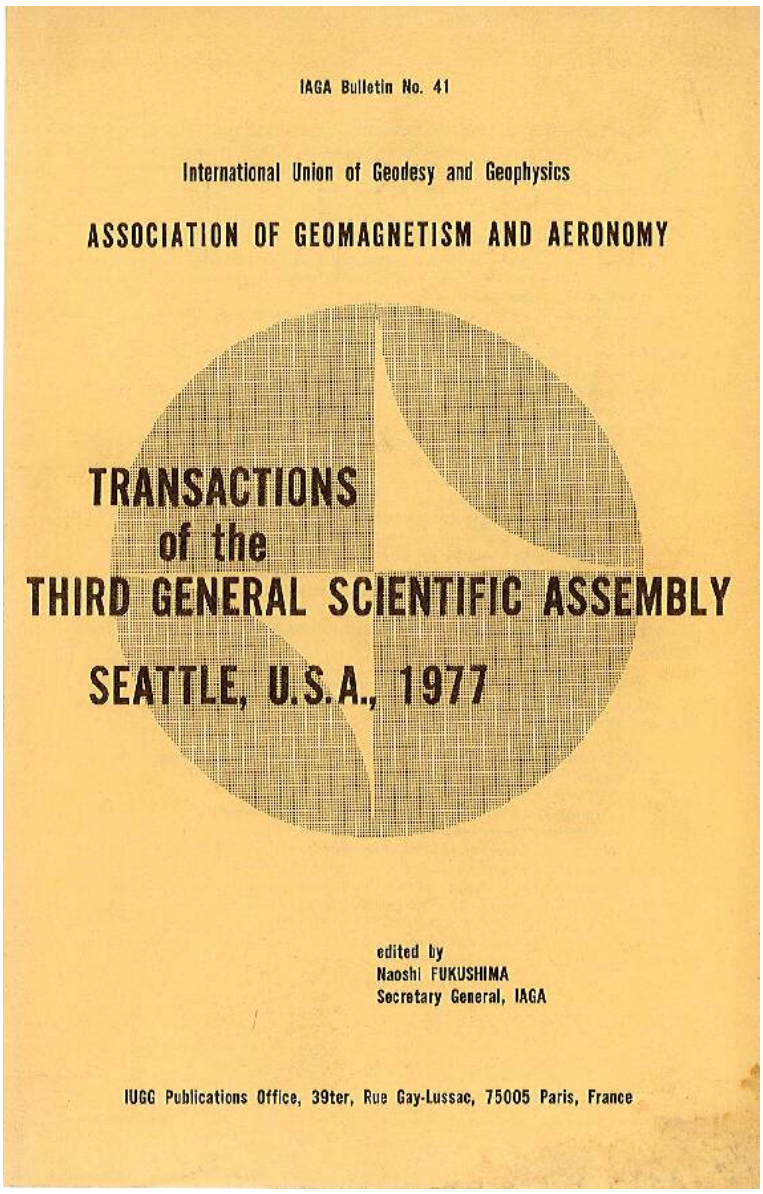

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IAGA Bulletin No. 41

International Union of Geodesy and Geophysics

ASSOCIATION OF GEOMAGNETISM AND AERONOMY

TRANSACTIONS of the THIRD GENERAL SCIENTIFIC ASSEMBLY SEATTLE, U.S.A., 1977

edited by
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Secretary General, IAGA

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

In the past, some proceedings of special IAGA symposia have also been published. All the available IAGA Bulletins (as of June 1978) are shown on the back cover of this booklet, and they are on sale at the IUGG Publications Office (39ter, rue Gay-Lussac, 75005 Paris, France).

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.

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IAGA Sessions

ACKNOWLEDGMENTS

The success of the Joint IAGA/IAMAP Assembly is, of course, based upon the co-operation of a number of people who worked both in the planning stage and during the conference.

Appreciation should first be given to the American Geophysical Union, which invited IAGA and IAMAP to hold their assemblies jointly in Seattle. The efforts of Dr. Arthur E. Maxwell (President), Dr. A. Fred Spilhaus, Jr. (Executive Director), and their assistants are greatly acknowledged, especially Ms. Susan A. Poling and Cynthia L. Beadling for their practical services.

The work of the people in the University of Washington is also greatly appreciated. After the Seattle Assembly the Secretary General of IAMAP took the initiative to present a letter of thanks to Dean Ronald Geballe, on behalf of IAGA and IAMAP. The letter contained the thanks to the following persons: Drs. Franklin I. Badgley and George K. Parks for their work as Cochairmen of the Local Committee; Mrs. Jean Huntly and Marjory Scott (Office of Short Courses and Conferences) for their excellent management and service before and during the assembly; Mrs. Josephine Pletcher for her guardianship and management of the Conference hall; audiovisual operators for their performance; Mrs. Gloria Bookter, Debbie Proctor-Bennett and their staff at Terry-Lander Hall for their hospitality to the participants who stayed in the university dormitories.

Finally, IAGA would like to express its heartfelt thanks to Mr. Stanley Ruttenberg, Secretary General of IAMAP, who, in close contact with the President of IAGA, devoted himself to the preparation of the Joint IAGA/IAMAP Assembly. Mrs. Gail Young and Miss Christine Kingsland, through their excellent supporting work, ran the secretarial office during the Seattle Assembly.

REPORT OF THE AD HOC COMMITTEE ON STATUTES AND BY-LAWS

GENERAL

After the proposal of the U.S.A. National Committee for a modification of the IAGA Statutes (IAGA Bull. No. 37, page 3) and the appointment of IAGA STATUTES AND BY-LAWS COMMITTEE (ditto, page 20; members: J. O. Cardus, C. M. Carmichael, B. R. Leaton, M. Petit, A. D. Powsner, and B. A. Tinsley), the work of the Committee can be sumarized in three stages:

1) preparation of a text to be presented at the end of the Grenoble Assembly;
2) preparation of a second text after receiving modifications and suggestions from National Committees;
3) preparation of a final text receiving minor changes from National Committees; this final text to be circulated by the end of February 1977, six months prior to the Seattle Assembly in accordance with present IAGA Statutes.

FIRST PERIOD

The work done during the Grenoble Assembly, the main ideas used as guide-lines for this work and the precise time-table for its execution were explained at the Grenoble Final Plenary Session (ditto pages 122–124) and it resulted in the DRAFT OF IAGA STATUTES AND BY-LAWS (dated 2 September 1975) and circulated by the IAGA General Secretary to all National Committees in its French and English versions.

SECOND PERIOD

It was stated that the Statutes Committee (S.C.) could receive amendments until the end of February 1976, and if fact it received answers from 17 National Committees, 7 of them accepting the draft presented and the other 9 with several very good remarks. Two National Committees sent their suggestions too late to be included in this period, but fortunately one could be considered as "minor amendments" and was, therefore, included in the third period.

The S.C. got, in all, 204 suggestions for modifications to the Statutes and By-Laws: 3 were of a general type, 70 to the Statutes and 131 to the By-Laws. Some amendments were only small changes in the wording or corrections to misprints of the text; others were more important, carrying on the directional ideas of the work. All the By-Laws and all but three (3, 10 and 24) of the Statutes were amended.

All members of the S.C. got all the material received and could send their votes on each of the amendments. With the answers I received, I took the opportunity of meeting Prof. Tinsley at Boulder during the Symposium on Solar Terrestrial Physics, to revise all the material we had in hand and to draw the new Draft. Unfortunately we could not reach

a final decision on 2 amendments to the Statutes and on 5 to the By-Laws. As time was running short for the distribution of the new version to National Committees, it was decided, in accordance with the IAGA General Secretary, to send the English text as we had prepared and to introduce some modifications, if needed, afterwards. In the meanwhile, the S.C. could prepare the French version of the English text.

At Grenoble it was decided that the S.C. would produce the revised text by the end of June 1976. Unfortunately the time allowed by us to revise by correspondence the material received, proved too short and the English version was distributed only at the end of July 1976 and the French version not until the month of September 1976.

The main changes introduced to the Statutes in the June version were the duration of office of the members of the IAGA Executive Committee (Article 7): the President could be reelected once in the September 1975 version, and may not be reelected to the same office in the June 1976 version; for the five additional Members of the Executive Committee it was decided that they could not hold office for more than three consecutive periods.

Articles 21 and 22 of the Statutes, about modification of the Statutes, were also changed in order to establish more clearly what sort of majority was needed, and who had the right to propose modifications.

In the By-Laws the main modifications introduced in the June 1976 version were:

Change of numbering for better clarity: no. 13 went into no. 10 and therefore nos. 10, 11 and 12 were renumbered 11, 12 and 13.

In the Nominations Committee (B-L 13; old 12) no member of the Executive Committee, either eligible for reelection or not, may be present.

In B-L 14 the possibility of voting by correspondence was formally introduced.

Finally, in B-L 20, some restriction was introduced in paying travelling expenses of Executive Committee Members.

As the June 1976 version was distributed to National Committees too late it was decided, in accordance with the IAGA General Secretary, to allow National Committees until the end of November 1976 (instead of end of October 1976, as said in Grenoble) for sending *minor* corrections to the new text.

THIRD PERIOD

The S.C. received comments from only 7 National Committees: 2 expressing their acceptance of the new Draft, 2 arriving after the work of the S.C. had been finished and 3 in due time. With the addition of the remarks that came too late to be included in the second period, this made a total of 4 suggestions to be studied. In all there were 6 possible modifications to the Statutes and 16 to the By-Laws. After consultation by air-mail with the members of the S.C., it was decided to introduce a few changes that were sumarized in the "Remarks on the final version of the proposed IAGA Statutes and By-Laws" distributed to National Committees by the IAGA General Secretary on February 19 (Ref No. NC/11) in the following way:

STATUTE 23: after *a simple majority,* add *of Member Countries who have accredited Delegates to the Assembly, in accordance with articles 5 and 14 of the Statutes,* to make it consistent with article 21.

BY-LAWS:

1.1 The first paragraph has been modified to make it more clear.

1.1 We retain for Division V the old word *Observatories* instead of *Observations*, that was introduced by mistake in the previous drafts.

2. The word *role* has been introduced before *structure.*

2. In the last sentence the word *following* has been deleted.

2.2 The sentence *write to the President expressing . . .* has been changed to *express in writing to the President . . .*

9. In the 4th line, *It* has been changed to *The provisional agenda.*

11.1 The last word *voting* has been changed to *meeting* because, as a matter of fact, the voting (although by correspondence) started as soon as a National Committee, not represented at a meeting of the Conference of Delegates, sent its vote by correspondence.

These were the minor modifications accepted in the third period and they appear in the Final version of February 1977. However, in this final version there are still two other changes, that, as I said before, could not be introduced in time to the June 1976 version. The first one was certainly a major change and was introduced at the end of B-L 11, where it is added that "the President's ruling may be challenged as prescribed in Statute 17". The second change is in B-L 19 where the duties of the Secretary General are described. Although the wording and also the lettering of this B-L has been thoroughly modified, it is, in fact, only a minor change to make this important B-L more explicit.

FINAL

I wish to thank National Committees who have helped so much the S.C. with their suggestions or with their expression of agreement of the work done. Without it the work of the S.C. would have been practically impossible.

My very special thanks go to members of the Statutes Committee who took a great part of their valuable time to consider the suggestions made and to answer my several letters on the subject, and especially it is a pleasant duty to thank Dr. Petit who had, almost alone, the task of preparing the French version of the successive texts.

Let me now finish with the hope that the work of the National Committees and of the Statutes Committee, if accepted at the Seattle Extraordinary General Assembly, will help the work of our International Association.

Many thanks.

J. O. Cardus, Chairman
Ad Hoc Committee on Statutes and By-Laws

OPENING CEREMONIES of the JOINT IAGA/IAMAP ASSEMBLY

The formal opening ceremonies and joint plenary meetings of the IAGA/IAMAP Assembly were opened at 3.00 p.m. on August 22, in the Meany Hall of the University of Washington.

Dr. Arthur E. Maxwell, Chairman of the U.S. National Committee for IUGG, presided over the meeting and introduced the speakers. In the first part of the ceremonies, the addresses were given by

Ronald Geballe, Vice Provost and Dean of the Graduate School, University of Washington

Dixy Lee Ray[1], Governor, State of Washington

Attia A. Ashour, President of the International Union of Geodesy and Geophysics.

There was an interlude played by members of the Seattle Symphony. The latter half of the Opening Ceremonies was devoted to lectures by the Presidents of both IAGA and IAMAP as follows.

Juan G. Roederer[2]: The Future of International Cooperation in Geophysics: For the Benefit of Whom?

Christian Junge: The Chemical Evolution of the Earth's Atmosphere in the Light of Geophysical Evidence.

After the ceremonies in Meany Hall, an outdoor reception was held in the open area in front of the hall.

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1) Her address entitled "Scientists and Government" was published in the Transactions of the American Geophysical Union (E⊕S), 1978 February issue, pages 116–117.

2) His Presidential Address is included in this Transactions, pages 3–8.

INTRODUCTION

General

The Joint IAGA/IAMAP Assembly in Seattle during August 22 — September 3, 1977, was the combination of the Third General Scientific Assembly of the International Association of Geomagnetism and Aeronomy and the Second Special Assembly of the International Association of Meteorology and Atmospheric Physics. This Assembly was jointly organized by the American Geophysical Union and the American Meteorological Society on behalf of the U.S. National Committee for the International Union of Geodesy and Geophysics.

The Joint IAGA/IAMAP Assembly was held at the University of Washington, Seattle, by arrangement by the Office of Short Courses and Conferences. Excellent facilities in Kane Hall and Smith Hall were offered for the ordinary scientific sessions and meetings. Meany Hall was also used for the opening ceremonies, frontier lectures and movie presentations. The basement of the Undergraduate Library was the hall for registration, paper distribution, mail boxes, coffee and tea, and notices for the assembly. The university dormitories were opened to the participants during the Conference period.

IAGA convened an Extraordinary General Assembly at the beginning of this assembly, and the new Statutes and By-Laws were adopted. As to the scientific activity, IAGA held four symposia jointly with IAMAP, and forty-five sessions of its own.

The Resolutions Committee during the Seattle Assembly consisted of M. Gadsden (chairman, U. K.), P. N. Mayaud (France), A. Nishida (Japan), A. N. Pushkov (U. S. S. R.) and T. J. Rosenberg (U. S. A.).

