by negotiation between donor and receiver groups. Hopefully scientific collaboration would also take place to their mutual advantage.

The ad hoc Committee for Geomagnetism and Aeronomy in Developing Countries

This committee (consisting of the following members) was formed on 14 August 1981 to take next steps in strengthening IAGA sciences in the developing vountries. It should also generate a set of terms of reference for confirmation as soon as possible by the Executive Committee of IAGA.

E. Oni (Nigeria) Chairman	J.P. Patel (Kenya)
I. Galindo (Mexico)	I. Pacca (Brazil)
Q.-L. Liu (China)	G. Rajaram (India)
K.L. Svendsen (North America)	S.R.C. Malin (Europe)
V.A. Troitskaya (U.S.S.R.)	N. Fukushima (ex officio)

K.D. Cole (ex officio, Added by the President of IAGA subsequent to the meeting.)

PROGRAMMES AND HIGHLIGHTS OF THE IAGA SCIENTIFIC SESSIONS

During the Fourth Scientific Assembly of IAGA in Edinburgh, the following 46 scientific sessions were held, in addition to the Reporter Review sessions of Divisions I-V. For ordinary sessions, 1013 papers were submitted, and the Programme-Abstracts booklet was published as IAGA Bulletin No.45, consisting of 614 pages (8 pages for general remarks, 100 pages for the programme section, 490 pages for the abstracts, and 16 pages for the index of 1564 authors). The total number of papers actually presented at the ordinary scientific sessions was 854. The actual programmes of the ordinary scientific sessions are given below, along with short summaries by the conveners and/or chairmen of these sessions.

The Secretary General wishes to convey his thanks to all the conveners and chairmen for their kind service, which enabled him to compile this part of the Transactions of the IAGA Edinburgh Assembly.

ORDINARY SCIENTIFIC SESSIONS

Code	Session Title	No. of Papers Presented
I1	Scientific Results from the MAGSAT Mission	26
I2	Mathematical Modelling of the Main Geomagnetic Field	17
I3	The Magnetohydrodynamics of Planetary Interiors	13
I4	Electromagnetic Induction Studies in the Oceans and their Implications for Suboceanic Layers	7
I5	Audiofrequency Magnetotellurics and Crustal Studies Using ELF Wave Propagation	16
I6	Regional Electromagnetic Induction Studies	39
I7	Physical Parameters Related to Geomagnetic Anomalies (Permanent and Time-Dependent)	9
I8	Time Scales of Geomagnetic Secular Variation	22
I9	Paleomagnetic Aspects of the Evolution of the Mediterranean and North Atlantic Region	21
I10	Magnetic Reversal Stratigraphy, Including Studies of Polarity Transitions	37
I11	Properties of Natural and Synthetic Titanomagnetites: Application to Magneto-Petrology	21
I12	Physical and Chemical Processes of Magnetic Overprinting in Relation to Geological Events	27
I13	Effects of Stress on the Magnetic Properties of Rocks and Minerals	15
GI	General Contributions to Division I	13

Code	Session Title	No. of Papers Presented
2S	High Latitude Ionospheric Irregularities and Small-Scale Structures	18
2C	Atmospheric Phenomena Linked with Polar Cusps	10
2D	Dynamics of Thermospheres and Exospheres of the Earth and Planets	37
2A	Auroral Emissions: X Ray, Ultraviolet, Visible and Infrared	29
2M	Middle Atmosphere Scientific Symposia	71
G2	General Contributions to Division II	15
3S	Special Symposium on Saturn	13
3T	Theory of Planetary Magnetospheres	13
3A	Acceleration Processes	16
3AP	Hydromagnetic Wave Particle Interactions	28
3I	Role of Ion Composition in Understanding Magnetospheric Processes	21
3L	Characteristics and Large-Scale Structure of Pi 2 Pulsations	24
3P	The Physics of Pulsation Resonance Regions	37
3Q	Quantitative Comparisons of Magnetospheric Event Data and Models	23
3M	Polar Cusp and Magnetosphere Boundary Layers	32
3C	Polar Cap Phenomena	9
G3	General Contributions to Division III	34
4L	Large-Scale Structure and Evolution of the Solar Wind	13
4K	Kinetic Physics and Plasma Turbulence in the Solar Wind	21
4S	Solar Wind during Solar-Maximum Period	6
4O	Origin and Composition of the Solar Wind	6
G4	General Contributions to Division IV	4
VW	Workshop on Observatory and Repeat Station Practice	7
VC	Comparisons of Analytical Techniques for National and Regional Magnetic Charts	4
VM	Production of Regional Magnetic Charts using Recent Satellite Data	3
GV	General Contributions to Division V	4
AR	Recent Results from Magnetic and Aeronomic Research in the Antarctic	13
HI	Geomagnetism and Aeronomy - the Historical Perspective	10
ER	Representation of Magnetospheric and Ionospheric Source Fields and their Induction Effects	13
ES	Effects of Source Characteristics on Electromagnetic Induction	6
EI	Induction Risk	10
EM	Solar and Lunar External and Internal Magnetic Variations, and Related Phenomena	21
	Total:	854

I1. SCIENTIFIC RESULTS FROM MAGSAT (Conveners: R.A. Langel, D.R. Barraclough)

August 4, a.m. Room: LT1

Data Characteristics, Main Field Studies and External Field Studies

Chairman: D. Barraclough

R.A. Langel, J.P. Murphy, G.W. Ousley: Characteristics of the MAGSAR data (I1.01).

K.L. Svendsen: The availability of surface magnetic data for the MAGSAT project (I1.02).

R.L. Wilson, D. Barraclough: A MAGSAT test of Maxwell's equations (I1.03).

E.R. Benton,M.C. Coulter, C.V. Voorhier: Total pole-strength of the Earth from MAGSAT and upper limits to the low order geomagnetic moments (il.04).

D.P. Stern: Studies of the Backus effect using MAGSAT (I1.05).

D.E. Winch: Geomagnetic potential from MAGSAT data by analysis of cartesian field components (I1.06).

D.F. Smart, M.A. Shea, J.E. Humble, N. Petrou, P. Goret: Attempts to use cosmic radiation data to evaluate magnetic field models (I1.07).

D.J. Cooke, D.F. Smart, M.A. Shea: Changes in the position of the main cosmic ray penumbral features with time and geomagnetic field model (I1.07a).

W.P. Olson, K.A. Pfitzer: The accurate determination of the magnetospheric magnetic field in the vicinity of the Earth (I1.08).

L.J. Zanetti, T.A. Potemra, M. Sugiura: Preliminary evaluation of distant magnetic field idsturbances from Birkeland currents using MAGSAT data (I1.09).

August 4, p.m. Room: LT1

Crustal Anomaly Studies Chairman: R.A. Langel

R.A. Langel: Global magnetic anomaly map from MAGSAT (I1.11).

P.J. Wasilewski: The Ivrea zone as a model for the distribution of crustal magnetization (I1.12).

M. Mayhew: Inversion and interpretation of satellite magnetic anomaly data (I1.13).

R. von Frese, W.J. Hinze, J.L. Sexton, L.W. Braile: U.S. aeromagnetic and satellite magnetic anomaly comparisons (I1.14).

I.J. Won: Comparative study of MAGSAT data in the eastern U.S. (I1.15).

R.A. Black, R.S. Carmichael: Analysis and use of "MAGSAT" satellite magnetic data to help interpret crustal character of U.S. central midcontinent (I1.16).

R.L. Coles, G.V. Haines, A. Nandi, G. Jansen van Beek, J.K, Walker: Preliminary maps of magnetic anomalies over Canada from MAGSAT data (I1.17).

Crustal Anomaly Study and Secular Variation Studies Chairman: M. Mayhew

M.B. Longacre, W.J. Hinze, R.R.B. von Frese, L.W. Braile, E.G. Lidiak, G.R. Keller: Satellite elevation magnetic and gravity models of major South American Plate Tectonic features (I1.18).

M. Yanagisawa, M. Kono, T. Yukutake, N. Fukushima: Magnetic anomalies over Japan and its surrounding area (I1.19).

C.G.A. Harrison, H.M. Carle: MAGSAT magnetic anomalies in the Eastern Pacific Ocean (I1.20).

J.L. LaBrecque, S.C. Cande, R.D. Jarrard: The analysis of intermediate wavelength anomalies employing the marine magnetic data set (I1.21).

R.F. Brammer, R.V. Sailor, A.R. Lazarewicz: MAGSAT investigation of Lithospheric magnetic anomalies in the eastern Indian Ocean(I1.22).

B.P. Singh: Results from MAGSAT investigations at the Indian institute of Geomagnetism (I1.23).

M. Ritzwoltz, C.R. Bentley: Comprison between MAGSAT and other geopotential data over Antarctic (I1.24).

H. Nevanlinna, C. Sucksdorff: A two year impulse in global geomagnetic "secular variation" 1977····1979 (I1.25).

W. Shukowski: MAGSAT investigations in Brazil.

The Magsat spacecraft collected data from November 2, 1979 through June 11, 1980. This data constituted the first global vector survey of the near-earth magnetic field. At the time of the Edinburgh Assembly, analysis of the Magsat data, while still a long way from complete, had reached the point where significant results were becoming available.

Prior to the IAGA Assembly on July 30-31, the Magsat Investigator Team met at Murchison House, Geomagnetism Unit, Institute of Geological Sciences, to discuss the data, recent results and problems in interpretation. The meeting was graciously hosted by David Barraclough and colleagues of the Institute of Geological Sciences. Detailed discussions of the nature of the Magsat data, including calibration techniques, attitude determination errors, formats, data quirks, etc., dominated the first third of the meeting. The next portion of the meeting was allocated to working group discussions in which investigators conducting similar research sat down together to compare problems, results and techniques and to speculate on possible interpretation. Finally, the entire group re-assembled and heard summaries of the significant problems and results. The meeting was quite valuable to all who participated.

Session I-1 itself consisted of three session. In the morning the papers dealt with the data characteristics, studies of the earth's main field and studies of fields orginating external to the earth. As an important aid to users of Magsat data, Svendsen has been visiting observatories and sponsoring agencies to encourage acquisition and prompt release of key observatory and repeat data. His report indicated that such data will indeed be forthcoming but that certain countries are finding it difficult to carry out the needed measurements. Wilson, has been searching for fields other than those represented by the standard spherical harmonic potential function. Using Magsat data prior to final attitude correction he noted a toroidal field. This field corresponds closely to a "yaw" attitude correction, and, in fact, it is not possible to determine from the data if the effect is an attitude error requiring correction or an actual toroidal field. Benton et al. have noted that the total Pole-strength of the earth is nearly invariant with time. Using this fact they were able to assign upper limits to the magnitudes of the low degree and order harmonic coefficients. They concluded that g_1^0 is at present only 28% lower that its upper limit indicating that we are not near a reversal. They were also able to calculate the radius of the core-mantle boundary to within 65 km of the seismic value. Stern reviewed the systematic errors which arise in spherical harmonic models determined from scalar data only, the Backus effect, and demonstrated their character by comparing two Magsat models --one based only on scalar data, the other on vector data. Winch reviewed

some principals of field modeling using vector component data. Smart et al. and Cooke et al. showed how calculated cosmic ray paths are affected by the characteristics of the spherical harmonic model assumed. They suggested that comparison of measured penumbral features with model calculations might be a diagnostic tool to evaluate the field models. Olson reminded us that in spite of great advances in understanding the fields due to magnetopause, tail and ring currents, the effects of these fields near the Earth are not known to very great accuracy. Finally, Zanetti et al. showed that the effects of Birkeland currents is not confined to the auroral belt but often extends to much lower latitudes.

Papers in the afternoon session dealt with studies of crustal anomaly fields, Anomaly maps for low latitudes (Langel), northern polar latitudes (Coles et al.) and southern polar latitudes (Ritzwoller) were presented. Except for the southern high latitudes, these included vector component maps. Methods, and problems, of isolating fields of crustal origin were discussed and general correlations with known tectonics pointed out. Wasilewski reminded us that our interpretations needed to include known magnetic characteristics of crustal and upper mantle rocks. He presented and analysis of rocks from the Ivrea Zone and concluded that most of the large scale magnetization is resident in the lower crust. Mayhew reviewed his method of inversion and presented a magnetization map for the U.S. It's resolution is a great deal better than a similar map derived from POGO data.

Hinze et al. and Won compared satellite (Magsat and POGO) anomaly maps to filtered and upward continued versions of the recent Naval Oceanographic Office aeromagnetic survey of the U.S. Although there are disagreements, both concluded that, in the main, the agreement was good. Carmichael presented a more detailed anomaly map of the central U.S. and some correlative tectonic data.

Discussion of crustal anomalies continued in the evening session, with emphasis on preliminary interpretation. Hinze et al. presented crustal models of a portion of the Andean subduction zone and of the Amazon River area, which they interpret as an aulacogen. Fukushima et al. mapped the anomalies near Japan. They find a correlation between a high heat flow region and a magnetic low which they interpret in terms of crustal thinning. Harrison calculated the magnetization required to cause some of the oceanic anomalies, if the sources were confined to the crust, and found extremely high values. In another analysis of an oceanic region, La Breque et al. compared filtered shipborne data from the northern Pacific with satellite anomaly data and showed that the agreement was excellent. Sailor et al. examined data in the eastern Indian Ocean showing correlations with Broken Ridge, the Diamantina Fracture Zone and other tectonic features. They indicate that the "noise floor" of the data is less than 0.5 nT and the limit of resolution, for the earlier high altitude process, is about 250 km. Singh and Shukowsky reported on Magsat investigations in India and Brazil, respectively. These were just getting underway and results will be reported at future meetings. Finally, Nevanlinna reported on a rapid change, or impulse, in secular variation in the 1977-1979 time frame.

Attendance at all sessions was good with substantial relevant discussions.

We note that many of the papers presented in this session have now been published in the April 1982 issue of Geophysical Research Letters.

(R.A. Langel)

I2. MATHEMATICAL MODELING OF THE MAIN GEOMAGNETIC FIELD -A.N. PUSHKOV MEMORIAL SESSION- (Convener: N.W. Peddie)

August 5, a.m. Room: LT1

Chairman: N.W. Peddie

G.I. Kolomijtzeva, V.N. Lugovenko, N.M. Rotanova: To Dr. A.N. Pushkov's memory (September 28, 1930- August 12, 1980) (I2.01).

D.R. Barraclough, B.M. Hodder, S.R.C. Malin: The IGS proposal for a new IGRF (I2.02).

N.W. Peddie, E.B. Fabiano: A proposed international geomagnetic reference field for 1965-1985 (I2.03 and I2.09, combined).

R.A. Langel, R.H. Estes, G.D. Mead: A new method for combining surface and satellite magnetic data in spherical harmonic models (I2.04).

R.A. Langel, R.H. Estes, G.D. Mead: A model of the Earth's main magnetic field: 1950-1980 (I2.05).

L.A. Muth: Prediction of the internal geomagnetic field based on frozen flux magnetohydrodynamics of the Earth's core (I2.10).

L.R. Alldredge: Geomagnetic signals from the core of the Earth and secular variations (I2.11).

August 5, p.m. Room: LT1

Chairman: L.R. Alldredge

N.P. Benkova, G.I. Kolomiitzeva (presented by N.W. Peddie): On geographical distribution of residuals between selected geomagnetic field models (I2.12).

B.M. Hodder: How to monopolize the secular variation (I2.13).

B.P. Gibbs: Geomagnetic field modeling by optimal recursive filtering (I2.15).

R. Thompson, D.R. Barraclough: Cross validation, cubic splines and historical secular variation (I2.16).

G.P. Gregori: An approach to the mathematical modelling of the geomagnetic field (internal and external origin, electrojets) (I2.17).

J.A. As: The shape of the geomagnetic field and its change in time (unscheduled).

E.R. Benton, R.H. Estes, R.A. Langel, L.A. Muth: Dependence of several geomagnetic properties on truncation level of spherical harmonic expansions (I2.19).

L. Shure, R.L. Parker, G.E. Backus: Harmonic splines: a method for obtaining very smooth potential field models (I2.20).

A. Chargoy, L. Chargoy: New contributions in geomagnetic potential (I2.21).

F.J. Lowes: Errors in Fourier and spherical harmonic analyses (I2.23).

The Session opened with a tribute, presented by M.S. Zhdanov, to the memory of Dr. A.N. Pushkov, which recalled his wide-ranging interests and considerable accomplishments in the Earth sciences, and his efforts in the cause of international cooperation.

The International Geomagnetic Reference Field was scheduled for a major update at this Assembly. Three papers describing derivations of models proposed as updates were presented : Hodder reported on the models proposed by the U.K. Institute of Geological Sciences (IGS) which were derived from several pre-MAGSAT models along with a new analysis of recent secular

variation; Peddie described the models proposed by the U.S. Geological Survey (USGS) which consist of a 1980 model based on MAGSAT data and models for earlier epochs derived by extrapolating the 1980 model using secular variation models based on observatory data; Langel described the U.S. National Aeronautics and Space Administration (NASA) proposal which is based on an analysis of MAGSAT, observatory, and other kinds of data, in which the spatial and temporal terms were combined, and in which parameters representing anomalies at observatory sites were included.

Muth showed how some of the theoretical results on the physical of the core can be used as a constraint in making forecasts of the field. Alldredge, using a radiating dipole in the core as a model source, concluded that more spherical harmonic terms may be necessary to describe very short-period secular variation of the main field than to describe the main field itself.

In a paper presented by Peddie, Benkova showed that residuals between observatory data and four recent global models, including one based on MAGSAT data, exhibit similar variation with respect to latitude. Using monopoles placed on the surface of the core, one below each observatory, Hodder, derived models of the secular variation whose resolution depends on the density of observatories. Gibbs recommended the use of optimal recursive (e.g., Kalman) filters for geomagnetic forecasting. Thompson discussed the use of Bauer-type plots of changes in the magnetic field direction over the last four hundred years, and of least squares periodic tensor splines, for modeling the main field. Gregori discussed techniques for choosing truncation level and significant terms in spherical harmonic analysis.

In an unscheduled talk, As presented physical models of surfaces defined by "dipole vectors" which help in the visualization of some aspects of the field and its secular variation. Benton discussed the consequences of truncating the spherical harmonic series on the coefficients themselves, on the magnetic energy, and on critical points in the core. Shure showed how spherical harmonics can form a set of spline functions when subjected to smoothness criteria, and can yield resolution that is dependent on data density. Lowes showed that the standard deviations of the spherical harmonic coefficients are overestimated unless two or more independent data sets are used.

During one of the breaks in the program, the personnel of the Geomagnetism Unit of IGS were invited to describe their procedure for estimating the secular variation from observatory annual means. Barraclough, Hodder, and Malin responded with a delightfully animated performance that illustrated how the "by eye" procedure is carried out.

(N.W. Peddie)

I3. THE MAGNETOHYDRODYNAMICS OF PLANETARY INTERIORS (Convener: D. Loper)

August 6, a.m. and p.m. Room: LT1

Chairmen: E.N. Parker, P.H. Roberts, E.R. Benton

M.H.A. Hassan, I.A. Eltayeb: Topographic coupling at the core-mantle interface (I3.01).
L.A. Muth: Can core surface velocities be determined from geomagnetic fields? Developments towards a comprehensive theory (I3.02).
E.R. Benton: A test for the presence of significant vertical motion in the uppermost layer of the Earth's core (I3.03).
S. Mollett: Magnetic and thermal constraints on the cooling of the Earth (I3.04).
D.R. Fearn, M.R.E. Proctor: MAC waves and the geodynamo (invited paper) (I3.05).
R.L. Wilson: A review of paleo- and archeomagnetic results which constrain geomagnetic dynamo theory (I3.06).
D.J. Ivers, R.W. James: Antidynamo theorems for compressible flows (I3.07).
L.O. Nicolaysen: The gravity-powered terrestrial dynamo is mantle-coupled and exhibits bistable crystallisation (I3.R1).
C. Jones: Model equations for the geodynamo (invited paper)(I3.09).
E.N. Parker: The flux ejection dynamo (I3.10).
D.J. Stevenson: Evolution and hydrodynamics of the lunar core (I3.11).
L.L. Hood: Absence of paleomagnetic evidence for a former lunar dynamo (I3.12).
R. Hide: Comments on the influence of rotation, thermo-electric effects, and compressibility on the generation of planetary magnetic fields (I3.13).

This session consisted of two invited papers and eleven contributed papers. In the first paper, *Eltayeb* and *Hassan* found it possible to obtain topographic coupling of sufficient strength to explain certain observed changes in the length of day for a wide range of parameter values. Next, *Muth* concluded that the top of the core is not likely to be stably stratified. In a similar talk, *Benton* found evidence for such motion and also concluded that the upper layers of the core are not stratified. In the fourth talk, *Mollett* estimated the present heat flux from the core to lie between 4 and 20×10^{12} W and found that sufficient energy to drive the dynamo has been available since core formation. In an invited talk *Fearn* reviewed previous work on buoyancy driven waves in a rotating fluid in the presence of a strong zonal magnetic field, then reported on recent work by *Proctor and himself* on the stability of such waves in a rotating sphere with a zonal shearing flow. Preliminary numerical results indicate the possibility of a new instability not predicted by current theories. Next *Wilson* presented a review of paleo- and archeomagnetic results including polarity inversions, direction and magnitude variations within one polarity, magnitude during an inversion, the various periods of fluctuation and time-averaged asymmetries. Recent advances in antidynamo theorems for compressible flows by *Ivers and James* were reported by the second author. In particular they have proven a new theorem precluding maintainence in a sphere of any magnetic field by a flow with a radially symmetric radial velocity component, provided certain conditions are satisfied. *Nicolaysen's* paper presented a number of new proposals and was quite controversial. In particular, he argued that the dynamo may be driven by freezing either at the inner-core boundary or at the mantle-core boundary but that due to a pressure induced oscillation, freezing occurs only at one boundary at a time. In the second invited talk, *Jones*

showed that one can obtain Lorentz's 'strange-attractor' equations from a severely truncated model of the hydromagnetic dynamo but explained that the random reversals it exhibits do not accurately model those of the geomagnetic field because the Coriolis force is not included. Next, *Parker* explained a new way to obtain dynamo action in a convective flow with helicity which may be mirror symmetric and speculated upon its possible occurrence in the Earth and the Sun. *Stevenson* argued that the moon's core is still partially molten and is stirred by precessionally driven motions but not sufficiently vigorously to drive a dynamo, thus supplying possible constraints on dynamo theories. In a closely related talk, *Hood* concluded that transient magnetic fields produced by local processes (such as meteorite impacts) are the most likely explanation of the available data. Finally, *Hide* presented some comments on the influence of rotation, thermoelectric effects, and compressibility on the generation of planetary magnetic fields, in which he argued that the axisymmetric thermoelectrically driven dynamo advocated by Hibberd is not possible and that finite compressibility does not significantly aid dynamo action.

(D. Loper)

I4. ELECTROMAGNETIC STUDIES IN THE OCEANS AND THEIR IMPLICATIONS FOR SUBOCEANIC LAYERS (Conveners: C.S. Cox and S.R.C. Malin)

August 11, p.m. Room: LT1

Chairman: C.S. Cox

P.C. Kendall, R.C. Hewson-Browne: Global induction problems for oceans in electrical contact with the mantle (I4.01).

D. Beamish, R.C. Hewson-Browne, P.C. Kendall, S.R.C. Malin, D.A. Quinney: Electromagnetic induction in arbitrarily shaped oceans - the effect of variable depth (I4.02).

M.S. Zhdanov: Modern problems of electromagnetic induction studies in the oceans (invited paper I4.03).

P.C. Kendall, S.R.C. Malin, D.A. Quinney: Vector Legendre function analysis of induction at Sq frequencies in an ocean in electrical contact with a plane stratified spherical mantle (I4.04).

T.J. Shankland, K.A. Kariya: Upper bounds on crustal temperatures inferred from electrical conductivity (I4.05).

L.J. Srnka, D.E. Willen: Active-source em soundings: Land and Sea (I4.07).

C.S. Cox: Results of an active source experiment (I4.08).

The origin of many of the difficulties for interpretation of global scale electromagnetic induction in the earth resides in the discontinuous nature of the hydrosphere and the high contrast between the conductivities of the ocean and the surrounding rocks. *Malin* described a series of attempts to account for the anomalous Sq behaviour at near shore observatories through models of oceanic induction which include the complexities of oceanic shape and variations of ocean depth. Despite successively improved models the observatory anomalies remain unexplained. *Kendall* described methods for constructing models which allow for leakage of electric current from the ocean through the ocean crust into the earth's interior. The oceanic edge effect depends critically on the crustal conductivity.

The conductive contact between the deep sea bed and the oceanic mantle is through sediments, basalt and gabbroic layers. *Shankland* summarized

extensive laboratory data from many sources for dry basalts at sub solidus temperatures. On average, basalts are more conductive than granites and fine grained rocks more conductive than coarse. Presumably gabbros are less conductive than basalts.

Observations of magnetic fields at sea have been started off the coast of Russia by use of proton procession magnetometers mounted on buoys. *Zhdanov* described the use of fluctuations in the gradient of total field to infer the electromagnetic impedance over deep water. *Srnka* descrived the applicability of a controlled source dipole method in the search for mineral deposits in sediments below the sea. *Cox* described use of similar method to infer the conductivity of the deep sea crust.

(C.S. Cox)

I5. AUDIOFREQUENCY MAGNETOTELLURICS AND CRUSTAL STUDIES USING ELF WAVE PROPAGATION (Conveners: D.W. Strangway, S.E. Hjelt, V.R.S. Hutton)

August 13, a.m. Room: LT1

Chairmen: S.E. Hjelt, D.W. Strangway

D.W. Strangway, A. Gubins, D. Hsu: AMT Sounding/MT Sounding in the Williston Basin of Saskatchewan and Manitoba (I5.01).

M. Novak, V.R.S. Hutton: An AMT survey in a High Heat Flow region underlain by a granite batholith (I5.02).

G. Fischer, P.A. Schnegg, G.J.K. Dawes, V.R.S. Hutton: A preliminary AMT survery of the Travale geothermal field, Tuscany, Italy (I5.03).

G.J.K. Dawes: An automatic wide-band magnetotelluric data acquisition system (I5.o4).

M.E. Ander, R. Goss, D.W. Strangway, A.W. Laughlin: AMT/MT study of the Jemez Lineament, New Mexico (I5.05).

A.J. Smith, K.H. Yearby, T.R. Kaiser: Measurement of ELF/VLF wavefields near to electrical power transimission lines in Newfoundland due to the flow of currents at harmonics of 60 hz (I5.06).

G. Musmann, J. Otten: A new audio-frequency magnetotelluric equipment with a grounded electric dipole source (I5.07).

R. van Blaricom: The application of audio-frequency magntotellurics using a control source as a deep search EM for massive sulphides (I5.08).

G. Fischer, E.V. LeQuang: One-dimensional magnetotelluric modelling (I5.09).

S.E. Hjelt: Scalar AMT in high latitudes - experiences and problems (I5.10).

P. Kaikkonen, K. Pajunpaa: Audiomagnetotelluric measurements across the Lake Ladoga - Bothian Bay zone in central Finland (I5.11).

C.W. Carstens, P. Kaspersen: AMT measurements used in sulfide ore prospecting in Norway (I5.12).

J.D. Redman, D.W. Strangway, D. Hsu: AMT surveys and nuclear waste disposal sites (I5.13).

E. Lakanen: Comparison of natural and controlled source AMT measurements in a geologically complex environment (I5.14).

J.B. Jepsen, L.B. Pedersen, T. Rasmussen: Evaluation of tensor - AMT measurements in Scandinavia (I5.16).

K. Vozoff, J. Holliday: Anomalous AMT impedances near 2 kHz (I5.17).

August 13, p.m.

Earlyburn field trip + poster and instrument display.

Sixteen papers were presented in the session covering all aspects of audiofrequency magnetotellurics (AMT), instrumentation, interpretation, source field studies and case histories. The session was completed by an informal poster session at the Earlyburn field station where some equipment was on display.

In a considerable number of regional studies AMT soundings were combined with low frequency MT soundings. Regional AMT was reported for lineament and basin studies in the USA and Canada, for geothermal and high heat flow areas in Italy and England, for conductive schist zone delineation in Finland and for the location of fractures and faults in the selection of nuclear waste disposal sited in Canada. Successful applications of the AMT method in ore prospecting were reported from several sites in Finland, Norway and the USA, both using scalar techniques and controlled source techniques (CSAMT). The main advantages of CSAMT seem to be good repeatability of measurements and assured presence of a source field, whereas scalar techniques can be carried out with easily portable instruments. Normally very complicated interpretation methods are not needed in prospecting work- although there is a need for continuing studies of the AMT fields of complex, 2D and 3D structures as well as of the properties of inversion techniques.

The most disturbing factor of AMT work in most areas is power line fields at the mains and its harmonic frequencies, which can overpower the natural field at least to a distance of 3-4 skin depths of the surrounding medium. On the contrary, measurements at mains frequqncy and its harmonics were also reported to have been used successfully.

The increasing complexity of instrumentation seemed in most cases motivated because of the improved quality of data. Correlation and coherent detection techniques, digital filtering, preliminary data processing in the field and graphical display for a "quick look" were common features for most systems described.

Sample spectra of AMT source fields were presented from Australia, Iceland and Finland. Low signal levels and coherencies were common to all cases in the region around I-3 kHz, and sometimes in the low-frequency part of the AMT spectrum. Unstable increases in signal levels were also reported. There is a pressing need of a better understanding of the nature of the source field variations both in time and space.

A prepoint distributed after the session showed interesting research development to take place also in the People's Republic of China.

The session and especially the discussion during the field trip showed a great need for exchange of experiences and for AMT sessions also at future meetings. There are many established groups performing AMT measurements in a routine manner for various applications, most notably for mineral prospecting. The amount of regional work will be increasing, when the instrument systems under construction are completed. The increasing amount of data creates a need for better understanding of the behaviour of complex geological structures in AMT fields. Great changes in instrumentation are not expected in the immediate future, whereas comparative studies of various CSAMT systmes and natural source AMT will be of value, as well as systematic synopit studies of the earth's natural field at AMT frequencies.

(S.E. Hjelt)

I6. REGIONAL ELECTROMAGNETIC INDUCTION STUDIES (Conveners: R. Banks and J. Janowski)

August 10, a.m. and p.m. Room: LT1 and 11, a.m.

Chairmen: J. Janowski, R. Banks

A.G. Jones: The electrical crust-mantle structure in Fennoscandia: coast effect and asthenosphere (I6.01).

A.A. Kovtun, L.N. Porokhova, N.D. Chicherina: Deep conductivity distribution of the Russian platform (I6.02).

J.F. Hermance: Regional response functions using global magnetic data (I6.03).

R.P. Kane: Effects on the induction of low latitude geomagnetic field (I6.04).

A.G. Krasnobaeva: Correlation of deep geoelectric cross-sections of geosyncline and platform, based on the data from the middle Urals and the Baltic Shield (I6.05).

M. Ilkisik: Magnetotelluric depth sounding in long period range at Tehran, Iran (I6.06).

I.I. Rokityansky, S.G. Kreimer: Asthenospheric studies in the south of Ukraine (I6.07).

A. Adam, L. Szarka, J. Vero, A. Wallner, S.E. Hjelt, P. Kaikkonen, K. Panjupaa: Combined magnetotelluric and audiomagnetotelluric measurements in Finland (I6.08).

A. Junge: Long period electric field recording with small separation of electrodes (I6.09).

J.M. Febrer, J.C. Gasco, C. Pomposiello, M. Mamani, B. Baldis, H.C. Fournier: Magnetotelluric profile across the Nazca plate subduction beneath South America in Central Argentine (I6.10).

J.G. Negi, P.D. Saraf: On multifrequency magnetotelluric sounding over the Himalayan type colliding plate boundaries (I6.11).

E.W. Mbipom: An application of a diakoptic solution program in magnetotelluric modelling (I6.12).

D. Beamish, R.J. Banks: Magnetometers across a granite (I6.13).

V.R.S. Hutton, M. Novak, M.R. Ingham: Magnetotelluric and magnetovariational measurements in S. Scotland and N. England (I6.14).

D. Kao, D. Orr: Magnetotelluric studies in the Market Weighton area of Eastern England (I6.15).

I.I. Rokityansky, S.N. Kulik, I.M. Logvinov, D.A. Rokityanskaya: Geomagnetic variation anomaly in the north-west of the U.S.S.R. (I6.16).

D.J. Bennett, D.A. Christoffel, R.K. Midha: Investigation of the electrical conductivity of the asthenosphere beneath the central North Island, New Zealand, by magnetotelluric and geomagnetic depth sounding techniques (I6.17).

D.I. Gough, M.R. Ingham, D.K. Bingham: A magnetometer array program in Western Canada (I6.18).

M.S. Zhdanov, I.M. Varentsov, A.I. Billinsky: The investigation of the induction anomaly in the Soviet Carpathians (I6.19).

J. Jankowski, V. Cerv, J. Pek, V. Pett, J. Pecova, O. Praus: Geoelectric models in the marginal zone of the Carpathian plate (I6.20).

F.E.M. Lilley, B.R. Arora, B.P. Singh, B.J. Srivastava, S.N. Prassad, M.N. Sloane: Geomagnetic induction in north-west India (I6.21).