The program and abstracts of all IAGA and IAMAP papers were compiled and published by the American Geophysical Union along with the other useful information for the participants. This booklet was distributed at the time of registration at Seattle. In the past the IAGA program-abstract booklet was given a IAGA Bulletin number and was available from the IUGG Publications Office. This time, however, the combined IAGA/IAMAP program-abstract booklet is not on sale in the traditional way, but the American Geophysical Union has kindly supplied some copies to the Secretary General of IAGA for distribution upon request. This Transactions, which is IAGA Bulletin No. 41, contains all the records of administrative affairs during the Seattle Assembly, reports on the activity of IAGA organizational units, and the program and highlights of each scientific session. The Secretary General is grateful to all the leaders of IAGA organization units, conveners and chairmen of scientific sessions, who kindly provided their reports.

Frontier Lectures

The following special lectures were given during 13–14 h in the Meany Hall.

August 23 (Tuesday), Keith D. Cole: Energy Balance in the Atmosphere-Ionosphere System

August 25 (Thursday), Paul Crutzen: Atmospheric Ozone as Affected by Man's Activities: A Global Environmental Problem

September 1 (Thursday), Mikhail Ya. Marov: Planetary Atmospheres, Their Evolution, Composition and Dynamics

On August 30 (Tuesday), some movies on aurora and space research were presented.

After the banquet on the evening of August 31 (Wednesday) at the Olympic Hotel in downtown Seattle, the following frontier lecture was held:

Carl Sagan: Implications to Life of Geophysical Events.

Social Events

On August 22 (Monday), from 15h, immediately after the Joint IAGA/IAMAP Opening Ceremony, a reception where wine and cheese were offered to participants, was held in the open area outside the Meany Hall.

On August 25 (Thursday), the participants enjoyed an eventful evening at Tillicum Village on Black Island Marine State Park. This included a Makah Indian salmon bake and North Coast Indian dances.

On August 28 (Sunday), a special picnic outing took place at Whidbey Island, including a visit on the way to the charming old historical towns of Coupeville and La Connor. Spectacular views of Deception Pass and war canoes at Fort Casey were also seen.

The formal cocktail party and banquet was held at the Olympic Hotel in downtown Seattle on the evening of August 31 (Wednesday). A frontier lecture by Carl Sagan followed the dinner.

ADDRESS BY THE PRESIDENT OF IAGA

J. G. Roederer

The Future of International Cooperation in Geophysics— For the Benefit of Whom?

Madame Governor of the State of Washington, Mr. President of the U. S. National Committee, Mr. President of IUGG, ladies and gentlemen, colleagues:

It has been a tradition in recent IAGA General Assemblies that the President review the activities of the Association and the progress of its scientific disciplines during the preceding period. In order to keep up my bad reputation as a breaker of traditions, I have decided—to break the tradition.

I would like to discuss international scientific cooperation as it applies to, and is an integral function of, IAGA, IAMAP and any other non-governmental international scientific body. And in this context I would like to work my way up toward finding an answer to the question: who should be the ultimate beneficiary of such international scientific cooperation? I am afraid that my presentation will leave an aftertaste of pessimism, for I will mainly point out problems without offering solutions. Maybe I will come up with some proposals at our next Assembly in Canberra!

In recent years the structure of the International Council of Scientific Unions (ICSU) and of many ICSU bodies have increasingly come under criticism from governments, scientific academies, and individual scientists. National Committees are taking a hard look at the benefits of adhering to this or that nongovernmental organization, and threats of withdrawal are being voiced here and there. The worldwide wave of nationalism and/or isolationism, the wave of anti-intellectualism sweeping through many countries, and the frightening turn to introspection, even spiritism and occultism of the young generation in many countries all have had an impact on government and politics that in my view seriously imperils the future of international cooperation in scientific research. We scientists with a social responsibility and accountability to our fellow men and women cannot remain indifferent.

This particularly applies to geophysicists, for of all disciplines of science, geophysics no doubt ranks as one of the most relevant to the survival of humanity. The factors mentioned above are pretty much out of our immediate control as scientists; we may do something about them as citizens. But there are recent developments that do affect international science whose effects *can* be controlled to a certain extent by the scientists themselves.

Let me first merely identify some of these developments. After that, I will focus on two crucial issues and dwell on them in a more organized and detailed fashion.

1. There is an increasing trend toward an *interdisciplinary approach to scientific re-*

search; traditional disciplinary boundaries are being demolished, new fields appear—and interdisciplinary scientific cooperation is becoming a way of life for the international research community. The traditional bodies of ICSU do not yet have the flexibility to self-adjust to this requirement in scientific cooperation.

2. The revolution in communications and information-dissemination among scientists, and the sophistication of data-acquisition and -handling techniques have *increased the pace of scientific research* and the demands on the individual participant by orders of magnitude. The traditional bodies of ICSU operate and react on a time-scale that is much longer than that of the duration of present-day research projects.

3. The research itself is becoming so complex that one project often requires *simultaneous participation of many groups, the establishment of national laboratories, and national and international governmental agencies.* Bi- and multilateral governmental agreements on specific scientific projects proliferate, and so do special symposia and meetings. Non-governmental bodies such as ICSU have little or no participation in these activities.

4. A *new generation of scientists* is taking over the research with an informal, matter-of-fact, and cost-effectiveness-minded approach that leaves little room and respect for the traditionally formal, bureaucratic, and quasi-diplomatic mode of operation of ICSU bodies.

5. Developments in science and technology have contributed and will continue to contribute to *widening the gap between developed nations and the developing of underdeveloped countries.* Non-governmental international scientific organizations *can* offer an adequate forum for information and technology transfer to counteract this awesome trend, provided their scientists are willing to convert into social responsibility part of what many believe to be their scientific responsibility (to crank out one paper after another).

6. *A gradual erosion of the non-political tradition* of international scientific bodies is taking place, mainly because of an increasing worldwide awareness of the social relevance and impact of scientific research. Non-governmental bodies cannot escape from, nor efficiently defend themselves from, such a trend—because these organizations in themselves are all linked in one way or another to political structures.

I would like now to focus on just two of these issues, which I find to be the most relevant ones to the main theme of my address: (1) the "*interdisciplinarification*" of scientific research; and (2) the "*politicization*" *of scientific research.* I contend these are two inescapable issues, an integral part of the fabric of today's science, which have a profound impact on international scientific cooperation.

Let me turn to the first issue: the fact that more and more topics, techniques and interest areas of scientific research diffuse across classical disciplinary boundaries. It is clear from a couple of centuries of science history that science is not a steady, cumulative acquisition of knowledge. Rather, its course alternates between two distinct modes of evolution. One represents peaceful interludes with slow and continuous refinement of knowledge; the other consists of intellectually violent revolutions or crises in which one conceptual world view is replaced by another. The first mode of continuous development allows for the setting of scientific goals and for scientific planning; the second mode of revolutionary transition cannot be planned nor can its outcome be predicted. It is during these sudden transitions that classical disciplinary boundaries of science are demolished or rearranged.

Geophysics, of course, has not escaped such transitions. As an example germane to our own Association, let me discuss the advent of the Space Age and its impact on IAGA and on the relations of IAGA with other ICSU bodies and with IAMAP.

After the advent of the "Space Age" in the late fifties, the frontiers of geophysics went into a far-reaching expansion to incorporate vast portions of new, intriguing territory: the outer environment of planet Earth and its subtle influence on man's immediate environment. What until then was accessible only through *in*direct studies and remote sensing from the earth's surface suddenly became a major area of in situ measurement and exploration. Solar-terrestrial physics emerged as a new discipline cutting across existing boundaries. Many Unions of the ICSU family were affected, and interunion bodies such as SCOSTEP and COSPAR, dealing with the new science and associated techniques, had to be established. The very nature of space techniques, space research logistics and data flow techniques accelerated the cycle of discovery, exploration, and understanding to the point of making the conventional structures of ICSU unresponsive to the increased demands of quick information exchange and short-term coordination. Meetings on solar-terrestrial physics began to proliferate, sometimes in mutual conflict; resentment began to develop between the sluggish Unions and the more dynamic and flexible interunion bodies and their short-term projects dealing with space topics. And the wedge of space research that penetrated the traditional components of ICSU also began to widen even further the gap between the scientific interests of advanced or developing countries. The reorganization of the structure of IAGA that took place in 1972–73 was nothing but an attempt at in-house adaptation to the impact of the space age.

Another revolutionary transition came when bodies of the solar system other than the earth became accessible to in situ scrutiny and exploration. Now it was the *geo*physical methods and techniques that cut into the discipline of astronomy and planetology; geophysicists began to realize that by finding out all about the planets they would be able to expand the knowledge of our own planet earth. Indeed, by now the discipline of "geophysics" has transcended far beyond the original bounds implied by the meaning of the Greek prefix of this term, and IUGG and its Associations are getting more and more involved in the study of other bodies of the solar system.

Turning more specifically to our own Associations, a diffusion of boundaries is becoming clearly noticeable. It is in aspects where the photochemical, photoionization and other ionizing processes, and ionic diffusion processes interact with the motional aspects of the neutral atmosphere that IAGA and IAMAP concerns are mutual. Approaches from directions of interests of *both* Associations are needed to solve complex problems. This is particularly so in the middle atmosphere—the stratosphere and mesosphere—where ionization, excitation, dissociation and interactions between neutral and ionized constituents are complex and important. Through these regions energy is transferred from external electro- and hydromagnetic sources down into the lower atmosphere and, conversely, from the hydro- and thermodynamic sources in the latter out into the ionosphere and magnetosphere. With respect to physical processes in this atmospheric region, one simply cannot treat the "aeronomical" and "meteorological" aspects separately. What for one Association's approach is an "input," a "boundary condition," or a "perturbation," must be provided as an "output" by the other Association's discipline and vice versa.

Both Associations must work together and achieve a mutual scientific coordination that is independent of circumstantial factors such as the personalities that happen to be in charge of these two organizations.

I now turn to the second issue, which I have called the "politicization" of scientific research, and its impact on international scientific cooperation. Let me again base the discussion on a critical example.

Recently the IUGG has gone through an agonizing period of internal debate in connection with the conditional application for membership received from the People's Republic of China. No one questioned the desirability of counting the People's Republic of China as a member of the Union—a country encompassing such a vast territory of our globe with many thousands of most active geophysicists could not be left outside the framework of international scientific cooperation. But the problem was that an acceptance of the condition stipulated in the application implied the simultaneous cancellation of the membership of Taiwan; although it must be noted here that as a result of direct negotiations conducted by the Secretary General of IUGG and more recently by the new President also, the PRC has agreed to the participation in Union Assemblies and scientific meetings of scientists from Taiwan as individuals.

The IUGG statutes do not provide a mechanism for canceling the membership of a dues-paying country. Furthermore, the cancellation of a membership on grounds other than failure to fulfill its obligations might contravene an ICSU resolution recommending that the Scientific Unions of ICSU not exclude from membership any community of scientists which effectively represents the scientific activity in a definite territory (the principle of Universality of Science).

The heart of the question lay in the meaning of the term "country" in IUGG Statute No. 4, which states that membership in the IUGG is by *countries*, not by "territories" or "communities of scientists." It is intrinsically impossible to avoid a political judgment whenever the term "country" is to be interpreted. From the text of a motion submitted on this matter to the Extraordinary General Assembly that was held in Durham, England, on August 6, 1977, it can be concluded that the Bureau of the Union has de facto accepted that, in case of dispute, the term "country" is to be applied to a nation which is recognized by, or has diplomatic relations with, a great majority of member countries of IUGG. It also follows that by reaffirming in that same motion the right of every qualified scientist from every part of the world to participate as an individual in IUGG meetings, the IUGG Bureau has held that the basic tenets of the principle of Universality of Science are being met, a view later shared by the ICSU Executive Board. The motion, whose two main action items were the acceptance of the application of the PRC and the cancellation of the representation of Taiwan in the Council of IUGG, was carried in secret ballot by 47 votes against 7, with no abstentions. Making abstraction of the particular question voted upon, this result unequivocably has told yet another lesson: a vast majority of the member countries *do* accept the fact that political issues can be forced upon the Union on certain occasions.

Is it desirable and if so, is it feasible to eradicate politics from our Union, from other non-governmental organizations, from international cooperation in general? Desirable, perhaps (depending on one's own ideology), but feasible—hardly. Young nations are emerging in political turmoil; adolescent nations are struggling toward stability in internal

political ferment or under external political or military pressure. The story with the PRC is bound to recur. No statute, however "perfect" on paper, will prevent the Union from facing political issues and choices in the future.

To pretend that international science has a strictly non-political tradition and that such a tradition can be maintained is, in my opinion, most unrealistic. There are several issues in international scientific cooperation where interactions of a political nature just *cannot* be avoided. One such issue comes to the surface whenever the need arises to recognize boundaries of, or subdivisions in, the communities carrying out scientific research. An example of this has just been discussed. It has been proposed that to avoid this issue international scientific organizations be established on the basis of membership by *individuals*, or groups of individuals, rather than by countries. But who would support these organizations? Their individual members, as in the European Geophysical Society or the American Geophysical Union? Not only would this bring in a far more blatant international political issue, but it would raise a socioeconomic issue that, at least on the surface, is absent in the present framework of ICSU!

Another issue where the interface of science with politics transcends into the framework of international cooperation is to be found in the identification of goals for cooperative projects, hence in the definition of the projects themselves. Social value judgments and social relevance, accountability to the public or government and credibility are all inextricably fused with political issues. So are the effects of scientific findings on governmental regulation, on environmental control, on potential hazards of research. And increasing awareness of these issues is having an impact on the direction of international cooperative research with yet-to-be-appraised consequences. Witness the emphasis placed on the ozone layer in the Middle Atmosphere Program Planning Document; the emphasis on possible sun-weather correlations in the International Magnetospheric Study; and, in the preliminary discussions on a follow-up to the Geodynamics Project, the emphasis placed on seeking an understanding of crustal processes related to the concentration of hydrocarbons and other mineral resources.