K. Bahr: Magnetotelluric and geomagnetic deep sounding in the Harz Mountains (I6.22).

M.L. Richards, U. Schmucker, E. Steveling: Electrical conductivity in the Urach geothermal area (I6.23).

P. Kaikkonen, S.E. Hjelt, K. Panjunpaa, L.L. Vanyan, I.L. Osipova, P.P. Shilovski: A preliminary geoelectrical model of the Karelian megablock of the Baltic Shield (I6.R1).

J.L. LeMouel, M. Menvielle: A semi-quantitative interpretation of geomagnetic variation anomalies (I6.24).

J.F. Hermance: Bias of long-period magnetotelluric response parameters due to current channelling in surficial three-dimensional lateral heterogeneities (I6.25).

J. Mosnier: Study of natural telluric currents induced in an inhomogeneous Earth's crust (I6.26).

T.C. Dawson, J.T. Weaver: H-polarization induction at a coastline with an underlying resistive crust (I6.27).

H.W. Dosso, E. Chan, W. Nienaber, L.K.Law: A model study of electromagnetic induction in the Queen Charlotte Islands region of British Columbia (I6.28).

M. Menvielle, J.C. Rossignol, P. Tarito: New results about deep source conductivity anomalies (I6.29).

J.R. Booker, E.G. Hensel: A channelled electric current driven into the northwest United States by the geometry of the coastline (I6.30).

N.K. Thakur, M.V. Mahashabde, B.R. Arora, B.P. Singh, B.J. Srivastava, S.N. Prasad: Signature of Indo-Ceylonese graben in the geomagnetic variation (I6.31).

W.G.V. Rosser: Electromagnetic induction studies in Devon (I6.32).

J. Mosnier: Recent examples of "current channelling" investigations in France (I6.33).

A. Berktold, K. Kemmerle, G.J.K. Dawes, V.R.S. Hutton, T. McGavigan, E. Finzi, A. Norinelli, S. Spitz, A. Zaja, V. Haak, G. Schwarz, J. Mosnier: Comparative electromagnetic studies in the geothermal field of Travale Tuscany (I6.34).

Poster Presentation, Room: T8

J. Pecova, K. Pec: A model of spatial distribution of electric conductivity in upper mantle (I6.35).

J.M. Febrer, J.C. Gasco, C. Pomposiello, M. Mamani, B. Baldis, H.C. Fournier: Magnetotelluric measurements defining a continental mantle plume in a zone of the Andean belt, south-east of the Altiplano in Argentina (I6.36).

P.H. Morat: Sea and terrestrial electric field measurements: origins of noises and perturbations (I6.37).

A. Dupuis, A.L. Thera: Natural electromagnetism in the Rhine graben (I6.38).

The papers presented in this symposium covered three distinct groups of topics in three half-day sessions. The first group of papers dealt with the problem of establishing on a regional basis the vertical distribution of electrical conductivity within the lithosphere and at deeper levels, using both magnetotelluric and magnetic gradient sounding methods. *Parker & Whaler* outlined a theoretical procedure for categorizing the conductivity models which fit the electromagnetic response data at a defined confidence level. They showed the importance of the δ-function models in this context, raising considerable doubts about the basis of our present understanding of the conductivity structure of the mantle. *Jones* presented a conductivity profile based on data from the Scandinavian magnetometer array, showing a structure in the depth range 50-300 km. *Junge* described efforts to measure long period telluric variations using clay and clay/plastic electrodes, with line lengths of only 100-200m. His results suggest the possibility of using this method to obtain electromagnetic response estimates in the frequency range 6 to 1 c.p. day.

A second group of papers dealt with the delineation of conductivity 'anomalies', structure in the laternally heterogeneous outer shell of the Earth. GDS and MT studies of anomalies in the United Kingdom, the Carpathians, Germany, India, New Zealand, Canada and South America were reported. One noticeable trend was for station spacing to decrease, and for frequency range to increase, as investigators realised the amount of structural complexity at shallow depths which can be detected. Investigations of granites in northern England *(Beamish)* and the Harz mountains *(Bahr)* in particular, pointed to the amount of information which could be retrieved and interpreted from areas of only 50 x 50 km.

A third, very crowded and extremely stimulating session dealt with some of the fundamental problems which underline the interpretation of regional electromangetic induction data. These included the relative importance of currents induced locally in the structure, and those induced elsewhere. 'Elsewhere' includes of course the oceans, so several papers dealt with the nature of the oceanic-continental interaction. *Weaver* demonstrated the profound influence which a resistive layer underlying the ocean can have in spreading the H polarisation ocean effect to very great distances within the continent. *Dosso* demonstrated the complexities of the ocean effort at an irregular coastline by modelling. *Booker* produced a nice example of a magnetic variation anomaly which could be followed from the ocean edge into the continent. The difficulties which three dimensional structures in the surface layer create for interpretation were well demonstrated in a paper by *Hermance*. He showed that MT stations very close to 3D structures could yield skewness and other measures which would, in isolation, lead the interpreter to conclude that a two, or even one-dimensional interpretation was valid. Equally revealing of the ambiguities of GDS and MT data was a presentation by *Haak* of the joint investigations by a number of different groups of the Travale geothermal field. Stations 1 km apart or less gave significantly different responses for both the MT and GDS methods.

The overall impression gained from the meeting was of a greater concern for the fundamentals underlying the use of MT and GDS methods. In the past, electrical models of the crust and upper mantle were derived on the basis of very simplified models of the induction process, and of data which was probably too limited in terms of frequency range, precision, and spatial distribution. I think we can look forward to much better models in the future.

(R. Banks)

I7. PHYSICAL PARAMETERS RELATED TO GEOMAGNETIC ANOMALIES (PERMANENT AND TIME-DEPENDENT) (Conveners: W. Mundt, C.C. Weber, C.G.A. Harrison)

August 12, a.m. and p.m. Room: LT1

Chairmen: W. Mundt and C.G.A. Harrison

Secular Variation

W. Mundt, H. Nevanlinna: Possible secular variation anomalies in Europe (I7.01).

D.D. Jackson, C. Demetrescu: Secular variation model for geomagnetic variations in Southern California (I7.02).

Magnetic Anomalies

P. Hood: Quantitative interpretation of magnetic anomalies: A review (I7.08).

P.J. Wasilewski, M.A. Mayhew: Crustal xenolith magnetic properties and long wavelength magnetic anomaly source requirements (I7.09).

Z.A. Krutikhovskaya, I.K. Pashkevich: A magnetic model for the Earth's crust of the platform type (I7.11).

J. Meyer, J.H. Hufen, M. Siebert, A. Hahn: Magnetic field of a global model of the Earth's crust (I7.14).

P.J. Wasilewski: State of magnetization of peridotites - further evidence for the non magnetic state of the upper mantle (I7.17).

D. Tamsett: Magnetic anomalies in the Gulf of Aden.

J.L. LaBrecque: Medium wavelength magnetic anomalies in the Northern Pacific.

A total of seventeen papers were originally planned, but due to the cancellation of ten of these and the addition of two during the IAGA meeting, nine only were presented. No papers were presented in the session on "Time Dependent Magnetic Fields".

Mundt suggested that there is a regional secular variation anomaly in Europe which may be caused in the mantle. *Jackson* showed that a proposed tectonomagnetic anomaly could just as easily be explained by the interaction of the secular variation with anomalous regions.

Hood presented a review of quantitative methods of interpretation of crustal magnetic anomalies. *Tamsett and LaBrecque* discussed marine magnetic anomalies, LaBrecque's paper dealing with intermediate magnetic anomalies in the North Pacific, and Tamsett's paper discussing short wavelength anomalies in young crustal regions which may be caused by thermal anomalies over spreading centers. *Krutikhovskaya* presented a crustal model for magnetic anomalies over the Ukrainian Shield and compared it with other geophysical data. *Meyer* produced a detailed global magnetic model of the Earth's crust, in an attempt to illustrate the pattern of magnetic anomalies which might be observed over crust of different types. *Wasilewski* discussed the constraints on the source regions of magnetic anomalies from a petrologic and rock magnetic viewpoint.

(C.G.A. Harrison)

I8. TIME SCALES OF GEOMAGNETIC SECULAR VARIATION (Conveners: C.E. Barton and P. Tucholka)

August 7, a.m. and p.m. Room: LT5

Chairmen: P. Tucholka, K.P. Games, C.E. Barton

K.M. Creer: Ten years of limnomagnetic research (invited)(I8.01).
W.E. Senanayake, M.W. McElhinny: Variations in the geomagnetic dipole, 2: The last 5 million years (I8.02).
P.L. McFadden, W.E. Senanayake, M.W. McElhinny: Variations in the geomagnetic dipole, 3: Analysis of the observed distribution of the Earth's VDMs for the past 5 million years (I8.03).
R. Dodson: The distribution of late Tertiary secular variation of the geomagnetic field vector (I8.04).
C.E. Barton, M.W. McElhinny: Time sereries analysis of the 10,000 yr geomagnetic secular variation record from SE Australia (I8.05).
S.P. Lund, S.K. Banerjee: Time-series analysis of late quaternary paleomagnetic records from two North American lakes (I8.06).
G.M. Raisbeck, F. Yiou: Use of cosmogenic ^{10}Be for investigating geomagnetic variations (I8.07).
M.W. McElhinny, W.E. Senanayake: Variations in the geomagnetic dipole, 1: The latest 50,000 years (I8.08).
S.P. Burlatskaya: Reliability and characteristics of geomagnetic secular variations of about 300 - 2000 years (I8.09).
G.S. Hoye, M.E. Evans: Archeomagnetic secular variation in Italy (I8.10).
M. Kovacheva: Archaeomagnetic results concerning geomagnetic field variation for the last 8000 years in Bulgaria (South-East Europe) (I8.11).
M.J. Aitken, P.A. Alcock, G.D. Bussell, V. Jones, C.J. Shaw: Geomagnetic intensity variation, 5000 - 2000 BP, for the Eastern Mediterranean and the Near East (I8.12).
Q.Y. Wei, D.J. Li, G.Y. Cao, W.X. Zhang, S.P. Wang: The polar wandering path for the last 6000 years (I8.13).
Q.Y. Wei, D.J. Li, G.Y. Cao, W.X. Zhang, S.P. Wang: Study on changes of the magnetic moment of the earth (I8.14).
E.T. Green: Correlation of geomagnetic secular variation data from archaeological baked-clays with secular variation data from dry-lake sediments (I8.15).
J.C. Liddicoat, R.S. Coe, K.R. Lajoie, D.J. Varnes, S.W. Robinson: Paleosecular variation for the late Pleistocene of Western North America recorded in Lacustrine Deposits (I8.16).
G.M. Turner, M.E. Evans: Paleomagnetic secular variation 31,000 - 19,000 years bp in Western Canada (I8.17).
N. Abrahamsen: Recent geomagnetic secular variation in W. and N. Greenland (I8.18).
M. Hyodo, N. Isezaki, K. Yaskawa: Geomagnetic secular variation deduced from the magnetization of recent sediments in Japan (I8.19).
R.H.W. Bradshaw, G.M. Turner, R. Thompson: Dating methods for secular variation in Icelandic sediments (I8.20).
M. Ernesto, I.G. Pacca: An analysis of palaeosecular variation using sequences of Mesozoic Serra Geral basaltic flows (I8.21).
P. Tucholka: Identification of minor features in records of Holocenian geomagnetic secular variation (I8.22).

A valiant effort was made by all speakers to condense many millenia of geomagnetic history into 12 minutes. The original intention of the convenors was to emphasis time scale aspects of secular variation records. In practice few authors addressed this problem specifically and only two papers dealt with time series analysis of archeo-secular variation records. The poor quality of the time scales associated with most secular variation records still remains a major stumbling block.

A large part of the session was devoted to the presentation of new and revised archaeomagnetic curves for various parts of the globe. Two contributions from China were particularly welcome. In a number of regions, notably the USSR, Europe, the Mediterranean, the Middle-East and Southwestern USA, there are sufficient data to provide almost continuous records for many thosands of years.

Much discussion centred on whether rapid, large amplitude (50%) fluctuation in field strength can occur at a given site. Results presented showed rates of change equal to those only observed today within isoporic focii, yet sustained for up to 200 years. These dramatic changes appear to be localized manifestations of the non-dipole field.

An analysis of global archaeointensity data indicated that the popular concept of a quasi-sinusoidal oscillation in dipole moment is not valid prior to 8000 years ago. For most of the last 50,000 years the dipole moment has been typically one half the present-day value. This has important implications for radiocarbon dating. Palaeointensity results for the last 5 million years indicate no significance in mean VDM between normal and reversed polarity states, and that the variance is due prodominantly to dipole fluctuations.

Measurements of Be-10 provide a novel approach to learning more about the Earth's dipole moment in the past. Although the technique is still at the proving stage, the possibility of getting global-average intensities beyond the range of archaeointensity studies in intriguing.

Progress is being made in obtaining secular variation records from rapidly deposited sediments. Such records are gradually being extended into the Pleistocene. In wet sediments, periods as short as 200 years can often be resolved repeatedly, but the quality of lacustrine records remains poor in comparison with good archaeomagnetic data.

In 1895 L.A. Bauer could have had little inkling of the orgy of loops to which we were treated. Westward drift of the non-dipole field with a characteristic cycle time of about 2000 years is still in vogue.

Two papers discussed the statistical properties of the palaeo-secular variation and field models which satisfy these constraints. The most interesting result being that for the late Tertiary, a geocentric dipole plus core-mantle radial dipole model must have the distribution of radial dipoles strongly biased towards the poles. This is pertinent to current views of the character of reversal transitions.

Together with Professor K.M. Creer, the convenors are editing a volume based on a selection of papers presented at the session, together with a number of invited contributions. The volume entitled "Geomagnetism of baked clays and recent sediments" will be published by Elsevier in 1983.

(C.E. Barton, P. Tucholka)

I9. PALEOMAGNETIC ASPECTS OF THE EVOLUTION OF THE MEDITERANEAN AND NORTH ATLANTIC REGION (Conveners: J.D.A. Zijderveld, R. Van der Voo)

August 10, a.m. and p.m. Room: LT2

Chairmen: J.D.A. Zijderveld, R. Van der Voo

K.M. Storetvedt: Paleomagnetism and the early tectonomagnetic evolution of the Canary and Cape Verde Islands (I9.01).

R. Van der Voo: Late Cretaceous and Early Tertiary paleomagnetism of Aruba and Bonaire, and the evolution of the southern Caribbean (I9.02).

J. Urrutia Fucugauchi: On the evolution of Middle America: paleomagnetic evidence from Mexican rocks. (I9.04).

E.R. Deutsch, J.N. Prasad: Mid-Mesozoic paleomagnetism in Newfoundland and the time of initial opening of the North Atlantic (I9.05).

A. Schult, A.G. Hussain, H.C. Soffel: Paleomagnetism of Upper Cretaceous volcanics and Nubian sandstones from Wadi Natash, Egypt and the polar wander path for Africa in the Mesozoic (I9.06).

L. Daly. I. Bucur, M. Prevot, M. Bina: Paleomagnetisme de l'Eocene Iranien (I9.07).

J. Besses, J.P. Pozzi: Paleomagnetism of Tertiary autochthonous sediments for Sicily (I9.08).

E. Marton, D. Veljovic: Paleomagnetism of Istra Peninsula, Yugoslavia (I9.09).

W. Pohl, H.C. Soffel, S. Buser: Paleomagnetic results from Permo-Triassic rocks in northern Slowenia and the eastward extension of the Adriatic plate (I9.10).

J.B. Edel: Apports du paleomagnetisme en Sardaigne a la connaissance de la geodynamique en Mediteranee occidentale (I9.12).

C.G.A. Harrison: Polar wandering for North America during the Mesozoic

R. Thompson, R.M. Clark: Fitting apparent polar wander paths (I9.14).

P. Morel, E. Irving, L. Daly, A. Moussine: Permian Pangea configuration (I9.15).

M. Jelenska, S.A. Vincenz, K. Aiinehsazain: Paleomagnetism of Permo-Carboniferous sediments on Spitsbergen (I9.16).

V. Bachtadse, F. Heller, A. Kroener: Preliminary results of paleomagnetic investigations in the Hercynian realm of Middle Europe (I9.17).

H. Perroud, N. Bonhommet: Paleomagnetic evidence for the origin of the Ibero Armorican arc in the context of the Variscan plate tectonics (I9.18).

R. Van der Voo, C. Scotese: Paleomagnetic evidence for a large (c.2000 km) sinistral offset along the Great Glen fault in the Carboniferous (I9.19).

R. Van der Voo: The assembly of the Old Red continent and its internal disruption due to the Carboniferous collision with Gondwana (I9.20).

D.V. Kent, J.D. Keppie: Paleomagnetic evidence for displaced terrains in the northern Appalachians and their relation to circum-Atlantic continental movements in the Later Paleozoic (I9.22).

K.L. Buchan; J.P. Hodych: Paleomagnetic reexamination of the Lower Ordovician Wabana group of the Avalon Peninsula of Newfoundland (I9.23).

D.J. Dunlop: Did a north Atlantic ocean exist in the Upper Proterozoic? (I9.24).

A total of 21 interesting papers were presented in this session, interspersed often with lively discussions. Four submitted papers (I9.03, 9.11, 9.13, 9.21) were withdrawn or not presented, and one substitution was made with C.G.A. Harrison giving an impromptu talk on "Polar Wandering for North America during Mesozoic".

The papers presented can be grouped time-wise as well as geographically. The morning session on Mesozoic-Cenozoic results discussed the Atlantic Margin (Newfoundland) and the islands of Canary and Cape Verde, the Caribbean and Central American area, and the European, Asian and African areas around the eastern Mediterranean and its continuation towards Iran. The afternoon session on Paleozoic positions of the Atlantic-bordering continents, as well as with the orogenic belts of Hercynian, Caledonian and Appalachian/Acadian/Taconic age. The last paper of the session explored whether earlier, Recantriau, orogenies such as the Operville orogeny could be related to Protero-Atlantic oceans.

(J.D.A. Zijderveld)

I10. MAGNETIC REVERSAL STRATIGRAPHY, INCLUDING STUDIES OF POLARITY TRANSITIONS (Conveners: W. Lowrie, A.N. Khramov)

August 11, a.m. Room: LT2

Geomagnetic Polarity Transitions Chairman: M. Fuller

L.J. Pesonen, H. Nevanlinna: Late Precambrian Keweenan asymmetric reversals: non-dipole field explanation (I10.01).

V.P. Rodionov, A.N. Khramov: Paleomagnetism of Upper Cambrian transitional layers of Southern Siberian platform (I10.02).

V.V. Metallova, A.O. Mostrukov, A.G. Losifidi, V.P. Rodionov, A.N. Khramov: Secular variations of geomagnetic field intensity during the polarity transitions (I10.03).

E. Herrero-Bervera, C.E. Helsley, V. Hsu: Paleomagnetism of a lower Triassic polarity transition (I10.04).

M.B. Steiner: Geomagnetic excursion within the boundary reversal of the cretaceous long normal interval (I10.05).

K.A. Hoffman: Geomagnetic field excursion recorded in an Australian basalt sequence and possible VGP path systematics associated with southern hemsiphere sites (I10.06).

R.S. Coe, E.A. Mankinen, C.S. Grommé, M. Prévot: Behaviour of the complete field vector during a geomagnetic reversal: a preliminary report (I10.07).

T. Sato, K. Kobayashi: Paleomagnetic field intensity variation and polarity transitions revealed from four deep-sea cores (I10.08).

Analysis and Modelling of Polarity Transitions Chairman: R.S. Coe

M. Fabre, M. Taieb, E. Bonifay, M.F. Bonifay, N.-A. Mörner: Detailed paleomagnetic record of about o.0 My from France (I10.10).

J. Shaw, N. Roberts: The magnitude of the Upper Tertiary paleomagnetic field (I10.11).

G.M. Raisheck, P. Yiou: Use of ^{10}Be to investigate transient field intensity variations during geomagnetic reversals (I10.12).

I. Williams, M. Fuller: Harmonic model to simulate inclination and intensity variation during a polarity transition (I10.13)
Sunhee Lee, M.W. McElhinny: Spherical harmonic analysis of the time-averated palaeomagnetic field and its relation to polarity transitions (I10.15).
H.-A. Mörner: Geomagnetic excursions during the last 140,000 years (I10.17).

August 11, p.m. Room: LT2

Paleozoic, Triassic and Jurassic Magnetic Stratigraphy

Chairman: M.W. McElhinny

H.C. Palmer, W.R.A. Baragar, J.H. Foster, M.C. Fortier: Polarity sequence during the Franklin magnetic interval (I10.18).
B.J.J. Embleton, M.W. McElhinny, X.H. Ma, Z.K. Zhang: Late Palaeozoic magnetic reversal stratigraphy in China (I10.19).
A.N. Khramov, V.P. Rodionov: Paleozoic paleomagnetic scale (I10.20).
C.E. Helsley: Magnetostratigraphy of lower Triassic strata in the western United States (I10.21).
P.N. Shive, D.T. Huycke, M.B. Steiner: Magnetic reversals in the Triassic Chugwater formation in Wyoming (I10.22).
F. Honer, P. Heller: Lower Jurassic magnetostratigraphy from the Breggia gorge (Ticino, Switzerland) (I10.23).
C.M. Brown, E.A. Hailwood: Preliminary palaeomagnetic results from some British Jurassic sedimentary rocks (I10.24).
J.G. Ogg, J.E.T. Channell, E.L. Winterer, P.O. Baumgartner: Magneto-stratigraphy of Oxfordian and Kimmeridgian cherts and siliceous limestones of northern Italy (I10.26).
E. Marton: Late Jurassic-Early Cretaceous magnetic stratigraphy for the Sumeg section, Hungary (I10.26).

Cretaceous and Tertiary Magnetic Stratigraphy Chairman: A.N. Khramov

B. Keating, C.E. Helsley: Cretaceous magnetiostratigraphy (I10.28).
N. Petersen, F. Heller, W. Lowrie: Magnetostratigraphy of the Cretaceous-Tertiary boundary (I10.29).
N.-A. Morner: Paleomagnetism of the Maastrichtian/Danian stratorype (I10.30).
R.F. Butler, E.H. Lindsay: Magnetic polarity stratigraphy of latest Cretaceous to Early Eocene continental deposits, San Juan Basin and Clark's Fork Basin (I10.31).
W. Lorie, W. Alvarez: A revised magnetic time scale for the Cenozoic and Late Cretaceous (I10.32).
F. Theyer, S.R. Hammond, B.U. Haq: Tertiary magnetic polarity sequence in Central Pacific sediments (I10.33).
J.L. LaBrecque, L. Tauxe, K. Hsu, P. Tucker, N. Petersen, S. Percival, R. Wright, D. Poore, A Gumbos, E. Schreiber, J. McKenzie, A. Karpoff, H. Weissert, K. Pisciotto, M. Carman: DSDP Paleogene and upper cretaceous magnetic stratigraphy (I10.R1).

Late Tertiary and Quaternary Magnetic Stratigraphy Chairman: W. Lowrie

W.D. MacDonald: Miocene-Pliocene boundary in the Cibao valley, Dominican Republic (I10.35).
J.C. Salloway: Palaeomagnetic results from DSDP site 514 (I10.36).

D.A. Christoffel, W. Mak: Magnetic reversal stratigraphy from paleomagnetic measurements in sedimentary sequences in New Zealand (I10.37).
D.A. Valencio: Evidence for a short normal event at the base of the Matuyama reversed epoch: Neuquen normal event (I10.38).
K.M. Creer, P.W. Readman: Plio-Pleistocene magnetostratigraphy in sediment cores from Italy (I10.39)
K. Fromm: Some magnetostratigraphic results from W. Germany (I10.40).
G.W. Pearce, J.W. Westgate, S. Robertson: A Pleistocene reverse polarity episode within a sedimentary sequence from N.W. Yukon (I10.41).

The number of pages contributed to this one-day session was larger than anticipated. It was not possible to extend the session to a second day and, therefore, morning, afternoon and evening sessions were needed. A total of 44 papers were submitted, of which 7 were withdrawn, generally because the author could not obtain financial support to attend. The 37 papers presented were grouped into categories that formed natural subdivisions of the theme of this session. These were: (a) geomagnetic polarity transitions (8 papers, chairman: M. Fuller), (b) analysis and modelling of polarity transitions (6 papers, chairman: R.S. Coe), (c) Paleozoic, Triassic and Jurassic magnetic stratigraphy (9 papers, chairman: M.W. McElhinny), (d) Cretaceous and Tertiary magnetic stratigraphy (7 papers, chairman: A.N. Khramov), (e) Late Tertiary and Quaternary magnetic stratigraphy (7 papers, chairman: W. Lowrie).

All sessions were well attended, including the evening one. In view of the short time allocated to each talk (12 minutes), the chairmen rigorously enforced the rule of 10 minutes for presentation and 2 minutes for discussion. The limitation was respected by the overwhelming majority of the speakers who had prepared their talks accordingly. Discussion was sometimes lively.

The broad distribution of paper topics reflects the general interest in this field of paleomagnetic research. As in previous meetings, the study of magnetic transitions and excursions, especially in young sediments continues to engage many scientists, but there does not yet appear to be unanimity about the configuration of transitional fields. Magnetic stratigrpahy results in Tertiary and Cretaceous sections are concordant with oceanic magnetic anomaly interpretations, although it is uncertain whether some extra events are real. Magnetic stratigraphy studies in Mesozoic rocks now place emphasis on the importance of confirming and calibrating the Early Cretaceous and Late Jurassic M-sequence polarity history, and of establishing and dating the reversal sequences in the Early Jurassic and Triassic. Comparatively few studies were reported for the Paleozoic and this remains an important and potentially fruitful field for future research.

(W. Lowrie)

Ill. PROPERTIES OF NATURAL AND SYNTHETIC TITANOMAGNETITES (Conveners: G.N. Petrova, W. O'Reilly)

August 12, a.m. Room: LT2

Chairman: W. O'Reilly

D.J. Dunlop: Characteristic magnetic properties of titanomagnetites in continantal igneous rocks (Ill.01).

C. Radhakrishnamurty, S.D. Likhite, E.R. Deutsch, G.S. Murthy: On the complex magnetic behaviour of titanomagnetites (Ill.04).

S.P. Verma, S.K. Banerjee: Magnetic properties of igneous rocks from deep sea drilling project leg 63, NE Pacific (Ill.05).

W.E. Senanayake, M.W. McElhinny: Low temperature susceptibility characteristics of magnetites and titanomagnetites and applications to basaltic rocks (Ill.07).

P.W. Readman, E. Schmidbauer: Low temperature magnetic properties of titanomagnetites (Ill.08).

J.P. Hodych: Magnetic hysteresis as a function of low temperature for large titanomagnetite grains in deep-sea basalts (Ill.09).

V.P. Shcherbakov: To the theory of the low-temperature oxidation of titanomagnetite grains (Ill.10).

N. Petersen, A. Moll: Low temperature oxidation of synthetic Al- and Mg-doped titanomagnetites (Ill.11).

August 12, p.m. Room: LT2

Chairman: N. Petersen

M.B. Stainer: TI loss during low temperature oxidation (Ill.12).

V.P. Shcherbakov: Thermomagnetic investigations of basalts.

D.J. Dunlop, M. Prevot, L.D. Schutts, C.J. Hale, M.E. Bailey: Deuteric oxidation of titanomagnetites in mafic and felsic intrusive rocks (Ill.14)

C.M. Keefer, P.M. Shive: Magnetic and crystallographic properties of synthetic titanomaghemite (Ill.15).

A.G. Zvegintsev: Magnetic properties of synthetic titanomagnetites (Ill.16).

P. Dankers, N. Sugiura: On the PSD to MD transition of magnetite (Ill.17).

H.C. Soffel, E.R. Deutsch, E. Appel, P. Eisenach, N. Petersen: The domain structure of synthetic stoichiometric (TM 0 - TM 75) and Al, Mg, Mn, V-doped (TM 60)) titanomagnetites (Ill.18).

S.L. Halgedahl, M. Fuller: Magnetic domain observations of nucleation processes in natural pyrrhotite and titano-magnetite (Ill.19).

H.C. Soffel, E. Appel: The domain structure of small synthetic titano-magnetites and experiments with IRM and TRM (Ill.20).

N. Sugiura: A new model for the acquisition of thermoremanence of multi-domain magnetite (Ill.21).

K.A. Hoffman: Partial self-reversal in basalts containing mildly low-temperature oxidized titanomagnetite (Ill.22).

F. Heller, N. Petersen: Evidence for NRM 0 self-reversal in the Olby-Laschamp basalts (Auvergne, France) (Ill.23).

Poster Presentation

J.P. Patel, H.C. Palmer: Results of optical, thermomagnetic, and electron microprobe analyses of titanomagnetite grains (Ill.24).

Although interest in the magnetic properties of rocks and minerals was conceived in the context of geomagnetism, applications of the measurement of such magnetic properties and found outside of geophysics in archaeology, historical human geography and hydrology (see e.g. abstracts in Geophys.J.R.astro.Soc., 69, 293-294, 1982). The these of session I-11 was, however, part of the basic role of rock magnetism in geophysics which is to provide the physical and chemical basis of the palaeomagnetic method. The papers of session I-11 were more concerned with the chemical basis, i.e. the influence of chemical composition on the magnetic properties of minerals. The approach of some workers was to study synthetic analogues of naturally occurring minerals. Some studies provided data on the intrinsic properties of titanomagnetite - Curie point, saturation magnetization, unit cell edge - as a function of composition, including the presence of Al and Mg and non-stoichiometry. The kinetics of the development of non-stoichiometry was also studies both experimentally and theoretically. Other investigations concentrated on the domain structures observed in magnetic minerals of synthetic analogues. A number of papers described measurements of the magnetic properties of a variety of igneous rocks, including deep-sea basalts, and the interpretation of these properties in terms of the composition and microstructure of the magnetic mineral fraction. The influence on magnetic properties of both deuteric oxidation of titanomagnetites and silicates and post-deuteric alteration processes such as maghemitization and serpentinization, was demonstrated. Measurements on rocks and minerals at low temperature provide useful information about magnetic mineralogy and also provide a means by which the physical origin of some of the complicated magnetic properties of minerals can be worked out.

The proceedings of this session will appear as a spcial issue of Physics of Earth and Planetary Interiors.

(W. O'Reilly)

I12. PHYSICAL AND CHEMICAL PROCESSES OF MAGNETIC OVERPRINTING IN RELATION TO GEOLOGICAL EVENTS (Conveners: I. Hedley, F. Heller, D.J. Dunlop)

August 4, a.m., p.m., and 5 a.m. Room: LT2

Chairmen: K. Storetvedt, W. Lowrie, P. Turner, P. Shive

P.W. Schmidt, B.J.J. Embleton: Magnetic overprinting characteristics from thermal and AF stability (I12.01).

M. Stupavsky, D.T.A. Symons: Isolation of multiple pre-Grenvillian metamorphic remanance components in the Grenville Province by point density contour plots (I12.02).

C.M. Carmichael, A. Hayatsu: Magnetic overprinting by Late Devonian dykes in the Glen Coe area of Scotland (I12.03).

H. Turnell: Relation between igneous activity and magnetisation in the Assynt area, N.W. Scotland (I12.04).

D.R. Watts: A multicomponent, dual-polarity regional overprint from the Moine assemblage, NW Scotland (I12.05).

R. Løvlie, J.G. Mitchell: Complete demagnetization of some Permian dykes from W-Norway induced during burial/uplift (I12.06).

H.C. Halls, H.C. Palmer: A test of the Logan Loop (I12.07).

L.D. Schutts: Thermal magnetic overprinting in the Canadian Superior Province at 1.8 Ga (I12.08).

R. Pucher, K. Fromm: Rock magnetic study of the Tauern window (Austrian Alps) (I12.09).

D.A. Christoffel, P. Garden: Resetting of paleomagnetic directions in Beacon sediments, Antarctica, by Jurassic dolerite intrusions (I12.10).

E.A. Hailwood, V. Graterol: Palaeomagnetic investigations of the Proterozoic Imataca geological province, Venezuela (I12.11).

S.K. Banerjee: Viscous remanent magnetization (VRM) of the ocean crust - A review and an analysis (invited) (I12.13).

Ö. Özdemir, S.K. Banerjee: An experimental study of magnetic viscosity in synthetic mono-domain titanomaghemites (I12.14).

D.J. Dunlop: Viscous magnetization: dependence on time, temperature and grain size (I12.16).

P.Y. Galibert, N. Bonhommet: Hydrothermal alteration of basalts from the Afar depression and its geodynamic significance (I12.18).

D.J. Dunlop, M. Prévot: CRM of serpentinized oceanic gabros and peridotites: signal or noise ? (I12.19).

M.E. Bailey, C.J. Hale: What does CRM record? An experimental study of synthetic chemical remanent magnetizations (I12.20).

M.B. Steiner: Depositional remanence in hematite? (I12.21).

E. Liebes, P.N. Shive: Timing of magnetization in two Mesozoic red sandstones (I12.22).

H. Perroud, N. Bonhommet: Could chemical overprint in red beds be correlated to late transgressive sedimentation? (I12.23).

P.A. Hunt, P.W. Schmidt, B.J.J. Embleton: Discrete laterite events versus continuous weathering processes (I12.24).

R.F. Butler: Magnetic mineralogy of latest Cretaceous to early Eocene continental deposits, San Juan Basin and Clark's Fork Basin (I12.25).

C. McCabe, D.R. Peacor, C. Scotese, R. Van der Voo: Secondary magnetizations in the Devonian Helderberg group (New York) residing in magnetite: A search for a mechanism (I12.26).

R. Freeman, F. Heller: The magnetization of slumped red Jurassic limestones from the Southern Alps (I12.27).

J.E.T. Channell, R. Freeman, F. Heller, W. Lowrie: The timing of diagenetic haematite growth in red pelagic limestones from Gubbio (Italy) (I12.28).

A.G. Zvegintsev, V.V. Onufriyonok: The effect of conditions of synthesis on magnetic properties and crystal structure of pyrrhotites (I12.30).

E. McClelland Brown: Discrimination of TRM and CRM by blocking temperature spectrum analysis (I12.R1).

This session was planned to present recent progress in investigations which are relevant to the relations between magnetization and rock forming and rock alteration processes, such as (1) processes due to low grade metamorphism, e.g. medium to deep burial or intrusive re-heating; (2) processes leading to alteration of igneous rocks, particularly oceanic basalts, e.g. discrimination of CRM and TRM (formation of T-CRM), the influence of metasomatism and hydrothermal activity, the effects of low temperature oxidation of titanomagnetites; (3) diagenetic processes, including the comparison of DRM and post-DRM characteristics, the formation and dehydration of Fe, Mu- hydroxides, surface weathering, hematite produced by different modes of origin and diagenetic history.

In total 26 papers were actually presented at this session, which was well attended. The session consisted of three subdivisions, i.e. "Analysis of multicomponent NRM", "Magnetization of altered mafic rocks", and "Diagenetic magnetization processes". The whole session integrated palaeomagnetic and rock magnetic aspects, and the magnetic overprinting was discussed from the point of view of its analysis and also to identify its various cases. The distinction between TRM and CRM as magnetization processes is rather well recognized, but the business of separating them is a very difficult one. The occurrence of viscous and shock remanences is also recognized in some cases. In sedimentary rocks it is becoming clear that the palaeomagnetist must also be a very competent sedimentologist in order to correctly interpret the magnetization in relation to, for example, the reddening of sediments, their slumping, dewatering, bioturbation, weathering, lateritization, etc.

Some of the papers presented to this session will be published jointly in a special issue of "Physics of the Earth and Planetary Interiors" with papers of IAGA session I11.

(F. Heller)

I13. EFFECTS OF STRESS ON THE MAGNETIC PROPERTIES OF ROCK AND MINERALS (Convener: J.P. Hodych)

August 5, a.m. and p.m. Room: LT2

Chairman: J.P. Hodych

R.S. Carmichael, P.S. Clarke: Vector change of remanent magnetization in magnetite under hydrostatic pressure to 5 kilobars (I13.01).

Radha Govindarajan, C.M. Carmichael, H.H. Schloessin: Permeability and curie temperature of magnetite at high pressure (I13.03).

A.G. Zvegintsev, V.V. Onufriyonok: Change of magnetic properties of pyrrhotites under high pressure (I13.04).

G.W. Pearce, J.A. Karson: On pressure demagnetization (I13.05).

T. Nagata: Piezoremanent magnetization for weak mechanical stresses (I13.07).

P.J. Wasilewski: Characterization of magnetic properties associated with shock induced substructure and shape change in 200 to 1200 A iron spheres (I13.08).

P. Hurren, G. Martelli, P.N. Smith, R. Flavill, R. Bianchi, P. Cerroni, M. Coradini, M. Fulchignoni, W. Waldner: Macroscopic hypervelocity cratering experiments (I13.09).

Y. Hamano, M. Fuller: Susceptibility anisotropy of igneous rocks under uniaxial compression (I13.10).

J.S. Rathore, H.J. Mauritsch: The inter-relationship between the stress induced fracturing and magnetic susceptibility anisotropy in rocks (I13.11).

A. Morash, N. Bonhommet: Deviation of I.R.M. during simple shortening experiements (I13.12).

August 5, late p.m. Room: LT2

Chairman: M. Jelenska

R.J. Martin III: Piezomagnetism as a stress dominated property (I13.13).

T.L. Henyey, S.J. Pike: The effect of stress on the magnetization of some igneous rocks from California, as determined with a superconducting magnetometer (I13.14).

Gao Long-sheng, Huang Ping-zhang, Xu Ming-fa, Jin Yao: The magnetic susceptibility change of rock samples under uniaxial compression before and after failure (I13.15).

Steve P. Lund, T.L. Henyey: On the use of vector cryogenic magnetometers for field tectonomagnetic investigations (I13.16).

J.P. Hodych: Evidence for magnetospherictive control of coercivity in multidomain and pseudo-single-domain magnetite (I13.17)

Response to the call for papers was excellent and a very wide range of interests was represented.

Six papers concerned the effects of high stresses on magnetic properties. A strong renewed interest in the effects of hydrostatic loading was apparent. A greater adoption of the approach of modern high pressure physics was evident in the theoretical as well as in the experimental work.

Three papers dealt with tectonomagnetism. There were convincing demonstrations that piezomagnetic changes are dependent on stress alone, giving them an advantage over microcrack-dominated properties in monitoring stress changes accompanying earthquakes.

Three papers concerned shock and the magnetization of extra-terrestrial material. The complex behaviour of iron was well demonstrated.

The remaining papers were extremely varied in subject matter and sometimes surprising, ranging from studies of magnetization changes on deforming plasticene to low temperature evidence of internal stresses controlling coercive force.

The field looks healthy with fresh approaches and renewed interest.

(J.P. Hodych)

GI. GENERAL CONTRIBUTIONS TO DIVISION I ON INTERNAL MAGNETIC FIELDS (Convener: D.I. Gough)

August 13, p.m. Room: LT1

Chairman: D.I. Gough

H.A. Roeser: Magnetic anomalies in the magnetic quiet zone off Morocco (GI.01).
N. Sugiura, D.W. Strangway: Magnetic properties of the Abee meteorite (GI.02).
M.W. McElhinny, B.J.J. Embleton, X-H Ma, Z-K Zhang: Late Palaeozoic plate tectonics of Asia (GI.03).
R.W. Girdler, P. Styles, D. Tamsett: Recent magnetic surveys in the Gulf of Aden and their relevance to the structure of the Alura-Fartak transform (GI.04).
G.-T. Ren: Study on the magnetic field of Eastern Asia continent (GI.05).
E. Dawson, L.R. Newitt: The magnetic poles of the earth (GI.08).
K. Yaskawa, N. Isezaki, H. Inokuchi, M. Hyodo, H. Morinaga, H.G. Barsczus, L. Chungue: Preliminary paleomagnetic results from two atolls in the Tuamotu Archipelago (Central South Pacific Ocean / French Polynesia) (GI.09).
M. Stupavsky, D.T.A. Symons: Isolation of Pre-Grenvillian metamorphic remanence components in the Grenville Province by point density contour plots (GI.10).
A. Quick, D.T.A. Symons, M. Stupavsky: Archean paleomagnetism from banded iron formations in the Central Superior Province of the Canadian shield (GI. 11).
G.P. Gregori, L.J. Lanzerotti: GDS: comparing the transfer function technique and the canonical analysis (GI.12).
R.A. Livermore: Spherical harmonic analysis of the palaeomagnetic field (GI.13).
A.L. Orozco: Analysis of solar cycle variation on magnetic observatory annual means (GI.14).
P. Styles, R.W. Girdler: The correction of marine magnetic profiles acquired in equatorial regions for transient variations of the geomagnetic field (GI.R1).

This "General Contributions" session is to provide a forum for those papers of high scientific interest, which do not exactly fit into the other 13 sessions of specified topics under IAGA Division I. This means that Division I deals with a variety of geomagnetic problems, as the titles of the above papers indicate.

It will be noted that several papers dealt with paleomagnetic results in relation to models of plate tectonics, and others with magnetic surveys and their correction for transient geomagnetic variations. Both are live topics at the present time.

(D.I. Gough)

2S. HIGH LATITUDE IONOSPHERIC IRREGULARITIES AND SMALL SCALE STRUCTURE (Conveners: S.L. Ossakow, A. Brekke)

August 7, a.m. and p.m. Room: LT4

Chairmen: S.L. Ossakow, J.F. Vickrey, P.J. Palmadesso

A.V. Shirochkov, B.Y. Nekrasov, I.A. Shumirov: Investigation of the polar ionosphere irregular structure by oblique incidence sounding (invited) (2S.01).

J.W. MacDougall, J.A. Fulford: Distribution of irregularities in cleft and polar cap (2S.02).

A. Brekke, O. Holt, T. Flå: Studies of D-region fine scale structures by the use of the partial reflection technique (2S.05).

E.V. Thrane, B. Grandal, T. Flå, A. Brekke: Irregularities in the ionospheric D-region, measured in situ by means of a sounding rocket, as possible sources of partially reflected high frequency radio waves (2S.06).

J-P. St-Maurice, K. Schlegel: Heating of the high latitude E region by unstable plasma wave dissipation (2S.07).

M.W.J. Scourfield, J.G. Keys, E. Nielsen: Ionospheric electric fields measured by STARE and simultaneous TV imaging of drifting auroral arcs (2S.08).

G. Marklund, I. Sandahl, H. Opgenoorth: A study of the dynamics of a discrete auroral arc (2S.09).

M. Petitdidier, J.P. Treilhou: Small scale auroral structures recorded on ground by a TV camera and onboard balloon through X-ray measurements (2S.11).

P.K. Chaturvedi, P. Satyanarayana, S.L. Ossakow: Collisional ion cyclotron waves in auroral F-region (2S.14).

J.F. Vickrey, M.C. Kelley, C.L. Rino: A review of high latitude ionospheric irregularities - experimental results (invited)(2S.15).

E.J. Fremouw, J.M. Lansinger: On the three-dimensional configuration of scintillation producing irregularities in the auroral zone (2S.16).

P. Rodriguez, E.P. Szuszczewicz, J.C. Holmes, D.N. Walker, M. Singh: Density irregularities in the auroral F-region (2S.17).

M.J. Keskinen, S.L. Ossakow, P.K. Chaturvedi: Nonlinear evolution of ionospheric irregularities in the high latitude F region ionosphere (2S.18).

J.D. Kelly: Radar observations of small-scale structure in the dayside high-latitude ionosphere (2S.19).

C. Hanuise, M. Crochet, J.P. Villain, A. Hedberg: F region plasma instabilities in the auroral zone observed with a coherent HF radar system (2S.20).

R.D. Hunsucker, F.T. Berkey: HF digital sounder investigations of auroral ionosphere irregularity structure at Cleary, Alaska (2S.21).

A. Urban, K.M. Torkar: Low energy electron measurements during the energy budget campaign(2S.23).

T.A. Kornilova, T.N. Kolosova, M.I. Pudovkin, S.A. Chernouss, A.A. Khruchshinsky: Pulsating auroral bistructures and magnetospheric plasma conductivity (2S.12).

This session was planned to discuss the progress in research, both experimental and theoretical, on high-altitude ionospheric irregularities in the sub-auroral, auroral and polar regions. The two invited papers introduced the up-to-date experimental knowledge on the ionospheric irregularities; one related to spread-F and sporadic-E phenomena obtained from the oblique incidence radiopath network in the Arctic region, and the

other the morphology of F-region irregularities detected from measurements by polar orbiting satellites, backscatter radars, etc. The contributed papers presented a variety of recent experimental study with ground-based facilities, balloon and rocket launchings, as well as satellite measurements. Some theoretical papers on the interpretation of observed irregularities from the viewpoint of plasma physics were presented. All of the papers presented at this session will contribute to the understanding of the ionospheric irregularities in high-latitude regions associated with aurora, particle injection, and field-aligned currents.

(S.L. Ossakow)

2C. ATMOSPHERIC PHENOMENA LINKED WITH POLAR CUSPS (Convener: M.H. Rees)

August 10, a.m. Room: LT4

Chairman: M.H. Rees

G.G. Shepherd, L.L. Cogger: Characteristics of the dayside aurora viewed from the ISIS-II satellite (2C.01).
W.A. Gault, R.A. Koehler: Spectrum of the dayside cleft aurora (2C.02).
G.G. Sivjee, C.S. Deehr, G.J. Romick: Spectral differences between mid-day and night time aurorae (2C.03).
G.J. Romick, C.S. Deehr, G.G. Sivjee: Simultaneous meridian scanning photometer observations of day and nightside aurorae (2C.04).
D.J. McEwen: Coordinated rocket-ground-measurements in the polar camp (2C.05).
T.J. Fuller-Rowell, D. Rees, I.S. Mikkelsen: Comparison of neutral wind measurements in the dayside polar cap with the predictions of a three-dimensional time-dependent model (2C.06).
M.F. Smith, T.J. Fuller-Rowell, D. Rees, R. Gordon: Heating and dynamical effects in the termosphere due to magnetospheric electrons (2C.07).
P. Rothwell, B. Lanchester, R.W. Thomas: Daytime auroral motions imaged with an all sky low light level TV camera in Spitzbergen (2C.08).
R.H. Father, S.B. Mende: Auroral motions under the dayside cusp (2C.09).
M.H. Rees: Recent advances in observations and modeling of auroral effects in the polar cusp (2C.10).

The ten papers presented in this session focused on polar cusp observations and modeling. The characteristics of precipitating electrons as measured by rocket borne instruments were described by *McEwen*. Optical and spectroscopic observations were the subject of six reports. *Shepherd* showed images of the cusp aurora viewed from the ISIS II satellite at 1400 km. in the red and green lines of oxygen and the First Negative bands of ionized molecular nitrogen. The spectrum of the mid-day aurora was described by *Gault* and by *Romick*. Both speakers emphasized the prominence of atomic emission features in cleft spectra over molecular features which dominate in nightside aurora. Using meridian scanning photometer observations,

Romick noted, in another paper, the occurrence of simultaneous enhancements in auroral optical radiation in the dayside and in the nightside auroral regions. Large scale auroral motions in the cusp were described by *Eather* using photometric observations carried out in Antarctica. Continuous darkness around winter solstice provide the intensity distribution of the 6300 Å oxygen radiation over a long time sequence and a wide range in latitude. Rapid, fine scale auroral motion and structure were obtained with an all-sky TV imaging system, as reported by *Lanchester*. Sensitivity to low light levels allowed studying the dynamics of faint auroral forms, showing that the dayside cusp aurora is fully as active as nightside aurora.

The application of a three-dimensional time dependent thermospheric model to the dayside cusp region was examined in two papers. *Fuller-Rowell* reported on the analysis of chemical trail releases to test the model predictions of the neutral wind while the influence of energy input in the cusp on global heating and dynamics was discussed by *Smith*. An overview of atmospheric and ionospheric effects resulting from particle precipitation in the dayside cusp was presented by *Rees*.

(M.H. Rees)

2D. DYNAMICS OF THERMOSPHERES AND EXOSPHERES OF THE EARTH AND PLANETS
(Conveners: P. Bauer, A.F. Nagy, C.A. Reddy)

August 5, a.m. Room: LT4

Thermosphere Chairman: E.G. Fontheim

R.W. Blum, K.G.H. Schuchardt: Models of the neutral thermosphere (invited) (2D.01).

D. Rees, T.J. Fuller-Rowell: The role of thermospheric models in improving our understanding of the processes affecting the thermosphere (invited) (2D.02)

R.L. Walruscheid: Semiannual oscillation in the thermosphere as a conduction model (2D.04).

G.C. Sethia, J.K. Hargreaves, G.J. Bailey, R.J. Moffett: Effects of thermospheric winds on total electron content (2D.05).

J.W. Meriwether, Jr., C.A. Tepley, P.B. Hays, L.L. Cogger, G. Hernandez, C.A. Romick, M.H. Rees, R. Sica: First results of thermospheric neutral wind observations from the north american median chain of Fabry-Perot interferometers (2D.06).

H. Rishbeth: Directional Property of electric currents in Sporadic E Layers (2D.07).

R.J. Moffett: Neutral dynamics of the terrestrial equatorial thermosphere: a review (invited) (2D.08).

J.M. Forbes: Tides in the thermosphere (invited) (2D.09).

C. Mazaudier, M. Blanc: Seasonal variations of the electrodynamic parameters and of the resulting electric current flow over Saint-Santin on quiet days (2d.10).

August 5, p.m. Room: LT4

High Latitude Dynamics and Electrodynamics and Their Coupling to Midlatitude Dynamics Chairman: C.T. Russell

R.W. Schunk: Theoretical models of high-latitude electrodynamics (invited) (2D.11).

A. Hruska: Relation of the field aligned currents to the ionospheric motions and to the structure of the auroral zone ionosphere (2d.12).

D. Rees, P. Charleton, M. Carlson, T.J. Fuller-Rowell: Mesosph-ric and thermospheric winds over Scandinavia during the energy budget campaign (2D.13).

G.J. Romick, T.J. Hallinan, G.G. Sivjee, G. Hernandez: High time resolution intensified television images of λ5577A and λ6300A Babry Perot fringes applied to auroral thermospheric studies (2D.14).

S. Quegan, G.J. Bailey, R. J. Moffett, R.A. Heelis, T.J. Fuller-Rowell: A quantitative model of the effects of convection on the high-latitude ionosphere (2D.15).

C.R. Philbrick, J.P. Mc Isaac, K.H. Bhavnani: Atmospheric structure associated with dynamical processes in the mesosphere and lower thermosphere (2D.16).

M. Blanc: The effects of magnetospheric activity on the structure and dynamics of the thermsphere and ionosphere at modlatitudes: a review (invited) (2D.17).

A.D. Richmond: Atmospheric waves generated in the auroral ionosphere: a review (2D.18).

C. Mazaudier, M. Blanc, M.L. Duboin, D. Alcaydé: An incoherent scatter study of midlatitude ionospheric parameters disturbances (electric field, neutral wind, temperatures and electric currents) during a magnetic storm (2D.19).

W.L. Oliver, J.V. Evans, J.M. Holt, R.H. Wand: Features of thermospheric behavior during geomagnetic storms over the magnetic latitude range 35-75 degrees as observed from Millstne Hill (2D.20).

G.M. Khocholava, N.N. Mebagishvili, V. Sh. Orvelashvili: On latitudinal distribution of ionosphere disturbances (2D.21).

August 6, a.m. Room: LT4

Equatorial Electrodyanamics Chairman: H. Rishbeth

C.A. Reddy: Electrodynamics of the equatorial thermosphere (invited) (2D.22).

H.F. Chan, G.O. Walker: Simulations of the ionospheric equatorial anomaly at solar minimum (2D.23).

M. Blanc, C. Mazaudier, C. Hanuise, M. Crochet: Dynamo simulation and radar observations of the January 21, 1977 counter electrojet (2D.24).

J.N. Desai, S.P. Gupta, R. Raghavarao, V.V. Babu, V. Sudhakar: Preliminary results on neutral winds and temperatures at F-region altitudes by rocket-released vapour clouds during onset of equatorial spread-F (2D.26).

Exospheres Chairman: H. Rishbeth

B.A. Tinsley, R.R. Hodges: The non-isothermal non isotropic terrestrial exosphere (invited) (2D.27).

J.L. Bertauz: Recent progress in the study of planetary exospheres (invited) (2D.28).

S. Kumar: The escape of hydrogen from planetary atmosphere (invited) (2D.29).
J.W. Meriwether, Jr., O,B, Gats, J.H. Yee: Observations of O^+ twillight intensities and thermal winds with a double etalon interferometer (2D.30).
S.K. Atreya, J.W. Meriwether: Line profile measurements of the geocoronal Balmer alpha (2D.31).

August 6, p.m. Room: LT4

Planetary Atmospheres and Exospheres Chairman: P. Bauer

T.E. Cravens, A.F. Nagy: The ionospheres of the inner planets (invited) (2D.34).
U. Von Zahn: The upper atmospheres of the terrestrial planets (invited) (2D.35).
H.G. Mayr, I. Harris: Dynamics of planetary thermospheres (invited)(2D.36).
C.T. Russell, J.G. Luhmann, R.C. Elphic, F.L. Scarf, L.R. Brace: On the loss of plasma from the Venus ionosphere : the role of the magnetosheath magnetic field in the detachment process (2D.37).
T.E. Cravens, A.F. Nagy, S. Crawford: A two-dimensional model of the ionosphere of Venus (2D.38).
R.R. Hodges, B.A. Tinsley: The role of charge exchange reactions in producing tue "hot" exospheric hydrogen on Venus (2D.39).
D.M. Hunten: A comaprison of the planetary atmospheres (invited)(2D.40).
S.K. Atreya: Atmospneres, ionospheres and evolution of the giant planets and Titan (invited)(2D.41).

The Symposium Dynamics of Thermospheres and Exospheres of the Earth and Planets gathered about 70 participants during four half day sessions. A large part of the symposium consisted in invited talks (16 out of 37 papers). The first part of the symposium was devoted to the modelling of the properties of the thermosphere. Very elaborated models of the thermosphere have been developped in the last ten years which incorporate large amount of ground based and satellite data. They have proved to be of considerable interest in order to improve the understanding of the processes affecting the thermosphere. The study of High latitude dynamics and Electrodynamics and their coupling to middle latitude dynamics was the second topic to be covered. A large efforts has been made towards the qualitative and quantitative understanding of the electrodynamical coupling of the high and middle latitude thermospheres. The processes involved in the momentum and energy transfer from the high latitude ionosphere to the thermosphere as well as in the interaction of magnetospheric electric fields with the thermosphere were described in much details.

The last topic of this symposium concerned the exosphere and atmospheres of the inner and outer planets. Recent observations of planetary atmospheres have raised a number of important questions concerning the ionic composition of Venus, the maintenance of the night-time Venus ionosphere, the neutral composition of the Venus atmosphere, the thermal structure of the Venus atmosphere, the superrotation of the Venus atmosphere, the thermal structure of the Mars atmosphere and the atmospheres of the giant planets.

(P. Bauer)

2A. AURORAL EMISSION: X RAY, ULTRAVIOLET, VISIBLE AND INFRARED
(Conveners: A. Vallance-Jones, R.R. Meier, N.N. Shefov)

August 14, a.m. and p.m. Room: LT1

Chairmen: A. Vallance-Jones, R.R. Meier

V.M. Ignatyev, V.A. Yugov, K.V. Atlasov: Non-thermal profiles of oxygen atom emission in aurora (invited) (2A.01).

P.D. Feldman: Far and extreme ultraviolet spectroscopy of aurora (invited) (2A.02).

J.M. Ajello, S.K. Srivastava, Y.L. Yung: H_2 and SO_2 fluorescence spectra in the vacuum ultraviolet by electron impact: Laboratory study and application to Jovian aurora and Io torus (2A.04).

A.B. Christensen, G.G. Sivjee: Radiative entrapment of auroral EUV leading to enhanced OI(7990A) emissions (2A.05).

R.R. Meier, R.R. Conway, D.E. Anderson, Jr., P.D. Feldman, D.J. Strickland, E.P. Gentieu: Observations and analysis of N_2 and OI far UV auroral emissions (2A.06).

V. Singh, J.C. Gérard: Model calculation of auroral ultraviolet emission on Jupiter (2A.07).

S. Trajmar, S.K. Srivastava, O.J. Orient: Electron impact excitation and dissociation of SO_2 (2A.08).

W. Benesch: Processes leading to the production of type B red auroras (2A.09).

D.P. Cauffman, W.L. Imhof, M. Walt, J.G. Luhmann: Electron spectra from satellite X-ray images: Practical considerations (2A.10).

A.T. Stair, Jr., D.J. Baker: Infrared aurora - A review (invited) (2A.11).

G. Lange, H. Trinks, H. Lauche: Ground based observations of the infrared emission of $O_2(^1\Delta_g)$ and OH together with 5570Å, 6300Å and 3914Å during the winter 1980/81 from Kiruna/Sweden (2A.12).

J.C. Ulwick, K.D. Baker, A.T. Stair, Jr.: Rocketborne measurements of infrared spectra and related parameters (2A.13).

P.F. Mizera, D.J. Boucher, J.G. Luhmann: Auroral X-rays and electron spectra (invited) (2A.14).

J.P. Treilhou: A semi-empirical method to obtain the precipitated electron energetic spectrum from the X-ray spectrum (2A.15).

R.A. Goldberg, C.H. Jackman, L.A. Treinish, J.R. Barcus: Simultaneous observations of bremsstrahlung X-rays above and below aurorae (2A.16).

K. Henriksen, G.G. Sivjee, C.S. Deehr: High latitude He emissions (invited) (2A.18).

Yu.A. Nadubovich, L.P. Korobtsova: Fast variations of subauroral ionosphere luminosity (2A.19).

J. Kozyra, T.E. Cravens, A.F. Nagy: Atmospheric effects of precipitating energetic O^+ fluxes (2A.20).

G.J. Romick, J. Olson, T. Morse: Periodic variations in the intensity of the evening auroral arc preceding auroral breakup (2A.21).

R.R. Vondrak, J.S. Murphree, C.D. Anger: Remote sensing of high-latitude ionization and conductivity with the ISIS-2 auroral scanning photometer (2A.22).

D.J. McEwen: Spectral characteristics and infrared electron energies in pulsating aurora (2A.24).

T. Oguti, S. Kokubun, K. Hayashi: The modes of auroral pulsation (2A.25).

A.J. Deans, G.G. Shepherd: Rocket measurement of the temperature profiles derived from molecular rotational density distributions in the aurora (2A.26).

J.B. Kumer, R.D. Sears, J.E. Evans, S.E. Harris, R.M. Nadile: Application of all sky auroral spectrophotometric image intensified TV measurements to modeling the time dependent two dimensional infrared earthlimb emission (2A.27).

D.A.R. Simmons: Auroral emissions: A photometric study of some recent displays (2A.28).

E.J. Llewellyn: Excitation mechanism for atomic oxygen emissions in aurora (invited) (2A.29).

R.L. Gattinger, A. Vallance-Jones: Temporal variations of forbidden emission features in pulsating and rapidly fluctuating aurora (2A.30).

J.A. Gledhill, H. Karszenbaum, D.A. Gagliardini: Predicted airglow and ionization intensities in the South Atlantic anomaly (2A.32).

T. Watanabe, J.S. Kim: Photometric and interferomic observations of the SAR arc event of March 5/6, 1981 (2A.34).

This full-day session was devoted to the discussion of the ionospheric processes involved in the emission of radiation in the aurora as a result of the deposition of energy by energetic particles. A total of 29 papers were displayed by posters. Most of the papers were concerned with the interpretation of recent experimental results on auroral emissions on earth (or even Jupiter and Saturn) from the ground or by means of satellites. It was shown that knowledge and understanding of the far and extreme ultraviolet regions of the spectrum have advanced rapidly. New results in infrared auroral studies were reported. Satellite x-ray and visible region imaging were shown to be promising tools for synoptic studies of the characteristics and spatial distribution of the particle fluxes giving rise to aurora. It was however clear that some excitation processes (such as that for λ5577) are not yet completely understood, particularly where energy transfer reactions are suspected to play an important role. There was a great deal of lively discussion at this well attended session.

(A. Vallance-Jones)

2M. MIDDLE ATMOSPHERE SCIENTIFIC SYMPOSIA (Convener: L.R. Megill)

August 10, p.m.; 11, a.m., p.m.; 12, a.m., p.m.; 13, a.m., p.m. Room: LT5

Review of Problems in Dynamics Chairman: L.R. Megill

I. Hirota: Planetary scale motion in the middle atmosphere (invited)(2M.01).

G.C. Reid: Small scale disturbances in the middle atmosphere (invited) (2M.02).

J.M. Forbes: Tides in the middle atmosphere (invited)(2M.03).

D.M. Cunnold, F.N. Alyea, R.G. Prinn: Modeling the interaction between stratospheric chemistry and transport (invited)(2M.04).

J.B. Gregory: Wind measuring techniques for studies of middle atmosphere dynamics (invited)(2M.05).

Electrodynamic Coupling and Lower Ionosphere Dynamics
Chairman: E.S. Kazimirovsky

J. Taubenheim, E.A. Lauter, J. Bremer, G.V. Cossart, G. Entzian: D-region ionization as a diagnostic tool for ground-based monitoring of middle atmosphere dynamics (invited)(2M.06).

P. Bencze: Turbulence at the top of the middle atmosphere deduced from ionospheric sporadic E (2M.07).

R.A. Vincent: Some aspects of D-region dynamics (invited)(2M.09).

T. Ishimine: The spatial variation of the winter anomaly in ionospheric absorption (2M.10).

S. Ganguly: Recent D-region research at Arecibo (2M.11).

E.S. Kazimirovsky, V.D. Kokourov, V.F. Petrukhin, G.V. Vergasovs, N.A. Chernobrovkina, N.V. Larlonov: The dynamical region of ionospheric D-region over East Siberian (2M.12).

C.A. Tepley, J.D. Mathews, S. Ganguly: Ion-neutral collision frequencies and temperatures derived from incoherent scatter radar observations of the lower ionosphere (2M.13).

J.D. Shelton, C.S. Cardner, C.F. Sechrist, Jr.: Theoretical and lidar studies of sodium layer dynamics (2M.14).

A. Crenieu, J. Bertin: Incoherent scatter in the D-region.

B.L. Kashchyev, et al.: Peculiarities of equatorial circulation at the meteor zone.

C. Granier, G. Megie, M.L. Chanin: Diurnal variation of the upper atmospheric sodium layer (2M.15).

J.P. Jegou, M.L. Chanin: Theoretical explanation of the seasonal and latitudinal behavior of the alkali metals (2M.16).

H.M. Sullivan: The seasonal variation of twilight lithium emission (2M.17).

C. Nagasawa, M. Hirono, M. Uchiumi, M. Fujiwara: Lidar observation of the mesospheric sodium layer in Fukuoda (2M.18).

G. Cevolani, S.P. Kingsley, H.G. Muller: Simultaneous observations of the quast 2-day neutral wind oscillation in the meteor region over latitudes 45 to 60 degrees north (2M.19).

Energetic Particles Chairman: M.H. Rees

G.C. Reid: Effects of energetic particles on neutral and ion chemistry (2M.20).

R.A. Goldberg, C.H. Jackman, J.D. Mitchell, J.R. Barcus: Nighttime ion-ion recombination coefficients in the middle atmosphere determined during energetic auroral events (2M.21).

G. Sátori: The study of the effect of Forbush-decreases and particle events at the base of the lower ionosphere by means of atmospheric radio noise (2M.22).

A. Urban: Low energy auroral electron measurements performed during the energy budget campaign (2M.23).

C. Hanuise, J.P. Villain, A. Hedberg, M. Crochet, G. Hamberg: Safari electric fields measurements during the energy budget compaign (2M.24).

E.J. Schmidlin, C. Russel Philbrick, D. Offermann: Energy budget compaign (November 1980): Stratospheric and the mesospheric temperature and wind structure (2M.25).

D.J. Baker, A.J. Steed, G.A. Ware, A.T. Stair, Jr.: Time-resolved infrared airglow spectra and temperatures (2M.26).

A.T. Stair, K.D. Baker, J.C. Ulwick: Rocketborne infrared measurements of the energy budget campaign (2M.27).

A. Brekke, O. Holt, T. Hansen: Partial reflection measurements at Ramfjordmoen, Norway during the energy budget campain (2M.28).
K.U. Grossmann, W. Fings, R. Hennig, D. Offermann: A measurement of mesospheric CO_2 and H_2O emission by means of a rocketborne cryogenic infrared spectrometer (2M.29).
W. Joos, H. Boy, D. Krankowsky, P. Lämmerzahl: Measurements of the ion population in the disturbed and quiet polar D- and E-regions (2M.30).
V. Bucha: Effect of increased geomagnetic activity on the lower atmosphere (2M.31).

Solar Irradiation Fluxes from X-ray to Near UV Chairman:

P.C. Simon: Solar irradiance and its variation at wavelengths greater than 180 nm (invited) (2M.32).
H.F. Hinteregger, K. Fukui, B.R. Gilson: Solar EUV irradiance at 140-1850 Å observed from satellite AE-E over present solar cycle (2M.33).
H.E. Hinteregger: Solar irradiance and its variation at wavelengths below 185 nanometer (invited) (2M.34).
R.W. Kreplin, D.M. Horan: Solar X-ray irradiance and its vatiability (2M.36).
K. Montierth, L.R. Megill: A measurement of the scattered U.V. light component in the stratosphere (2M.37).