This trend of demanding "relevance" in scientific research is pervading many fields of pure science, often causing a distortion of the original goals, issues or mechanisms in order to shoe-horn some expectations of outright phony society-oriented relevance. It has been proposed that to avoid this, international non-governmental scientific bodies and international scientific cooperation should stick to pure, basic science and leave all applied aspects and potential technological spin-off deliberately out of sight. However, let us not forget that political issues arise in science whenever the *individuals* who create the science or the *individuals* who receive its benefits or detriments enter the picture. And not even the most basic and fundamental aspects of science can be totally disconnected from the individual—more precisely, from the peculiar modes of operation of the human cognitive apparatus. Indeed, science has emerged as a "transfiguration" of natural brain function, created by man as an extension and complement to allow for predictive operations that exceed the temporal scale, the innate possibilities, and the accuracy of the human brain. Science has emerged as a collective human effort to correct the misrepresentation of events and cause-and-effect relationships that unavoidably are incorporated into the brain during the course of its interaction with the environment. Scientific thought will always be based on whatever

information-processing modes have been acquired during the early lifetime of the human brain and its early interaction with the environment. Scientific thought will always be conditioned to the limitations of current learning and teaching methods and associated intra-human communication systems. Scientific thought will always be limited by the natural boundaries of cerebral information-processing per se. Is it then surprising if science cannot be dissociated from individual human brain function, hence from collective human behavior, hence from politics?

So where do we stand and where do we go from here in international scientific cooperation? What are the mechanisms to be followed, what are the goals to be pursued? Who is going to look after these developments? And, to come to the principal question in the title of my address, who is to be the main beneficiary? Since we cannot fully eliminate political issues, let us strive toward a structure that minimizes chances of political interference, maximizes objectivity and political impartiality, and that provides for a forum of information exchange free from extra-scientific pressures. Since we cannot convert non-governmental scientific organizations into private clubs, let us strive toward a structure that maximizes responsiveness to the needs of the individual participating scientist or group of scientists. Since we cannot realistically predict the course of science, we must seek a structure that is stable enought to satisfy the needs of a continouous development of science, yet flexible enough to allow for quick adjustments to revolutionary breakthroughs of knowledge. Since we cannot restrict the field of activities to pure and basic science, we must seek a mechanism for international scientific cooperation that allows for a continuous, real-time evaluation of its societal relevance, identification of needed research, identification of potential hazards, and evaluation of its credibility.

May I point to an alarming development in this context: on one side, there are too many of the so-called "science policy researchers" who have too little knowledge about the science whose policy they are pretending to research. On the other, there are too many scientists concerned with petty self-interest and self-promotion who show little concern about the rest of the world in which they are living. Science is too important to be left to either. The world is rapidly evolving toward a state in which survivability and progress are determined first and foremost by information-handling capability. Industrial, military and economic power will be conditioned to information-processing power. Social structure, societal organization and government will be conditioned to information-flow capacity between the constituent elements of the population. Science, not technology, is bound to become the main pillar on which the postindustrial "information society" is to be built—if humanity is to survive.

To me, the crux of the matter lies in the social responsibility of the working scientist—a responsibility that recognizes neither national nor ideological boundaries, a responsibility toward humanity as a whole. And international scientific cooperation is one mechanism, perhaps the only mechanism left, through which the scientist can exercise such responsibility in an effective way. Who is then to be the beneficiary of international scientific cooperation? Every single human being is.

REPORT ON THE IAGA EXTRAORDINARY GENERAL ASSEMBLY

Seattle, Washington
August 22, 1977, 1300–1415h

After checking their credentials, General Secretary Fukushima invited the twenty-three Chief Delegates present to take their seats in the first two rows of the Assembly room. Other Delegates and Associates filled the rest of the room to capacity.

President Roederer called the Extraordinary General Assembly (EGA) to order. He explained that this EGA was called with the approval of the IAGA Executive Committee, having only one action item on the agenda: to consider the adoption of new Statutes for the Association. He gave a brief report of the history of the process, initiated in Grenoble with a motion from the Chief Delegate of the United States of America to adopt a new set of Statutes. He pointed out the diligent and meticulous work of the ad hoc Statutes Committee set up for this purpose (J. O. Cardus, chairman; C. M. Carmichael, B. R. Leaton, M. Petit, A. D. Powsner, and B. A. Tinsley). After consultation with the IAGA National Correspondents, this Committee produced a final draft that was submitted to all member countries in February 1977. The President explained that since it was apparent from the beginning that it would be unrealistic to expect that the required votes (2/3 majority of total IAGA membership) could be obtained at an Assembly, it was decided to submit the proposed Statutes to a postal vote. This action was taken in May 1977. The President declared that, therefore, the vote on the new Statutes was in progress and that this voting process would be brought to a conclusion in this EGA. He ruled, with previous consent of the Executive Committee, that (i) since the vote was already in progress, motions to amend the text of the proposed Statutes would not be allowed by the Chair; (ii) the result of the postal vote would be disclosed only after the completion of the voting process at the EGA; (iii) unless explicitly called for by a voting member, the chair would not reveal which countries had cast affirmative votes and which had cast negative ones in the mail ballot.

The President then allowed for questions of clarification on the voting process from the Chief Delegates. A request to open a discussion from U. S. Delegate W. H. Campbell was denied on the grounds that (i) the voting process on the adoption of new Statutes was already in progress; (ii) only Chief Delegates had voting rights on a change in Statutes (IAGA Statute No. 23, paragraph 2) and it is only these Chief Delegates who shall be recognized for questions.

The President proceeded to call on those delegates present whose country had not submitted its vote by mail to cast his or her country's vote. After collecting the ballots, the President declared a five-minute recess to allow for the counting of the ballots. The two Vice-Presidents and the General Secretary acted as scrutineers.

The EGA was called again to order. The President explained that according to the interpretation of the authoritative French text of IAGA Statute No. 2, there were 57 members of IAGA (pays qui se sont inscrits comme membres de l'Association). Two of these were in arrears in payment of dues to the Union, thus being disqualified to vote according to IUGG Statute No. 11. Hence the 2/3 majority needed to pass the new statutes (IAGA Statute No. 23) was 37 affirmative votes. The President announced the result of the vote on the adoption of new Statutes. Affirmative: 38; negative: none. There not being a challenge, the new Statutes (pp. 11–24) were declared adopted.

The Chief Delegate from France moved to put the new Statutes into force at once (new Statute No. 20). This was seconded by the Chief Delegate from Japan. There being no discussion, the motion was put to a vote and passed.

The President declared that the Assembly was now operating under the new Statutes and ruled that the accredited delegates present in the Assembly room constituted a Conference of Delegates as defined in IAGA Statute No. 5. He explained that a set of draft By-Laws had also been submitted to the member countries in February 1977. To allow for consideration, debate and vote on the draft By-Laws under Statute No. 23, the President reminded the Conference of Delegates that only Chief Delegates were entitled to vote.

It was moved and seconded that the new By-Laws be adopted. The Chair called for discussion. A motion to amend By-Law No. 2 failed to obtain a second; a motion to delete the first paragraph of By-Law No. 10 was seconded, debated and defeated.

The President called for a vote on the main motion. The By-Laws in their total text* (see pp. 14–17 and 21–24) were adopted by 20 affirmative votes against 2 negative votes (and one abstention).

The Chief Delegate from Canada raised a motion of thanks to the ad hoc Statutes Committee for its dedication and efficient work during the last two years. After being seconded, the motion was unanimously passed by acclamation.

Three items of information on the Agenda were briefly mentioned by the President, namely, a report on the IUGG Extraordinary General Assembly held in Durham on August 6, 1977; some decisions of the IUGG Bureau and Executive Committee Meeting held at the same place on August 3–7, 1977; remarks for the Seattle Assembly. After finishing the scheduled Agenda, the Chief Delegate from the U. K. suggested that the IAGA 1981 Assembly be held in his country. He said he was confident that a formal invitation would be issued given a favorable reaction from IAGA. The President declared the EGA closed and the Conference of Delegates adjourned until September 3, 1977, at 0900h.

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* The Conference of Delegates amended By-Law No. 1 on September 3, 1977. See p. 50.

NEW STATUTES AND BY-LAWS

INTERNATIONAL ASSOCIATION OF GEOMAGNETISM AND AERONOMY

STATUTES*

I. Objectives, Structure and Membership of the Association

1. The objectives of the International Association of Geomagnetism and Aeronomy (henceforth 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 for publication of the results of the researches indicated above;

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

2. To achieve its objectives, the Association may establish any number of Component Bodies both within the Association and jointly with other Associations of IUGG or components of other ICSU Bodies.

3. The countries which adhere to the IUGG are members of the IAGA and may participate in its activities.

4. Each Member Country shall be represented by a single body (henceforth referred to as IAGA National Body), established in that country by the body that adheres to the IUGG.

II. Administration

5. The work of the Association shall be directed by the Conference of Delegates.

The Conference of Delegates shall consist of the Delegates of the Member Countries, such accreditation having been communicated to the Secretary General prior to the start of the Assembly by the respective IAGA National Bodies. Among the Delegates from each Member Country, one shall be identified by the respective IAGA National Body as Chief Delegate for the purpose of casting that country's votes on administrative and financial matters as stipulated in Articles 14 and 15 of these Statutes.

A Delegate may represent only one Member Country. A member of the Executive Committee (see Article 7) may not be Chief Delegate, except in the case where that member is the only one person in attendance from the country in question.

A Conference of Delegates shall be convened during each Assembly of IAGA. An ordinary General Assembly of IAGA shall normally be held in connection with each ordinary General

* Adopted by the Extraordinary Assembly of the Association, Seattle, 1977.

Assembly of IUGG.

The interval elapsing between the end of one ordinary General Assembly and the end of the next one will, for the purposes of the Statutes, be termed one period.

6. Responsibility for the direction of IAGA affairs between meetings of the Conference of Delegates shall be vested in the Executive Committee of the Association elected by the Conference of Delegates. Decisions of the Executive Committee must be reported to the Conference of Delegates. Any decision or recommendation failing to receive the concurrence of the Conference of Delegates may be remitted to the Excutive Committee for further study.

7. The Executive Committee shall consist of the President, two Vice-Presidents, the Secretary General, five other Members, and the retiring President, ex officio.

Except for the retiring President all members of the Executive Committee shall be elected by the Conference of Delegates as an administrative matter as stipulated in Article 14 of the Statutes.

The President shall be elected for one period, and may not be reelected to the same office. The Vice-Presidents shall be elected for one period and may be re-elected once. A retiring Vice-President may be elected Presidnet. The Secretary General shall be elected for two periods and may be reelected for successive single periods. The five additional Members shall be elected for one period and may be reelected for successive single periods; they may not hold office for more than three consecutive periods. The retiring President is a member ex officio for only one period.

In the event of any vacancy occurring in the membership of the Executive Committee during one period, the Executive Committee shall have the power to fill the vacancy by appointment, until the end of the period. The eligibility for election of a person so appointed shall not be affected by such an appointment. If the vacancy is that of the Presidency, the Executive Committee shall appoint one of the two Vice-Presidents to act as President until the end of the period.

8. The duties of the Executive Committee shall be to administer the afffairs of the Association in accordance with these Statutes and By-Laws and with the decisions of the Conference of Delegates.

The Executive Committee shall meet at the beginning and end of an Assembly and at least once more between ordinary General Assemblies.

9. The duties of the Component Bodies within IAGA (See Article 2 of the Statutes) shall be to further the scientific objectives of the IAGA through: a) effective coordination of appropriate scientific researches; b) organizing scientific meetings; c) promoting the exchange of information and data; and d) advising the Executive Committee on the formulation of general policies to guide the scientific work of the Association.

10. The duties of the Bodies that are established jointly with other Associations of IUGG or components of other ICSU bodies (See Article 2 of the Statutes) shall be to deal with, and coordinate, those scientific programs and/or meetings that cover topics of mutual interest.

III. Finance

11. The Secretary General shall prepare, for each period, a budget estimate of receipts and expenditures during that period. The Secretary General shall lay this before the Executive Committee during the General Assembly immediately preceding that period and, having received the approval of the Conference of Delegates, may proceed with the disbursement of funds in accordance with that approved budget.

12. At least six months before the opening of an Ordinary Assembly, a Finance Committee shall be appointed by the Executive Committee to examine the accounts and to report the results of their examination to the Conference of Delegates. No Executive Committee member may at the same time be a member of the Finance Committee.

IV. Voting

13. When a vote is taken on a question which is by nature exclusively scientific, each duly accredited Delegate present at a meeting of the Conference of Delegates shall have one vote.

14. On questions of an administrative nature the voting shall be by Member Countries, each Member Country having one vote cast by its Chief Delegate (or that person's representative, in accordance with the By-Laws).

15. On questions of a financial nature, the voting shall be by Member Countries, each Member Country having a number of votes equal to the number of its category of membership in IUGG. Such votes shall be cast by the Chief Delegate of each Member Country (or that person's representative in accordance with the By-Laws).

16. Matters which are partly scientific and partly administrative in character and not involving matters of finance shall be classified as administrative matters.

17. Before a vote, the President shall decide whether the matter under consideration is scientific, administrative or financial in character.

The President's ruling can be challenged only by the Chief Delegate of a Member Country. In the event of such a challenge, the President's ruling can be changed by a two thirds majority of the Chief Delegates present.

18. Voting on matters of an administrative or financial nature may be conducted by correspondence (in accordance with the By-Laws).

19. For the validity of the deliberations of the Conference of Delegates, half at least of the accredited Chief Delegates must be present (or represented in accordance with the By-Laws).

Decisions of the Conference of Delegates shall be taken by a simple majority except as otherwise specified in the present Statutes. If a tie should occur, the decision shall rest with the President. Simple or two thirds majority shall be determined by the proportion of affirmative votes to the sum of the affirmative and negative votes.

V. General

20. These Statutes or any further modifications thereof shall come into force at the close of the General Assembly at which they are adopted, or as otherwise decided by the Conference of Delegates.

21. These Statutes may not be modified except with the approval of at east a two thirds majority of Member Countries who have accredited Delegates to the Assembly, in accordance with articles 5 and 14 of the Statutes.

22. Only Member Countries may propose a change of these Statutes. Any such proposal must reach the Secretary General at least six months before the announced date of the General Assembly at which they are to be considered. The Secretary General shall notify all Member Counries of any proposed change, at least four months before the announced date of the General Assembly.