Neutral and Ion Chemistry and Airglow Including H_2O, OH and NO
Chairman: D.G. Torr

R.S. Stolarski: Neutral and ion chemistry in the middle atmosphere (invited paper) (2M.38).
S. Solomon, P.J. Crutzen: Photochemical model studies of mesospheric water vapor (2M.39).
J.J. Olivero, C.J. Gibbins, R.M. Bevilacqus, P.R. Schwartz, D.L. Thacker: Recent measurements of mesospheric water vapor by ground-based microwave radiometry (2M.41).
P.R. Schwartz, C.J. Gibbins, H. Penfield, D.L. Thacker, R. Bevilacqua, A.E. Lilley: Millimeter-wavelength spectroscopy of H_2O, O_3 and O_2 in the middle atmosphere (2M.42).
M.J. Taylor: A wide field, low light level TV system to measure the state of polarisation of light (2M.43).
C.E. Meek, A.H. Manson: Measurement of structure and drift velocity of airglow (557.7 nm) fluctuations (2M.44).
M.A. Hapgood, M.J. Taylor: Analysis of airglow image data (2M.45).
P. Rothwell, M.J. Taylor, M.A. Hapgood: Observations of gravity waves in the upper atmospheric nightglow emissions (2M.46).
C.A. Tepley, R.G. Burnside, K.W. Meriwether, Jr.: Horizontal thermal structure of the mesosphere observed from OH(8-3) band emission (2M.48).
C. Gay, G.E. Tohmas: Radiative temperature relaxation in the upper stratosphere, and lower mesosphere (2M.50).
T. Hirasawa, H. Fukunishi, T. Nagata: Japanese MAP project in Antarctica (2M.53).
L.V. Zelenkova, M.I. Pudovkin: Variation of the parameters of D-region of the ionosphere during ionospheric disturbances (2M.54).
J.B. Kumer, W.G. Uplinger, L. Newkirk, A. Goldman, D. Murcray, R. Harris, R. Megill: Impact of Spectral resolution of accuracy of species retrieval from earth limb emission data (2M.56).

A.E. Roche, J.B. Kumer, R.D. Sears, T.C. Nast, P.B. Forney, D. Murcray, R. Megill: Measurement of stratospheric minor species and temperature using a cryogenically cooled solid Fabry Perot infrared spectrophotometer (2M.57).

H. Takahashi, V.W.J.H. Kirchhoff, P.P. Batista, B.R. Clemesha, Y. Sahai: Measurements of sodium nightglow and other mesospheric parameters (2M.58).

R. Prange: Morphological study of the particle precipitation events in the Brazilian anomaly and its consequences on the region (2M.59).

P.C. Wraight: Association of atomic oxygen and airglow excitation mechanisms (2M.61).

Laboratory Aeronomy Chairman: D. Smith

B.A. Thrush: Laboratory studies of the mechanism of airglow and other chemiluminescent processes (invited)(2M.62).

T.G. Slanger, G. Black: $O(1_S)$ production and loss processes in the airglow (2M.64).

Noctilucent Clouds Chairman: M. Gadsden

R.R. Burke: Kinetic rate data for $H^+(H_2O)N$ formation and growth reactions (2M.67).

L.G. Bjorn, F. Arnold: Mass spectrometric measurements of precondensation nuclei (2M.69).

E. Kopp, P. Eberhardt, U. Hermann, L.G. Bjorn: Positive ion composition of the high latitude summer D-region with noctilucent couds (2M.70).

D.K. Chakrabarty, P. Chakrabarty, G. Witt: Formation of positive aerosol ions - large sized hydrated protons - during noctillucent clouds (2M.71).

J.J. Olivero, R.M. Revilacqua: Noctilucent clouds and their environment (2M.72).

R.P. Turco, O.B. Toon, R.C. Whitten, R.C. Keesee, D. Hollenbach: Simulated notilucent clouds (2M.74).

C.P. Mckay, G.E. Thomas: Zonally-averaged calculation of temperature and water vapour in the noctilucent cloud region (2M.75).

M.J. Taylor: A wide field, low light level TV system to measure the state of polarization of light (2M.76).

D.A.R. Simmons: Measurement of the airflow at the mesopause from noctilucent cloud observations (2M.77).

A.F. Roddy: The nucleation and growth of ice crystals in a noctilucent cloud environment (2M.78).

M. Gadsden: Detection of noctilucent clouds before they become visible (2M.79).

J.J. Olivero, R.M. Bevilacqua: Noctilucent clouds and their environment (2M.80).

D.H. McIntosh, M.H. Hallissey: Noctilucent cloud over Western Europe 1970-1980 (2M.81).

P.H.G. Dickinson: Atomic oxygen measurements in subvisible noctilucent cloud condition (2M.82).

G.E. Thomas, C.P. McKay: Forthcoming satellite observations of noctilucent clouds (2M.83).

The "Middle Atmosphere Symposia" were held jointly between IAGA and I/MAP, and they were conducted over the second week of the IAGA Edinburgh Assembly and the first week of the IAMAP Assembly in Hamburg. It was attempted to divide the subjects in a manner which would include the widest possible participation from the respective members of IAGA and IAMAP. The program shown above constitutes the first half of the two-week symposia, beginning with a half-day review session with tutorial papers on upper atmospheric circulation.

The remaining 3 full days were devoted to the presentation of contributed papers concerning different specific subjects, which are very close to traditional areas of interest to IAGA.

In the discussion of electrodynamic coupling and lower ionosphere dynamics, the importance of the study of D-region and lower E-region conditions with various observational techniques, such as radar and lidar, was emphasized. The middle atmosphere dynamics will be better understood in connection with the physical condition and processes of the lower ionosphere.

The middle atmosphere over the world is indirectly influenced by the inflow of energetic particles in high latitudes, especially in auroral regions. The physical mechanism for the middle atmosphere modification deserves concentrated study, and a project, "Energy Budget Campaign", is carried out in Northern Scandinavia to contribute to the understanding of this important subject.

Exact knowledge on the solar irradiation is very important, especially its long-term variation. The precise measurement of the solar radiation is being made for different wavelengths, especially with spacecraft. It is very likely that the solar UV variability over a solar cycle is ~1% at wavelengths longer than 2100°_{A}, but it increases markedly for shorter wavelengths, to more than a factor of 4 in coronal lines of wavelengths less than 1000°_{A}.

The role of minor constituents is very important in the neutral and ion chemistry of the middle atmosphere, and the resulting photo-emission or absorption. A variety of spectroscopic studies were presented, followed by two papers of laboratory study.

The final part of the symposium in Edinburgh was devoted to the presentation of recent theoretical and observational research on noctilucent clouds. A poster session was also held for this subject, and it was very successful to exchange information and stimulate discussion among the participants.

All of the above subsessions included excellent contributions to the understanding of the total stratosphere-mesosphere region and its connection with the lower ionospheric region.

(L.R. Megill)

G2. GENERAL CONTRIBUTIONS TO DIVISION II ON AERONOMIC PHENOMENA (Conveners: H. Rishbeth, A.D. Danilov)

August 14, a.m. and p.m. Room: 3d and LT3

Chairman: A.V. Shirochkov

E.H. Carman: Equatorial plasma bubbles in the 630.0 nm airglow at Vanimo (G2.02).

S. Alex, G. Rajaram: Dynamics of the F region inferred from the hmF2 - foF2 relationship (additional paper).

G. Rajaram, S. Alex: Changes in the position and structure of the mid-latitude plasmatrough as a function of geomagnetic activity (additional paper).

S.M. Radicella, J.R. Manzano, N. Ortiz de Adler: Satellite and ground observations of a marked negative phase during the recovery of an ionospheric storm (G2.04).

H. Tanabe, A. Takechi, A. Miyashita: Narrow depressions of low latitude 6300Å airglow intensity (G2.05).

L.S. Alperovitch, V.A. Troitskaya, V.M. Sorokin, G.V. Fedorovitch, N.M. Drobzev, M. Candidi: Long-period geomagnetic variations as a result of electrodynamic correlation in the mid-latitude ionosphere (G2.06).

A.G. Khantadze, A.I. Gvelesiani: The influence of the ionospheric plasma on the general circulation in upper atmosphere (G2.08).

R.M. Robinson, R.R. Vondrak, T.A. Potemra: Observed relationships between field-aligned currents and ionospheric electric fields and conductivities (G2.09).

T. Nagata, T. Hirasawa: Electron number density within auroras (G2.10).

C.-U. Wagner, H. Ranta, A. Ranta, J. Oksman: Night-time ionospheric absorption during and after magnetospheric storms from auroral (L = 6.0) to medium (L = 2.7) latitudes (G2.11).

A.S. Rodger: Night-time movements of the mid-latitude trough and a comparison with movements of the plasmapause (G2.12).

V. Afonin, K.D. Cole, J. Smilauer: Compressive heating of the ionosphere at high L-values (G2.13).

V. Afonin, K.D. Cole, J. Smilauer: Asymmetrical conjugate points effects in electron density and temperature at 500 km altitude and low L-values (G2.14).

N.M. Shutte, K.D. Cole: Daytime variations of charged particle fluxes at low L-values (G2.15).

C. Taieb, C. Senior, P. Bauer, L. Barouch: Nitric oxide influence on electron distribution in the E region (G2.18).

Among 15 papers presented to this session, 12 papers were mainly concerned with the ionospheric characteristics in middle and low latitudes, and 3 papers were for high latitudes.

Carman reported some observations of plasma depletions at Vanimo by means of 630.0 nm airglow measurements. He claims that there is evidence of these airglow depletions with the range type of spread F. Alex and Rajaram used Alouette 2 data to study changes in various parameters of the mid-latitude plasma trough. Purely morphological type of exploration. The paper by Rajaram and Alex is a rather interesting study of the latitudinal distribution of hmF2 variations depending on the local time, the latitude and on the geomagnetic activity level. The authors think that the tidal patterns in electron drift velocities in the E region can somehow propagate

up to the F region. Manzano showed an analysis of F2 layer parameters from South American ionosonde chain together with total electron content and ion composition data from S3-2 satellite. Good agreement was shown to exist between them. Some chemistry calculations confirm it also. Tanabe et al. reported some narrow depressions observed in the 6300A airglow intensity at geomagnetic latitude 13°N in Japan in March 1979. Some morphological features of this phenomenon are discussed. Troitskaya et al. observed a new type of geomagnetic oscillation (with period 5-20 min.) which is generated by the dynamic process in mid-latitude ionosphere. The authors claim the existence of ionospheric sources of electromagnetic waves connected with substorms, large industrial explosives and earthquakes. Khantadze and Gvelesiani showed a possibility of the vortex formation on the neutral atmosphere due to the influence of ionospheric plasma. The winds system is calculated for neutral atmosphere.

Vondrak et al. compared Chatanika incoherent radar data with Triad satellite data. Very close morphological relationship is found between the two sets of data. The ionization morphology can be used for prediction of the correspondent pattern of the field-aligned currents. Nagata and Hirasawa presented the results of the rocket launches at Syowa Station, Antarctica (geomag. lat. 70.0°S), measuring electron density in the D and E layers. The correlation between aurora luminosity and electron density values was investigated for different heights. Oksman et al. observed with their Finland riometer network, smooth long-lasting absorption increases in the recovery phase of the storm. The time variations of the phenomena are discussed. Rodger reported that the main features of the diurnal, seasonal and solar cycle variations in the occurrence of the mid-latitude trough have been established using night-time ionograms from Halley Bay, Antarctica ($L = 4.2$). These results are compared with movements of the plasmapause from both experimental and theoretical models. Cole et al. presented their analysis of the Cosmos-200 Satellite data. In the vicinity of the ionospheric trough the strong inverse correlation of electron density and electron temperature were found, which is a very interesting phenomenon. There are both symmetrical and asymmetrical effects in electron density and temperature at conjugate points, although the reasons for these are unknown. Sporadic fluxes of electrons and ions with energies of 100 eV - 20 keV were observed at altitudes $\sim$500 km at 11.5 - 12.3 hours MLT. The morphological aspects of this phenomenon are discussed. Taieb et al. found an asymmetry between morning and afternoon electron density values at equal solar zenith angle in the incoherent scatter radar data at Saint-Santin, France. They gave some theoretical explanation (rather preliminary) of this phenomenon.

(A.V. Shirochkov)

3S. SPECIAL SYMPOSIUM ON SATURN (Convener: V.M. Vasyliunas)

August 3, p.m. Room: George Square Lecture Theatre

Chairman: V.M. Vasyliunas

R. Hide: Introductory public lecture: Saturn and Jupiter: Giant magnetic rotating fluid planets (3S.01).
A. Brahic: Dynamics of Saturn's rings (invited review) (3S.02).
D.J. Stevenson: The internal magnetic field of Saturn (3S.04).
G.L. Siscoe: The magnetosphere of Saturn (invited review) (3S.05).
E.J. Smith, L. Davis, Jr.: Pioneer 11 observations of Saturn's magnetic field and its solar wind interaction (3S.06).
N.F. Ness, M.H. Acuna, K.W. Behannon, L.F. Burlaga, J.E.P. Connerney, R.P. Lepping, F.M. Neubauer: Preliminary results at Saturn from the magnetic field experiment on Voyager 1 (3S.07).
D.B. Beard, D. Hirschi: Saturn's magnetosphere (3S.08).
H.S. Bridge, J.W. Belcher, A.J. Lazarus, S. Olbert, J.D. Sullivan, F. Bagenal, P.R. Gazis, R.E. Hartle, K.W. Ogilvie, J.D. Scudder, E.C. Sittler, A. Eviatar, G.L. Siscoe, C.K. Goertz, V.M. Vasyliunas: Plasma observations near Saturn (3S.09).
L.J. Lanzerotti, C.G. Maclennan, S.M. Krimigis, E.P. Keath, W.I. Axford, T.P. Armstrong, G. Gloeckler: Low energy charged particles in Saturn's magnetosphere: Voyager 1 (3S.10).
J.A. Simpson, T. Bastian, J.F. Cooper, R.B. McKibben, K.R. Pyle: Investigations of Saturn's trapped radiations with Pioneer 11 (3S.12).
A.J. Kliore: Saturnian atmosphere and ionosphere (invited review) (3S.13).
J.H.Waite,Jr., S.K. Atreya, A.F. Nagy, T.M. Donahue, T.E. Cravens: The upper atmosphere and ionosphere of Saturn (3S.15).
H.G. Mayr, I. Harris, B.J. Conrath: Thermal focusing in planetary atmospheres: rigid shell super-rotation and differential rotation (3S.17).

A special symposium on Saturn was held on the first day of the IAGA Edinburgh Assembly, without any parallel sessions. This symposium was organized by Division III and cosponsored by Divisions I, II and IV of IAGA. The program consisted of an introductory public lecture, three invited review papers, five reports by Pioneer and Voyager investigators and observations from spacecraft flybys past Saturn, and four contributed papers.

The program covered a wide range of topics related to Saturn and the Saturnian system, including the dynamics of the rings, the properties of the internal magnetic field, the magnetosphere of Saturn and its interaction with the solar wind and with Titan and other Saturnian moons, the radiation belts, the ionosphere, and the structure and dynamics of the atmosphere. The introductory public lecture as well as many of the subsequent presentations stressed analogies or contrasts between Saturn and other planets, especially Jupiter. The audience was attentive and quite large, with peak attendance estimated to be near on in excess of 300, attesting to the widespread interest in Saturn aroused by the Pioneer and Voyager flyby series.

(V.M. Vasyliunas)

3T. THEORY OF PLANETARY MAGNETOSPHERES (Conveners; G.L. Siscoe and A.A. Galeev)

August 6, a.m. Room: LT2

Chairman: G.L. Siscoe

V.M. Vasyliunas: Theory of planetary magnetospheres as a unified subject: The common, the peculiar, and the understandable (invited, 3T.01).

R.C. Elphic, C.T. Russell: Magnetic flux ropes in the Venus ionosphere: Implications for the source and evolution of quasi-force-free magnetic structures (3T.02).

R.C. Elphic, C.T. Russell, J.G. Luhmann, F.L. Scarf: Scale thickness of the boundary between the solar wind and a planetary ionosphere: The Venus ionopause current sheet (3T.03).

J.G. Luhmann, C.T. Russell, R.C. Elphic, L.H. Brace, J.D. Mihalov: Two states of the Venus - solar wind interaction (3T.04).

D.B. Beard, I.M. Engle: Concise representation of the magnetic field of the Jovian equatorial current (3T.07).

M.H. Acuna, J.E.P. Connerney, N.F. Ness: Quantitative modeling of Jupiter's magnetosphere and effect on energetic charged particle motion (3T.08).

A. Nishida, Y. Watanabe: Heating of the Jovian ionosphere accompanying enforcement of corotation to its outer magnetosphere (invited, 3T.09).

R.M. Thorne: Mechanism for injection and removal of energetic particles in the middle Jovian magnetosphere (3T.10).

R.M. Thorne: The role of Jovian auroral secondary electrons on Io torus thermodynamics (3T.11).

L.L. Hood: Satellite absorption of trapped energetic particles at Jupiter and Saturn (3T.12).

A.J. Dessler, F.C. Michel: Extension of Jovian and Saturnian magnetospheric physics to pulsars (3T.13).

S. Grzedzielski, W. Macek: A long Jovian magnetic tail and its influence upon Saturn (3T.14).

G.H. Voigt, T.W. Hill, A.J. Dessler: A quantitative model for the magnetosphere of Uranus (3T.15).

This session was planned to present recent progress in understanding the planetary magnetospheres, based on the observed data by the space missions to various planets in the solar system. The papers in this session dealt mainly with the magnetospheres of Venus (3 papers) and Jupiter (8 papers), but some discussions were presented also on the magnetospheres of Saturn and Uranus. It is now hoped to begin to synthesize the data into a coherent theory encompassing planetary magnetospheres and solar wind - planetary interactions as a single unit, taking account of comparative aspects of the planetary magnetospheres so far known to us.

(G.L. Siscoe)

3A. ACCELERATION PROCESSES (Conveners: R.L. Dowden, P.J. Palmadesso)

August 4, a.m. and evening Room: LT5

Chairman: P.J. Palmadesso

J.R. Sharber, J.A. Whalen: Particle acceleration and the continuous (diffuse) aurora (3A.01).

J.F. Fennell: Auroral acceleration processes: Evidence viewed from inside the acceleration region (3A.02).

A.D. Jonstone: Suprathermal electron bursts in the high altitude auroral ionosphere (3A.04).

J.P. Treilhou, L. Lazutine, I.A. Zhulin: Quasi periodic relativistic electron precipitation (3A.05).

D.S. Hall, D.A. Bryant, N.C. Maynard: Acceleration processes inferred from measurements in auroral rays (3A.06).

P.J. Palmadesso, H.L. Rowland, K. Papadopoulos: Strong D.C. anomalous resistivity in a magnetized plasma (invited) (3A.07).

R.A. Smith: Vlasov simulation of plasma double layers (3A.08).

L.R. Lyons: The field-aligned current versus electric potential relation and auroral electrodynamics (3A.10).

P.B. Dusenbery, L.R. Lyons: Generation of ion-conic distributions by downward auroral currents (3A.11).

W.P. Olson, S.J. Scotti, K.A. Pfitzer: The acceleration of charged particles by the daily wobble of the geomagnetic field (3A.12).

W. Lennartsson: Transverse acceleration of auroral particles and generation of cyclotron waves in an oblique space charge structure (3A.13).

E.G. Fontheim, K.-S. Hwang, R.S.B. Ong: Electrostatic turbulence and wave emission excited by field-aligned current sheets along high latitude field lines (3A.14).

H. Kikuchi: The plasmapause and high latitude holes as a double layer, shock or soliton in space (3A.15).

W.N. Spjeldvik: Energetic particle motion in the interior of the plasma sheet during a geomagnetic disturbance (3A.17).

W.J. Heikkila: Formation of auroral arcs by plasma sheet processes (3A.18).

A. Hruska: Non-adiabatic energization of the magnetospheric plasma (3A.19).

This session was planned to discuss mainly the recent conclusions on acceleration processes and wave particle interaction in the 3000-10000 km altitude region in the earth's environmental space, including the problems of anomalous resistivity, double layers, electrostatic shocks, etc. The experimental evidence for particle acceleration was provided from satellite observations (such as by ISIS-2, S3-3, OGO-6, ISEE-1) and rocket launchings. The laboratory experiments and some theoretical results were also presented. All of the papers presented to this session were of good quality, and we hope that a unified picture of the acceleration mechanism in the magnetosphere will emerge in the near future.

(P.J. Palmadesso)

3AP. HYDROMAGNETIC WAVE PARTICLE INTERACTIONS (Convener; W.J. Hughes)

August 4, p.m. Room: LT5

Chairmen: L.J. Lanzerotti and P.R. Sutcliffe

S. Perraut: Wave-particle interactions in the ULF range: GEOS-1 and -2 results (invited) (3AP.01).

A. Korth, G. Kremser, S. Perraut, A. Roux, C. de Villedary, D.T. Young: Energy source for ion cyclotron wave (3AP.02).

R. Gendrin, A. Roux, D.T. Young: Heating of thermal He^+ ions at the expense of energetic anisotropic protons via ion cyclotron waves (3AP.03).

A.J. Norris, J.F.E. Johnson, G.L. Wrenn, N. Cornilleau-Wehrlin, A. Roux: Experimental evidence of the acceleration of thermal electrons by quasi-electrostatic ULF waves (3AP.04).

B.J. Fraser: Generation and propagation of Pc 1-2 pulsations in the magnetosphere (invited) (3AP. 05).

R.L. Arnoldy, L.J. Cahill, Jr., S.B. Mende, R. Risler: ULF wave-particle interactions on the L = 4.2 shell (3AP.06).

K. Hayashi, S. Kokubun, T. Oguti, T. Watanabe: Consequence of Pc 1 geomagnetic pulsation deduced from multi-station observation in high latitudes (3AP.07)

N.F. Maltseva, V.A. Troitskaya, F.Z. Feigin, S. Åsheim, J.A. Holtet, A. Egeland, J. Kangas: IPDP and "a plateau"-effect (3AP.08).

M.G. Kivelson, D.J. Southwood: Wave particle interaction theory (invited) (3AP.09).

S. Kokubun, K.N. Erickson, R.L. McPherron: Energetic particle flux modulations associated with Pc 4-5 waves (3AP.10).

A.D.M. Walker, R.A. Greenwald, A. Korth, G. Kremser, G. Haerendel, M. Candidi: GEOS 2 and STARE observations of Pc 5 pulsations associated with the drift mirror instability (3AP.11).

S.M. Kaye, E.C. Shelley: The radial gradient of 0.1 - 32 kev H^+ and O^+ and the azimuthal wave electric field as inferred from a large-scale dayside pulsation (3AP.26).

J.L. Rauch, A. Roux, S. Perraut: Ray-tracing of Pc 1 waves in an inhomogenous multicomponent plasma (3AP.13).

J. Solomon, O. Picon: Charge exchange and wave particle interaction in the proton ring current (3AP.14).

M. André, K.Ronnmark, D. Jones: Loss-cone instabilities in a two ion species magnetospheric plasma (3AP.15).

N. Cornilleau-Wehrlin, A. Roux, J.L. Rauch: Acceleration of thermal electrons by quasi-electrostatic ULF waves (3AP.16).

M. Townend, P.J. Christiansen, M.P. Gough, A. Pedersen, R. Grad, S. Perraut, A. Roux, E. Ungstrup, G.L. Wrenn, A.J. Norris, D.T. Young: Electrostatic ion-cyclotron harmonic waves as seen by GEOS 1 (3AP.17).

N. Klöcker: The Cerenkov instability as a possible interaction mechanism between observed ULF-waves and precipitating electrons (3AP.18).

C.G. Gelpi, E.A. Bering, R.M. Robinson: Electric and magnetic observations of a hydromagnetic wave in an auroral arc (3AP.19).

N. Maltseva, V. Selivanov, G. Loginov: Some peculiarities of spatial-time IPDP behaviour controlled by magnetic activity (3AP.20).

S. Kokubun, K. Hayashi, T. Oguti, K. Tsuruda, S. Machida: Correlations between VLF chorus bursts and impulsive magnetic variations at L 4.5 (3AP.21).

R.M. Thorne, B.T. Tsurutani: Generation mechanism for magnetosheath lion roars (3AP.22).

T. Hirasawa, T. Nagata: Effect of magnetospheric compression and expansion on spectral structure of ULF and VLF emissions (3AP.23).

M. Kawamura, M. Kuwashima, T. Toya, K. Koike, T. Hirasawa, H. Fukunishi, M. Ayukawa: Source region and generation mechanism of periodic hydromagnetic emissions with frequency of Pc 1 range (3AP.24).

H. Kikuchi: Evidence of a model for Pc-1 pulsations (3AP.25).

Z.A. Kereselidze, Z.L. Kobaladze, A.C. Khantadze: Hydromagnetic waves Rossbey type in magnetosphere of the earth (3AP.27).

P.P. Belyaev, S.V. Polyakov, V.O. Rapoport, V.Yu. Trakhtengerts: The Alfvén sweep maser (3AP.28).

T.J. Odera, W.F. Stuart: Characteristics of low-frequency waves upstream of the bow shock and relation between the waves and the geomagnetic pulsations observed on the ground (3AP.30).

Symposium 3AP included both oral and poster presentations. This experiment in symposium organization proved very successful. The first half day was devoted to 12 oral papers; the three invited reviews were each followed by three complementary contributed papers. The remaining 18 papers were presented in a poster session the following day. The posters were on view for the entire first week of the assembly so that these papers got excellent exposure and lively discussion resulted.

There was great excitement in the ULF wave results from GEOS. One-third of the papers at the symposium were devoted to some aspect of this work. Perraut gave an excellent summary of the GEOS observations in her review talk. Two types of electromagnetic waves in the frequency range 0.2 - 11 Hz have commonly been observed by the GEOS-1 and -2 satellites. The first type are ion cyclotron waves, which can propagate along lines of force and be observed at the ground as Pulsations. The second type can be interpreted as magnetosonic waves; they have their magnetic field aligned along the main magnetic field and have a typical harmonic structure.

Papers presented in the first half session dealt mainly with various aspects for the first type of wave. Some aspects discussed were local time and space distribution, wave spectra and polarisation characteristics and plasma populations associated with the waves. Probably the most important result which came up in the session is the part played by He^+ ions in the generation propagation of the ion cyclotron waves.

Fraser reviewed other spacecraft work. He reported some new results derived from ATS 6 data with similar coclusions to the GEOS work. Again He^+ plays a dominant role. Longer period hydromagnetic wave particle interactions were introduced by a theoretical review paper by Kivelson and Southwood. They discussed the sets of particle variation one might expect to see in spacecraft detectors and offered new explanations of some published data. Walker et al. described a wave seen on GEOS and STARE in terms of the drift mirror instability. Finally Kaye and Shelley showed how the presence of a hydromagnetic wave allows particle gradients to be estimated.

(P.R. Sutcliffe, W.J. Hughes)

3I. ROLE OF ION COMPOSITION IN UNDERSTANDING MAGNETOSPHERIC PROCESSES

(Convener: R.G. Johnson)

August 11, a.m. Room: LT3

Cold, Warm and Hot Plasmas Chairman: H. Balsiger

J.M. Cornwall, M. Schulz: Principles of magnetospheric ion compsotion (invited) (3L.01).

D.T. Yong, J. Geiss, H. Balsiger, C. Farrugia: Thermal ions observed by the GEOS spacecraft (invited) (3I.02).

L.D. Sivtseva, V.A. Ershova, Yu.I. Galperin, L.M. Nikolaenko, J.A. Sauvaud: The light ion trough investigations from aureole satellities (3I.03).

C.R. Chappel, J.L. Horwitz, D.L. Rasoner, C.R. Bugher, P.D. Craven, J.L. Green: Low energy plasma composition regults from the ISEE and SCATHA satellites (invited) (3I.04).

E. Duginin, B. Hultqvist, R. Lundin, A. Zackarov, N. Pissarenko: Some characteristics of accelerated ionospheric ions in the altitude range 4-20 R_E above the auroral zone (3I105).

R.G. Johnson, E.G. Shelley, A. Ghielmetti, R.D. Sharp: Hot plasma composition results from the S3-3 spacecraft (invited) (3I.06).

R. Lundin, B. Hultqvist: Composition of hot magnetospheric plasma observed with the Prognoz-7 satellite (invited) (3I.07).

M. Candidi, S. Orsini, H. Balsiger, A. Ghielmetti: The Z component of the stormtime electric field in the magnetotatil boundary layer and plasma lobes (3I.08).

S. Orsini, M. Candidi, V. Formisano, F. Mozer, K. Ogilvie, A. Ghielmetti: Structure of the plasma lobe-plasmasheet interface in the geomagnetic tail at 22 R_E (3I.09).

W.K. Peterson, R.D. Sharp, W. Lennartsson, E.G. Shelley: Hot plasma composition results from the ESEE-1 spacecraft (invited) (3I.10).

August 11, p.m. Room: LT3

Hot plasmas and Energetic Ions Chairman: T.A. Fritz

V.A. Troitskaya, F.Z. Feigin, A.L. Kalisher, Yu.P. Kurchashov: Ring current O^+ as a candidate source of the mid-latitude PC 1-2 geomagnetic pulsations (3I.11).

H. Balsiger, G. Geiss, D.T. Young. M. Stokholm: Composition of hot plasmas (0.1 - 16 kev/E) observed near the geostationary orbit (invited) (3I.12).

L.R. Lyons- T.E. Moore: Effects of charge exchange on the distribution of ionospheric ions trapped in the radiation belts near synchronous orbit (3I.13).

R.J. Strangeway, R.G. Johnson, E.G. Shelley: Hot poasma composition results from the SCATHA spacecraft (invited) (3I.14).

T.A. Fritz, W.N. Spjelovik: Geomagnetically trapped energetic heavy ions and their implications fro theory (invited) (3I.15).

D. Hovestadt, E. Mitchell, B. Klecker, M. Scholer: Transport of heavy ions in the outer radiation belt of the earth (3I.16).

W.N. Spjeldvik, T.A. Fritz: Ions heavier than oxygen in the earth's magnetosphere (3I.17).

M.I. Panasyuk: Shaping of the energetic ion spectra at the geostationary orbit (3I.18).

H.M. Fischer, C.P. Vieille, G. Wibberenz, E. Keppler: Magnetically quiet time particle observations the morning sector of the magnetosphere ($L \leq 2 \leq 8$) on board ISEE-2 (3I.19).

V. Jentsch: Equilibrium solutions for radiation belt protons ($1 \lesssim L \lesssim 7$) at arbitrary pitch angle (3I.20).

M. Lockwood: Upward flow of thermal O^+ ions in the topside auroral ionosphere.

This symposium on the Role of Ion Composition in Understanding Magnetospheric Processes brought into sharp focus the important, and sometimes dominant, role that the ionosphere is playing in populating the hot plasmas in nearly all regions of the magnetosphere. Of equal importance, the ion composition measurements have shown that major magnetospheric processes are occurring which are not yet understood. Major progress has been made on the large scale morphology of the ion composition for the major ions (H^+ and O^+) at energies from 0.1 to 16 keV. The auroral acceleration region is a major source of the hot ionospheric ions. Acceleration of ionospheric ions in the equatorial regions is occurring, but its importance in supplying ions to the relatively dense hot plasmas is still uncertain. Composition measurements on the cold and warm plasmas (E<100eV) in the equatorial regions outside the plasmasphere have shown the importance of ionospheric ions in the population, of wave-particle heating of the ions, and of diffussive transport for the O^{++} ions. The transport, energization, and loss processes for this cold and warm ion population appear complex, dynamic, and as yet poorly understood. Composition measurements at ion energies above 300 keV/nucleon have recently improved significantly in mass resolution and sensitivity and have made important contributions to understanding the origin, energization, transport, and loss processes for the higher masses and at high energies. The carbon, nitrogen, and oxygen measurements above 300 keV/nucleon show their origin to be the sun, and strongly indicate that the high density O^+ ions of ionospheric origin in the hot (keV) plasmas do not get accelerated to MeV energies.

The invited papers from this ysmposium will be published, along with selected complementary papers, in a book entitled "Energetic Ion Composition in the Earth's Magnetosphere" to be published jointly by the Terra Scientific Publishing Company (Tokyo, Japan) and the D. Reidel Publishing Company (Dordrecht, Holland).

(R.G. Johnson)

3L. CHARACTERISTICS AND LARGE SCALE STRUCTURE OF Pi 2 PULSATIONS (Convener: W.J. Hughes)

August 14, a.m. Rooms: LT5 and TR8

Chairman: W.J. Hughes

J.C. Samson: Pi 2 pulsations: high latitude results (invited) (3L.01).

T. Sakurai: Characteristics of Pi 2 observed on the ground an in space (invited) (3L.02).

O.M. Raspopov: Micro- and macro-structure of Pi 2 pulsations (invited) (3L.03).

D.J. Southwood: Informal review of poster papers (invited).

L.T. Afanas'yeva, I.N. Men'shutina, O.M. Raspopov: Wave characteristics of magnetic Pi 2 pulsations at conjugate stations and their relationship to structure within the magnetosphere (3L.05).

P.R. Sutcliffe: Temporal variations in the spectral characteristics of Pi 2 pulsations at low latitudes (3L.06).

D.N. Chetaiev, A.N. Os'makov, B.M. Alexeev, V.P. Lependin, M.L. Kuligin, A.L. Strus: Wavestructure of the largescale Pi 2 pulsations ground field (3L.07).

O.M. Raspopov, W. Baumjohann, A.B. Pashin, A.G. Yahnin, R. Pellinen, H. Opgenoorth: An experience of two-dimensional Pi 2 study (3L.08).

A.N. Zaitzev, E.G. Kartashov: The long-period geomagnetic pulsations Pi3 (Ps6) type as observed at 145° geomagnetic meridian (3L.09)

M. Kuwashima: A model of magnetic Pi2 pulsations based on a concurrent ULF observation from high to middle latitudes on the ground (3L.10).

L.J. Lanzerotti, L.V. Medford: Impulsive hydromagnetic waves measured at closely-spaced stations at subauroral latitudes (3L.11).

J.C. Gupta: A study of P12 pulsations at Canadian magnetic observatories (3L.13).

T. Saito, K. Yumoto, M. Seto, S.-I. Akasofu, F.J. Smith: Substorm and Pi2 observed simultaneously at circum-northern Pacific and Alaskan chain stations (3L.14).

G.J. LaQuandra: Pi2 pulsations on a three satellite array (3L.15).

W.J. Hughes, G.J. LaQuandra, J. Quinn: Substorm associated plasma injections and magnetic pulsations at geo-stationary orbit (3L.16).

W. Baumjohann, A. Pashin, A.G. Yahnin, O.M. Raspopov, H.J. Opgenoorth, R.J. Pellinen: On the relationship between Pi2 magnetic pulsations and auroral structures (3L.17).

M. Lester, D. Orr: Correlations between ground observations of Pi2 and satellite plasma density observations (3L.18).

H.J. Singer, W.J. Hughes, P.F. Fougere, D.J. Knecht, W.F. Stuart: Pi2 pulsations at midlatitude ground networks and geostationary orbit. (3L.19).

M. Kuwashima, R.L. Mcpherron: A model of magnetic Pi2 pulsations based on a coordinated ground-satellite ULF observation (3L.20).

L.L. Lazutin, I.A. Zhulin, Ya.A. Sakharov, A.O. Melnikov, A.A. Khruschinsky, G. Gustafsson, G. Kremser: Investigations of Pi2 pulsations and energetic electron precipitations (3L.22).

J.K. Chao, R.R. Heacock: Substorm-associated pulsations and magnetopause -magnetosheath fluctuation (3L.23).

J.A. Holted, S. Aasheim, J. Bjordal, R. Blix, L.P. Block, K. Bronstad, C.I. Haldoupis, M. Havag, I.B. Iversen, J. Kangas, G. Kremser, M.M. Madsen, N.V. Malseva, E. Nielsen, W. Riedler, J. Stadsnes, P. Tanskanen, K.M. Torkar, V.A. Troitskaya, S. Ullaland: Micro-structure of irregular magnetic pulsations (PiB) and electron precipitation during substorm onset (3L.24).

R.E. Horita, R.L. McPherron, J. Kangas: Quasi-harmonic structure in PiB events (3L.25).

T. Bosinger, J. Kangas, H. Opgenoorth, W. Baumjohann: Fine structure of PiB type magnetic pulsations and its correlation with small scale equivalent current loop structures and auroral activity(3L.26).

A new approach was taken in organizing this session. Only the three invited papers were presented orally, the remaining 19 papers were presented as posters. The posters were put on display two days before the formal session, in a room by themselves near a coffee stand. This meant the papers received a wider audience than they might otherwise have received. The morning of the session was split into three parts: First an hour of poster viewing followed by the invited talks and finally more poster viewing. This proved to be a very successful approach, the invited talks giving the session a focus and a point of assembly and breaking up what might otherwise have been too long a poster session.

Samson reviewed high latitude ground studies of pi2's. He recommended the study of simple isolated pi2's of the type dubbed dPi's by Stuart, as these are not complicated by the presence of a large break-up event. He maintained that pi2's originate near the equatorward end of the Harang discontinuity and suggested that the plasma-pause plays little part in the midlatitude signal which he claims can be totally explained by the auroral current system. *Sakurai*, reviewing ground satellite work and midlatitude results disagreed. He maintains that fundamental mode resources are excited at both high and midlatitudes with the plasma pause playing a role. *Raspopov* reviewed recent Soviet work. The latitudinal polarization reversal occurs some 2° North of the secondary amplitude maximum and not where the plasma-pause is expected to be. He also described a study correlating auroral data with high latitude pi2 bursts. The polarization pattern and the location of the amplitude maximum changed cycle to cycle in response to auroral movement. The oral part of the symposium was concluded by *Southwood* who undertook the difficult task of reviewing the poster papers. He thinks the subject is becoming quite orderly with a suprising amount of agreement between papers. The basic morphology is well established and we are now measuring scale sizes and wavelengths. He noted in particular the work associating pi2's with field-aligned currents and auroral displays (3L.08, 3L.11). Pi2's could also be used for monitoring substorm activity at midlatitudes (3L.19) and for a warning of imminent plasma injections at geostationary orbit (3L.16). From a theoretical point of view he pointed out that a Pi2 must contain both a fast mode wave (to transfer pressure changes) and a transverse wave (to carry field-aligned currents) and that they could be initiated in different places.

In conclusion, the symposium seemed to be unusually successful and a lively one - perhaps because it focussed on a well defined problem which has received a good deal of attention lately. The experiment with poster presentation was particularly well received as it led to much more discussion than usually occurs at an oral session.

(W.J. Hughes)

3P. THE PHYSICS OF PULSATION RESONANCE REGIONS (Convener; W.J. Hughes)

August 13, a.m. and p.m. Room: LT4

Chairmen: D.J. Fraser, D. Orr, W.J. Hughes

Solar Wind Control & Spacecraft Observations

H.J. Singer: Multisatellite observations of resonant hydromagnetic waves (invited paper) (3P.01)

E.W. Greenstadt, T.L. McPherron, M. Hoppe, C.T. Russell, R.R. Anderson, F.L. Scarf; A short-time, dusk Pc5 event observed in the outer magnetosphere by ISEE 1 and 2 (3P.02).

C.T. Russell, M.M. Hoppe: Further evidence for solar wind control of the periods of magnetospheric pulsations: the dependence of upstream wave periods on IMF strength (3P.03).

A.D.M. Walker: The Kelvin-Helmholtz instability in the low latitude boundary layer (3P.04).

B. Higel: Direct electron density measurements onboard GEOS during pulsation events (3P.05).

K. Takahashi, R.L. McPherron: Harmonic number of standing Alfven waves at L=6.6 (3P.06).

J.A. Lawrie: A method for higher dimensional micropulsation models (3P.Rl).

Tail Vortices and other Waves in the Tail

E.W. Hones, Jr.: Vorticity in the magnetospheric plasma flow (invited paper) (3P.08).

T.A. Fitz: ISEE-1 energetic ion measurements associated with the December 11, 1977 "vortex" event (3P.09).

P. Ellis, W.A.C. Mier-Jedrzejowi, M.A. Saunders, E.W. Hones, Jr.: Ground -spacecraft correlations using the ISEE spacecraft pair and U.K. IMS magnetometer network (3P.10)

M.A. Saunders, D.J. Southwood, F.W. Hones, Jr., S.J. Bame, T.A. Fritz, C.T. Russell: Theoretical interpretation of ISEE vortex data for 11 December 1977 (3P.11).

A. Nishida, E.W. Hones, Jr.: Undulation of field-line loops in the neutral sheet (3P.12).

Other magnetospheres

R.J.Walker: ULF fluctuations in the Jovian and Saturnian magnetospheres (invited paper) (3P.13).

Field Line Resonance Theory

M. Six: Asymmetric solutions in a dipolar magnetosphere (3P.14).

J.A. Fejer, E. Krenzien: Guided magnetospheric propagation of Alfven waves in the Pc 4-5 frequency range (3P.15).

M. Siebert, D. Lummerzheim, F. Krummheuer: An analytic solution of the coupled hydromagnetic wave equations for a spherical magnetic field distribution (3P.16).

D.R. McDiarmid: A new theoretical approach to the modelling of toroidal Pc 5 pulsations (3P.17).

E. Amata, V.A. Troitskaya, O.V. Bolshakova: Pc3 occurrence in space and ground and their correlation with IMF (3P.

K.-K. Tschu, Sen-Wei: State of magnetosphere and micropulsation classification (poster) (3P.19).

Co-chairmen: R.L. McPherron, J.C. Samson

Ground - Satellite and Ground Array Studies

C.A. Green: The role of ground array magnetometers in the study of pulsation resonance regions (invited) (3P.20).

E.M. Poulter, E. Nielsen, T.A. Potemra: STARE and TRIAD observations of field aligned currents associated with Pc5 pulsations (3P.21)

R. Grard, A. Pedersen, T.A. lindqvist: Simultaneous observations of pulsating electric fields in the magnetosphere and on the ground (3P.22).

I.B. Iversen, L.P.Block, K. Bronstad, U. Fahleson, R. Grard, G. Haerendel, H. Junginger, A. Korth, G. Kremser, M.M. Madsen, J. Niskanen, W. Riedler, P. Tanskanen, T. Torkar, S. Ullaland: Correlated observations of a pulsation event with balloons and with a geo-stationary satellite (3P.23).

H. Ranta, U. Wedeken: Pc5 recorded by riometers and magnetometers on a north-south profile in northern Scandinavia (3P.24).

J.V. Olson, J.C. Samson, G. Rostoker: Precipitation signatures of ULF resonance regions (3P.25).

W.F. Stuart, L.J. Lanzerotti: Long-period hydromagnetic wave inside the plasmasphere (3P.26).

K.H. Glassmeier, E. Nielsen, F. Kuppers: Magnetometer array observation of a pulsation event in the Pc-5 frequency band (3P.27).

G. Rostoker, B.T. Sullivan: Afternoon sector Pc 5 magnetic pulsations - their morphology and possible source mechanisms (poster) (3P.28).

F. Glangeaud: Analysis of pulsations - a review (invited paper) (3P.29).

D.P. Smits, P.R. Sutcliffe: The spectral structure of low latitude Pc3 pulsations (3P.30).

T. Saito, K. Yumoto, M. Seto, S. -I. Akasofu, E.J. Smith, B.T. Tsurutani: Characteristics of Pc3's recorded simultaneously by Rulfmeters at circum-northern Pacific stations (3P.31).

W.J. Hughes, H.J. Singer: The currents and wave polarizations associated with a pulsation resonance region (poster) (3P.32).

D. Orr, H.W. Hanson: Geomagnetic pulsation phase patterns over an extended latitudinal array (3P.33).

The effect of the Ionosphere

H.G.F. Gough, D. Orr: The effect of ionospheric damping and signal propagation time on the latitudinal variation of geomagnetic pulsation phase (3P.34).

H.-J. Lotz: First results from the ULF heating experiment, Or: Pulsations of the second kind (3P.37).

T.J. Rosenberg, P.B. Morris, L.J. Lanzerotti: Generation of hydromagnetic waves by solar X ray-induced change in ionospheric conductivity (3P.38).

F.W. Menk, K.D. Cole, J.C. Devlin: Interaction of hydromagnetic waves with the ionosphere (3P.39).

The session commenced with a review of multisatellite observation of resonant hydromagnetic waves in the magnetosphere by *Singer* (3P.01). Pc4-5 resonant region widths and the spatial and temporal localization of these and Pi2 events were discussed in detail. *Greenstadt et al.* (3P.02) discussed ISEE 1 and 2 magnetic field data associated with a stormtime dusk Pc5 mixed mode event observed in the L 7-5 region. Further evidence for the solar wind control of the pulsations was presented by *Russell and Hoppe* (3P.03) where a linear relationship was established between the strength of the IMF and the period of PC3-4 waves generated by ion beams observed on IMF lines connected to the bow shock.

Walker (3P.04) considered the Kelvin-Helmholtz instability in the low latitude boundary layer and using linear theory predicted that Pc3-5 wavelengths are of the order of ten times the thickness of the boundary layer. The characteristics of long period pulsations observed in conjunction with GEOS electron density measurements were discussed by *Higel* (3P.05). Both on equator and off equator measurements by ATS-6 of Pc3 wave resources, sometimes showing up to six harmonics with a fundamental of 12±3 mHz were discussed in terms of resonant field line theory by *Takahashi and McPherron* (3P.06). *Laurie* (3P.R1) outlined a method for theoretical modelling of long period pulsations when the dimensions of the MHD equations are greater than one.

The study of vortices and waves in the tail was the subject of five papers. Detailed study of the December 11, 1977 "vortex" event on the ISEE spacecraft pair has been fruitful with contributions coming from bulk plasma measurements (*Hones*, 3P.08) energetic ion sounding (*Fritz*, 3P.09) and a theoretical evaluation of these data together with magnetometer data was presented by *Saunders* (3P.11). Correlation of a vortex event with ground based IGS data was given by *Ellis* (3P.10). The mode of propagation of these magnetotail vortices to the ground requires further study. *Nishida* (3P.12) interpreted the alternating north-south polarity observed in the magnetotail as a series of undulating field-line loops in the neutral sheet.

ULF fluctuations in the Jovian magnetosphere were reviewed by R.J. Walker (3P.13).

Dungey's hydromagnetic wave equations were revisited by *Six*(3P.14) and *Siebert* (3P.16) with different emphases. High latitude long period waves were considered in a transmission line approach by *McDiarmid* (3P.17) and in a generalized ray tracing exercise with application to ionosphere heating (*Fejer and Krenzien*, 3P.15) presented by Allan.

The second session of this symposium started with a discussion of ground/satellite studies of ULF waves. In an excellent review *Green* outlined recent advances but also problems that needed further attention. The growth of correlative studies was exemplified by the number of papers describing waves seen in the ionosphere and in space (3P.21, 3P.23) on three spacecraft (3P.22) and in the ionosphere and on the ground (3P.24, 3P.25). This work brings a whole new perspective to pulsation studies.

The session ended with four papers describing various aspects of the ionospheric interactive with ULF waves. Two of them described possible ionospheric sources of ULF waves, one natural (3P.38) the other manmade (3P.37).

Although this was an extremely full day, it was a lively and stimulating session which was well attended right to the end.

(W.J. Hughes)

3Q. QUANTITATIVE COMPARISON OF MAGNETOSPHERIC EVENT DATA AND MODELS (Convener: W.P. Olson)

August 12, a.m. and p.m. Room: LT4

Chairman: W.P. Olson

W.P. Olson: Introduction of meeting topic (3Q.01).

Quantitative Models

R.E. Holzer, J.S. Slavin: A quantitative model of variations in magnetotail flux density (3Q.02).

K. Maezawa, K. Yoshizawa, T. Murayama: A new coordinate system to describe the solar wind-magnetosphere interations (3Q.03).

R.J. Walker: Global MHD models of the interaction between the solar wind and the magnetosphere (invited) (3Q.04).

D.B. Beard, D. Hirschi, K. Propp: Accurate representation of magnetopause field in near earth tail region (3Q.05).

T.W. Hill: Quantitative modeling of planetary magnetosphere (invited) (3Q.06).

K.C. Kosik: A class of quantitative magnetospheric models (3Q.07).

G.H. Voigt: A quantitative magnetospheric model with a self-consistent tail plasma sheet (3Q.08).

Quantitative Event Modeling

R.H. Manka, T.A.Fritz, R.G. Johnson, K. Knott, W.P. Olson, M.J. Teague, J.I. Vette, R.A. Wolf: International coordinated data analysis workshop process: Scientific overview of CDAW-2; introduction of CDaw-6 (invited) (3Q.10).

R. Wilken, T.A. Fritz, D.N. Baker, P.R. Higbie: Energetic particle observations at and near the magnetopause during the dynamic phase of the SSC on July 29, 1977 (3Q.11).

D.N. Baker, P.R. Higbie, T.A. Fritz, P.H. Smith, B. Wilken, R. Link: Modelling of the observed motion of energetic particles injected during the July 29, 1977 event (3Q.12).

M. Harel, R.A. Wolf, R.W. Spiro: Modeling of magnetospheric convection for specific events (invited) (3Q.13).

W.P. Olson, K.A. Pfitzer: The quantitative representation of the magnetospheric electromagnetic field for specific events (invited) (3Q.14).

V.M. Mishin, T.I. Saifudinova, G.B. Shpynev, W. Baumjohann: Substorms of March 6, 1976 (3Q.15).

Model Tests and Uses Chairman: K.A. Pfitzer

E. Amata, M. Candidi, C. Signorini, F. Mariani: Comparison of measured magnetic field at GEOS 1 with some models of magnetospheric field (3Q.16).

H.B. Garrett: A test base for making quantitative comparisons with magnetospheric models (3Q.18).

K.A. Pfitzer, W.P. Olson: Quantitative magnetospheric studies using magnetic and electric field models (3Q.20).

N. Divine, H.B. Garrett: Charged particles distribution in Jupiter's magnetosphere (3Q.21).

Quantitative Description of Ionosphere - Magnetosphere Coupling

M. Mareschal, G. Rostoker, J.C. Samson: Response of dayside field-aligned current to changes in the interplanetary magnetic field and to substorm perturbations (3Q.24).

R.A. Greenwald, A.D.M. Walker, M. Candidi: Use of hydromagnetic waves to map geomagnetic field lines (3Q.25).

Quantitative Description of Ionosphere - Magnetosphere Coupling (cont'd)

M.M. Shepherd: Field line projections of 6300 Å auroral emissions into the outer magnetosphere (3Q.26).

D.A. Hardy, M.S. Gussenhoven, W.J. Burke, N. Heinemann, E. Holeman: The systematics in the location of the equatorward boundary of auroral electron precipitation and their relationship to the large scale magnetospheric electric field (3Q.27).

D. Fontaine, M. Blanc, P. Bauer, E. Barouch, O. De la Beaujardiere: A theoretical study of the morphology and dynamics of diffuse auroral zone and its equatorial boundary (3Q.28).

The meeting was divided into four topics: Quantitative Event Modeling, Quantitative Models, Model Tests and Uses, and Quantitative Description of Ionosphere/Magnetosphere Coupling. Quantitative modeling of specific magnetospheric events concentrated on the results of the second Coordinated Analysis Workshop. Attempts at modeling dynamic magnetospheric events were well underway at the time of the meeting. Previously, typical magnetospheric models attempted only to represent gross average magnetospheric features. The event models for the first time attempts to represent changes in various magnetospheric parameters through the period of the event. Several models of general magnetosphere features were also presented suggesting that the modeling community is growing worldwide. Also, cooperation between the modeling community and model users is increasing, as was evidenced by several papers on the testing of quantitative models with various observational data sets. Finally, several papers were presented on the question of coupling between the magnetosphere and ionosphere. It is now felt that electric fields controlled by the ionosphere may be coupled strongly to the magnetosphere and thus cause the ionosphere to exert a pronounced influence on magnetospheric behavior.

(W.P. Olson)

3M. POLAR CUSP AND MAGNETOSPHERE BOUNDARY LAYERS
(Convener: G. Paschmann)

August 7, a.m., p.m. and evening Room: LT2

Magnetopause and Boundary Layer Structure
(Chairmen: V.M. Vasyliunas and C.T. Russell)

B.U.Ö. Sonnerup: Magnetic field reconnection at the Earth's magnetopause (invited) (3M.01).

W.J. Heikkila: Magnetospheric topology of fields and currents (3M.02).

J. Berchem, C.T. Russell, R.C. Elphic: Measurements of the thickness of the magnetopause (3M.03).

O.L. Vaisberg, A.A. Galeev, L.M. Zeleny, G.N. Zastenker, A.N. Omeltchenko, S.I. Klimov, Yu.I. Yermolaev, S.P. Savin, V.N. Smirnov: Fine structure of the magnetopause according to measurements of Prognoz-7 and Prognoz-8 satellites (3M.04).

J.T. Gosling, J.R. Asbridge, S.J. Bame, W.C. Feldman, G. Paschmann, N. Sckopke, C.T. Russell: Evidence for quasi-stationary reconnection at the dayside magnetopause (3M.05).

T.E. Eastman, L.A. Frank: High-speed plasma flow observed near the earth's magnetopause (3M.06).

M.I. Pudovkin, M.F. Heyn: Influence of the solar wind magnetic field on the parameters of the magnetosheath (3M.07).

C.T. Russell: Flux transfer events (invited) (3M.08).

G. Paschmann, G. Haerendel, I. Papamastorakis, N. Sckopke, S.J. Bame, J.T. Gosling, C.T. Russell: Flux transfer events: prèssure balance and plasma flow behaviour (3M.09).

R. Lundin, B. Aparicio: Observations of impulsive penetration of solar wind plasma in the plasma mantle (3M.10).

N. Sckopke, G. Paschmann, G. Haerendel, B.U.Ö. Sonnerup, S.J. Bame, E.W. Hones, Jr., C.T. Russell: Structure of the low-latitude boundary layer (3M.11).

M. Roth: A kinetic magnetopause model compared with ISEE data (3M.12).

G. Haerendel: Microscopic processes at the magnetopause (invited) (3M.13).

R.R. Anderson, C.C. Harvey, M. Hoppe, B.T. Tsurutani, T.E. Eastman, J. Etcheto: Plasma waves near the magnetopause (3M.14).

K.D. Cole, R.J. Morris, E.T. Matveeva, V.A. Troitskaya, O.A. Pokhotelov: Hydromagnetic whistlers from the boundary layer (3M.15).

M. Dobrowolny, G. Mastrantonio, E. Trussoni: A numerical study of the Kelvin-Helmholtz instability for the magnetopause boundary (3M.16).

W.K. Peterson, E.G. Shelley, G. Paschmann, G. Haerendel: On the origin of the subsolar magnetospheric boundary layer (3M.17).

R. Lundin, B. Hultqvist, E. Dubinin, N. Pissarenko, A. Zacharov: Observations of accelerated ions of plasmaspheric origin in the dayside low-latitude boundary layer (3M.18).

E.W. Hones, Jr., S.J. Bame, G. Paschmann, C.T. Russell: Direction of the magnetic field in the boundary layer (3M.19).

D.J. Williams: Energetic particles signatures of magnetopause motions and field-line interconnection (invited) (3M.20).

M. Scholer, D. Hovestadt, F.M. Ipavich, G. Gloeckler: Energetic protons, alpha particles and electrons in magnetic flux transfer events (3M.21).

P.W. Daly, E. Keppler: Behaviour of flux transfer events at the dayside magnetopause (3M.22).

Coupling to Low Altitudes (Chairman: B.U.Ö. Sonnerup)

J. Lemaire, M. Scherer: Field-aligned distribution of ionospheric and magnetosheath plasma in a polar cusp flux tube (3M.23).

V.M. Vasyliunas: Birkeland currents and the ionospheric aspects of the magnetospheric boundary (invited) (3M.26).

R. Fujii, T. Iijima, T.A. Potemra: Seasonal dependence of large-scale Birkeland currents (3M.27).

E. Friis-Christensen: Polar cusp ionospheric currents (3M.28).

Minyun Zi, E. Nielsen, T.A. Potemra: Field-aligned currents near the dayside convection reversal (3M.29).

N.A. Saflekos, R.E. Sheehan, R.L. Carovillano, B. Shuman, R. Vancour, A. Rubin, M. Smiddy, A. Vampola: Simultaneous field-aligned current, charged particle, and electric field measurements in the cusps (3M.30).

N.G. Kleimenova, O.V. Bolshakova, V.A. Troitskaya, E. Friis-Christensen: Dayside dynamic using ground geomagnetic pulsations data on Greenland station net (3M.31).

V.M. Mishin, A.D. Bazarzhapov, B.G. Shpynev: Information on cusps, throat and magnetospheric cleft, gained from ground based measurements (3M.33).

K.A. Pfitzer, W.P. Olson, S.J. Scotti: The entry of low energy charged particles into a magnetically closed magnetosphere (3M.R1).
N.U. Crooker, G.L. Siscoe, C.T. Russell, E.J. Smith: Magnetic field compression at the dayside magnetopause (3M.R3).

This session was the first dedicated to this subject since the Chapman Conference on Boundary Layers in Alpbach, 1979. It covered the magnetopause and boundary layer structure as well as the coupling to the ionosphere. Much emphasis was given to the discussion of recent satellite measurements in terms of magnetic reconnection or other, competing types of plasma entry processes. A total of 32 papers were presented, 5 of which were invited. As a large fraction of the active researchers in the field participated in the session, it provided an excellent summary of the present status of the subject area.

(G. Paschmann)

3C. POLAR CAP PHENOMENA (Convener: C.T. Russell)

August 10, p.m. Room: LT4

Chairman: C.T. Russell

R.A. Wolf, R.W. Spiro, M. Harel,(read by P.H. Reiff): Polar cap electric field (invited) (3C.01).
P.H. Reiff, R.W. Spiro: Interplanetary magnetic field control of polar cap convection (3C.03).
E. Friis-Christensen: Current systems over the polar cap (invited) (3C.04).
L.J. Zanetti, T.A. Potemra: Asymmetric polar cap currents following a major magnetic storm (3C.07).
J.D. Winningham,(read by M.S. Gussenhoven): Polar cap particle precipitation (invited) (3C.08).
T. Ondoh, Y. Nakamura, S. Watanabe, T. Murakami, T. Ishimine: VLF Saucers observed in polar cap (3C.09).
A.C. Fraser-Smith: Pc 1-2 geomagnetic pulsations in the polar caps (3C.10).
M.S. Gussenhoven, W.J. Burke, D.A. Hardy: Auroral arcs in the polar caps (3C.11).
K. Lassen, C. Danielsen, V. Singh: Diffuse and discrete optical emissions observed on the poleward side of the morning auroral oval (3C.14).

Much of the scientific discussions in the symposium focussed on the control of the polar cap convection pattern by the interplanetary magnetic field. The evidence for this control is somewhat controversial. The convection pattern changes when the interplanetary magnetic field turns northward. Viscosity, as pictured by Axford and Hines, seems to drive convection at such times but this does not seem to be the entire story and high latitude reconnection may need to be invoked to explain the entire pattern.

(C.T. Russell)

G3. GENERAL CONTRIBUTIONS TO DIVISION III (convener: A. Nishida)

August 10, 11, a.m. Room: LT 5 and 4

Chairmen: A. Nishida, R.A. Wolf, G. Atkinson, W. Baumjohann

Dependence of Geomagnetic Activity on Solar Wind Parameters

T. Nagata, T. Hirasawa: Auroral substorm associated with storm sudden commencements and sudden impulses (G3.01).

A. Meloni, A. Wolfe, L.J. Lanzerotti: On the relationships between interplanetary quantities and the global auroral electrojet index (G3.02).

C.R. Clauer, R.L. McPherron: Solar wind control of geomagnetic activity (G3.03).

T. Murayama, K. Maezawa: Energy injection function from the solar wind to the magnetosphere to account for the time variation of the Dst index (G3.04).

R.J. Pellinen, W. Baumjohann, W.J. Heikkila, A.G. Yahnin, V.A. Sergeev: Convection bay and substorm trigger phase and their relation to the energy coupling between solar wind and magnetosphere (G3.05).

O.A. Troshichev, V.A. Gizler: A pattern of cusp field-aligned currents affected by IMF (G3.06).

S.W.H. Cowley, W.J. Hughes: Magnetospheric asymmetries associated with the X and Y components of the IMF (G3.07).

Structure and dynamics of Magnetotail

A.S. Jolleys, S.W.H. Cowley: The properties of one-dimensional current sheets-particle orbits and self-consistent equilibria (G3.08).

H. Goldstein, K. Schindler: On the existence of the ion tearing mode in the magnetotail (G3.09).

M.G. Brown, J.W. Dungey, C. Robertson: Numerical modelling of a magnetic neutral sheet (G3.10).

J. Birn, E.W. Hones, Jr.: Nonlinear 3-D tearing instabilities and substorm dynamics in the geomagnetic tail (G3.11).

C. Robertson, S.W.H. Cowley, J.W. Dungey: Wave-particle interactions in a magnetic neutral sheet (G3.12).

A. Nishida, H. Hayakawa, E.W. Hones, Jr.: Observed signatures of reconnection in the magnetotail (G3.13).

D.J. Williams: Energetic ion beams at the edge of the plasma sheet (G3.14).

W.N. Spjeldvik, T.A. Fritz: Waves of periods 2-5 minutes observed in larger than or equal to 24 keV ions at the boundary of the plasma sheet (G3.15).

T. Nagai, N. Fukushima: Local-time dependence of substorm signatured synchronous satellite altitude (G3.16)

G. Atkinson: The narrow-channel approximation for magnetospheric convective flow (G3.17).

T. Iijima, T.A. Potemra: On the relationship between interplanetary quantities and Birkeland current amplitudes (G3.R1).

V.N. Mishin, G.B. Shpynev, D. Sh. Shirapov, A.D. Bazarzhapov: Regular UT-variations in magnetospheric structure, in electric fields and currents (G3.R2).

Auroral Current System

B.K. Madahar, A.N. Hunter: Diurnal behaviour of the auroral current system (G3.18).

T. Iijima, N. Fukushima, R. Fujii: Characteristics of magnetic field disturbances observed by MAGSAT (G3.19).

N.U. Crooker, G.L. Siscoe: On the relationship between the low-latitude asymmetric disturbance field, Birkeland currents, and substorms (G3.20).

B. Inhester, W. Baumjohann, R.A. Greenwald, E. Nielsen: Auroral zone currents during the passage of a westward travelling surge (G3.21)

H.J. Opgenoorth, R.J. Pellinen, G. Holmgren, W. Baumjohann, E. Nielsen, G. Marklund, J.A. Lundblad: Temporal and spatial development of western edge of expanding auroral bulge as seen by rocket detectors and the extensive ground network of instruments operated in northern Europe during the IMS (G3.22).

T.Iijima, Y. Kamide, R. Fujii, N. Fukushima: Spatial relationship between field-aligned currents and the auroral electrojets - MAGSAT Alaska chain observations (G3.23).

D. Hayward: An Alfven wave interpretation of auroral field-aligned currents (G3.25).

Aurora and Precipitation

G. Atkinson: Discrete auroral arcs: boundaries between magnetic flux tubed (G3.26).

P.J. Tanskanen, T. Turunen, R. Leitinger, G.K. Hartmann, W. Degenhardt, A. Hedberg: Studies of a wide-spread auroral substorm activity on December 4, 1977 (G3.27).

K. Makita, T. Hirasawa, R. Fujii, T. Nagata: Conjugacy of electron and proton auroras at Syowa Antarctica and Husafell, Iceland (G3.28).

J. Oksman, K. Kaila, E. Nielsen, H. Opgenoorth,: Observations of an auroral omega band structure (G3.29).

Yu. I. Galperin, V.A. Gladyshev, T.M. Mularchik, L.M. Nikolaenko, Ya. I Feldstein, T.E. Valchuk, J. -A. Sauvaud, J. Crasnier: Synthetic pattern of high-latitude auroral electron and proton precipitation at day and evening sectors (G3.30).

C.-I. Meng: Precipitation characteristics of the auroral oval during extremely quiet geomagnetic conditions (G3.31).

J.P. Treilhou, L. Lazutine, I.A. Zhulin, G. Kremser, R. Grard: Correlations between X-ray and electric field balloon measurements and GEOS 2 measurements around the same field line (G3.R3).

M. Zi, E. Nielsen: Spatial variations of ionospheric electric fields at high latitudes observed with stare on magnetic disturbed days (G3.R4).

A total of 34 papers were presented to this "General Contributions" session, and they were subdivided into 4 sections as shown in the above list of papers.

The papers in the section (Dependence of Geomagnetic Activity on Solar Wind Parameters) were concerned with dependence of geomagnetic activity on solar wind parameters. The first pepr G3.01 analyzed excitation of substorms (particularly, auroral breakup) by sudden compression of the magnetosphere and confirmed the well-known correlation. The other papers dealt with the effect of the interplanetary magnetic field, and specifically discussed the validity of Akasofu's ε parameter that is claimed to express the energy input rate. All papers concluded that ε is no better than other parameters that express the interplanetary electric or magnetic field. The paper G3.03 examined the response of the AE index to interplanetary parameters in further detail by using the linear response theory. This demonstrated the existence of a time delay of some tens of minutes. The last paper G3.07 developed a model of the open magnetosphere in which effects of B_x and B_y of the interplanetary magnetic field are taken into account.

In the second section for "Structure and Dynamics of Magnetotail", both theoretical and observational results were presented. The 6 theoretical papers (G3.08, G3.09, G3.10, G3.11, G3.12, G3.17) dealt with the relationship between the magnetotail configuration and charged particle or plasma motions in various ways, and the discussion was extended to the self-consistent equilibrium condition for the magnetotail, instabilities and triggering mechanism for magnetospheric substorms. The characteristic signatures for magnetospheric substorms or magnetic field reconnection reported in this section (G3.13, G3.14, G3.15, G3.16, G3.R1) were records observed by a number of satellites (such as IMP-6, ISEE-1, GOES, GMS, TRIAD). All of these observed signatures were worth noting in future analysis of satellite data. The last paper G3.R2 showed the dependence of the magnetospheric electric field and currents on UT and solar wind parameter.

In the section for "Auroral Current System", paper G3.18 presented the statistics on the auroral electrojets, westward from 2000 - 0900 LT and eastward from 1100 - 2100 LT. Papers G3.19 and G3.23 divided the perturbation fields observed by MAGSAT into parallel and perpendicular components to the main geomagnetic field; the latter being due primarily to field-aligned currents, whereas the former is due primarily to horizontal ionospheric currents. Comparison with ground observations indicates that the electrojets are tightly confined to the region of field-aligned currents. Papers G3.21 and G3.22 reported observations of the flows, electric fields and currents observed in and near westward travelling surges. The observed results by magnetometer network, STARE radar and a rocket in G3.22 were reasonably consistent, and generally showed electric fields towards the centre of the surge and intense upward field-aligned current in the centre. There were also indications that a high-conductivity (Cowling conductivity) channel existed to the east of the surge. Paper G3.20 was a theoretical paper showing that the storm asymmetry in low-latitude magnetic fields could be simply explained by the relative rotation of region 1 and 2 Birkeland currents. A simple formula for the equatorial amplitude in terms of the polar cap potential and the height integrated Hall conductivity resulted. Paper G3.25 suggested that auroral currents were standing Alfven waves propagating in an inward convecting nightside magnetosphere, from a stationary source in the tail to the ionosphere. Some events in the ISEE 1 and 2 magnetometer data were presented, which may be consistent with this model.