23. The Conference of Delegates shall have the power to adopt By-Laws within the framework of the Statutes of the Association. These By-Laws are adopted or may be modified by a simple majority of Member Countries who have accredited Delegates to the Assembly, in accordance with Articles 5 and 14 of the Statutes. By-Laws or any further modification thereof, shall come into force at the close of the General Assembly at which they are approved unless otherwise decided by the Conference of Delegates.

24. The present Statutes have been prepared in the official languages of the IUGG. The English text shall be authoritative if there is a question of interpretation.

BY-LAWS*

I. Composition

1. The Components of IAGA shall be called Divisions and Interdivisional Bodies (Commissions or Working Groups) 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 : Antarctic Research
Interdivisional Commission : History
Interdivisional Commission : Middle Atmosphere
Interdivisional Working Group : Relations between External and Internal Magnetic Variations.

2. Each Division or Interdivisional Body shall propose to the Executive Committee its own role, structure and modus operandi, which must be approved by the Executive Committee. The role and the effectiveness of each Division and Interdivisional Body shall be reviewed by the Executive Committee at each ordinary General Assembly.

3. The leaders for each Division and Interdivisional Body shall be appointed by the Executive Committee for one period, subject to ratification by the Conference of Delegates. Vacancies occurring in the interim shall be filled by the Executive Committee.

In order that their appointments shall become effective, Division and Interdivisional Body leaders must express in writing to the President their willingness to serve in the functions specified.

4. The leaders of Divisions and Interdivisional Bodies are empowered to appoint for each period reporters, working group leaders, and the leaders of other possible subdivisions.

5. While it is recognized that the prime criteria for the appointments in Articles 3 and 4 of these By-Laws should be the scientific and administrative competence of the candidates, Executive Committee and Division and Interdivisional Body leaders shall see that, wherever possible, these appointments are made with due respect to adequate geographical representation.

6. The Executive Committee may create Joint Bodies with other IUGG Associations and components of other ICSU Bodies to deal with topics of mutual interest and carries out the responsibilities of IAGA in the appointment of the appropriate leaders, members, or IAGA representatives, as is required.

In its dealings with non-IUGG Bodies, the Executive Committee shall not commit the name of the IUGG, or act on behalf of the IUGG, unless prior approval has been secured from the IUGG Executive Committee.

II. Administration

7. The President may at any time, with the approval of the Executive Committee, call an extraordinary General Assembly.

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* Adopted by the Extraordinary Assembly of the Association, Seattle, 1977 and modified by the Conference of Delegates, Seattle, 1977

The President shall be obliged to call such an Assembly at the request of not less than one-half of the Member Countries.

An extraordinary General Assembly shall have the same powers and be subjected to the same rules as an ordinary General Assembly.

Between ordinary General Assemblies of IAGA, Scientific Assemblies may be held in accordance with IUGG By-Laws.

8. Notice of the date and of the place of the meeting of any Assembly shall be sent by the Secretary General to the Member Countries at least nine months before that Assembly.

9. The provisional agenda of the meetings of the Conference of Delegates shall be prepared by the Secretary General and circulated to IAGA National Bodies at least three months before the opening of an Assembly. The provisional agenda shall include all items which have been submitted by IAGA National Bodies for discussion at the Conference of Delegates, together with questions placed on the provisional agenda by the Executive Committee. Any of which notice has not thus been given may only be discussed with the consent of the Conference of Delegates.

10. The meeting of the Conference of Delegates shall be open to the public. Any non-delegate may be heard in a discussion provided that person has been previously recognized by the President.

The President may, on his own initiative or at the request of a IAGA National Body, invite representatives of scientific bodies or individuals to attend a meeting of the Conference of Delegates in an advisory capacity.

11. A Member Country which is not represented at a meeting of the Conference of Delegates may vote by correspondence on any specific question of the type indicated in Articles 14 and 15 of the Statutes, with the exception of the election of the Executive Committee, provided that the question has been clearly defined in the final agenda distributed in advance to the Member Countries, provided that the substance of the questions has not been changed and provided that the said vote has been received by the Secretary General prior to the meeting.

Before a vote, the President shall decide whether the procedure of voting by correspondence applies. The President's ruling may be challenged as prescribed in Statute 17.

12. A Chief Delegate of a Member Country may designate another delegate from that country to be his representative at all or part of a meeting of the Conference of Delegates or, if he is unable to do this, the duly accredited Delegates from that Member Country may designate one of their number to be such a representative of the Chief Delegate. In either case, the Secretary General shall be informed prior to the meeting of the Conference of Delegates at which the representative of the Chief Delegate is to act.

13. At least six months before the opening of an Ordinary General Assembly, the President in consultation with the Executive Committee shall appoint a Nominating Committee, consisting of a Chairman and four members. Members of the Executive Committee may not be appointed to the Nominating Committee.

The Nominating Committee is required to present to the Conference of Delegates at least one candidate for each position of the Executive Committee, at least four days prior to the election.

Besides the proposals of the Nominating Committee, a Chief Delegate may make other nominations in writing to the Chairman of the Nominating Committee, at least two days prior to the election. The combined list of candidates must be made public at least one day prior to the election.

In general, the composition of the Executive Committee should reflect adequate geographical and disciplinary balance.

The election of officers shall be by secret ballot. The President shall select two scrutineers from among the Delegates present. The scrutineers shall not be members of the Executive Committee nor of the Nominating Committee nor candidates for elections.

14. The Executive Committee shall be convened by the President.

At a meeting of the Executive Committee, no member can be represented by another person. For the validity of the deliberations of the Executive Committee, at least half of its members must be present. All decisions of the Executive Committee shall be taken by simple majority of the total number of voting members present. In the case of a tie, the decision shall rest with the President.

When the importance and the urgency of a decision warrant it, a vote by correspondence may be organized by the Secretary General at the request of the President. It is subject to the same rules for validity and majority.

The President may, on his own initiative or at the request of another member of the Executive Committee or of an IAGA National Body, invite representatives of scientific bodies or individuals to attend an Executive Committee meeting in an advisory capacity.

15. Proposals concerning the agenda for meetings of the Executive Committee may be submitted by members of that Committee, by Division or Interdivisional Body leaders, or by IAGA National Bodies; they shall be in the hands of the Secretary General at least three months before the meeting. The final agenda after its approval by the President shall be distributed to the members of the Executive Committee at least one month prior to the meeting. Questions that have not been placed on the agenda may not be discussed at a meeting of the Executive Committee, unless a request to that effect has been approved by the Executive Committee.

16. In addition to the duties specified in Articles 6 and 8 of the IAGA Statutes and Articles 2, 3 and 6 of these By-Laws, and subject to general or special directives of the Conference of Delegates, the Executive Committee shall have the power to:

a) act as the organizing committee for all IAGA Assemblies, Symposia and Meetings, or delegate such responsibility to other persons by making the necessary appointments;

b) entrust to special commissions or to particular individuals the preparation of reports on subjects within the province of the Association;

c) invite or appoint persons or representative institutions belonging to countries which are not members of the Association, to be corresponding members of the Association.

17. The duties of the President of the IAGA are:

a) to represent IAGA in the IUGG Executive Committee;

b) to represent IAGA in its dealings with IAGA National Bodies, the other IUGG Associations and other ICSU Bodies;

c) to represent or to appoint a person to represent IAGA at meetings, conferences or celebrations where formal representation is requested or desirable;

d) to convene the Conference of Delegates and the meetings of the Executive Committee and to preside over their meetings; and

e) to submit a report to the ordinary Conference of Delegates at each General Assembly on the scientific work of the Association.

18. The duties of the Vice-Presidents, one or the other as shall be determined by the Executive Committee, are to preside at Conferences of Delegates or Executive Committee meetings in case of impediment to the President, and to represent the President in such an event at IUGG Executive Committee Meetings, as specified in Article 11, paragraph 2, of the IUGG By-Laws. The President may designate one of the Vice-Presidents to act on his behalf in any other function, meeting or conference in which formal representation of IAGA is requested or desirable.

19. The duties of the Secretary General are:

a) to serve as secretary of IAGA, to organize the Assemblies according to the instructions of the Executive Committee, to arrange for the meetings of the Executive Committee, to prepare and distribute promptly the agenda and the minutes of the meetings of the Conference of Delegates and of the Executive Committee;

b) to manage the administrative and scientific affairs of the Association, to attend to cor-

respondence, to maintain and preserve the records;

c) to inform members of the Executive Committee, during the interval between its meetings, about any important affair concerning the Association;

d) to advise the President during the meetings of the IUGG Executive Committee;

e) to receive and keep charge of such funds as may be allocated by the IUGG to the Association, or as may be received from any other source, to disburse such funds in accordance with the decisions of the Conference of Delegates or with the instructions of the Executive Committee, to keep the account of all receipts and disbursements and to submit such account, audited by a qualified accountant, for examination by the Finance Committee appointed according to Article 12 of the IAGA Statutes;

f) to prepare and publish the program and the transactions of the General Assembly;

g) to publish an internal Association bulletin (such as IAGA News) containing all information of general interest to the Association;

h) to prepare for each Assembly the list of the Delegates and Chief Delegates; and

i) to perform such other duties as may be assigned by the President or by the Executive Committee.

III. Finances

20. In the estimation of expenditures by the Secretary General and approval thereof by the Executive Committee, mentioned in Article 11 of the IAGA Statutes, provision shall be made to allocate the expected funds to the following items listed in order a), b), c) of decreasing priority:

a) Operation of the Secretariat of the Association, including the administrative arrangements in preparation for Assemblies and Executive Committee meetings, the publication of IAGA News and IAGA Transactions, and the travel expenses incurred in the representation of IAGA at IUGG Executive Committee meetings.

Meetings of the Executive Committee during General Assemblies, including travel expenses for the Executive Committee members who cannot otherwise obtain support.

Minor administrative expenses requested by those leaders of Joint Bodies, Divisions and Interdivisional Bodies who have expressed in writing that they were unable to obtain the necessary support from the IAGA National Body, if any, of their country, and from their home institution.

b) Meetings of the Executive Committee that are to take place between Assemblies, including travel expenses for the Executive Committee members.

Partial travel expenses to official administrative or IAGA-sponsored scientific meetings for those leaders of Divisions, Interdivisional Bodies and Joint Bodies, and those invited speakers, conveners, or program committee members, whose participation is judged by the Executive Committee to be essential for the success of the meeting, and who have expressed in writing that they were unable to obtain the necessary support from their home institution.

Travel expenses for the President to attend functions as the representative of IAGA.

Assistance as necessary with the regular publication of the international series of Geomagnetic Indices for which IAGA has primary responsibility.

c) Special publications, special administrative expenses, or any other item not mentioned in a) and b) above which is in accordance with the objectives of the Association.

STUTUTS ET REGLEMENT INTERIEUR NOUVEAUX

ASSOCIATION INTERNATIONALE DE GEOMAGNETISME ET D'AERONOMIE

STATUTS*

I. Buts, Structure et Composition de l'Association

1. Les buts de l'Association Internationale de Géomagnétisme et d'Aéronomie (AIGA) sont:

a) promouvoir les études de magnétisme et d'aéronomie relatives à la Terre et aux autres corps du système solaire et celles du milieu interplanétaire et de son interaction avec ces corps, lorsque ces études ont un intérêt international,

b) encourager les recherches faites indépendamment, dans ces divers domaines par des pays, des institutions ou des personnes et faciliter leur coordination internationale,

c) permettre, sur le plan international, la discussion et la publication des résultats des recherches précédentes,

d) promouvoir une normalisation convenable des programmes d'observation, des dispositifs d'acquisition de données ainsi que de leurs analyses et publications.

2. Pour atteindre ses buts, l'Association peut établir un nombre quelconque d'Organismes, aussi bien à l'intérieur de l'Association qu'en commun avec d'autres Associations de l'UGGI ou avec des sections d'autres Organismes du CIUS.

3. Les pays qui adhèrent à l'UGGI sont membres de l'AIGA et peuvent participer à ses activités.

4. Chaque Pays Membre est représenté par un Organisme unique (appelé Organisme National de l'AIGA), établi par l'Organisme de ce pays qui a adhéré l'UGGI.

II. Administration

5. Le fonctionnement de l'Association est dirigé par la Conférence des Délégués.

La Conférence des Délégués se compose des Délégués des Pays Membres, dont l'accréditation a été communiquée au Secrétaire Général avant le début de l'Assemblée par les Organismes Nationaux respectifs de l'AIGA. L'un des Délégués de chaque Pays Membre est désigné par son Organisme National comme Chef de Délégation pour voter au nom de son pays sur les questions administratives et financières ainsi qu'il est stipulé aux articles 14 et 15 des présents Statuts.

Un Délégué ne peut représenter qu'un seul Pays Membre. Un membre du Comité Exécutif (voir article 7 des Statuts) ne peut être Chef de Délégation, sauf s'il est le seul représentant du pays en question.

La Conférence des Délégués est convoquée durant chaque Assemblée de l'AIGA. Une Assem-

* Adoptés par l'Assemblée Générale Extraordinaire de l'Association à Seattle, en 1977.

blée Générale ordinaire de l'AIGA se tient normalement en même temps que chaque Assemblée Générale ordinaire de l'UGGI.

L'intervalle entre la fin d'une Assemblée Générale ordinaire et la fin de la suivante est désigné, dans ces Statuts, par le terme "période".

6. La responsabilité de la direction des affaires de l'AIGA entre les réunions de la Conférence des Délégués est confiée au Comité Exécutif de l'Association, élu par la Conférence des Délégués. Les décisions du Comité Exécutif doivent être présentées à la Conférence des Délégués. Toute décision ou recommandation ne recevant pas l'agrément de celle-ci peut être renvoyée au Comité Exécutif pour nouvelle étude.

7. Le Comité Exécutif comprend le Président, deux Vice-Présidents, le Secrétaire Général, cinq autres Membres, et le Président sortant, en tant que membre de droit.

A l'exception du Président sortant, tous les membres du Comité Exécutif sont élus par la Conférence des Délégués selon la procédure prévue pour les questions d'ordre administratif à l'article 14 des Statuts.

Le Président est élu pour une période, et ne peut être réélu à la même fonction. Les Vice-Présidents sont élus pour une période, et peuvent être réélus une fois. Un Vice-Président sortant peut être élu Président. Le Secrétaire Général est élu pour deux périodes; il peut être réélu plusieurs fois pour une période. Les cinq autres Membres sont élus pour une période et peuvent être réélus plusieurs fois pour une période; ils ne peuvent rester en fonction pendant plus de trois périodes consécutives. Le Président sortant est membre de droit pour une seule période.