In the last section for "Aurora and Precipitation", paper G3.26 proposed some new ideas on the generation of inverted V's and discrete arcs. Namely, arcs being formed at a boundary between two different magnetized plasmas where a sufficiently upward current is required by the difference in magnetic fields across the boundary. DMSP data, during two consecutive passes over an auroral bulge, in paper G3.27, showed a remarkably similar particle population, even though the auroral forms had clearly moved southward between the two passes. Paper G3.28 presented good evidence that electron aurora is quite similar at conjugate points during substorms, while there were great differences in the electron aurora observed during quiet times and in the proton aurora at all times. A multi-method study of auroral omega bands in paper G3.29 concluded that upward field aligned-current and precipitating electron were located in the band and moving eastward with it. The last paper G3.R4 compared the high-latitude electric field during quiet and disturbed times and attributed the differences to enhanced auroral zone conductivity and larger field-aligned currents during periods of enhanced activity.

(A. Nishida, R.A. Wolf, G. Atkinson, W. Baumjohann)

4L. LARGE SCALE STRUCTURE AND EVOLUTION OF THE SOLAR WIND (Conveners: O. Vaisberg and R. Schwenn)

August 5, a.m. and p.m. Room: LT3

Chairmen: O. Vaisberg and R. Schwenn

L.F. Burlaga, L.W. Klein: Magnetic fields in remanents of corotating streams between 2 AU and 5 AU Voyager 1 and 2 observations (4L.01).

E.J. Smith, B.T. Thomas: Observations of the distant heliospheric magnetic field: Pioneer II (4L.02).

M.I.Rudovkin, D.I. Ponyavin: Solar wind magnetic field in the vicinity of the sector boundaries (4L.04).

N.R. Sheeley, Jr., R.A. Howard, M.J. Koomen, D.J. Michels, R. Schwenn: Coronal mass ejections and interplanetary plasma measurements(4L.06).

G. Borrini, J.R. Gosling, J.R. Asbridge, S.J. Bame, W.C. Feldman: An analysis of shock waves and high helium abundance events observed at I.A.U. from 1971 through 1978 (4L.07).

T. Saito, M. Seto: A model of heliomagnetic excursion in every sunspot declining-minimum phase (4L.08).

Yu. I. Yermolaev, G.N. Zastenker, A.N. Omeltchenko, O.L. Vaisberg: Variations of heavy ion fluxes in the solar wind and the diagnostics of the solar corona (4L.09).

R. Woo, J.W. Armstrong, J.R. Asbridge: Radio scattering observations of a flare-generated shock wave (4L.10).

C. d'Uston, M. Dryer: Theoretical MHD developments in solar flares generated disturbances in the corona and interplanetary space (4L.11).

Y.C. Whang: Expansion of the solar wind from the polar regions of the sun (4L.12).

R. Steinitz, M. Eyni: Can empirical solar wind proton temperature gradients be reconciled with adiabatic cooling? (4L.14).

M. Eyni, R. Steinitz: How to avoid biasing in the interpretation of measurements of the azimuthal component of the interplanetary magnetic field (4L.15).

S. Bleszynski, S. Grzedzielski: Three dimensional solar wind and the shape of the heliosphere (4L.16).

In the morning session, two aspects of the problem were presented and discussed: i.e. corotating interaction regions (CIR) "both at large heliocentric distances and at 1 AU", and "interplanetary structures associated with solar activity".

Paper 4L.01 discussed the structures in the solar wind at large heliocentric distances that may be considered as the remnants of corotating interaction regions. Unlike the CIR's at 1 AU that are typically characterized by the interaction between slow and fast streams, some large compression/rarefaction waves were observed at distances between 2 and 5 AU in the absence of significant velocity changes across the interaction region. The model of the evolution of CIR in the pressure wave at large heliocentric distances was suggested. The difference in observed magnetic field profile by Voyager 1 and Voyager 2 travelling at different heliographic latitudes is explained by limited latitudinal extent of CIR. The authors suggested 3-dimensional structure of corotation interaction region.

Paper 4L.02 dealt with the behaviour of magnetic field components with a heliocentric distance up to 10 AU and the authors did not find a

significant difference between observed radial gradients and the spiral model of IMF (except small deviations in Bz). Assuming mean velocity of solar wind 430 m/s and corotation period 26.1 days, Smith and Thomas were able to demonstrate that changes of sign of radial IMF component and the orientation of normals to the sector boundaries may be associated with an existence of a plane current sheet inclined by some angle to the solar equator. Propagation of the solar wind with imbedded current sheet, produce the specific warped one-sector configuration. Significant dependence of IMF magnitude on the distance from current sheet is suggested by data analysis. This structure persisted during 3 years near the solar maximum but the change of IMF polarity in the middle of 1979 is revealed by measurements. The authors suggest that at a distance of about 7-8 AU, two corotating interaction regions develop into one CIR, forming a trap for energetic cosmic ray particles.

In the paper 4L.04 the authors analyzed one-hour averages of IMF near the sector boundaries. They did not find the dependence of the thickness of sector boundaries on solar wind conditions. The authors suggest that during quiet solar wind conditions, IMF structures near the sector boundaries may have closed-loop configurations while at disturbed conditions the IMF may have S-shaped structures.

Paper 4L.08 showed the association of recurrent geomagnetic disturbances with high speed solar wind streams, which are in turn associated with low-latitude coronal holes. Observations of recurrent geomagnetic storms on the declining phase of the solar cycle suggest that a large-scale current sheet makes a strong excursion (rotation) on the declining phase of the cycle.

Paper 4L.06 used the NRL observations of corona and MPIA solar wind observations on Helios to analyze the association between the coronal transients and the solar wind structure. The favourable location of Helios 1 orbit allowed them to observe the solar wind disturbances originating near the solar limb where coronal disturbances are clearly seen by coronagraph. Authors discussed 4 interesting events: disappearance of coronal streamers (opening of closed magnetic configuration by coronal transient), very fast transient with propagation velocity of 1500 km/s, non-compressive density enhancement associated with interplanetary shock, and ejection of dark cloud with velocity $\sim$1000 km/s. They have also demonstrated the possibility of identification of interplanetary and coronal events.

Paper 4L.07 made a superimposed epoch analysis of interplanetary shock structures. Both shock-centered analysis and the front of helium enhancement analysis were performed. It was very clearly shown that only strong shocks are followed by helium enhancement regions. The results of the front of helium enhancement centered epoch analysis were most interesting. It is shown that increase of He abundance in the solar ejecta is not associated with solar wind proton number density increase but rather with increase of magnetic field magnitude and with the significant decrease of proton temperature. Results of the study suggest that helium enhancements originate in regions of high /B/ and are carried at 1 AU mainly by transient phenomena with significant adiabatic cooling of helium-enriched region. The model of ejecta-associated interplanetary disturbance was discussed.

During the morning session the participants discussed the possibility of the continuation of the tracking of Helios spacecraft (see business meeting minutes), and also the information on future space probes to monitor the solar wind.

In the afternoon session, the first four papers dealt with the outflow of the solar wind from the Corona. The first paper 4L.09 reported on recent observations from Prognoz 7 of variable heavy ion fluxes which may be indicative of time variations and spatial structures in the corona. Paper 4L.10 demonstrated radio scattering observations of Voyager 1 in order to probe the corona. On August 18, 1979 a flare generated shock could be identified which had a peak solar wind speed of 3000 km/sec at 13 solar radii. The next paper 4L.11 was a progress report on calculations of the propagation of flare generated coronal and interplanetary disturbances, based on time dependent MHD-models. The following paper 4L.12 presented results of numerical calculations indicating strong dependencies of solar wind flow on the conditions at the Polar regions of the corona. Then, in two papers, 4L.14 and 4L.15, earlier Helios-measurements were reinterpreted. The authors claim that adibatic cooling may well account for the proton temperature gradient observed beyond 0.3 AU, if the spiral magnetic field is taken into account properly. They also demonstrated a method to avoid "Biasing" in the interpretation of magnetic field gradients. The final paper 4L.16 discussed the interaction of the solar wind with interstellar gases. Significant asymmetries in the temperatures of the distant solar wind between the directions to the apex, along the polar axis and to the antiapex, are predicted.

(O. Vaisberg, R. Schwenn)

4K. KINETIC PHYSICS AND PLASMA TURBULENCE IN THE SOLAR WIND (Convener: M. Dobrowolny)

August 6, a.m. and p.m. Room: LT3

Chairmen: F.M. Neubauer and M. Dobrowolny

MHD and whistler mode turbulence

H. Volland, M.K. Bird, P. Edenhofer, J.V. Hollweg: Observations of MHD wave activity in the solar corona with the helios spacecraft (4K.01).

F.M. Neubauer, K.U. Denskat, H.J. Beinroth: MHD and whistler mode turbulence in the solar wind between o.29 and 1.0 AU (4K.03).

B. Bavassano, M. Dobrowolny, F. Mariani: Hydromagnetic turbulence in the solar wind: radial evolution of the power spectrum (4K.04).

F. Mariani et al.: The occurrence rate of directional discontinuities as observed in 1976 by Helios 1 and 2 (4K.05).

H. Matsumoto, K. Nagai: Computer simulation of kinetic effects and wave-wave couplings in large amplitude magnetosonic waves (4K.06).

Kinetic studies in the solar wind

W.G. Pilipp, K.H. Mühlhauser, H. Rosenbauer, R. Schwenn: Pitch angle distribution of electrons in the solar wind as observed by the Helios probes between 0.3 and 1 AU (4K.07).

C.T. Dum, W.G. Pilipp, D.A. Gurnett: Quasilinear effects of ion sound turbulence and heat conduction in the solar wind (4K.08).

S.J. Schwartz: Wave-electron interactions in the high speed solar wind (4K.09).

S.J. Schwartz: Helium ions, proton anisotropies, plasma waves and other related aspects of the high speed solar wind (4K.10).

J.F. McKenzie, E. Marsch: Resonant wave acceleration of minor ions in the solar wind (4K.11).

E. Marsch, C.K. Goertz: Resonant cyclotron wave heating and acceleration of solar wind ions (4K.12).

Shock structure and associated phenomena

A.A. Galeev, V.M. Balebanov, G.N. Zanstenker, O.L. Vaisberg, S.I. Klimov, A.M. Omeltchenko, M.N. Nozdratchev, Yu. I. Yermolaev: Study of processes in the terrestrial bow shock on Prognoz-7 and prognoz-8 satellites (4K.14).

W.A. Liversey, M.M. Hoppe, C.F. Dennel, C.T. Russell: Magnetic-field strength overshoots in perpendicular bow shocks (4K.15).

M.M. Hoppe, C.T. Russell: Dual satellite characterization of the low frequency upstream waves (4K.17).

M.M. Hoppe, C.T. Russell, L.A. Frank, T.E. Eastman:E.W. Greenstadt: Foreshcok structure: upstream ULF waves and their association with backstreaming ion population (4K.18).

G. Moreno, C. Bonifazi, A. Lazarus, J. Sullivan, C.T. Russell: Earth's foreshock region: ISEE 2 and IMP 8 observations of solar wind wind velocities and low frequency magnetic field fluctuations (4K.19)

C. Bonifazi, G. Moreno: On the energization of solar wind protons by reflection at the Earth's bow shock (4K.21).

T.E. Eastman, R.R. Anderson, L.A. Frank, G.K. Parks: Ion beams and dispersed ion distributions in the Earth's foreshock (4K.21_

E.W. Greenstadt, M. Hoppe, C.T. Russell: ISEE observations of foreshock modification by solar wind discontinuities (4K.22).

R.R. Anderson, G.K. Parks, T.E. Eastman, D.A. Gurnett, L.A. Frank: Plasma waves associated with energetic particles streaming into the solar wind from the Earth's bow shock (4K.23).

J. Etcheto, M. Faucheux, J. Solomon, R. Fitzenreiter: A study of plasma waves and electrons upstream of the bowshock (4K.24).

The papers presented in the first part of the session contributed to a picture of the radial evolution of magnetic turbulence from the Sun to 1AU and were mostly based on HELIOS measurements.

The first paper (4K.01) *Volland, Bird, Edenhofer, Hollweg,* gave evidence of MHD wave turbulence in the outer corona (2-12 R_0) using Faraday rotation measurements. *Neubauer, Denskat, Beinroth* (4K.03) considered variation of properties of both whistler and MHD turbulence in the radial range spanned by the HELIOS spacecraft. Whistler mode turbulence (47 Hz- 470 Hz) increases like B as the Sun is approached. An interesting increase in steepness of the power spectra of magnetic fluctuations moving away from the Sun was also reported in the hydromagnetic range (2.4×10^{-5} Hz - 1.3×10^{-2} Hz). *Bavassano, Dobrowolny, Mariani* (4K.04) were also concerned with spectral analysis of MHD fluctuations and reported radial gradients of both spectral index and power increasing with frequency. The analyses of both papers 4K.03 and 4K.04 indicated, in addition to variation due to propagation in the ambient medium, the presence of some disipative mechanism on the MHD waves increasing with frequency. *Mariani* (4K.05) gave results of a statistical study of discontinuities and their orientation in the HELIOS radial range and comparison with previous such studies. *Matsumoto and Nagai* (4K.06) reported new results on the non linear evolution of large amplitude magnetosonic waves. In particular a good agreement was found with the prediction of linear Landau damping up to relative amplitudes of the waves of 30%.

In the second section (Kinetic Processes in the Solar Wind), *Pilipp, Muhlhauser, Rosenbauer and Schwenn* (4K.07) presented high angular resolution measurements of the pitch angle distribution of solar wind electrons. A marked change in such distributions (energies >100 eV) was reported near the sector boundaries of the interplanetary magnetic field with the indication of local scattering processes occurring. Distributions with two well defined peaks, indicative of observations at closed magnetic lines with foot points near the Sun were also reported. *Dum, Pilipp, Gurnett* (4K.08) used quasi-linear theory and observations of both ion sound turbulence and electron distribution functions to evaluate in detail the effects of anomalous electron heat conduction. *J. Schwartz,* in a first paper (4K.09) applied non-linear wave particle interaction theories to observed interplanetary fluctuations, to predict enhanced collision frequencies on the electrons with respect to classical Coulomb frequencies. The same author, in a subsequent paper (4K.10) depicted a plausible theoretical scenario for two important anomalies of solar wind observations in high speed streams namely, the anisotropy ($T_\perp > T_{\parallel}$) of the proton velocity distributions and the excess flow velocity of helium ions with respect to protons. *McKenzie and Marsch* (4K.11) discussed the effect of ion cyclotron resonance on the acceleration of minor ions pointing to the result that the differential speed between minor ions and protons increases with M/Q. *Marsch and Goertz* (4K.12) further substantiated this subject with a numerical study of the resonant interaction of solar wind ions with parallel ion cyclotron waves, based on a double adiabatic fluid model with heating and acceleration determined by quasi-linear theory.

In the third section (Structure of bow shock and upstream wave region) *Galeev, Balebanov, Zastenker, Vaisberg, Klimov, Omeltchenko, Nozdratchev, Yermolaev* (4K.14) reported detailed wave and particle measurements across the terrestrial bow shock by Prognoz satellites, with the aim of understanding the mechanism of plasma thermalization at the shock front. Evidence was presented of lower hybrid waves generated by two stream ion motion as producing the observed thermalization. *Livesey, Hoppe, Kennel, Russell* (4K.15) presented a statistical analysis, on a number of quasi-perpendicular bow shocks, of the phenomenon of overshooting of the field strength behind the shock front to values larger than those observed at some distance downstream.

The next two papers by *Hoppe and Russell* (4K.17) and by *Hoppe, Russell, Frank, Eastman, Greenstadt* (4K.18) were combined to give a very clear review of the topology and related wave-particle features of the foreshock regions, as obtained in the last years of research with ISEE data. *Moreno, Bonifazi, Lazarus, Sullivan, Russell* (4K.19) used data of ISEE 2 and IMP 8 in different regions of the foreshock to establish a correlation between solar wind deceleration and amplitude of shock connected MHD waves. *Bonifazi and Moreno* (4K.20) used ISEE 2 data and backstreaming protons to investigate statistically the prediction of Sonnerup model of particle energization at bow shock reflections. *Eastman, Anderson, Frank, Parks* (4K.21) presented detailed studies of correlations between upstream particle data and plasma waves in the Earth's foreshock. The analysis of high time resolution data indicated gyrophase organization of the upstreaming ions and the authors suggest that the dispersed distributions are produced primarily at sources near the bow shock. *Greenstadt, Hoppe and Russell* (4K.22) considered the problem of interaction of the bow shock with incoming discontinuities, in particular tangential discontinuities. These interactions are required to explain sudden appearances or disappearances of phenomena associated with the foreshock which are indicated by ISEE observations. *Anderson, Parks, Eastman,*

Gurnett, Frank (4K.23) presented an extensive survey of wave observations, both electrostatic and electromagnetic in several frequency domains upstream of the Earth's bow shock and discussed their association with different types of particles populations. *Faucheux, Solomon, Fitzenreiter* (4K.24) showed observations of electron plasma waves which appear in strong bursts when the spacecraft is connected to a field line tangential to the bow shock. Corresponding variations of electron distributions were also reported together with evidence of local wave generation.

(M. Dobrowolny)

4S. SOLAR WIND DURING SOLAR-MAXIMUM PERIOD (Conveners: M.H. Acuna, F. Mariani)

August 4, a.m. Room: LT3

Chairman: F. Mariani

F.M. Neubauer: The macroscopic interplanetary magnetic field from solar minimum to solar maximum between 0.29 AU and 1.0 AU: Helios-1 and Helios-2 (4S.01).

R. Schwenn, H. Rosenbauer, K.-H. Mühlhäuser: Solar cycle variations of the solar wind as observed from Helios (4S.02).

E.J. Smith, B.T. Tsurutani, L. Davis, Jr.: Interplanetary magnetic field during solar maximum (4S.03).

T. Saito, R. Howard: Evidence to support the two-hemisphere model on rotational reversing of the heliodipole in sunspot maximum phase (4S.04).

J. Feynman: Sudden commencement geomagnetic storms at sunspot maxima since 1900 (4S. 05).

P.H. Scherrer, J.M. Wilcox, H. Lundstedt: Solar flare acceleration of solar wind: Influence of active region magnetic field (4S.06).

The audience at this session was of the order of 30 people. The time allocated was sufficient for discussions and comments. A paper by Neubauer discussed the evolution of the statistical properties of the interplanetary magnetic field, in particular, its gross structure and polarity. In the following paper, Schwenn, Rosenbauer and Mühlhäuser demonstrated the occurrence of significant decreases of several solar wind parameters (bulk velocity, mass flux density, total energy budget) from conditions of medium to low solar activity. Smith, Tsurutani and Davis reported on the observation of the polarity reversal of the interplanetary field observed onboard ISEE-3 in the spring of 1980 (field now tends to be sunward in the northern hemisphere). Saito and Howard discussed details of an elaborate model of the three-dimensional structure of the field, in particular, showing how several observational features can be consistently interpreted. Feynman reported on a long term statistical study of geomagnetic activity. Long term trends and an almost constant 11-year variation appear to be superimposed in the more recent decades. Finally, Scherrer, Wilcox and Lundstedt, by comparing observations of photospheric magnetic fields and solar wind speed at Earth following solar flares, found that high speeds tend to be only associated with a southward field component on the sun.

(F. Mariani)

40. ORIGIN AND COMPOSITION OF THE SOLAR WIND (Conveners: W.I. Axford, K.I. Gringauz)

August 4, p.m. Room: LT3

Chairman: W.I. Axford

J.V. Hollweg: Ions in the low corona and the origin of the solar wind (40.01).
J.T. Gosling: Coronal streamers, the holioshperic current sheet, helium abundance, and the origin of the low speed solar wind (invited) (40.02).
J. Geiss: Solar wind composition measurements with the Apollo and ISEE missions (invited) (40.03).
R. Schwenn: Unusual solar wind (40.04).
R.A. Kipp, G. Borrini, G. Noci: Magnetic reconnection in coronal streamers (40.05).
S.J. Schwartz: A few days in the life of a solard minor ion (40.08)

Hollweg discussed the acceleration of minor species in the lower corona, assuming that only a combination of Coulomb friction and hydrostatics is important. He made specific predictions for abundance variations with solar wind conditions. *Gosling* discussed the nature of the "slow" solar wind - associating it with "closed" (non-hole) coronal regions surrounding a magnetic neutral sheet. *Geiss* presented measurements of elemental and isotopic abundances from ISEE 1 and 3 and Apollo. He made an interesting comparison of solar wind and coronal abundances showing agreement - also correlations of O, He temperatures and velocity variations showing strong evidence for wave effects. *Schwenn* discussed the Helios 1 and 2 observations of unusual structures and elemental abundances and showed evidence for He^{+} and O^{+2} in "piston" gas as well as the existence of "holes" in the solar wind where the proton density and temperature drop strongly (pressure balance by $B^2/8$). He showed a case in which a-particles disappear completely (i.e. below sensitivity) and another case in which electrons were not observable. He also showed a case of solar wind with speed $\ll 200$ km/sec (no α-particles but 2 proton peaks) and a case of subsonic solar wind. A high density "record" was set (0.31 AU) of $1400/cm^3$ (shock wave event). Finally, he showed a case of no observed solar wind at 0.3 AU lasting for several days. *Borrini* discussed coronal streamers with high density extending out to many solar radii, and she advocated quasi-steady reconnection as being important in streamers. Lastly, *Schwartz* discussed minor ions in the solar wind, using thermal/other diffusion to explain an initial He/H separation in transition region.

(W.I. Axford)

G4. GENERAL CONTRIBUTIONS TO IAGA DIVISION IV (Convener: L.F. Burlaga)

August 7, p.m. Room: LT3

Chairman: L.F. Burlaga

J.T. Gosling, J.R. Asbridge, S.J. Bame, W.C. Feldman, R.D. Zwickl, G. Paschmann, C.T. Russell, E.J. Smith: A sub-Alfvenic solar wind: interplanetary and magnetosheath observations (G4.01).

M.M. Hoppe, C.T. Russell: Upstream Waves: A Venus-Earth comparison (G4.02).

C.T. Russell, J.G. Luhmann, R.C. Elphic, F.L. Scarf: Pioneer-Venus observations of the distant wake and magnetotail of Venus (G4.03).

H. Takahashi, T. Chiba, N. Yahagi, K. Nagashima: Solar wind velocity, interplanetary magnetic field and cosmic ray anisotropies (G4.04).

Gosling et al., reported that on November 11-23, 1979, the solar wind was sub-Alfvenic. The solar wind was super-magnetosonic, however, and the earth's bow shock was still present. The sub-Alfvenic flow was associated with low densities and high field strengths, but the cause of these could not be determined. *Hoppe and Russell* compared the magnetic waves in the foreshock region near Venus with similar waves observed near earth. The high frequency waves were found to have a larger amplitude at Venus that at earth, whereas lower frequency waves had the same (large) amplitude at both planets. They inferred that the resonant speed of ions upstream was approximately twice the solar wind speed for all of the planets, suggesting that the ions were solar wind ions that were reflected from the bow shock. *Russell et al.* presented evidence for a magnetotail at Venus with a diameter of 4 Venus radii and a flux (not of planetary origin) of several megawebers. The polarity was consistent with that of a draped magnetic field. There was no single current sheet, but a strong field region with many magnetic holes and directional changes was observed, possibly due to a moving current sheet and/or a filamentary current sheet. *Takahashi et al.* showed that the north-south cosmic ray anisotropy increases with the magnitude of the interplanetary magnetic field and with the solar wind velocity.

(L.F. Burlaga)

VW. WORKSHOP ON OBSERVATORY AND REPEAT STATION PRACTICE (Convener: G. Fischer)

August 14, a.m. Room: TR6

Chairman: G. Fischer

U. Schmucker: The use of magnetic observatory data for investigations of crustal and mantle electric conductivity (invited) (VW.01)

D.E. Winch: Magnetic observatory yearbooks: A user's difficulties and recommendations (invited) (VW.02).

A.W. Green, Jr.: Optimal filtering of geomagnetic observatory data (VW.03).

Q. Taccetti, P. Palangio, A. Meloni, A. De Santis: Automatic recording of three geomagnetic field components by means of a proton vector magnetometer (VW.07).

E. Kring-Lauridsen: Improvements of some classic geomagnetic instruments (VW.08).

E. Kring-Lauridsen: A comparison between the accuracy and stability of a commercial fluxgate magnetometer and classic variometers (VW.09).

J.A. Joselyn, B.J. Williams: SELDADS: A unique operational real-time system for data collection, reduction, and display (invited) (VW.10).

The purpose of this workshop was to bring together users and producers of observatory data. While Schmucker considered the relationship between data accuracy and the conclusions that can be drawn regarding the deeper mantle conductivity structure, Winch directed his attention to the often fanciful presentation of observatory hourly means. In this respect it may be worthwhile referring observatory people to pp. 83-91 of IAGA News No.15 (November 1976), where they might find information relating to this type of data presentation. This reviewer's impression, however, is that IAGA News No.15 is inadequate in this respect. Something better needs to be done by Working Group V-1 or V-3. Green then discussed observatory data filtering whereas Taccetti presented an interesting vector-magnetometer, which he developed with several co-workers, based on a new combination of proton magnetometer and Helmholtz coils. Kring-Lauridsen, on the other hand, turned his attention toward improvements of classical instruments. Joselyn and Williams described the services obtainable through SELDADS (Space Environment Laboratory Data Acquisition and Display System). Among other things SELDADS gives advance warning of impending geomagnetic storms. This is of special value to electrical utility systems, whose power lines can be thrown off balance by magnetic activity. The SELDADS data are available worldwide through WMO (World Meteorological Organization) channels. The Workshop apparently achieved its goal of confronting the requests of users with improved methods of data acquisition proposed by observers. But it is to be regretted that several representatives of observatory people were unable to attend the Assembly, probably because of lack of funds, and their papers could, therefore, not be presented.

(G. Fischer)

VC. COMPARISONS OF ANALYTICAL TECHNIQUES FOR NATIONAL AND REGIONAL MAGNETIC CHARTS (conveners: E. Dawson, W. Mundt)

August 10, a.m. Room: LT3

Chairman: E. Dawson

W. Mundt: Construction of qualitative national and regional magnetic charts (invited) (VC.01).
L.R. Alldredge: Geomagnetic local and regional harmonic analysis (invited) (VC.03).
H. Nevanlinna: Recent secular variation as analysed by dipole models (invited) (VC.05).
J.V. Korhonen: Statistical interpretation of the aeromagnetic map of Finland (VC.06)

The review paper by *Mundt* discussed accuracy of interpolation, whether a map is an adequate representation of data, when considering the inherent errors and the density of data points. He proposed a limit for the scale of the map, and emphasized the need for compatibility of reference fields for neighbouring surveys.

Alldredge summarized non-spherical harmonic analyses (rectangular and cylindrical) for restricted areas, with examples from the European region. He showed that the consistency between components (as derivatives of a potential) can be maintained using this type of analysis.

Nevalinna used multiple-dipole models to represent the magnetic secular variation over Europe for 1965-75, and globally for 1956-78. Changes in the components were interpreted to be periodic. With the aid of a series of contour maps, he showed some fairly shortwavelength secular variations over Europe.

Korhonen presented an aeromagnetic anomaly map of Finland, along with discussions of characteristic anomalies and correlations with petrological units and tectonic features. Particular emphasis was made of the map with respect to ore deposits.

(E. Dawson)

VM. PRODUCTION OF REGIONAL MAGNETIC CHARTS USING RECENT SATELLITE DATA (Conveners: E.B. Fabiano, A.G. Hahn, R.L. Coles)

August 10, a.m. Room: LT3

Chairman: A.G. Hahn

E.B. Fabiano, N.W. Peddie: Total magnetic intensity models for the United States using aeromagnetic and Magsat data (VM.01).
L.R. Newitt, E. Dawson, R.L. Coles, A. Nandi: A total force chart of Canada for 1980 derived from Magsat data (VM.03).
J.F. Hermance: Electromagnetic induction and source field effects in Magsat data (VM.05).

The first two papers showed examples of constructing total field charts for United States and for Canada. For the U.S. chart, Magsat satellite data (in the form of a spherical harmonic model) and aeromagnetic data (especially Project Magnet data) were shown to be consistent and were combined to produce the final chart, which also showed secular variation. For the Canadian region, two charts were shown and compared, one derived from aeromagnetic data, the other from a subset of quiet Magsat data; these two charts were in close agreement, with no major systematic biases in the difference between them. The last paper drew attention to the effects of induction on satellite magnetic data. The possibility of correcting for ring current effects was discussed but it was shown that a general correction could not be readily derived because I(t)/E(t) was not constant in time. Currents in the ionosphere, in the presence of conductivity contrasts in the earth's crust, may cause corresponding anomalies in the magnetic field at satellite altitudes, of amplitudes sufficient to be detectable.

(R.L. Coles)

GV. GENERAL CONTRIBUTIONS TO DIVISION V ON OBSERVATORIES, INSTRUMENTS, INDICES AND DATA (Convener: C.G. Sucksdorff)

August 6, a.m. Room: LT5

Chairman: C.G. Sucksdorff

H.G. Barsczus: The secular variation station network in French Polynesia (GV.01).

H. Lühr: A newly designed fluxgate magnetometer with a digital output (GV.02).

M. Seto, T. Saito, K. Hirao: Ricrestometer, a high-speed processor to measure residual magnetisms of rock specimens and spacecraft parts (GV.03).

A. Badellas, A. Gounazis, L.N. Mauridis: Establishment of a geomagnetic network in the area of Thessaloniki.

Barsczus reported on various difficulties for setting up a secular variation station network in a region with strong magnetic gradients, usually $\sim$ 100 nT/m in F, sometimes $1^{o}/100$ m in D. As a solution, pillars were installed at the observation points, ensuring exact reoccupation to better than one cm in x, y and z coordinates.

Lühr described his new flux-gate magnetometer, in which integral over selected parts of the induction voltage of the sensor is used as a measure of the ambient field. Due to the direct proportionality between the integral over one pulse and the ambient magnetic field, this instrument shows an excellent linear behaviour without a feedback circuit.

Seto described a combination of high sensitivity ring core magnetometer with high speed spectrum analyzer, which is an extremely sensitive instrument for measuring weak residual magnetism of specimens down to 10^{-6} emu/cc even in strong artificial disturbance fields.

The paper by Mauridis et al. is the first results in Greece aiming at the development of gravimetric and geomagnetic methods of earthquake prediction. In the framework of this program a geomagnetic network was established in the area of Tessaloniki, around the epicenter of the strong earthquake (M = 6.5) of June 20, 1978. The measurements of the network were repeated in five observing periods between May 1979 and September 1980, showing variations of the order of 1 nT per year in one of the network stations.

(C.G. Sucksdorff)

AR. RECENT RESULTS FROM MAGNETIC AND AERONOMIC RESEARCH IN THE ANTARCTIC (Convener: J.A. Gledhill)

August 11, p.m. Room: LT4

Chairman: J.A. Gledhill

A.S. Rodger: Recent developments in British Antarctic aeronomic research - a review (invited) (AR.01).

T. Nagata: Geomagnetic secular variation in Antarctica 1960-1975 (AR.02).

A.N. Zaitzev, V.O. Papitashvili, O.A. Troshichev: Recent results from Soviet unmanned magnetometer network in Antarctica (invited) (AR.03).

R.L. Dowden, N.G. Kleimenova: VLF ground hiss in high latitudes of Antarctica and field aligned currents (AR.04).

A.J. Smith, K.H. Yearby, K. Bullough: Conjugate VLF observations of magnetosphere line radiation observed at Halley and Newfoundland (AR.05).

N. Sata, M. Sato, T. Hirasawa, T. Nagata: Conjugacy of ELF emissions at Syowa, Antarctica, and Husefell, Iceland (AR.06).

S. Perraut: Results of conjugated wave observations on the ground and onboard GEOS-1 and GEOS-2 satellites in the ULF and VLF frequency ranges (invited) (AR.07).

T.J. Rosenberg: Magnetospheric research at J.S. Antarctic stations (invited) (AR.08).

T.J. Rosenberg, D.L. Detrick, C.G. Park: The local time distribution and geomagnetic dependence of electron precipitation and VLF emissions at L-4 (AR.11).

S. Miyazaki, T. Ogawa, H. Mori, T. Hirasawa, T. Nagata: Characteristics of day- and night-electron density profiles in the polar ionoshpere obtained by rocket experiments at Syowa Station, Antarctica (AR.12).

A.S. Besprozvannaya, T.I. Shchuka, A.V. Shirochkov: Synoptic models of the anomalous phenomena in the Antarctic ionosphere derived from ground-based observations (AR.13).

R. Haggard, J.A. Gledhill: Anomalous diurnal variation of foE at Gough Island (AR.14).

O.M. Raspopov, V.L. Zverev, V.R. Tagirov, S.A. Chernouss, G.V. Starkov, V.G. Vorobyev: The results of aurora research in the Antarctic (AR.15).

The average attendence was about 35, ranging from 21 to 54. The session, in my opinion, served a very useful function in bringing to the notice of participants the wide variety of work being carried out in the fields of Geomagnetism and Aeronomy in Antarctica.