En cas de vacance en son sein, le Comité Exécutif a pouvoir de désigner quelqu'un pour remplir la vacance jusqu'à la fin de la période. L'éligibilité ultérieure d'une personne ainsi désignée n'en sera pas affectée. Si la vacance est celle du Président, le Comité Exécutif désignera l'un des Vice-Présidents pour exercer les fonctions de Président jusqu'à la fin de la période.

8. Le Comité Exécutif doit administrer l'Association conformément aux présents Statuts et au Règlement Intérieur ainsi qu'aux décisions de la Conférence des Délégués.

Le Comité Exécutif se réunit au début et à la fin d'une Assemblée et au moins une fois entre les Assemblées Générales ordinaires.

9. Le rôle des Organismes intérieurs à l'AIGA (cf. Article 2 des Statuts) est de servir les buts scientifiques de l'Association en prenant en charge la coordination des recherches scientifiques, en organisant des réunions scientifiques, en promouvant l'échange d'informations et de données entre chercheurs et en conseillant le Comité Exécutif en ce qui concerne la définition d'une politique générale en vue d'orienter les travaux scientifiques de l'Association.

10. Le rôle des Organismes qui sont institués en liaison avec d'autres Associations de l'UGGI ou des membres d'autres Organismes du CIUS (cf. Article 2 des Statuts) est d'assurer la coordination des programmes ou des réunions scientifiques qui concernent des sujets d'intérêt mutuel.

III. Finances

11. Le Secrétaire Général prépare, pour chaque période, un projet de budget des recettes et des dépenses pendant cette période. Au cours de la session de l'Assemblée Générale qui précède immédiatement cette période, le Secrétaire Général présente ce projet au Comité Exécutif et, après approbation de la Conférence des Délégués, peut engager les dépenses prévues au budget.

12. Au moins six mois avant l'ouverture d'une Assemblée Ordinaire, le Comité Exécutif désigne un Comité des Finances pour examiner les comptes et présenter à la Conférence des Délégués un rapport sur les résultats de cette vérification. Un membre du Comité Exécutif ne peut être en même temps membre du Comité des Finances.

IV. Droit de Vote

13. Lorsqu'un vote porte sur une question d'ordre exclusivement scientifique, chaque Délégué dûment accrédité et présent à une réunion de la Conférence des Délégués dispose d'une voix.

14. Pour les questions d'ordre administratif, le vote a lieu par Pays Membre, chaque Pays Membre disposant d'une voix en la personne du Chef de Délégation (ou de son représentant, conformément au Règlement Intérieur).

15. Pour les questions d'ordre financier, le vote a lieu par Pays Membre, chacun d'eux disposant d'un nombre de voix égal au numéro de la catégorie d'appartenance à l'UGGI. Les voix sont exprimées par les Chefs de Délégation de chaque Pays Membre (ou par leurs représentants, conformément au Règlement Intérieur).

16. Les questions qui sont en partie d'ordre scientifique et en partie d'ordre administratif et qui ne mettent pas en jeu de questions financières, sont considérées comme administratives.

17. Avant un vote, le Président décide si la question à débattre est d'ordre financier, administratif ou scientifique. La décision du Président ne peut être contestée que par le Chef de Délégation d'un Pays Membre. Dans cette éventualité, la décision du Président peut être modifiée par les Chefs de Délégation, à la majorité des deux tiers des présents.

18. Les votes sur des questions d'ordre administratif ou financier peuvent se faire par correspondance (conformément au Règlement Intérieur).

19. Pour la validité des délibérations de la Conférence des Délégués, la moitié au moins des Chefs de Délégation accrédités doivent être présents (ou représentés conformément au Règlement Intérieur).

Les décisions de la Conférence des Délégués sont prises à la majorité simple, sauf dans les cas spécifiés par les présents Statuts. S'il y a égalité de voix, la décision appartient au Président. La majorité simple ou la majorité des deux tiers sont calculées par le rapport des votes affirmatifs à la somme des votes affirmatifs et négatifs.

V. Généralités

20. Ces Statuts, de même que toute modification ultérieure, prennent effet à compter de la clôture de l'Assemblée Générale à laquelle ils ont été adoptés, sauf décision contraire de la Conférence des Délégués.

21. Ces Statuts ne peuvent être modifiés qu'avec l'approbation d'une majorité des deux tiers des Pays Membres qui ont accrédité des Délégués à l'Assemblée ,conformément aux articles 5 et 14 des Statuts.

22. Seuls les Pays Membres peuvent proposer une modification de ces Statuts. Toute proposition doit parvenir au Secrétaire Général au moins six mois avant la date annoncée pour l'Assemblée Générale à laquelle elle sera examinée. Le Secrétaire Général devra notifier les changements proposés à tous les Pays Membres au moins quatre mois avant la date annoncée pour l'Assemblée Générale.

23. La Conférence des Délégués est habilitée à adopter un Règlement Intérieur, dans le cadre des Statuts de l'Association. Ce Règlement Intérieur est adopté et peut être modifié par un vote à la majorité simple des Pays Membres qui ont accrédité des Délégués à l'Assemblée, conformément aux articles 5 et 14 des Statuts. Le Règlement Intérieur, ou toute autre modification ultérieure de celui-ci, prend effet à compter de la clôture de l'Assemblée Générale au cours de laquelle il a été adopté, sauf décision contraire de la Conférence des Délégués.

24. Les présents Statuts ont été rédigés dans les langues officielles de l'UGGI. Le texte anglais fait foi en cas de problème d'interprétation.

REGLEMENT INTERIEUR*

I. Structure

1. L'AIGA est composée de Divisions et d'Organismes Inter-Divisions (Commissions ou Groupes de Travail). Ce sont:

Division I : Champs Magnétiques Internes
Division II : Phénomènes Aéronomiques
Division III : Phénomènes Magnétosphériques
Division IV : Vent Solaire et Champ Magnétique Interplanétaire
Division V : Observatoires, Instruments, Indices et Données
Commission Inter-Divisions : Recherche Antarctique
Commission Inter-Divisions : Histoire
Commission Inter-Divisions : Moyenne Atmosphère
Groupe de Travail Inter-Divisions : Relations entre Variations Magnétiques Externes et Internes.

2. Chaque Division ou Organisme Inter-Divisions soumet son rôle, sa propre structure et son mode de fonctionnement à l'approbation du Comité Exécutif. Le rôle et l'efficacité de chaque Division et Organisme Inter-Divisions sont réexaminés par le Comité Exécutif à chaque Assemblée Générale ordinaire.

3. Les responsables des Divisions et des Organismes Inter-Divisions sont nommés par le Comité Exécutif pour une période, sous réserve de ratification par la Conférence des Délégués. Les vacances survenant au cours d'une période sont pourvues par le Comité Exécutif.

Pour que leur nomination devienne effective, les responsables de Divisions et d'Organismes Inter-Divisions doivent adresser au Président une lettre d'acceptation exprimant leur volonté de servir dans les fonctions auxquelles ils sont appelés.

4. Les responsables des Divisions et des Organismes Inter-Divisions sont habilités à désigner, pour chaque période, des rapporteurs, des responsables de groupes de travail et les responsables d'autres sous-divisions possibles.

5. Etant bien entendu que les principaux critères pour les désignations visées aux articles 3 et 4 de ce Règlement Intérieur sont la compétence scientifique et administrative des candidats, le Comité Exécutif et les responsables de Divisions et d'Organismes Inter-Divisions veillent à ce que, dans toute la mesure du possible, ces désignations tiennent compte d'une représentation géographique adéquate.

6. Le Comité Exécutif peut créer des Organismes Communs avec d'autres Associations de l'UGGI ou avec des sections d'autres Organismes du CIUS en vue de traiter de sujets d'intérêt commun; il exerce la responsabilité de l'AIGA dans la désignation, en fonction des besoins, de leurs responsables, de leurs membres ou des représentants de l'AIGA.

Dans ses relations avec des Organismes n'appartenant pas à l'UGGI, le Comité Exécutif ne peut engager l'UGGI, ou agir au nom de l'Union, sans l'accord préalable du Comité Exécutif de l'UGGI.

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* Adopté par l'Assemblée Générale Extraordinaire de l'Association à Seattle, en 1977, et modifié par la Conférence des Délégués à Seattle, en 1977.

II. Administration

7. Le Président peut à tout moment, avec l'approbation du Comité Exécutif, convoquer une Assemblée Générale extraordinaire.

Le Président est tenu de convoquer une telle Assemblée si elle est demandée par la moitié au moins des Pays Membres.

Une Assemblée Générale extraordinaire a les mêmes pouvoirs et est soumise aux mêmes règles qu'une Assemblée Générale ordinaire.

Entre les Assemblées Générales ordinaires de l'AIGA, des Assemblées scientifiques peuvent être tenues, conformément au Règlement Intérieur de l'UGGI.

8. Le Secrétaire Général notifie aux Pays Membres la date et le lieu de réunion de toute Assemblée au moins neuf mois à l'avance.

9. L'ordre du jour provisoire des réunions de la Conférence des Délégués est préparé par le Secrétaire Général et communiqué aux Organismes Nationaux au moins trois mois avant l'ouverture de l'Assemblée. Y figurent toutes les questions qui ont été soumises par les Organismes Nationaux pour être discutées par la Conférence des Délégués, ainsi que celles qui ont été proposées par le Comité Exécutif. Toute question qui n'aurait pas été ainsi notifiée ne peut être examinée qu'avec l'assentiment de la Conférence des Délégués.

10. Les réunions de la Conférence des Délégués sont publiques. Tout non-délégué peut participer à une discussion, pourvu que le Président l'y ait autorisé.

Le Président peut, de sa propre initiative ou à la demande d'un Organisme National de l'AIGA, inviter des représentants d'organismes scientifiques ou des personnalités à assister à une réunion de la Conférence des Délégués avec voix consultative.

11. Un Pays Membre qui n'est pas représenté à une réunion de la Conférence des Délégués peut voter par correspondance sur toute question du type indiqué aux articles 14 et 15 des Statuts, à l'exception de l'élection du Comité Exécutif, pourvu que la question ait été clairement définie dans l'ordre du jour définitif distribué à l'avance aux Pays Membres, que la substance de la question n'ait pas été changée et que le vote du Pays soit parvenu au Secrétaire Général avant la réunion.

Avant un vote, le Président décide si la procédure de vote par correspondance s'applique. La décision du Président peut être remise en cause ainsi qu'il est décrit dans l'article 17 des Statuts.

12. Le Chef de Délégation d'un Pays Membre peut désigner un autre délégué de ce pays pour le représenter à tout ou partie d'une réunion de la Conférence des Délégués. Si le Chef de Délégation est dans l'impossibilité de faire cette désignation, les Délégués dûment accrédités de ce pays peuvent désigner un des leurs comme représentant du Chef de Délégation. Dans les deux cas, le Secrétaire Général en sera informé avant la réunion de la Conférence des Délégués à laquelle le représentant du Chef de Délégation aura à exercer son mandat.

13. Au moins six mois avant l'ouverture d'une Assemblée Générale ordinaire, le Président, après consultation du Comité Exécutif, désigne un Comité des Nominations, composé d'un Président et de quatre Membres. Les membres du Comité Exécutif ne peuvent pas faire partie de ce Comité.

Le Comité des Nominations est chargé de présenter à la Conférence des Délégués au moins un candidat pour chaque poste à pourvoir au Comité Exécutif et cela au moins quatre jours avant l'élection. En dehors de ces propositions du Comité des Nominations, un Chef de Délégation peut présenter d'autres candidatures en écrivant au Président du Comité des Nominations au moins deux jours avant l'élection. L'ensemble de toutes ces candidatures doit être rendu public au moins un jour avant l'élection.

En général, la composition du Comité Exécutif devrait refléter un équilibre convenable entre régions et entre disciplines.

L'élection des membres du Comité Exécutif est faite à bulletins secrets. Le Président choisit

deux scrutateurs parmi les Délégués présents qui ne sont ni membres du Comité Exécutif, ni membres du Comité des Nominations, ni candidats aux élections.

14. Le Comité Exécutif est convoqué par le Président.

Lors d'une réunion du Comité Exécutif, aucun de ses membres ne peut se faire représenter par une autre personne. Pour la validité des délibérations du Comité Exécutif, la moitié au moins des membres doivent être présents. Toutes les décisions du Comité sont prises à la majorité simple du nombre total des membres présents. S'il y a égalité des voix, la décision appartient au Président.

Lorsque l'importance et l'urgence d'une décision le justifient, un vote par correspondance peut être organisé par le Secrétaire Général à la demande du Président. Les mêmes règles de validité et de majorité s'appliquent.

Le Président peut, de sa propre initiative ou à la requête d'un autre Membre du Comité Exécutif ou d'un Organisme National de l'AIGA, inviter des représentants d'organismes scientifiques ou des personnalités à assister à une réunion du Comité Exécutif avec voix consultative.

15. Les propositions relatives à l'ordre du jour des réunions du Comité Exécutif peuvent être présentées par les membres de ce Comité, par les responsables de Division ou d'Organisme Inter-Divisions, ou par les Organismes Nationaux de l'AIGA; elles doivent parvenir au Secrétaire Général trois mois au moins avant la réunion. L'ordre du jour définitif, après approbation du Président, doit être envoyé aux Membres du Comité Exécutif un mois au moins avant la réunion. Une question non inscrite à l'ordre du jour ne peut être discutée à une réunion du Comité Exécutif, sauf si une requête en ce sens a reçu l'approbation du Comité Exécutif.

16. Outre les fonctions définies aux articles 6 et 8 des Statuts de l'AIGA et aux Articles 2, 3 et 6 du présent Règlement Intérieur et dans la limite des directives générales et particulières de la Conférence des Délégués, le Comité Exécutif est habilité:

a) à agir en tant que comité d'organisation pour toutes les Assemblées, Colloques et Réunions de l'AIGA, ou à déléguer cette responsabilité à d'autres personnes en faisant les désignations nécessaires.

b) à confier à des commissions spéciales ou à certaines personnalités la préparation de rapports sur des sujets de la compétence de l'Association.

c) à inviter ou désigner, comme membres correspondants de l'Association, des personnalités ou des institutions représentatives de pays qui ne sont pas membres de l'Association.

17. Les attributions du Président de l'AIGA sont:

a) de représenter l'AIGA au Comité Exécutif de l'UGGI,

b) de représenter l'AIGA dans ses relations avec les Organismes Nationaux correspondants, les autres Associations de l'UGGI et les autres organismes du CIUS,

c) de représenter ou de désigner une personne pour représenter l'AIGA aux réunions, conférences ou cérémonies où une représentation officielle est requise ou souhaitable,

d) de convoquer et de présider les réunions de la Conférence des Délégués et du Comité Exécutif

e) et de soumettre à la Conférence ordinaire des Délégués à chaque Assemblée Générale, un rapport sur les travaux scientifiques de l'Association.

18. Les attributions des Vice-Présidents, l'un ou l'autre selon les dispositions prises par le Comité Exécutif, sont, en cas d'empêchement du Président, de présider les réunions des Conférences des Délégués ou du Comité Exécutif et de représenter le Président aux réunions du Comité Exécutif de l'UGGI, conformément à l'article 11, paragraphe 2, du Règlement Intérieur de l'UGGI.

Le Président peut désigner l'un des Vice-Présidents pour agir en son nom en toute autre fonction ou lors de réunions ou conférences pour lesquelles une représentation officielle de l'AIGA est requise ou souhaitable.

19. Les attributions du Secrétaire Général sont:

a) d'assurer le secrétariat de l'AIGA, d'organiser les Assemblées conformément aux directives du Comité Exécutif, d'organiser les réunions du Comité Exécutif, de préparer et de distribuer

rapidement l'ordre du jour et les compte-rendus des réunions de la Conférence des Délégués et du Comité Exécutif,

b) de gérer les affaires administratives et scientifiques de l'Association, de s'occuper de la correspondance, de tenir à jour les archives et d'en assurer la conservation,

c) de tenir informés les membres du Comité Exécutif, entre les réunions de ce dernier, de toute affaire importante concernant l'Association,

d) d'assister le Président au cours des réunions du Comité Exécutif de l'UGGI,

e) de recevoir et de gérer les fonds qui peuvent être alloués à l'Association par l'UGGI ou qui peuvent provenir de toute autre origine, de dépenser ces fonds conformément aux décisions de la Conférence des Délégués ou aux instructions du Comité Exécutif, de tenir le compte de toutes les recettes et dépenses et de soumettre ce compte, certifié par un comptable qualifié, à la vérification du Comité des Finances désigné selon l'article 12 des Statuts de l'AIGA,

f) de préparer et publier le programme et les compte-rendus de l'Assemblée Générale,

g) de publier un bulletin interne à l'Association (tel que le IAGA News) contenant les informations d'intérêt général pour l'Association,

h) de préparer, pour chaque Assemblée, la liste des Délégués et Chefs de Délégation

i) et d'accomplir toute autre tâche qui peut lui être confiée par le Président ou par le Comité Exécutif.

III. Finances

20. Lors de la prévision des dépenses par le Secrétaire Général et au moment de son approbation par le Comité Exécutif, comme mentionné à l'Article 11 des Statuts de l'AIGA, les fonds attendus sont affectés, par ordre a), b), c) de priorité décroissante, aux besoins suivants:

a) Fonctionnement du Secrétariat de l'Association, y compris la préparation administrative des Assemblées et des réunions du Comité Exécutif, la publication des IAGA News et des compte-rendus, et les dépenses de voyage liées à la représentation de l'AIGA aux réunions du Comité Exécutif de l'UGGI.

Réunions du Comité Exécutif durant les Assemblées Générales, y compris les frais de voyage des Membres du Comité Exécutif qui ne peuvent obtenir un autre soutien financier.

Dépenses administratives mineures demandées par les Responsables des Organismes Communs, des Divisions et des Organismes Inter-Divisions qui ont indiqué, par écrit, qu'ils n'ont pu obtenir le soutien nécessaire de l'Organisme National de l'AIGA,s'il existe dans leur pays, ou de l'Institution à laquelle ils appartiennent.

b) Réunions du Comité Exécutif qui ont lieu entre les Assemblées, y compris les frais de voyage des membres du Comité Exécutif.

Contribution partielle aux frais de voyage, pour des réunions officielles soit administratives soit scientifiques et patronnées par l'AIGA, qu'il s'agisse de responsables de Division, d'Organisme Inter-Division et d'Organisme Commun ou qu'il s'agisse de conférenciers, d'organisateurs ou de membres d'un comité des programmes, dont le Comité Exécutif juge la participation essentielle au succès de la réunion et qui ont indiqué par écrit qu'ils n'ont pu obtenir le soutien nécessaire de l'Organisme National de l'AIGA, s'il existe dans leur pays, ou de l'Institution à laquelle ils appartiennent.

Frais de voyage du Président pour remplir ses fonctions de représentation de l'AIGA.

Aide, si nécessaire, aux publications régulières du Service International des Indices Géomagnétiques, dans lesquelles l'AIGA a une responsabilité fondamentale.

c) Publications particulières, dépenses administratives particulières ou tout autre besoin non mentionné en a) ou b) et conformes aux buts de l'Association.

MINUTES OF THE IAGA EXECUTIVE COMMITTEE

Seattle, Washington, U.S.A.

The IAGA Executive Committee (henceforth EC) met eight times in connection with the Seattle Assembly:
August 21, 1400–1705; August 23, 1745–1945; August 26, 1800–2000; August 27, 1010–1230; August 30, 1730–2145; August 31, 1300–1635; September 2, 1730–1930; September 3, 1150–1245.

All EC members were present except A. J. Dessler at the first session, and M. Ackerman at the fourth session. Honorary EC member T. Nagata attended the first session, and M. Nicolet the second, fifth, seventh and eighth sessions. The fifth and sixth sessions were devoted to meeting with the IAGA Division Chairmen. The third session was a joint meeting with the IAMAP Executive Committee.

The minutes of the meeting with Division leaders and a report on the joint meeting with IAMAP EC members are given on pp. 40–45 and pp. 46–47, respectively. The following is a summary of discussions and conclusions of the EC meetings only (not always keeping the chronological order).

I. Approval of the Agenda

Gadsden proposed to include an item V.b on the Middle Atmosphere Program (MAP), although this would also include a part of item VIII, namely the cooperation with SCOSTEP. This was approved.

Gadsden proposed to include as an item the approval of the minutes of the 1976 EC meeting. Roederer reminded the EC that the minutes in question have been approved by correspondence and published in IAGA News No. 15. Gadsden pointed out that the approval was not unanimous and that he wished to have it noted that he had raised some objections to the minutes of the previous meeting in his letter of November 12, 1976, to the General Secretary.

II. New Statutes and By-Laws

Roederer remarked that it is impossible to expect to obtain a 2/3 majority vote of all IUGG member countries, some of which are not interested in IAGA and have never responded to IAGA mailings. Not even a postal vote could remedy this situation. In the context of this matter, he pointed out an important difference in the meaning of the French and English texts in the present Statute No. 2. The authoritative French text translates correctly as saying "countries which adhere to the IUGG have the right to *register* as members of IAGA". ("Les pays qui adhèrent a l'Union Géodésique et Géophysique Internationale auront le droit de s'inscrire comme membres de l'Association et de nommer des délégués pour se faire représenter aux reunions de l'Association.") It was agreed by all EC members present that, as a consequence of the interpretation of the authoritative French

text of IAGA Statute No. 2, only those countries which have officially designated IAGA Correspondents and communicated this designation or appointment to IAGA or IUGG are to be considered voting members of IAGA. Out of 76 IUGG member countries, 57 fall into this category. Out of these, 2 are disqualified to vote by reason of IUGG Statute No. 11. This leaves the number of voting members at 55, with the 2/3 majority necessary to pass new Statutes (IAGA Statute 23, section 2) standing at 37.

Procedural matters for the Extraordinary General Assembly were discussed and approved (see Report on the Extraordinary General Assembly).

III.a. Report on the IUGG EC Meeting in Durham

Roederer gave an account of the IUGG EC meeting, which took place August 5–7, 1977, in Durham, in conjunction with an Extraordinary General Assembly of IUGG to discuss the admission of the People's Republic of China. He pointed out that he would concentrate on items of interest or direct concern to IAGA.

Concerning the question of countries in arrears of payment, IUGG Secretary General Melchior has instructed the Secretaries of all Associations to stop sending any kind of material of the Associations to these countries and, of course, to prevent them from taking part in a vote. [In this context, the EC asked Secretary Fukushima to write to these countries and tell them that from now on their National Committees will not receive IAGA publications, as per instructions from the IUGG Secretary General, and at the same time recommend that they take steps to rectify the situation so that we can again send them our material. This withholding of publications will not apply to individual scientists of these countries.]

The Executive Committee of IUGG has formalized a policy which refers to scientists from non-member countries or countries in arrears attending meetings of IUGG bodies. These scientists can still participate as individuals, but their badges should state the *institution* of origin, *not* the country.

Roederer turned to the Union's Finance Committee report. The important item to report was that the Chairman of the Finance Committee has seriously mentioned the possibility of deferred payments to the Associations, because (1) a UNESCO contribution to the Union has been decreased substantially, and (2) countries have been very remiss in meeting the deadline for payment of dues—the whole Union was in effect almost one year behind in income because of this. The Finance Committee also reported that it is recommending that the Union approach the Associations with an appeal to share in the expenses of special projects (e. g., the Geodynamics Project).

IAGA has been asked to submit to IUGG the name of the IUGG–IAGA representative on the WDC Panel of ICSU. This panel is supposed to become particularly active in view of the upcoming data-intensive programs—some of them already existing—such as GARP and IMS. In other words, the person should be *very* familiar with data handling, particularly with the modern techniques of storage, handling, compression, etc. [The EC decided to recommend the name of Dr. Hiroshi Maeda* from the University of Kyoto, Japan.]

* Dr. Maeda has agreed to serve in such capacity if appointed by IUGG.

Roederer then reported that the IUGG Executive Committee has appointed Mr. Alan H. Shapley as IUGG representative in the Geosciences Panel of CODATA. [The EC noted this with satisfaction since Mr. Shapley is strongly related to IAGA.]

Concerning the IUGG Assembly in Canberra, Prof. P. Angus-Leppan, Chairman of the Local Organizing Committee in Australia, was invited to report on the preparations for the assembly. He distributed a memorandum with general information. The registration fee would be approximately 75 U. S. dollars. The first circular would be mailed out in May 1978. It was mentioned during the discussion that ICSU is considering levying a $5 head tax on each participant in any Union meeting.

20 topics were selected for the IUGG symposia at the Canberra Assembly, and all Associations were asked to recommend their conveners or program committee members. IAGA was asked to send to the IUGG Secretary General a sample of the IAGA instructions to conveners for the Seattle Assembly to be used as a prototype circular for all Union symposia and Association sessions. Some technical problems were also discussed, such as maximum number of papers per day, frequency of slide showing, judgement for adoption or rejection of submitted papers, etc. It was emphasized that all conveners of Union symposia *must* prepare a two-page report on their session for publication in the IUGG Chronicle (apparently this was not sufficiently enforced at Grenoble).

During the next General Assembly there will again be Union lectures; the final selection will be made by the President of the Union. He requests all Associations to send suggestions by November 1. There have been some suggestions: Second Objectives of GARP; Extraterrestrial Techniques for Positioning; Comparative Planetology; Hydrology; and Deep Sea Drilling.

International Geodynamics Project: It will end in 1979; however, there are proposals about a continuation. It was made clear that it should not be merely a continuation but something new centering on crustal dynamics, including satellite imagery. An explicit aim should be to set up a framework to study processes relevant to the exploitation of economic resources: the understanding of processes related to concentration of hydrocarbons and other mineral resources. A 10-year program is being proposed, starting perhaps in 1980 or 1981. The promoters would like to see IASPEI–IAGA–IAVCEI–IAG participating.

Standard Earth Project: Dr. N. V. Shebalin, who is in charge of it, asked for extra time to deal with the project, promising that the first circular would be distributed in February 1978.

III.b. The IUGG Extraordinary General Assembly in Durham

Roederer proceeded to report briefly on the IUGG Extraordinary General Assembly held August 6, 1977, in Durham. After long negotiations with the People's Republic of China (PRC), first by the Secretary General of the Union and then including the new President, a motion was prepared by the Bureau of the Union and put to a vote of the member countries. The main items of the motion were: to accept the membership of the PRC; to cancel the representation of Taiwan in the Council; to reaffirm the right of every scientist to participate as an individual in IUGG Assemblies (Appendix Ia). Roederer pointed out that as a result of these negotiations the PRC took a more "conciliatory" stand and did not

request that the IUGG take certain steps which, for instance, the IUGS had to take prior to receiving the official application from the PRC.

This motion was sent out to the member countries and an Extraordinary General Assembly (EGA) was called to vote on it. Forty-seven countries were represented; seven votes were received by mail. Before the Council Meeting, the Executive Committee of IUGG decided that the application had scientific merit (such a decision is required by Union statutes). Also, the Finance Committee of the Union decided on category 6 for the PRC (the same, for example, as for the German Federal Republic). The motion was put before the Council Meeting and opened for discussion. The President of IUGG assured the Council that the officials of the PRC did not oppose having scientists from Taiwan participate as individuals in Union Assemblies and that the Union will continue to welcome the scientists of Taiwan as individuals to all its future meetings. During the discussion, the Presidents of the Associations were asked to make brief statements. Roederer explained that since the whole matter of the PRC application was termed "strictly confidential" by the Secretary General of IUGG, he was prevented from consulting the IAGA EC. He passed out to the EC members the statement which he had read on that occasion (Appendix Ib). His position at the Council meeting was, in summary, that the whole matter be tabled until 1979; this position was identical to that of at least two other Association Presidents. The Chief Delegate of Taiwan was recognized to make a detailed defense of his country's continued membership in the Union. Other delegates made statements pro and con. Put to a secret vote, the motion passed 47 to 7 with no abstentions, which therefore meant that the application of the People's Republic of China was accepted and the representation of Taiwan cancelled. The decision of the IUGG Council was later reported to the IUGG Extraordinary General Assembly, and obtained the concurrence of the accredited delegates present (with a smaller majority: affirmative, 47; negative, 30; abstentions, 5).