(J.A. Gledhill)

HI. GEOMAGNETISM AND AERONOMY - THE HISTORICAL PERSPECTIVE (N.V. Pushkov Memorial Session) (Convener: H.B. Garrett)

August 7, p.m. Room: LT1

Chairman: H.B. Garrett

A.S. Thom: The geometry and Astronomy of megalithic man (HI.01).
M. Gadsden: CTR and Ben Nevis (HI.02).
H. Rishbeth, R.W. Smith, P.H.G. Dickinson: Fifty years of Ionospheric sounding at Slough (HI.03).
G.L. Siscoe, S.M. Silverman: Scientific uses of historical solar-terrestrial data (HI.04).
S.R.C. Malin: The discovery of geomagnetic secular variation (HI.05).
D.R. Barraclough: The north magnetic pole from Ross to the present day (HI.06).
Joan Feynman: Solar terrestrial relations since the Maunder minimum (HI.07).
W. Schröder: Early view of aurora borealis (HI.08).
N. Fukushima: History of IAGA - organization, assembly and publications (HI.09).
T.A. Potemra: Fridtjof Nansen: "Principal investigator" for the FRAM Expedition - an early IMS program (1893-1896) (HI.10).

The History Session on Friday afternoon was attended by over 200 people. This session was devoted to the late Professor N.V. Pushkov, who was the founder of the History Commission in IAGA and passed away on 28 January 1981.

Dr. A. Thom gave the introductory paper on stone circles in Scotland; this proved to be an excellent introduction to the 'stone ring' tour on the Saturday and Sunday, ably hosted by M. Gadsden, under History Commission sponsorship. All other talks listed above were excellent reviews of either some important historical events during the development of geomagnetism and upper atmosphere physics, or the scientific uses of historical data, all of which attracted the attention of so many participants. The Chairman would like to praise, also, an outstanding display on the history of Geomagnetism prepared by S.R.C. Malin, which was the focal point of the opening reception at the Royal Scottish Museum on the evening of Wednesday, 5 August.

(H.B. Garrett)

ER. REPRESENTATION OF MAGNETOSPHERIC AND IONOSPHERIC SOURCE FIELDS AND THEIR INDUCTION EFFECTS (Conveners: S. Matsushita, W.P. Olson)

August 13, a.m. Room: LT3

Chairmen: S. Matsushita and W.P. Olson

W.P. Olson: The history of the study of daily variations in the earth's surface magnetic field (invited) (ER.01).

W.H. Campbell: Source constraints obtained from the annual and semi-annual changes in Sq phase and amplitude at the earth's surface (invited) (ER.02).

U. Schmucker: The effect of the earth's conductivity on the surface field of magnetic variations (invited) (ER.03).

E. Oni: On the question of how best to describe the inducing source fields at low latitudes (ER.04).

C.A. Reddy, V.V. Somayajulu, K.S. Viswanathan: Current circuits in the electrodynamic coupling of the auroal and equatorial dynamo regions (ER.06).

S. Matsushita: Ionospheric and field-aligned current systems and their contributions to the earth's surface magnetic Sq variation - A review (invited) (ER.07).

A.D. Richmond, R.G. Roble, R.E. Dickinson: Ionospheric dynamo currents calculated with winds from a three-dimensional thermospheric dynamics model (ER.08).

D.M. Klumpar, D.M. Greer: A technique for modelling the magnetic perturbations produced by field-aligned current systems (ER.09).

K.A. Pfitzer, W.P. Olson: The contribution of non-ionospheric currents to variations in the earth's surface magnetic field (invited) (ER.10).

R.E. Holzer, J.S. Slavin: A quantitative model of geomagnetic activity (ER.11).

Poster Presentations:

K. -K. Tschu, J. -X. Zhang, C. -F. Liu: Analysis of geomagnetic effect of 5 previous solar eclipses occurring in China during the past 50 years (ER.12).

D.N. Chetaev, S.V. Shamanin, E.N. Fedorov, A.N. Os'makov, M.G. Savin, Yu.G. Izrailsky: Impedances of horizontal propagating magnetotelluric field (ER.13).

E.I. Zhovty: Potential electric fields generated by a regular horizontal wind (ER.14).

The purpose of Session ER was to examine the form and magnitude of each current source as well as its associated magnetic field, in an attempt to assess quantitatively the importance of each source with respect to the variations in the surface magnetic field. This assessment provided the basis for the accurate description of the geomagnetic field and induction effects, as well as for the study of ionosphere-magnetosphere interactions.

Invited reviews were given on the following subjects: (1) The history of the study of daily variations in the earth's surface magnetic field, (2) Source constraints obtained from the annual and semi-annual changes in Sq phase and amplitude at the earth's surface, (3) The effect of the earth's conductivity on the surface field or magnetic variations, (4) Ionospheric and field-aligned current systems and their contributions to the earth's surface magnetic Sq variations, and (5) The contribution of non-ionsopheric currents to variations in the earth's surface magnetic field.

It was emphasized that field-aligned currents play a very important role in polar magnetic daily variations. Other highlights were discussions on three-dimensional dynamo currents and the electrodynamic coupling between high and low latitudes.

(S. Matsushita)

ES. EFFECTS OF SOURCE CHARACTERISTICS ON ELECTROMAGNETIC INDUCTION (Convener: J.F. Hermance)

August 12, p.m. Room: LT3

Chairman: J.F. Hermance

M.N. Berdichevsky, V.I. Dmitriev, U. Schmucker: Generalized magneto-telluric and magnetic gradient relation for a layered half-space (ES.01).

J.F. Hermance: Finite source fields coupled to lateral conductivity heterogeneities: Effects on magnetotelluric and magnetic gradiometric deep sounding experiments (ES.02).

A.G. Jones, J.T. Weaver: Induction by uniform and non-uniform source fields over northern Scandinavia: Field data and numerical modelling (ES.03).

L. Carlo, A.K. Agarwal, R.G. Rastogi, B.P. Singh: Effect of source field geometry on currents induced in the Ethiopian region (ES.04).

G.P. Gregori, L.J. Lanzerotti, A. Meloni: Canonical GDS on a planetary scale by Sq: An initial quantitative analysis (ES.05).

B.J. Srivastava, S.N. Prasad, B.P. Singh, B.R. Arora: Coastal induction anomalies in Peninsular India and the electrojet field (ES.08).

This session was planned to deal with the character of specific features of the external source field and/or how these characteristics might affect electromagnetic induction in plane-layered or multi-dimensional conductivity variations within the earth. Three of the presented papers discussed the electromagnetic induction in the earth caused by the intense electrojet of narrow latitudinal width along the auroral zone and the geomagnetic equator. The remaining three papers discussed, theoretically, the induction effect by nonuniform or finite source field for possible application to the geomagnetic deep sounding.

(J.F. Hermance)

EI. INDUCTION RISK (Convener: W.H. Campbell)

August 12, a.m. Room: LT3

Chairman: W.H. Campbell

W.H. Campbell: Current status of research on the induction effects of geomagnetic disturbances upon technological systems (EI.01).
J.A. Joselyn: Geomagnetic disturbance forecasting (EI.02).
A.C. Fraser-Smith: ULF geomagnetic "smog" (EI.03).
S.O. Ognade: Induced electromagnetic fields in oil pipelines under electrojet current sources (EI.04).
V.D. Albertson, N. Mohan, J.G. Kappenman, J.W. Porter: Geomagnetically-induced currents in long-line electric power system components (EI.06).
D.H. Boteler, T. Watanabe, R.M. Shier, R.E. Horita: Geomagnetically induced currents in a 500 kV power line in B.C. (EI.07).
R. Pirjola: Induction in power transmission lines during geomagnetic disturbances (EI.08).
A. Meloni, L.V. Medford, L.J. Lanzerotti, G.P. Gregori: Geomagnetic induction on trans-oceanic communications cables (EI.09).
J. Hruska: The effects of geomagnetic disturbances on magnetic mapping in Canada (EI.10).
M. Menvielle, J. Zlotnicki, J.L. Le Mouel, J.P. Pozzi, G. Simon: Detailed study of abnormal geomagnetic variations in Basse-Terre Island (F.W.I.): Implications for the study of the volcano-magnetic field (EI.11).

This session was planned to discuss the special effects of geomagnetic variations at the earth's surface that have a direct impact upon human enterprise in modernized society. Typical examples are strong induced electric currents in long oil pipelines or electric power transmission lines under the auroral zone. The trans-oceanic communications cables are also influenced by geomagnetic induction. Some remarkable observational results associated with great magnetic storms were presented, along with some technical suggestions to the damage caused by induction currents.

(W.H. Campbell)

EM. SOLAR AND LUNAR EXTERNAL AND INTERNAL MAGNETIC VARIATIONS AND RELATED PHENOMENA (Conveners: J.C. Gupta and D.E. Winch)

August 13, p.m. and 14, a.m. Room: LT3

Chairmen: J.C. Gupta and D.E. Winch

S. Matsushita: Sq and L in polar regions
H. Deebes: Lunar and Solar quiet daily variations at Pruhunice (EM.02).
R. Sellek: Secular trends in the daily magnetic variation (EM.05).
J.C. Gupta: Solar and Lunar seasonal variations in the North American sector (EM.06).
D.E. Winch, R.J. Stening: Some aspects of lunar magnetic variations (invited) (EM.07).
D.E. Schlapp: Lunar tidal temperature variations in the Mesosphere and below (EM.08).
G.O. Walker, S.I. Kannangara: Quiet day magnetic field variations and Sq currents at solar minimum (EM.09).
V.M. Mishin, C.-U. Wagner: Dynamics of the global Sq-field (EM.11).
E.C. Butcher: On the position of the Sq(H) focus in years of sunspot minimum (EM.12).
B.A. Hobbs, D. McKirdy, G. Roberts: Response measures obtained from Sq analyses (EM.13).
S. Matsushita: Solar-cycle and seasonal variations of Sq and L-A review (invited) (EM.14).
A.K. Agarwal, R.G. Rastogi, B.P. Singh: Equatorial electric fields due to quiet day dynamo and due to solar disturbances (EM.15).
C.A. Onwumechili, C.E. Agu: Regional variations of equatorial electrojet parameters (EM.16).
D. Hesse: An investigation of the equatorial electrojet by means of ground -based magnetic measurements in Brazil (EM.17).
V.V. Somayajulu, B.V. Krishna Murthy, C.A. Reddy: Tidal component behaviour during counter electrojet events (EM.18).
N.S. Sastri, B.R. Arora, D.R.K. Rao: Effect of the equatorial counter-electrojet in the Indian region on the geomagnetic solar and lunar daily variations, from the magnetic equator to the middle latitudes (EM.19).
M.L. Richards: Daily variations of voltage on a long submarine cable (EM.20).
W.D. Parkinson: Bi-diurnal geomagnetic variations (EM.21).
M. Menvielle, J. Ducruix: Interaction between the level of external activity and the main internal geomagnetic field: New evidence (EM.22).
G.P. Gregori, L.J. Lanzerotti, A. Meloni: Canonical GDS on a planetary scale by SQ: An initial application to deducing the ecternal fields (EM.25).
H. Deebes: The ordinary wave critical frequency for the F2 layer variation at Yamagawa and its behaviour with the lunar distance (EM.26).

The emphasis of the program was to present results on Sq and L studies from long series of global geomagnetic data. The overwhelming response to "Call for Papers" led to the extension of the program to two half day sessions. The sessions, each containing a review paper, were very well attended.

The origins of Sq and L and the levels where their current systems flow, still remain controversial topics which deserve through investigation in the future. However, data analysis and theoretical work have made significant advances in our understanding of Sq and L.

Evidence was presented to show that in parts of the winter hemisphere, the solar and lunar dynamos are either very weak or are totally absent. The asymmetric dynamos were also claimed to produce field-aligned currents between the northern and southern hemispheres. The development of a three-dimensional model of the Sq system was encouraging as it seemed to explain some of the hitherto unclear aspects of daily variation. Also theoretical calculations have shown that the F-layer currents influence those flowing in the E-layer affecting the magnetic diurnal variations at high latitudes and semi-diurnal variations at mid and low latitudes. The diurnal variations of both Sq and L were noted to undergo secular changes and evidence was found for the existence of magnetic variation corresponding to the atmospheric K_1 tide. But the observed absence of the influence of the bi-diurnal mesospheric winds on the magnetospheric variations is perplexing and demands theoretical explanation. The data analysis also revealed that the Sq focus shifts equatorward or poleward on the normal Quiet Days and on the Abnormal Quiet Days depending upon the time of occurrence of substorms at high latitudes. However, the cause of the Abnormal Quiet Days was not yet quite clear.

Several papers were presented on studies of the equatorial electrojet and counter electrojet using ground data except in one case where the data from the POGO satellite were used. The satellites have the distinct advantage of producing data over the large ocean areas surrounding the equator. It was felt that our knowledge of these electrojets would be enhanced when more ground data - especially from the chain of stations across the equator - and the satellite data from future missions become available.

It is now planned to publish the selected papers in this session in the Annales de Géophysique (Fascicule 3, T.38, 1982).

(J.C. Gupta, D.E. Winch)

RESOLUTIONS OF THE IAGA EDINBURGH ASSEMBLY

(adopted on 15 August 1981)

Resolution of Thanks

IAGA expresses its appreciation to The Royal Societies of London and Edinburgh and its sincere gratitude to the Local Organizing Committee for the excellent hospitality, scientific meeting arrangements, the social programme and the weather which have produced a very enjoyable and fruitful assembly.

Resolutions

1. IAGA, noting that a proposal is to be made to URSI that a feasibility study should be made for a containerised Southern Hemisphere Incoherent Scatter Facility (SHISCAT) and noting that the scientific results obtainable with such a facility would be of great interest recommends that such a feasibility study be made and requests URSI to keep IAGA informed of progress in this project.

2. IAGA, noting that the World Data Centers for Solar-Terrestrial Physics have, in the past, played a vital role in helping to provide IAGA scientists with primary and support data necessary for them to carry out their research effectively and noting that the success of the data analysis phases of the International Magnetospheric Study and the upcoming Middle Atmosphere Program are strongly dependent on the continued availability of the large data archives handled by the World Data Centers, strongly recommends that national agencies which house and support the World Data Centers do all in their power to ensure that the high standards of data archiving and dissemination achieved by these organizations in recent years are maintained and, if possible, upgraded over the coming decade.

3. IAGA, noting that Reporter Reviews of the divisions of IAGA are considered to be an integral part of the process of alerting IAGA scientists to recent developments in their areas of research and further noting that the non-attendance of reporters in certain topic areas which they are assigned to cover leads to a gap in reporting results which extend over two years of development in the areas concerned, strongly urges that organizations at which the reporters are based do all in their power to ensure that reporters are given the resources which will permit them to prepare their reviews and to deliver them orally at the IAGA and IUGG General Assemblies.

4. IAGA, noting the new and unexpected results from the HELIOS-mission as solar activity evolves and noting the excellent technical status of the payload and the spacecraft and recognizing the unique capabilities of HELIOS-1 to study the interplanetary medium between 0.3AU and 1.0AU during the declining phase of the solar cycle urges the appropriate agencies in the FRG to ensure the continued support of mission operations and data analysis.

5. IAGA, recognizing the need for geomagnetic data in the equatorial region of South America, requests that the Surinam authorities support the continuation of the Geomagnetic Observatory Paramaribo.

6. IAGA, recognizing the importance of Nairobi Geomagnetic Observatory as part of the East African contribution to international geophysical science, and noting the need for improving the quality of operation, urges the Kenyan authorities to provide the necessary funds to rehabilitate and continue to maintain the observatory operation, with due regard to unified standards established for East African observatory and field survey needs.

7. IAGA, recognizing with thanks the efforts of Mozambique authorities in maintaining the high standard of the Maputo Geomagnetic Observatory, and noting the improvement that the Nampula Geomagnetic Observatory will provide in filling a gap in the network of magnetic observatories, recommends the continuous operation of the Nampula Observatory.

8. IAGA, recognizing the immense value to the scientific community of the derivation and publication of auroral electrojet (AE) indices, thanks WDC-C2 (Kyoto, Japan) for producing AE in published form for the first half of 1978, and urges that WDC-C2 continue to produce AE indices; understanding that 6 of the 12 observatories whose records are used in deriving AE are now recording digitally, strongly urges that the remaining stations (Cape Wellen, Tixie Bay, Cape Chelyuskin, Dixon Island, Abisko, and Leirvogur) rapidly convert to digital recording magnetometers to facilitate the prompt production and publication of AE indices.

9. IAGA, noting that most radar meteor systems are now automated, considering the need for a more effective geographical distribution of radar meteor stations and recognizing high degree of coordination necessary to undertake simultaneous world-wide observations recommends that

   (1) IAGA member countries be encouraged to support and extend the radio meteor network

   (2) international coordination be undertaken through a Global Meteor Observation System (GLOBMET) and that this coordination be effected in the immediate future through the Middle Atmosphere Program in SCOSTEP

   (3) a committee be formed within SCOSTEP with representatives from IAGA, IAMAP, IAU and URSI to produce a GLOBMET planning document.

10. IAGA, recognizing the need for magnetic repeat surveys in developing countries which lack the equipment and expertise in these operations, suggests that consideration be given by these countries to obtaining assistance from agencies who have these facilities or from individuals who have the expertise.

11. IAGA recognizes the need for workshops in magnetic operations in the regions of developing countries to provide training of technicians for these operations and urges that countries in need of such training and appropriate international agencies join in support of these workshops.

12. IAGA, recognizing the usefulness of Magsat satellite vector magnetic data in defining IGRF 1980, and noting the complexity of secular variation, urges that another such satellite survey be made; recognizing the value of such data in mapping intermediate-wavelength anomalies attaches great importance to the acquisition of such data at an altitude less than 200 km.

13. IAGA, recognizing the continuing need for an International Geomagnetic Reference Field, recommends that:

    1. IGRF 1980 be used for the interval 1980 to 1985
    2. DGRF 1965, DGRF 1970, and DGRF 1975 be used, with linear interpolation, for applications requiring definitive values for the interval 1965 to 1975
    3. PGRF 1975 (ie DGRF 1975 and IGRF 1980 interpolated linearly) be used for the interval 1975 to 1980 until DGRF 1980 is produced.
    4. This pattern be maintained in future updates.

    In the above text, DGRF denotes a Definitive International Geomagnetic Reference Field, and PGRF a Provisional International Geomagnetic Reference Field. The values of spherical harmonic coefficients for DGRF 1965, DGRF 1970, DGRF 1975, and IGRF 1980 with secular variation terms for 1980-1985 are shown in this publication on page 197.

14. IAGA, noting the need to extend our knowledge of the geomagnetic secular variation beyond the limited range of historical and observatory records, and recognizing the large increase during the past decade in secular variation records from a world-wide network of sites obtained from archaeomagnetic studies and palaeomagnetic studies of sedimentary sequences, urges that a data bank be established, and subsequently transferred to a World Data Centre to enable all workers to gain ready access to the available data.

15. IAGA, recognizing the great contributions that detailed aeromagnetic surveys would make in understanding the structure and geological history of Antarctica and its surrounding oceanic areas, strongly urges member countries of SCAR to acquire such data from those regions.

RESOLUTIONS AIGA DE L'ASSEMBLEE DE EDINBOURG

RESOLUTION DE REMERCIEMENTS

L'AIGA exprime sa reconnaissance aux Sociétés royales de Londres et d'Edimbourg et ses sincères remerciements au Comité d'organisation local pour l'excellente hospitalité, pour la bonne organisation des rencontres scientifiques, pour le programme de détente et le beau temps qui ont rendu ces réunions agréables et fécondes.

RESOLUTIONS

1. L'AIGA, notant qu'une proposition doit être faite à l'URSI demandant qu'une étude de faisabilité soit faite pour une facilité mobile de Radar Incohérent dans l'hémisphère Sud (SHISCAT) et notant que les résultats scientifiques que l'on pourrait obtenir avec cet instrument seraient d'un grand intérêt, recommande qu'une telle étude de faisabilité soit réalisée et demande à l'URSI de tenir l'AIGA informée des progrès de ce projet.

2. L'AIGA, notant que le Centre Mondial de données de physique Soleil-Terre (S.T.P.) a dans le passé joué un rôle vital en procurant aux scientifiques de la Communauté des données de base et périphériques, nécessaires pour mener à bien leurs recherches, et notant que les succès de l'analyse des données du programme international de la magnétosphère (IMS) et du futur programme de la moyenne atmosphère (MAP) dépendent fortement de la disponibilité permanente des archives des données traitées par le Centre Mondial de Données, recommande instamment que les agences nationales qui hébergent et soutiennent le Centre fassent tout ce qui est en leur pouvoir pour assurer que la haute qualité de l'archivage et la dispersion des données effectuée par ces organisations pendant ces dernières années soient maintenues et si possible améliorées au cours des dix prochaines années.

3. L'AIGA, notant que les synthèses des rapporteurs des divisions de l'AIGA sont considérées comme une partie intégrale du processus d'information des scientifiques de l'AIGA, concernant des récents développements dans leurs domaines de recherches, notant ensuite que l'absence de rapporteur dans certains domaines qu'ils ont accepté de prendre en charge conduit à une lacune dans la présentation des résultats qui s'étend sur la période de deux années, encourage vivement que les organisations auxquelles les rapporteurs appartiennent fassent tout ce qui est en leur pouvoir pour assurer qu'il leur soit donné les moyens qui leur permettront de préparer leur synthèse et de les communiquer oralement aux assemblées générales de l'AIGA et de l'IUGG.

4. L'AIGA, notant les résultats nouveaux et inattendus de la mission Hélios alors que l'activité solaire évolue, notant la qualité technique excellente de l'expérience et du véhicule, et reconnaissant les possibilités uniques d'Hélios I à étudier le milieu interplanétaire entre 0.3 UA et 1 UA pendant la phase de déclin du cycle solaire, recommande aux agences appropriées de la RFA d'assurer le soutien des opérations de mission et de l'analyse des données.

5. L'AIGA reconnaissant le besoin des données géomagnétiques dans la région équatoriale de l'Amérique du Sud, demande que les autorités du Surinam soutiennent la poursuite de l'Observatoire géomagnétique de Paramaribo.

6. L'AIGA reconnaissant l'importance de l'Observatoire géomagnétique de Nairobi, comme une partie de la contribution Est-Africaine à la science géophysique internationale et notant la nécessité de faire progresser la qualité de l'opération recommande aux autorités du Kenya de mettre en place les fonds nécessaires pour réhabiliter et continuer à maintenir l'Observatoire opérationnel, avec tous les soins requis pour unifier les standards établis par l'Observatoire Est-Africain et les besoins des études sur le terrain.

7. L'AIGA reconnaissant avec gratitude les efforts des autorités de la Mozambique qui ont maintenu le haut niveau de l'Observatoire géomagnétique de Maputo et notant les améliorations apportées par l'Observatoire géomagnétique de Nampula en complétant le réseau des observatoires magnétiques, recommande le suivi des opérations à cet observatoire.

8. L'AIGA reconnaissant l'importance pour la communauté scientifique d'évaluer et de publier les indices de l'electrojet auroral (AE), remercie WDC-C2 (Kyoto - Japon) pour la publication de l'indice AE au cours de la première partie de l'année 1978 et recommande que WDC-C2 continue à produire ces indices, comprenant que six des douze observatoires dont les enregistrements sont utilisés pour déduire l'indice AE sont maintenant enregistrés sous forme digitale, recommande fortement que les autres stations (Cape Wellen, Tixie Bay. Cape Chelyuskin, Dixon Island, Abisko et Leirvogur) convertissent rapidement les magnétomètres à un enregistrement digital pour faciliter la rapide production et publication des indices AE.

9. L'AIGA notant que la plupart des radars météoriques sont maintenant automatisés, considérant la nécessité d'obtenir une plus efficace distribution géomagnétique des stations météoriques et reconnaissant le haut niveau de coordination nécessaire pour assurer simultanément des observations à l'échelle mondiale recommande

   (1) que les pays membres de l'AIGA soient encouragés à soutenir et étendre le réseau de radars météoriques ;

   (2) que la coordination internationale soit organisée pour un système global d'observation météorique (GLOBMET) et que cette coordination soit effective dans un futur immédiat à travers le Programme d'Atmosphère Moyenne (au sein du SCOSTEP) ;

   (3) qu'un Comité soit formé à l'intérieur de SCOSTEP avec des représentants de l'AIGA, de l'AIMPA, de l'UAI et de l'UISR pour réaliser un plan de travail concernant GLOBMET.

10. L'AIGA reconnaissant le besoin de station de répétition magnétique dans les pays en voie de développement qui, pour ces opérations, manquent d'équipements et d'expertises, suggère que soit apportée à ces pays une assistance de la part des agences qui ont ces facilités ou de la part des scientifiques experts.

11. L'AIGA reconnait le besoin des ateliers spécialisés dans le domaine des opérations magnétiques dans les régions en voie de développement pour faciliter la formation des techniciens pour ces opérations et recommande aux pays qui ont un tel besoin de s'adresser aux agences internationales pour l'organisation de ces ateliers.

12. L'AIGA reconnaissant l'utilité des données géomagnétiques du satellite Magsat dans la définition de YGRF 1980 et notant la complexité des variations séculaires, recommande de renouveler une telle expérience satellite, reconnaissant la valeur de telles données pour dresser la carte des anomalies de longueur d'ondes intermédiaires, attache une grande importance à l'acquisition de telles données à une altitude de moins de 200 km.

13. L'AIGA reconnaissant le basoin permanent pour un Champ International Géomagnétique de Référence, recommande que :

    1. L'IGRF 1980 soit utilisé pour la période 1980 à 1985 ;
    2. DGRF 1980, DGRF 1970 et DGRF 1975 soient utilisés avec une interpolation linéaire pour les applications qui nécessitent des valeurs définitives (pour la période des années 1965 à 1975) ;
    3. PGRF 1975 (i-e DGRF 1975 et IGRF 1980 interpolé linéairement) soit utilisé pendant la période 1975 à 1980 jusqu'à ce que DGRF 1980 soit réalisé ;
    4. Le schéma soit maintenu dans le futur.

"Dans le texte précédent, le sigle DGRF signifie Champ International géomagnétique de référence Définitif et PGRF correspond au champ Provisoire. Les valeurs des coefficients des développements en harmoniques sphériques pour DGRF 1965, DGRF 1970, DGRF 1977 et IGRF 1980 en fonction des termes de variation séculaire pour la période 1980-1985 sont données dans cette publication en page 197."

14. L'AIGA notant le besoin d'étendre notre connaissance des variations géomagnétiques séculaires au delà de la période limitée des données historiques et des enregistrements d'observatoires et reconnaissant l'important accroissement pendant la dernière décade des enregistrements des variations séculaires provenant d'un réseau mondial de stations obtenues grâce aux études archéomagnétiques et paléomagnétiques des séries sédimentaires, recommande qu'une banque des données soit mise en place et dans un second temps rattachée à un centre mondial de données de manière à permettre à tous chercheurs d'avoir accès aux données disponibles.

15. L'AIGA reconnaissant les grandes contributions que les campagnes aéromagnétiques peuvent apporter dans la compréhension de la structure et de l'histoire géologique de l'Antarctique et des zones océaniques qui l'entourent, recommande instamment aux pays membres du SLAR de se procurer de telles données.

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APPENDICES TO THE TRANSACTIONS OF THE FOURTH SCIENTIFIC ASSEMBLY OF IAGA IN EDINBURGH, SCOTLAND, AUGUST 1981

APPENDIX I. INTERNATIONAL GEOMAGNETIC REFERENCE FIELD 1980

IGRF 1965, the first international geomagnetic reference field, was adopted by the International Association of Geomagnetism and Aeronomy (IAGA) in 1968 [IAGA Commission II Working Group 4, 1969]. It consists of a model of the main field at 1965.0, along with a model of secular variation for use in extending the main field model in time, both backward (not earlier than 1955.0) and forward (not later than 1975.0). IGRF 1975, adopted later, consists of IGRF 1965 extended to 1975.0, along with a revised model of secular variation for use in extending the main field model up to 1980.0 [IAGA Division I Study Group, 1976].

By the late 1970's, the cumulative effect of the inevitable uncertainties in the secular variation models had led to unacceptable inaccuracies in the IGRF. To satisfy the need for an accurate international geomagnetic reference field, this working group recommended the following additions:
(1) An international geomagnetic reference field for the interval 1980.0 to 1985.0 (IGRF 1980), consisting of a model of the main field at 1980.0, along with a model of secular variation for use in extending the main field model up to 1985.0.
(2) A definitive international geomagnetic reference field (DGRF) for the interval 1965.0 to 1975.0, consisting of models of the main field at 1965.0 (DGRF 1965), 1970.0 (DGRF 1970), and 1975.0 (DGRF 1975), with linear interpolation of the model coefficients for intervening dates.
(3) A provisional international geomagnetic reference field for the interval 1975.0 to 1980.0 (PGRF 1975), defined to be the linear interpolation of DGRF 1975 and IGRF 1980 (main field).

The working group also recommended that the pattern of these additions should be followed in future updates.

The recommendations, proposed as Resolution 13, were adopted by IAGA on August 15, 1981 at the Fourth Scientific Assembly at Edinburgh.

IGRF 1980 is discontinuous with IGRF 1975 at 1980.0. DGRF, unlike IGRF, results from retrospective analysis. Further revision of DGRF is not anticipated. PGRF 1975 now supersedes IGRF 1975. PGRF 1975 will be superseded if and when a definitive model of the main field at 1980.0, different from IGRF 1980, is adopted.

DGRF 1965, DGRF 1970, DGRF 1975, and IGRF 1980 (including secular variation forecast model) are given in the form of spherical harmonic expansions whose coefficients are listed on the next page. Each main field model has 120 coefficients (10th degree and order). The secular variation forecast model has 80 coefficients (8th degree and order). The coefficients are Schmidt quasi-normalized [Chapman and Bartels, 1940] and refer to a radius of 6371.2 km. For converting geographic coordinates to spherical polar coordinates the use of the international ellipsoid is recommended: equatorial radius 6378.160 km and flattening factor 1/298.25 [International Astronomical Union, 1966].

For information regarding the availability of the coefficients in computer-readable form, and computer programs for synthesizing field values, contact World Data Center A for Rockets and Satellites, Code 601, NASA/Goddard Space Flight Center, Greenbelt, MD 20771, USA; or World Digital Data Center C1, Geomagnetism Unit, Institute of Geological Sciences, Murchison House, West Mains Road, Edinburgh EH9 3LA, United Kingdom; or World Data Center A, National Oceanic and Atmospheric Administration, EDIS/NGSDC (D62), 325 Broadway, Boulder, CO 80303, USA.

The working group consisted of the following members: N.W. Peddie (chairman), D.R. Barraclough (vice-chairman), N.P. Benkova, E.B. Fabiano, B.R. Leaton, F.J. Lowes, W. Mundt, R.D. Regan, S.P. Srivastava, R. Whitworth, D.E. Winch, T. Yukutake, and D.P. Zidarov. The working group was assisted by the following consultants: L.R. Alldredge, F.S. Barker, R.L. Coles, E. Dawson, P. Hood, R.A. Langel, S.R.C. Malin, and R. Thompson. D.I. Gough was chairman of IAGA Division I.