Roederer reported that after the decision had been confirmed by the Assembly, he had asked Secretary Fukushima to send telegrams both to the PRC and Taiwan (Appendix Ic). A reply was received from the chairman of the National Committee for Geodesy and Geophysics of the PRC expressing his thanks and regretting absence due to pressing time. No reply has been received so far from Taiwan.

IV. Instructions to Division Chairmen for Business Meetings during the Seattle Assembly

Division Chairmen will be informed that the IUGG Executive Committee has identified 20 Symposia of interassociation nature for the 1979 Canberra General Assembly, nine of them involving IAGA. They should be turned over to appropriate IAGA divisions. Division chairmen must propose candidates for conveners or program committee members. Fukushima will remind Division leaders that not too many IAGA sessions should be proposed, when they plan their own IAGA sessions in addition to the IUGG Symposia*.

Gadsden, who will act as Chairman of the Resolutions Committee during the Seattle Assembly, brought an extract of the IAGA principles for Resolutions (IAGA News No.

* The outcome of the discussion on the proposal of IAGA sessions for the Canberra Assembly is given in the report on the meeting with Division and Commission Chairmen.

13, page 18) for distribution to the Division and Commission Chairmen. He stressed that business should be kept to a minimum in a Scientific Assembly.

V.a. Consideration of Reports and Suggestions from Division Chairmen

The various reports from Divisions and Commissions were acknowledged with thanks. Gadsden remarked that four Division officers will have been in office (as Commission officers before 1973) for 8 years by 1979. The original idea in the IAGA reorganization was that they serve 2–4 years. Troitskaya proposed that we should be ready to do something in 1979. Weill proposed to wait until the new By-Laws are adopted and follow them in regard to this matter (By-Law No. 3).

V.b. The Middle Atmosphere Program (MAP)

Roederer displayed a copy of the MAP Planning Document which is an outcome of the MAP meeting held at Urbana, Illinois, U.S.A., shortly after the IAGA EC meeting at Peaceful Valley in 1976. He pointed out that a note on the position of IAGA about the Middle Atmosphere Program* prepared at Urbana by Vice Presidents Weill and Cole, the official IAGA representatives, was *not* included in the Planning Document. Cole reported that Dr. Bowhill is taking corrections for this document and that this statement can thus be included now.

Roederer then referred to a letter from Gadsden of September 27, 1976, in which he reports on a meeting with IAMAP Secretary Ruttenberg. The key points in this letter are the recommendations (i) to recognize the differences in modus operandi between IAGA and IAMAP (while, because of its structure, IAGA does not need a distinct liaison committee to coordinate joint symposia, IAMAP does); (ii) a satisfactory compromise for an ad hoc committee for the IAGA/IAMAP joint symposia is simply that our "Program Committee" works with whoever is designated by IAMAP and however the IAMAP designation is done (which is none of our business).

Returning to MAP, Roederer remarked that this project is strongly linked to the future of SCOSTEP. Cole, newly elected President of SCOSTEP, reported on the SCOSTEP Bureau meeting held here in Seattle just prior to our Assembly. He said that two members from IAGA needed to be appointed to the interim MAP Steering Committee. As to the

* The text of this note is as follows:

IAGA welcomes the successful development of sound scientific plans for MAP and is looking forward to the output of the MAP Planning Conference.

At its meeting on June 18–20, 1976, the IAGA Executive Committee discussed the means by which the Association could best contribute to the development and pursuit of the Middle Atmosphere Program. In this venture, IAGA intends to cooperate closely with IAMAP with a view to providing international organizational support to the Program. IAGA plans to investigate with IAMAP the possibility of jointly creating, for the duration of the Program, a Special Middle Atmosphere Commission having specially allocated funds. Such a joint commission, working closely with the appropriate Divisions of IAGA, Commissions of IAMAP, and other interested bodies, would function to further promote and develop the study of the Middle Atmosphere on an international basis.

K. D. Cole G. M. Weill

question of the continuation of SCOSTEP beyond 1980, the Bureau suggested that SCOSTEP be changed from a *Special* to a *Scientific* Committee (like COSPAR and SCAR). The extension of interunion cooperation in solar-terrestrial programs is well justified. This discipline is here to stay and several Unions are interested. Not only because of MAP; even the biosphere and biological phenomena are now being mentioned as targets of solar-terrestrial research. The Bureau will follow this approach: (i) ask the SCOSTEP national committees whether they wish to continue their financial support of SCOSTEP or a similar organization beyond 1980 (properly adjusted); (ii) ask SCOSTEP national comittees to persuade their country's delegate in the ICSU Council (in 1978) to support a positive solution to this problem for after 1980. Cole thinks that at the ICSU Executive Committee meeting in September 1977 the SCOSTEP matter will be postponed until the ICSU General Assembly in 1978.

Roederer called for comments on the question "Should we recognize that MAP is a SCOSTEP project and go ahead and nominate two representatives?". Dessler reaffirmed that an umbrella is needed for MAP. Gadsden pointed out that if our two representatives to MAP were also chairman and vice-chairman of a IAGA MAP Commission as proposed at the previous EC meeting in Peaceful Valley (see Minutes, item III.3 and IV), the stability of MAP would be assured. He proposed the formation of a special MAP Commission.

After a lengthy discussion, it was decided to propose to establish an *Interdivisional Commission on MAP**, with special funds (to be specified) for its function (see Minutes of previous meeting in Peaceful Valley, item IV). The Chairman and the Vice Chairman of this Commission shall be the IAGA Representatives in the interim MAP Steering Committee of SCOSTEP. This would require, according to the new By-Laws, an amendment of By-Law No. 1 at the Conference of Delegates ("Plenary") scheduled for September 3. According to By-Laws No. 3 and 2, respectively, the EC shall appoint the chairman and vice-chairman, and they would then decide on the structure of the Committee and its operation. However, the EC would like to see the following terms of reference explicitly included: (i) to act as a link between the IAGA Divisions and the MAP Steering Committee; (ii) to identify subjects for MAP that are specific to IAGA (airglow studies, particle precipitation effects, etc.) and build them into the MAP program; (iii) to maintain relations with the homologous body in IAMAP and coordinate work on MAP between both Associations.

After a lengthy discussion in which personal qualifications, fields of activity and geographic distribution were carefully considered, L. R. Megill from Utah State University, Logan, Utah (U.S.A.) was nominated chairman and J. Taubenheim from the Zentralinstitut für Solar-Terrestrische Physik, Berlin-Adlershof (GDR) was nominated for vice-chairman. Roederer was asked to contact Megill** and to cable Taubenheim***.

Cole suggested that the EC of IAGA pass a motion to the effect that IAGA endorses the further development of MAP, but Roederer stated that IAGA, having previously endorsed the concept of MAP, and having now appointed two persons as IAGA representatives

* The Conference of Delegates on September 3 decided to establish an Interdivisional Commission on the Middle Atmosphere, instead of the Middle Atmosphere Program (see p. 49).

** Agreed to serve.

*** Replied asking for details on tasks involved before deciding on acceptance, but agreed later to serve.

on the interim steering committee for MAP (as requested by SCOSTEP), has by these actions, surely endorsed the further development of MAP.

VI. IAGA-IAMAP Relations

The discussion turned to the joint IAGA and IAMAP EC meeting scheduled for August 26 at 18: 00. It was agreed that the President of IAGA act as host and the President of IAMAP be asked to chair the meeting. In considering the topics for that joint meeting, the question of organizing joint IAGA/IAMAP symposia in the future was brought up. It was decided that the responsibility for furthering communications between IAGA and IAMAP will be assigned to the Chairmen of Divisions II and III and of the Interdivisional Commission on MAP. It was hoped that IAMAP would identify a similar group to facilitate this interaction*. Tasks for this ad hoc group would be: (i) to help organize the program of joint symposia; (ii) to help organize joint scientific meetings on MAP; (iii) to keep the EC's informed of the Associations' activities of common interest; and (iv) to generate new ideas of cooperation.

It was also pointed out that the EC would welcome joint IAGA/IAMAP EC meetings in the future.

VII. Cooperation of IAGA with Other Bodies within IUGG

Fukushima reminded the EC that one action on this item has already been taken at the meeting with Division Chairmen: the appointment of D. A. Valencio to the Kisslinger Committee. Then he reported on his correspondence with the chairman of the IUGG Committee on Geochemistry. The EC concurred with the appointment of Dr. D. Lal as secretary of that committee.

The IAGA–IASPEI Interassociation Commission on Planetary Sciences was brought up. Roederer reminded the EC that at the 1976 EC meeting it was decided to approach IASPEI to consider a solution to the problem, reported by several IAGA officials and Division Chairmen, namely, the impossibility of obtaining a response from the Chairman of this Commission. After the 1976 EC meeting, the Secretary General of IASPEI was approached several times by correspondence and in personal conversation, but the problem was not solved. Roederer stated that IAGA was much too busy an organization to be able to afford being concerned with inactive components. He proposed that the IAGA–IASPEI Interassociation Commission on Planetary Sciences be disbanded. The EC decided that this should be proposed to IASPEI.

VIII. Cooperation with Other ICSU Bodies

a) *URSI*

Fukushima reported on the correspondence with the URSI Secretary General regarding the URSI proposal on rules for Interunion Working Groups. The EC reiterated the position of IUGG (Grenoble, 1975) that neither Union nor ICSU approval is necessary when an Association of IUGG establishes a body jointly with a Commission of URSI (which formal-

* See Report on joint EC meeting.

ly would be at the same organizational level as an Association). The EC noted that several of IAGA's Joint Working Groups with URSI were functioning satisfactorily and reaffirmed that it was not in favor of designing elaborate rules or agreements when they were not necessary, nor called for from a logistical point of view. Secretary Fukushima was asked to negotiate again with the URSI Secretary General.

b) *COSPAR*

Honorary Member Nicolet, who is IUGG representative in COSPAR, reported that during the last COSPAR meeting in Tel Aviv, he proposed that COSPAR meet every two years, in even years when IAGA (and IUGG) are not having Assemblies. Roederer informed the EC that the IUGG Bureau had agreed with such a suggestion.

Roederer reported that he was nominated by IUGG to the Steering Committee for the International Solar System Program (ISSP) and appointed. He said he was unable to attend the first meeting of this Steering Committee held in Tel Aviv. The ISSP was now entirely under the control of COSPAR—just as originally suggested by IAGA. Roederer will report to the EC any further developments of note.

c) *SCOSTEP*

Roederer reminded the EC that the question of the continuation of SCOSTEP has already come up once (Agenda Item V.b). He wanted to add to Cole's earlier remarks that SCOSTEP programs such as IMS and MAP could never be carried out by an organization such as IAGA: they require financial and secretarial staff support that goes far beyond what IAGA or any IUGG Associations combined could offer. He proposed that the EC present an emergency resolution on SCOSTEP to the Conference of Delegates on September 3 similar to one expected to be adopted by IAMAP, but a majority of EC members were not in favor of submitting an emergency resolution. Roederer stated that as the IUGG/IAGA representative in the SCOSTEP Bureau he was deeply embarrassed by the lack of a IAGA pronouncement on this matter in the past and said that if nothing happened this time he would not remain as the IUGG representative on the SCOSTEP Bureau. Troitskaya stated that the question of continuation of SCOSTEP (as a special committee or a scientific committee) is a matter to be decided by the participating countries. Roederer agreed, but stated that what is urgently needed is that the IAGA opinion be given to the IUGG representative in ICSU, i.e., the IUGG President, before the ICSU Bureau meets next week in Budapest. It was finally agreed that a cable be sent to A. A. Ashour asking him to urge the ICSU Bureau not to take any decision on the matter until all participating countries have been consulted.

d) *Other ICSU Bodies*

Fukushima reported that quite often he receives questions from ICSU organizations, UNESCO, etc., that are difficult to answer. The EC suggested that he consult with appropriate EC members in future cases.

Roederer displayed a letter received from Nicolet pointing out that in two reports on Atmospheric Sciences Programs prepared for ICSU, no mention was made of the role and the programs of IAGA. The EC pointed out the importance of advertising the activities of IAGA.

IX. Preparations for the 1979 Assembly in Canberra

(see the minutes of the meeting of EC and Division Chairmen on pp. 40–45)

X. IAGA Sponsorship of International Conferences

The EC agreed to co-sponsor:

(1) the Conference on Results from the Antarctic and Southern Hemisphere Aeronomy Year (ASHAY) in Alpbach (near Innsbruck), Austria, just before the 1978 STP Symposium. T. Nagata will be asked to be the IAGA representative in the organizing committee.

(2) the Fourth Workshop on the Electromagnetic Induction in the Earth, to be held in Murnau/Oberbayern, FRG, September 1978.

A decision on whether to sponsor an International Symposium on Solar-Terrestrial Climatic Relationships at The Ohio State University was deferred until it is determined whether this Symposium is of truly international character and whether IAGA can still have a say in its program committee.

XI. Proposal for the International Project "Electric Conductivity of the Asthenosphere (ELAS)"

It was agreed that this item was taken care of by Resolution No. 6 (see p. 53 or 57).

XII. IAGA Finances

Roederer reminded the EC that according to the Statutes, budget estimates of receipts and expenditures shall be laid before the EC during General Assemblies. The EC took note of the financial report for 1976 prepared for IUGG by the Secretary General (Appendix II). There was discussion on whether it was feasible to keep administrative expenses below 25% of the total budget. Roederer stated that IAGA has a mission to fulfill which is certainly not that of accumulating fat balances; its mission is clearly spelled out in Statute No. 1. If it costs a little more than 25% of the budget to run the Association efficiently, a readjustment of the 25% rule would be in order.

The request from Division V for Dr. Mayaud's travel (see the minutes of the meeting with Division and Commission Chairmen, on page 40) was considered. Roederer said that he supported fully Dr. Mayaud's planned mission, but he cautioned that the matter must be discussed very carefully because of IAGA's limited budget. Cole suggested that living expenses and travel within a given country whose observatories are to be visited could be defrayed by local sources. It was also pointed out that it is important to secure continuity of the mission's objectives even if Dr. Mayaud decides to retire from research after his return. It was decided to (1) endorse the plan proposed by Division V to improve the K-indices; (2) urge the French Academy of Sciences and the Academies of the countries involved to offer partial financial support to the project; (3) authorize the Secretary General to reimburse Dr. Mayaud's travel expenses to a possible minimum extent; (4) urge Dr. Mayaud to take steps to insure that the original goals of the mission can be successfully achieved even if he decides to retire after his travel is completed.