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(N.W. Peddie, Chairman
IAGA WG I-1)

SPHERICAL HARMONIC COEFFICIENTS g_n^m and h_n^m (in nT) FOR
International Geomagnetic Reference Field (IGRF) 1980, and
Definitive International Geomagnetic Reference Field (DGRF) 1965-1975

		DGRF(1965)		DGRF(1970)		DGRF(1975)		IGRF(1980)		1980-85 in nT/yr	
n	m	g_n^m	h_n^m	g_n^m	h_n^m	g_n^m	h_n^m	g_n^m	h_n^m	$\dot{g}_n^m$	$\dot{h}_n^m$
1	0	-30334		-30220		-30100		-29988		22.4	
1	1	-2119	5776	-2068	5737	-2013	5675	-1957	5606	11.3	-15.9
2	0	-1662		-1781		-1902		-1997		-18.3	
2	1	2997	-2016	3000	-2047	3010	-2067	3028	-2129	3.2	-12.7
2	2	1594	114	1611	25	1632	-68	1662	-199	7.0	-25.2
3	0	1297		1287		1276		1279		0.0	
3	1	-2038	-404	-2091	-366	-2144	-333	-2181	-335	-6.5	0.2
3	2	1292	240	1278	251	1260	262	1251	271	-0.7	2.7
3	3	856	-165	838	-196	830	-223	833	-252	1.0	-7.9
4	0	957		952		946		938		-1.4	
4	1	804	148	800	167	791	191	783	212	-1.4	4.6
4	2	479	-269	461	-266	438	-265	398	-257	-8.2	1.6
4	3	-390	13	-395	26	-405	39	-419	53	-1.8	2.9
4	4	252	-269	234	-279	216	-288	199	-298	-5.0	0.4
5	0	-219		-216		-218		-219		1.5	
5	1	358	19	359	26	356	31	357	46	0.4	1.8
5	2	254	128	262	139	264	148	261	149	-0.8	-0.4
5	3	-31	-126	-42	-139	-59	-152	-74	-150	-3.3	0.0
5	4	-157	-97	-160	-91	-159	-83	-162	-78	0.2	1.3
5	5	-62	81	-56	83	-49	88	-48	92	1.4	2.1
6	0	45		43		45		49		0.4	
6	1	61	-11	64	-12	66	-13	65	-15	0.0	-0.5
6	2	8	100	15	100	28	99	42	93	3.4	-1.4
6	3	-228	68	-212	72	-198	75	-192	71	0.8	0.0
6	4	4	-32	2	-37	1	-41	4	-43	0.8	-1.6
6	5	1	-8	3	-6	6	-4	14	-2	0.3	0.5
6	6	-111	-7	-112	1	-111	11	-108	17	-0.1	0.0
7	0	75		72		71		70		-1.0	
7	1	-57	-61	-57	-70	-56	-77	-59	-83	-0.8	-0.4
7	2	4	-27	1	-27	1	-26	2	-28	0.4	0.4
7	3	13	-2	14	-4	16	-5	20	-5	0.5	0.2
7	4	-26	6	-22	8	-14	10	-13	16	1.6	1.4
7	5	-6	26	-2	23	0	22	1	18	0.1	-0.5
7	6	13	-23	13	-23	12	-23	11	-23	0.1	-0.1
7	7	1	-12	-2	-11	-5	-12	-2	-10	0.0	1.1
8	0	13		14		14		20		0.8	
8	1	5	7	6	7	6	6	7	7	-0.2	-0.1
8	2	-4	-12	-2	-15	-1	-16	1	-18	-0.3	-0.7
8	3	-14	9	-13	6	-12	4	-11	4	0.3	0.0
8	4	0	-16	-3	-17	-8	-19	-7	-22	-0.8	-0.8
8	5	8	4	5	6	4	6	4	9	-0.2	0.2
8	6	-1	24	0	21	0	18	3	16	0.7	0.2
8	7	11	-3	11	-6	10	-10	7	-13	-0.3	-1.1
8	8	4	-17	3	-16	1	-17	-1	-15	1.2	0.8
9	0	8		8		7		6			
9	1	10	-22	10	-21	10	-21	11	-21		
9	2	2	15	2	16	2	16	2	16		
9	3	-13	7	-12	6	-12	7	-12	9		
9	4	10	-4	10	-4	10	-4	9	-5		
9	5	-1	-5	-1	-5	-1	-5	-3	-7		
9	6	-1	10	0	10	-1	10	-1	9		
9	7	5	10	3	11	4	11	7	10		
9	8	1	-4	1	-2	1	-3	1	-6		
9	9	-2	1	-1	1	-2	1	-5	2		
10	0	-2		-3		-3		-3			
10	1	-3	2	-3	1	-3	1	-4	1		
10	2	2	1	2	1	2	1	2	1		
10	3	-5	2	-5	3	-5	3	-5	2		
10	4	-2	6	-1	4	-2	4	-2	5		
10	5	4	-4	6	-4	5	-4	5	-4		
10	6	4	0	4	0	4	-1	3	-1		
10	7	0	-2	1	-1	1	-1	1	-2		
10	8	2	3	0	3	0	3	2	4		
10	9	2	0	3	1	3	1	3	-1		
10	10	0	-6	-1	-4	-1	-5	0	-6		

APPENDIX II. STATUS REPORT IN AUGUST 1981 ON THE PROJECT ELAS (ELECTRICAL CONDUCTIVITY OF THE ASTHENOSPHERE)

U. Schmucker (Chairman of the Ad Hoc Committee on ELAS)

The Third General Scientific Assembly of IAGA in Seattle in 1977 adopted the following resolution No. 6:

IAGA, noting that the asthenosphere plays an important role in geo-dynamics and in the study of electrical conductivity of the Earth and that it is interesting to Working Group 3 of Division I,
recommends to National Adherents, support for the creation of an ad hoc Committee to prepare a Programme for a project for "Electrical Conductivity of the Asthenosphere" (ELAS), to concentrate efforts during 1978-1985 on magnetic and magnetotelluric measurements and their comparison with heat flow and seismic measurements.

In response to this resolution, Working Group 3 of Division I (Electromagnetic induction in the Earth and Moon) has held special meetings on the ELAS project during its Workshops at Murnau (1978) and Istanbul (1980) and during the IUGG conference in Canberra (1979). As a result a Committee on ELAS was set up with the intent that each participating country in the ELAS project is represented. Currently the Committee has the following members:

U. Schmucker (Fed.Rep. Germany) Chairman
L.L. Vanyan (U.S.S.R.) Vice-Chairman
A. Ádám (Hungary), A. Duba (U.S.A.), J. Febrer (Argentina), J. Filloux (U.S.A.)
H. Fournier (France), D.I. Gough (Canada), G.P. Gregori (Italy),
S.E. Hjelt (Finland), Y. Honkura (Japan), V.R.S. Hutton (U.K.),
A.M. Isikara (Turkey), J. Janowski (Poland), G.V. Keller (U.S.A.),
D. Loewenthal (Israel), E. Oni (Nigeria), W.D. Parkinson (Australia),
G. Porstendorfer (Dem. Rep. Germany) O. Praus (Czechoslovakia),
A. Soare (Rumania), B.J. Srivastava (India), N.B. Trivedi (Brazil)

Part I of the report summarizes the scientific background of the project which emphasizes international cooperation by
extending field surveys across boundaries,
sharing instruments and methods of data reduction and interpretation,
exchanging data relevant to the objectives of ELAS.
In addition agreement was reached to work jointly on a number of topics important to all participants as outlined in part II. So far nineteen participating countries have submitted to the Committee plans for their activity within the ELAS project. They form part III of the report.

Part I: Concept and Goals of the ELAS project

Since the work of SCHUSTER, CHAPMAN and PRICE, it is known that geomagnetic variations, as observed at the Earth's surface, allow estimates of the electrical conductivity of material within the Earth. Their global studies of diurnal Sq and smoothed stormtime Dst variations showed with certainty that the Earth's outer layers to considerable depth, are poor conductors with a steep rise in conductivity further down within the Earth's mantle. Their data were inconclusive, however, about details of this rise and about details of crustal and subcrustal conductivity.

The magnetotelluric method of CAGNIARD and TIKHONOV, which also uses natural variation field but in quite a different way by including their subsurface electric or telluric field, has found wide applications in shallow soundings of the Earth's crust and its cover by geological formations. Its major contribution was the discovery of a deep crustal or subcrustal zone of high conductivity, but the extension to greater depth so far has been problematic because at almost any site the telluric field of longperiod variations with a sufficiently great depth of penetration is distorted by local surface inhomogeneities. Thus, without consideration for such surface effects, magnetotelluric data are inconclusive for conductivities at upper mantle depth.

It is the purpose of the ELAS project to bridge the existing gap between alternative methods of electromagnetic soundings. It will concentrate on the depth range within the upper mantle which has so far been too deep for local magnetotelluric studies and too shallow for global studies of long-period geomagnetic variations. Since this depth range contains the GUTENBERG layer and the proposed asthenosphere, the basic question arises, whether or not the mantle zone of reduced S-wave velocity and presumably increased seismic absorption is also a zone of anomalous electrical conductivity.

If so a complementary geophysical method would exist to map regional characteristics of the asthenosphere which is thought to have a key role in dynamic processes connected with continental drift and plate motion.

As seen from the list of national ELAS programs, land-based observations are planned for quite different geological settings, i.e. stable shields, rift and subduction zones and zones of proposed continental collision. Similarly, seafloor observations are proposed for ocean basins, island arcs and mid-oceanic ridges.

Knowing the poor depth resolution of electromagnetic data, response estimates of great accuracy and of a wide range in period will be necessary, including Sq and Dst. This requires continuous observations over extended periods of time (weeks, months) with instruments of high base-line stability. It will be noted that the ELAS program pays particular attention to such instrumental aspects, both for the work on land and at sea.

Another major concern will be caused by surface effects, masking the response from conducting layers at the depth of the asthenosphere. Several proposed studies within the ELAS project will concentrate on those effects and their possible removal by corrections.

Even though the telluric field is affected most by such surface effects, this applies also to geomagnetic variations, when extreme surface conductors such as oceans or deep sedimentary basins are present. A number of field programs and theoretical studies will be concerned with such "ocean" effects which in view of the inductive coupling between surface and mantle conductors offer themselves a method of deep electromagnetic sounding.

Magnetic observatory data will be of outstanding importance for those programs within the ELAS project which study the response of global fields like Sq and Dst. Prompt and easy access to standard magnetograms or tabulated hourly means via the World Data Center will be greatly appreciated, in particular for those observatories which are situated faraway from coastlines.

This applies also to observatory records of telluric fields. It has been found out in the past that valuable material over many years of "earth current" observations exists in the archives of observatories to which access would also be most desirable.

As a physical indicator for upper mantle conditions the electrical conductivity is distinctly different from such bulk properties as P-wave velocity and density. Conductivity as a structure-dependent property is sensitive to impurities, fluid content and temperature and thus related to S-wave velocity (i.e. the ratio of P-wave to S-wave velocity), the quality factor Q of seismic absorption, (and thus to the viscous properties) and to thermal conductivity.

During the ELAS project laboratory experiments on rocks and minerals will be performed to test and, if possible, to calibrate the conductivity in relation to these properties for variable impurity content, fluid content and temperature. On the basis of such experiments field observations of the ELAS project will have direct bearing on the results of programs studying seismic waves and heatflow. Their combined interpretation may lead to new insights into the physical state of matter in the asthenosphere, the depth of its boundary and its possible regional variability in correspondence to large-scale motions of lithospheric material.

Part II: ELAS programs of concern to all participating countries

1. Instruments

Coordinator: NN

Test sites are offered for the comparison of instruments, recording on land magnetic and telluric variations in the period range of minutes to several days. It is hoped that a similar test can be arranged for seafloor instruments. In addition, services are offered for the exchange and repair of certain types of instruments. This applies in particular to ASKANIA variographs which were in wide use during the IGY 1957-59 and to GOUGH-REITZEL magnetometers. There are about 150 GOUGH-REITZEL magnetometers, built by groups in various countries. Even though each group has produced its own variant, a limited repair service may be arranged.

2. Inverse methods

Coordinator: A.G. Jones, Institut für Geophysik,
Gievenbecker Weg 61, D-4400 Münster, Fed. Rep. Germany

Even though proof exists that under certain constraints the inverse problem for electromagnetic data has a unique solution, the interpretation of real data involves uncertainties and arbitrariness. Through the initiative of Dr. Jones a comparative study of existing inverse methods has been carried out to interpret electromagnetic data by layered Earth models. In this study a set of magnetotelluric field data was distributed and each participant was asked to submit his solution in terms of a conductivity versus depth profile. The results of the study will be published. It is planned to repeat this comparison of inverse methods with other data sets, relevant for ELAS, with a possible extension to multi-dimensional data to be explained by models with laternal differences of conductivity.

3. Numerical models

Coordinator: J.A. Wright, Dept. of Physics, Memorial Univ. of Newfoundland, St. Johns, N.F., Canada A1C 5S7

Except for models of simple geometry, the electromagnetic induction problem for a given model has to be solved with numerical methods when lateral changes of conductivity are involved. Various methods exist which treat such models in quite different ways. A comparison has been started by distributing two-dimensional models, thin layer models and three-dimensional "island" models and to ask each participant for his solution in terms of the normalized magnetic and electric surface field.

It is planned to report on this model intercomparison in the near future. In the course of the ELAS project this study will be continued with a possible extension to lateral non-uniform spherical Earth models and a test against the results of scale model experiments. Here special emphasis will be given to modelling the effect of surface inhomogeneities on the response from deeper layers.

4. Laboratory measurements of electrical conductivity

Coordinator: A. Duba, Lawrence Livermore National Laboratory, Livermore, California 94550, U.S.A.

Reports describing techniques and results of laboratory measurements will be distributed among interested experimenters as soon as practical during the publication process. Selection of conductivity standards for comparison purposes will allow calibration of measurements from various laboratories.

5. Collection and exchange of data

Coordinator: Y.P. Kharin, World Data Center B2, Molodezhnaya 3, Moscow 117296, USSR

The ELAS project intends to promote international cooperation not only in the field observations but also in data interpretation. Through the initiative of Dr. Kharin a documentation of electromagnetic data relevant to the objectives of the ELAS program has been arranged. Raw data as well as electromagnetic response functions will be accepted.

Participants in the data exchange program will be asked to submit processed data in the following form

1. Station name and coordinates.
   Time of field observations.
2. Type of magnetometers and electrodes.
   Length and azimuth of telluric lines (if any). Mode of recording.
3. Total length of record (or number of events) used for analysis.
   Statistical procedure to derive response functions.
4. Response estimates, if available with confidence limits, for a given sequence of frequencies (or instants of time), including information on degrees of freedom of determination, coherence etc. Depending on the type of observation and analysis these estimates can be
   a) The four complex-valued elements of the magnetotelluric impedance tensor in unrotated coordinates
   b) pairs of apparent resistivities and, if available, of phases for unrotated or rotated coordinates with an indicated angle of rotation

c) coefficients relating vertical magnetic variations with or without subtraction of a normal component to the horizontal magnetic field at the same site, some reference site or a combination of reference sites
d) coefficients relating the horizontal magnetic variations at the recording site to the horizontal field at some reference site or combination of reference sites
e) response functions for global magnetic fields or electrojet fields, using the non-uniformity of the source field

5. Geological setting and other geophysical information available for the recording site and the surrounding region.
6. Comments on points relevant for the material presented (source effects, artificial noise, use of reference stations etc.)
7. Institution which can be consulted for further information, including information on published and unpublished reports on the material presented.

For the exchange of listed observatory data in the work on long period variations, the services of the World Data Centers will be sought. For the exchange of digitized observatory material on magnetic tape, Mr. W. Paulishak, World Data Center A, Environmental Data Service NOAA, Boulder Colorado, 80303 U.S.A. should be contacted for assistance.

Part III: National ELAS Programs

Argentina

(J. Febrer, Dpto. Geofisica, Observatorio Nacional de Fisica Cosmica, Avda Mitre 3100)

1. a) Transcontinental profile along 22-24° latitude South, in cooperation with the Instituto de Pesquisas Espaciais of Sao Jose Campos.
   b) Magnetotelluric study over the asismic region of the NW of Argentina - around San Miguel de Tucuman and Cafayate - to know the deepness of a conductive layer appearing very near the surface.
   c) Magnetotelluric study over the cratonic region of Province of Buenos Aires.
2. Deep magnetotelluric sounding in the Antarctic Peninsula and at the Belgrano II base (about 80° latitude South).

Australia

(W.D. Parkinson, Dept. of Geology, Univ. of Tasmania, Box 252-C GPO, Hobart, Tasmania 7001)

1. Magnetometer array study in northern India, including the Himalaya foothills, a cooperative program of the Australian National University (Canberra), the Indian Institute of Geomagnetism (Bombay) and the National Geophysical Research Institute (Hyderabad). Field-work completed in 1979.
2. Magnetotelluric survey in northern India, planned as a joint program of the National Geophysical Institute (Hyderabad) with the Bureau of Mineral Resources, Geology and Geophysics (Canberra) and Macquarie Univ.
3. Magnetotelluric soundings in combination with deep seismic reflection and refraction studies in selected regions of Australia.
4. Magnetotelluric traverse from the Australian continent to the floor of the Tasman Sea, a proposal under consideration. Collaboration between the Australian National University and the Scripps Institution of Oceanography, University of California.

5. Continued development and construction of an array of 24 microprocessor-based three-component digital fluxgate magnetometers for geomagnetic deep sounding in remote regions, and on the ocean floor by the Flinders University of South Australia.
6. Cooperative program to start in 1981 between Flinders University and Indonesia, of a 2-D geomagnetic deep sounding array study of the Java trench subduction zone using 12 (in 1981) and 24 (1982-1983) digital fluxgate magnetometers.
7. Large (24 digital magnetometer) array study of the coast effect and structure of the Gawler Pre-Cambrian Craton in South Australia (to commence 1982).

Brazil (N.B. Trivedi, Instituto de Pesquisas Espaciais, C.P. 515, 12200 S.J. dos Campos, SP)

1. Magnetotelluric measurements at Cachoeira Paulista (22°42'S,45°01'W, 25° dip) in the period range 10 seconds to 1 day, to begin in May 1981.
2. Magnetotelluric soundings in the basin of the river Parana are planned to take place in the years 1982 and 1983.
3. Magnetotelluric measurements were conducted at Eusebio (22°42'S, 45°01'W, 3.5° dip), a station under the equatorial electrojet during March, 1979-December, 1980.
4. A geomagnetic deep sounding experiment (jointly with telluric measurements) is planned provided instruments can be obtained from an institution outside Brazil. This experiment could be conducted in the region of electrojet or in the Brazilian Magnetic Anomaly region.

Canada (D.I. Gough, Institute of Earth and Planetary Physics, University of Alberta, Edmonton, Canada T6G 2J1)

1. Further development of seafloor magnetometer systems to be deployed in active tectonic areas in the Northwest Pacific with a few sites over older oceanic crust. In 1980 three seafloor stations have been installed off Vancouver Island and several stations on Vancouver Island.
2. Magnetometer array study in Western Canada. Emphasis will be on two newly discovered anomalies, one in southern Alberta and the south-east corner of British Columbia appears to be related to a Precambrian rift zone and the other within the Rocky Mountain Trench to a geothermal anomaly.

Czechoslovakia (O. Praus, Geophysical Institute, Czechoslovakian Academy of Sciences, Bocni II, 14131 Prague 4)

1. Re-analysis of magnetotelluric sounding curves from the Pannonian basin, the Carpathian foredeep and the Bohemian massif. Emphasis will be on long-period variations, including Sq.
2. New magnetotelluric and geomagnetic deep soundings in the regions mentioned under 1 in cooperation with Polish and Hungarian institutions.
3. Investigation of distortions caused by near-surface inhomogeneities. Construction of maps for the total conductivity in major sedimentary basins in Czechoslovakia.
4. Laboratory studies of the electrical conductivity at high temperature and pressure.

Finland (S.E. Hjelt, Dept. of Geophysics, University of Oulu, SF-90570 Oulu 57)

1. Magnetotelluric soundings on the Baltic (1980) and comparison with results in the Pannonian Basin, a cooperative project with the Geodetic-Geophysical Research Institute in Sopron (Hungary) under the auspices of the Finnish Academy and the Hungarian Academy of Sciences.
2. Magnetovariational array studies in the central parts of the Baltic Shield (1981/82). The Gough-Reitzel type magnetometers are on loan from the the Institut für Geophysik, Universität Münster (BRD).
3. Magnetotelluric and magnetovariational measurements on the Baltic Shield and the construction of the geoelectric model of the shield. A cooperative project under the auspices of the Finnish Academy and the Soviet Academy of Science.

France (H. Fournier, Laboratoire de Géomagnétisme, 24, rue Lhomond, F-75231 Paris, Cedex 05)

1. The facilities of the Geophysical Research Center of Garchy are offered for the calibration of magnetic and telluric recording devices.
2. Geomagnetic differential soundings in selected areas.
3. Magnetotelluric soundings in Southamerica and in the Antarctic, performed since 1976 in cooperation with geophysical institutes in San Miguel, Buenos Aires, La Rioja (Argentina) and San Jose dos Campos / Belem (Brazil).

Germany (Dem. Rep) (G. Porstendorfer, Bergakademie Freiberg, Sektion Geowissenschaften, DDR-9200 Freiberg)

1. Analysis of the longitudinal conductivity of sediments for deep investigations.
2. Work on methods for the interpretation of geomagnetic deep soundings and magnetotelluric soundings.
3. Development for study of the asthenosphere along an international geotraverse from the Caucasus-region to the north-west part of the GDR. Complex interpretation together with information from other geophysical methods. (Cooperation with the Academy of Sciences of the USSR and the Polish Academy of Sciences.)
4. Special magneto-telluric and geomagnetic deep soundings in crystalline complexes of the southern part of GDR.
5. Generalization of electromagnetic soundings, which have been made on the African continent.

Germany (Fed. Rep.) (U. Schmucker, Institut für Geophysik, Postfach 876, D-3400 Göttingn)

1. Comparison and calibration of magnetic and telluric recording devices suitable for the observation of long-period variations. Reconditioning of Askania variograph as a joint service of the Wingst observatory and the Geophysical Institute of Göttingen University.
2. EM sounding profile across the Alps in cooperation with institutions from Italy and Switzerland. This profile will cross a proposed continental collision zone.
3. EM sounding profile crossing of the Eastern Alps into the Pannonian basin, a cooperative program of German, Austrian and Hungarian institutions.

4. Comparative study of long-period telluric and geomagnetic variations in the Rhenish massif and Northern Germany with a possible northward extension towards the edge of the Fennoscandian Shield.
5. Wide-spread magnetometer array study in Western Germany for geomagnetic deep sounding with Sq, Dst and the normal variation field of substorms. The study is scheduled in connection with a survey of the geomagnetic mainfield in 1982/83. The magnetometer stations will be equipped also with telluric instruments specially designed for the recording of long-period variations. Emphasis will be on the distortion effect on the telluric field by surface inhomogeneities and the possible intrinsic anisotropy of deep crustal or mantle conductivity.
6. Laboratory studies of the conductivity of rocks and minerals relevant for the upper mantle at high temperature. Emphasis will be on controlled, realistic oxygen and water partial pressure.
7. Coordinated magnetotelluric soundings by the University of Münster, the Swedish Geological Survey (Uppsala) and the University of Oulu in Northern Scandinavia where the University of Münster has operated a magnetometer array during the IMS. The analysis of the magnetometer data has given evidence for an asthenosphere of low restivity beneath Northern Sweden.

Hungary (A. Ádám, Geodetic and Geophysical Research Institute, Hungarian Academy of Sciences, POB 5, H-9401 Sopron)

1. New magnetotelluric soundings in the Pannonian Basin and reinterpretation of the earlier MT material taking into account the different distortion effect by numerical modelling.
2. Magnetotelluric soundings in the transitional zones between (a) the Carpathians and the Pannonian Basin and (b) the Alps and the Pannonian Basin.
3. Magnetotelluric profile along DDS (deep seismic sounding) - profile across the Eastern Alps in cooperation with the Geophysical Institute Vienna University (Austria) and the institutions in the Federal Republic of Germany.
4. Magnetotelluric soundings on the Fennoscandian Shield a cooperative project of the Oulu University with the Geodetic and Geophysical Res. Institute Sopron (Hungary) under the auspices of the Hungarian and Finnish Academies of Science.

India (B.J. Srivastava, National Geophysical Research Institute, Uppal Road, Hyderabad - 500007)

1. Magnetometer array studies in India, 1978-1983:
Under this Indo-Australian collaboration project among the Indian Institute of Geomagnetism (Colaba/Bombay), the National Geophysical Research Institute (Hyderabad), and the Australian National University (Canberra) two array experiments were carried out: (a) in northwest India including the Lower Himalaya and its foothills and the Aravalli mountain belts; (b) in south Peninsular India covering the electrojet region and the eastern and western coastlines.
A path of concentrated induced currents transverse to the Himalaya and in alignment with the Aravallis has been identified, possibly in association with asthenospheric upwelling beneath the Aravallis. There is no evidence of a major conductor beneath the Himalaya along its strike.

A localized current channelling has been identified in the Palk Strait between India and Sri Lanka, which is possibly associated with the India-Sri Lanka graben, and a proposed step-structure of conductivity at the Moho boundary along the coastlines.

2. Magnetotelluric surveys in India, planned as a joint project of the National Geophysical Research Institute (Hyderabad), with the Bureau of Mineral Resources and Macquarie University (Australia). Telluric investigations in the Puga valley (Ladakh) in the Himalaya. Design and fabrication of a very low noise, low drift, pre-amplifier-filter-assembly for sensing magnetic signals.
3. Theoretical studies for modelling the asthenospheric parameters of dipping plate regions, taking into account the nature of the lithosphere-asthenosphere boundary and the preferred orientations of olivine crystals in the lithosphere. Feasibility study of resolving crustal discontinuities from surface impedance measurements in MT by varying frequencies. Multifrequency MT sounding over colliding plate boundaries of the Himalayan type to understand the basic tectonic process.

Israel (D. Loewenthal, Dept. of Geophysics, Tel-Aviv University, Ramat-Aviv, Tel-Aviv)

1. Existing magnetotelluric soundings at selected points will be extended to longer periods with the possible support of the Geophysical Institute of the Colorado School of Mines (U.S.A.).
2. A geomagnetic deep sounding experiment is planned, provided instruments can be obtained on loan from an outside institution.
3. There are tentative plans for a deep DC geoelectric sounding in cooperation with the Council for Scientific and Industrial Research (South Africa) and offshore magnetotelluric soundings in the Mediterranean Sea in cooperation with the Scripps Institution of Oceanography, Univ. of California (U.S.A.).

Italy (G.P. Gregori, Instituto di Fisica dell'Atmosfera, P. Luigi Sturzo 31, 00144 Rome)

1. Magnetotelluric and geomagnetic deep sounding profile across the Alps from Munich to Ferrara, a cooperative venture with institutions from the Federal Republic of Germany and Switzerland.
2. Magnetotelluric and geomagnetic deep sounding profile from Naples to Bari.
3. Local study of geomagnetic variations in the Abruzzi region in connection with seismic studies.
4. Local magnetotelluric soundings in the Siena graben zone, Travale area and Campi Flegrei area in cooperation with institutions from France and the Federal Republic of Germany.
5. Geomagnetic deep sounding on a planetary scale, using observatory data. This is a cooperative program of the Instituto di Fisica dell'Atmosfera (Rome), the Instituto Nazionale di Fisica (Rome) and the Bell Telephone Lab. (Dr. L.J. Lanzerotti, Murray Hill/N.J., U.S.A.). This is the first application of a theoretical study devoted to search for improved methods for geomagnetic depth sounding. It is planned to extend this investigation also into other period ranges, both for checking the method and for probing shallow and deep structure.

Japan (Y. Honkura, Department of Applied Physics, Tokyo Institute of Technology, 2-12-1 Ookayama, Meguro-ku, Tokyo 152)

1. Development of sea-floor magnetometers. (1980-1985).
2. Investigation of the electric state beneath the Japanese trench-arc-basin system by observing geomagnetic and telluric variations on a profile across the Northeastern Japan Arc. It is intended to extend these land-based observations toward the Japan Trench area in cooperation with the Scripps Institution of Oceanography, U.S.A. The electrical conductivity of the asthenosphere beneath the Western Pacific will also be studied from sea-floor magnetotelluric data (1981).
3. Geomagnetic deep sounding in Southwestern Japan with special reference to the subduction of the Philippine Sea plate. This includes sea-floor observations of geomagnetic variations in the Philippine and Japan Seas. A study of the island effect on Okinoshima Island in the Japan Sea will also be included in this project. (1984-1985).
4. Studies of the electrical conductivity of the oceanic asthenosphere from the island effect on Minami-daito Island (completed in 1980) and other islands in the Philippine Sea and the Western Pacific. (1984-1985).
5. Investigation of the effect of surface inhomogeneities which will be most relevant to the study in Northeastern Japan (project 1). It is planned to study this effect also in Central Japan, where a tectonic line, the Fossa Magna, geologically and tectonically separates Southwestern Japan from the Northeastern Japan Arc. (1984-1985).

Nigeria (E. Oni, Department of Physics, University of Ibadan, Ibadan)

1. Magnetotelluric and geomagnetic observations on profiles across the equatorial electrojet in cooperation with institutions from the Federal Republic of Germany and the United Kingdom.
2. Magnetometer array study of the Bernue trough.
3. Study of the coast effect in Nigeria.

Turkey (A.M. Isikara, Institute of Geophysics, Univ. of Istanbul, Fen Fakültesi, Istanbul)

1. Geomagnetic deep soundings along the North Anatolien Fault zone with a possible extension to other tectonically active areas in Turkey.
2. Magneto-telluric soundings.

United Kingdom (V.R.S. Hutton, Dept. of Geophysics, Univ. of Edinburgh, Mayfield Road, Edinburgh EH9 3JZ)

1. Broadband magnetotelluric and geomagnetic deep soundings at locations chosen to represent different geological zones in England and Scotland.
2. Magnetotelluric observations on South Georgia, Antarctica where the plate and plate fragments contain a complete microcosm of tectonic features.
3. Magnetotelluric and geomagnetic deep soundings in high heat flow region of Northern England (1979) and on the easteuropean platform in Poland (1980). These were cooperative studies with the Geophysical Institute of the Polish Academy of Sciences, Warsaw, and include a comparison of instruments, data analyses and modelling techniques.

4. Analysis of observatory records for global electromagnetic response estimates for periods greater than 2 days with a possible extension to shorter periods.
5. Theoretical studies of the electromagnetic relation of the oceans to the mantle. For investigation of upper mantle conductivities, methods will be developed to remove geomagnetic effects of surface inhomogeneities, such as the oceans.
6. Laboratory studies of seismic velocities and electrical conductivity of mantle-derived nodules.

U.S.A. (J. Filloux, Scripps Institution of Oceanography, Univ. of California, Mail Code A-030, La Jolla, Calif. 92093, U.S.A.; A. Duba, Lawrence Livermore Laboratory, Univ. of California, P.O. Box 808, Livermore, Calif., 94550, U.S.A.)

1. Extension of existing magnetotelluric soundings in the Northern Pacific westward over areas of increasing crustal age, crossing trenches, subduction zones and associated tectonic features. The recording time will be increased from two to at least four months. The instrumentation, consisting of 3-axial magnetometers and telluric devices, will be augmented by pressure sensors to improve the separation of gravitational tide signals from ionospheric signals. The existing instruments will be modified to increase the operating depth beyond 5 km.
2. EM deep sounding profile across the oceanic lithosphere from the western coast of North America to the Hawaian Islands, Japan and the Asian mainland. Cooperation is sought with institutions in Japan and the USSR.
3. Magnetotelluric survey in the Southwestern United States.
4. Laboratory studies of the electrical conductivity of rocks and minerals at elevated temperature and pressure.

U.S.S.R. (L.L. Vanyan, Soviet Geophysical Committee, Molodezhnaya 3, Moscow 117296)

1. Theoretical model studies with emphasis on the distortion of the EM response from the asthenosphere by near-surface inhomogeneities (coordinator: V.I. Dmitriev).
2. Laboratory studies of the electrical conductivity of rocks under high temperature and pressure (coordinator: A.B. Slutsky).
3. Development of instruments for land-based magnetotelluric soundings with long-period variations and for soundings at the seafloor (coordinator: V.N. Bobrov).
4. Theoretical studies of the inverse problem with emphasis on the problem to distinguish the asthenosphere against the normal background of upper mantle conductivity (coordinators: M.N. Berdichevsky, M.S. Zhdanov).
5. Field observations for the construction of geoelectric models of the asthenosphere beneath different geological zones of the U.S.S.R.:
   5.1 Baltic Shield (in cooperation with the Geophysical Institute of Oulu Univ./Finland).
   5.2 Eastern Carpathians (in cooperation with the Geophysical Institutes of the Hungarian, Polish and Czechoslovakian Academies of Sciences).
   5.3 Caucasus. 5.4 Central Asia. 5.5 Baikal rift zone.
   5.6 Transition zone between Asia and Pacific.
6. Collection and exchange of data (coordinator: E.P. Kharin). This is a joint enterprise of all countries, cooperating within the ELAS project (cf. part II).

APPENDIX III. OPTICAL CALIBRATION WORKSHOP IN ABERDEEN (17-19 August 1981)

As the result of a suggestion made by M. Gadsden at the Canberra meeting in 1979, IAGA Working Group V-4 on Optical Calibration Standards, held an 'Optical Calibration Workshop' in Aberdeen, Scotland, in conjunction with the IAGA Scientific Assembly. The aim was to continue the programme of intercalibration of low luminance standards used in airglow and auroral studies, which is described in detail in "Intercalibration of Instrumentation used in the Observation of Atmospheric Emissions: A Progress Report 1976-79" by R. Torr. This report, as well as the second one to be issued in the December 1981 time frame, are available from M.R. Torr.

The workshop was attended by 28 scientists, who brought 30 sources for comparison. Of these roughly two-thirds were radioactivity excited phosphors, and one-third tungsten filament based sources. The main business of the workshop was the actual measurement and comparison of sources. The C_{14} transfer source is now in the process of being calibrated against a recently purchased NBS calibrated lamp. Following the calibration, intercalibrated intensities will be mailed out to the owners of the 30 sources involved in the workshop.

In addition there were three sessions of lectures and discussion in the mornings; on Monday August 17 the workshop was introduced, with a history of the intercalibration project by M. Gadsden, and an outline of procedures by P.C. Wraight; on Tuesday Aug 18, F.A. Garforth gave a talk on calibration procedures for low luminance sources at the N.P.L.; R.H. Eather discussed practical procedures for use of reference sources in airglow and auroral research; K.C. Clark presented a design for a low light level diffuser and attenuator based on Lambertian scattering; and H. Tanabe described optical calibration procedures in Japanese research.

A discussion was held on Wednesday Aug. 19, to review the workshop and make recommendations for future calibration, chaired by P.C. Wraight in the absence of WG V-4 chairman M.R. Torr. The use of the transfer photometer was reviewed, and points where it could be improved noted; these included a better knowledge of filter transmission, and better facilities for automatic recording of data.

It was felt that the meeting had been extremely valuable. It was very much hoped that arrangements might be made for calibrations to be done in conjunction with the Hamburg meeting in 1983, and that a session be devoted to calibration at that meeting.

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