XIII. IAGA Publications

Secretary Fukushima reported that IAGA Bulletins No. 38 and No. 39 have already appeared, and No. 40 is being prepared, i. e.

No. 38. International Geomagnetic Reference Field 1975.0
(136 pages including charts and grid values)

No. 39. Supplementary Geomagnetic Data 1957–1975
(151 pages; Kn, Ks and Km, 1959–1963; aa 1968–1975; ssc list 1968–1975; activity diagrams 1957–1975)

No. 40. Dst indices for 1957–1969 (perhaps Dst for 1970–1975 may also be included).

The EC expressed its thanks to the authors of these publications.

A question was raised whether or not the "Program and Abstract Booklet for the Joint IAGA/IAMAP Seattle Assembly" must be given a IAGA Bulletin number, and it was agreed that no IAGA Bulletin Number should be assigned. However, it was decided to ask the American Geophysical Union for approximately one hundred copies of the IAGA/IAMAP Joint Assembly Booklet in order to be able to satisfy possible requests reaching Secretary Fukushima.

Fukushima presented a report on the situation of the IUGG Publications Office, and on the International Service of Geomagnetic Indices. The EC expressed its thanks for the valuable services of these offices. The Secretary General was asked to look for every possible way to help remedy the difficulties in the IUGG Publications Office.

The question of the publication of papers presented at the Seattle Assembly was raised. Bucha suggested that we should do something about this; IAMAP publishes proceedings of its Commission meetings. Troitskaya suggested that we ask Division Chairmen to select important papers from their sessions for special publication. Roederer said he finds symposium proceedings rather unprofitable for both authors and readers. Only on special occasions are they justified, and then only by having a special volume of a renowned and, if possible, refereed journal dedicated to it; this has been done in the past with several IAGA Symposia. It was agreed that the American Geophysical Union be urged to publish highlights of the scientific sessions in EOS. It was also agreed that Fukushima should write to all Seattle Assembly authors urging them to mention in a footnote that their paper was presented at the IAGA Seattle Assembly, should they decide to publish it in a scientific journal.

Roederer reported that he will have the papers given at the ODC Symposium printed at the University of Denver.

XIV. Resolutions (listed in final form in pp. 52–60)

The Chairman of the Resolutions Committee (M. Gadsden) presented the draft resolutions. Most resolutions passed without objection; several were amended slightly and some were sent back to the Resolutions Committee for editorial changes. One resolution emerging from Division V was not accepted to be included as a resolution on the grounds that it would be more appropriate to incorporate it in the instructions to conveners and chairmen of scientific sessions. Roederer was asked to report on this case explicitly at the Con-

ference of Delegates (adopted as Res. No. 17).

For consideration of a draft resolution of administrative nature, the EC welcomed the Division Chairmen to participate in the discussion*. The draft resolution in question referred to the decision taken by the IUGG Council at the Extraordinary General Assembly in Durham with regard to the membership application of the People's Republic of China and the cancellation of membership of Taiwan. Roederer stated that before opening the debate on this draft resolution, he would like to explain why he was opposed to the passing of this or any other resolution that contained a pronouncement on the Taiwan situation at this particular time. He emphasized that his opposition should not be interpreted as implying agreement with the cancellation of the membership of Taiwan. Instead, it was based on his feeling that the draft resolution was out of order for consideration at a IAGA Scientific Assembly. Indeed, the matter relates to a question of membership or non-membership of a country. IAGA membership is unmistakably defined in Statute No. 3: "The countries which adhere to the IUGG are members of the IAGA . . ." After the vote of the IUGG Council on August 6, 1977 (see item IIIb on pages 27–28), Taiwan is no longer a member country of IUGG, hence it is no longer a member of IAGA. The only correct route of expressing displeasure, if any, with this situation is through the respective National Committees of IUGG, not via the Scientific Assembly of an Association. Roederer informed the EC that IAGA had already stated its position publicly during the Council meeting and that a telegram had been sent on behalf of IAGA to the scientists of Taiwan reaffirming IAGA's adherence to the principle of Universality of Science (Appendix Ic). As the next step, Roederer would propose to the EC that, in accordance with By-Law 16c, the scientific community of Taiwan be invited to appoint a IAGA Correspondent. No resolution would be necessary to do that. After these remarks, Roederer opened the debate on the draft resolution that was before the EC.

Gadsden challenged Roederer's opinion that the draft resolution was out of order. He pointed out that the draft text did not speak of IUGG membership, and that IAGA resolutions were not limited exclusively to scientific matters. Dessler asked to what extent it was appropriate to sacrifice our ideals on the altar of expediency. He reported that everyone he had talked to felt that silence would imply consent. He proposed that the EC should try to get a wording that is not offensive but that states the position of an overwhelming majority of IAGA scientists on this matter. Cole supported Roederer's opinion that such a statement should go the route of National Committees. Dessler said that a resolution from IAGA would give guidance to the National Committees and help prevent the Council action in Durham from becoming a precedent for similar actions in the future. Troitskaya pointed out that one must consider the position of IAGA with respect to the Union: passing the resolution would not help Taiwan, and it is doubtful that it would do any good to the Association. Dessler asked the Chairmen of Divisions II, III and V (originators of the proposed resolution) how the vote on this question had gone in their Business Meetings. They reported as follows: Division II, unanimous; Division III, 20 yes, 1 no; Division V, unanimous. Weill stated that the draft resolution as it stands expresses a unanimous feeling and embodies what is contained in the telegram to Taiwan (Appendix Ic).

* The discussion of the administrative resolution was made during the meeting with Division Chairmen, p. 40.

The discussion turned to a similar draft resolution being considered by IAMAP, and to possible actions or reactions by ICSU regarding the IUGG Council decision. At this point Roederer invited the EC to end the discussion and called for amendments. After approval of several amendments and one reconsideration, the final text of the draft resolution (see Administrative Resolution, page 55 or 60) was put to a vote and passed. Roederer asked the Chairmen of Divisions II, III and V whether the amended text would be acceptable to them. Tinsley thought the EC text was weaker than the original text. Fälthammar and Serson found it acceptable.

XV. EC Meeting in 1978

Roederer reported that a kind invitation has been received from Weill to hold the next EC meeting in France in September 1978. Weill suggested 3 days in the middle of the first or second week of September, somewhere along the Riviera. This invitation was accepted by the EC with appreciation. It was pointed out that the dates proposed would leave time to make a recommendation to IUGG on the SCOSTEP matter, for consideration at the ICSU Assembly tentatively scheduled during the second fortnight of September 1978.

XVI. Any Other Business

It was agreed to invite the scientists of Taiwan to appoint a IAGA Correspondent according to By-Law 16c and the IAGA Administrative Resolution.

Nicolet asked Fukushima to send the proposed program for 1979 to the IUGG Chronicle as soon as possible, as well as information on the Seattle Assembly.

Gadsden reported on a proposed resolution from Division I, not passed as a resolution by the Resolutions Committee: that Working Group meetings be scheduled during the first three days of an Assembly. He also mentioned that Dr. Mayaud will not be available next time for the Resolutions Committee and had suggested Dr. Megie as his replacement.

The EC thanked Mrs. Gail Young for her efficient work as secretary in the EC sessions. The EC also expressed its great appreciation to President Roederer and the IAMAP Secretary General for their efforts in preparing the Joint IAGA/IAMAP Assembly in their home country.

Appendix Ia

Motion approved by the IUGG Council

1. The People's Republic of China is making an application for membership in IUGG. It is recognized by a very great majority of the member countries of IUGG that the government of the PRC is the legitimate representative of China and that Taiwan is a province of the People's Republic; consequently, only the PRC has the right to represent China in the Union and the representation assumed until now by the Taiwan delegation must be canceled (added as an amendment by the Council:) "and the application of the PRC accepted."

2. The IUGG reaffirms the right of every qualified scientist from every part of the world to participate as an individual in its General Assemblies and Scientific meetings.

3. The Societies of Geodesy and of Geophysics of the People's Republic of China being willing to work within the frame of IUGG, it is obvious that the People's Republic should determine, in agreement with the Finance Committee of the Union, its category at a suitable level corresponding to the importance of this country and to its activities in Geodesy and Geophysics. The category six is proposed.

Appendix Ib

Statement read by the President of IAGA to the IUGG Council

in Extraordinary General Assembly on the question of the application for membership in IUGG by the People's Republic of China

This statement represents my views of what I consider to be in the best interest of IAGA as an Association of the IUGG. Because of the confidential character assigned to this matter by the IUGG, this subject has not been discussed within the IAGA Executive Committee.

It should be of great mutual benefit —I stress the term "mutual"— to IAGA and the People's Republic of China (PRC) that the PRC become a member of IUGG so that her scientists may participate actively in the affairs of the Association.

I take a realistic approach in accepting the fact that in order to secure the membership of the PRC certain conditions must be met by IUGG which in essence imply the replacement—I stress the term "replacement"—of the delegates of the Academia Sinica, Taiwan, in the IUGG General Assembly and the Council by the delegates of the National Committee of Geodesy and Geophysics of the PRC.

However, it is vital that the Union preserve its integrity by proceeding in this matter in a way that (i) is compatible with the Union Statutes and with the guiding principles of ICSU; (ii) does not make the Union appear to the outside scientific world as having called an Extraordinary General Assembly with the sole action item of de facto expelling a dues-paying member, but rather (iii) emphasizes the positive action items (acceptance of the PRC membership application) and clearly and explicitly justifies any concomitant but necessary negative actions.

In particular, it is necessary to investigate if the conditions mentioned before can be satisfied without violating (i) the ICSU principle of Universality of Science (not to exclude from membership any community of scientists which effectively represents the scientific activity in a definite territory), and (ii) the IUGG Statutes (there is no provision for terminating the membership of a dues-paying country).

Since according to Statute No. 4 membership in the IUGG is by *countries* and not by "communities of scientists," the principle of Universality of Science *can* be upheld if guarantees are given to the scientists of Taiwan that they will be able to participate as individuals in scientific meetings of the Union and its Associations, and in their committees, working groups, divisions, etc., regardless of whether or not Taiwan is a member of the Union.

To determine whether the replacement in the IUGG General Assembly and Council of the delegates from the Academia Sinica, Taiwan, by the delegates accredited by the National Committee of Geodesy and Geophysics of the PRC implies a violation of the IUGG Statutes requires (i) a political judgment regarding the definition of the term "country"; (ii) a scientific judgment on which single Adhering Body is to be recognized as representing the geodetic and geophysical activities of China.

Regarding the political judgment called for, the IUGG, as a nongovernmental scientific organization, is not entitled to issue such. In my opinion, the most it can do is *to resolve* that, to the effect of interpreting Statute No. 4 in cases of doubt or challenge, the term "country" therein is to be applied exclusively to a nation which is recognized by, or has diplomatic relations with a majority of member countries of IUGG.

In view of the complexity of the issue before you, and taking into account that at the present time the original pressure to resolve this matter well *before* the next General Assembly in Australia has subsided, I consider it to be in the best interest of the Union that the motion before the honorable delegates of the Council be tabled until 1979, to allow for further consideration and careful study.

Appendix Ic

Text of telegram sent to the People's Republic of China:

> Noting that the application of the People's Republic of China for membership in the IUGG has been accepted at the Extraordinary Assembly in Durham, the International Association of Geomagnetism and Aeronomy welcomes a delegation of Chinese scientists to its Third General Scientific Assembly.

Text of telegram sent to Taiwan:

> In accordance with the IUGG, IAGA reaffirms principle of Universality of Science and welcomes scientists from Taiwan to its Third General Scientific Assembly to be held in Seattle.

APPENDIX II. Financial Report for 1976

(FORM 2)

INTERNATIONAL ASSOCIATION OF GEOMAGNETISM AND AERONOMY

Financial Report for the Year 1976

Amounts in USA dollars Exchange rate .....

RECEIPTS	IUGG	GRANTS & CONTRACTS
16. IUGG ALLOCATION	16,000.00	x
2. UNESCO GRANTS	x	0
3. OTHER GRANTS	x	0
4. CONTRACTS WITH UNESCO, etc....	x	0
5. SALES OF PUBLICATIONS	4,023.82	x
6. MISCELLANEOUS	936.80	x
7. TOTAL RECEIPT	20,960.62	0
8. CASH ON HAND AND IN BANKS Jan 1, 1976	21,930.91	0
10. TOTAL	42,891.53	0

EXPENDITURE	IUGG	GRANTS & CONTRACTS
11. ADMINISTRATION	3,498.51	x
12. PUBLICATIONS	3,611.16	0
13. ASSEMBLIES	728.60	0
14. SYMPOSIA	1,359.36	0
15. SCIENTIFIC MEETINGS	4,754.79	0
17. GRANTS (Permanent Services etc.).	0	0
18. CONTRACTS WITH UNESCO etc.	0	0
19. MISCELLANEOUS	51.13	0
20. TOTAL EXPENDITURE	14,003.55	0
21. CASH ON HAND AND IN BANKS Dec 31, 1976	28,887.98	0
23. TOTAL	42,891.53	0

	Jan 1, 1976		Dec 31, 1976	
24. ACOUNTS RECEIVABLE	0	0	0	0
25. ACOUNTS PAYABLE	0	0	0	0

Break-Down of Item 11

11.1 Personnel	0
11.2 Quarters	0
11.3 Supplies and Equipment ..	0
11.4 Communications	1,976.30
11.5 Travel (administrative) .	1,522.21
Total:	3,498.51

Break-Down of Item 12

12.1 C.R. Grenoble Assembly	1,900.00
12.2 C.R. Symposia	0
12.3 Periodicals (IAGA News)	1,711.16
12.4 Others	0
Total:	3,611.16

Break-Down of Item 15

IAGA Executive Committee Meeting .	3,995.14
Other Meetings	759.65
Total:	4,754.79

Date: 3 February 1977

N. Fukushima

N. Fukushima
IAGA General Secretary

MINUTES OF THE EC MEETING WITH DIVISION AND COMMISSION CHAIRMEN

(August 30, 1815–2145 and August 31, 1300–1635)

All five Division Chairmen were present. U. Schmucker was present representing A. A. Ashour, Chairman of the Interdivisional Working Group on Relations between External and Internal Magnetic Variations. The other Interdivisional Commission Chairmen presented their own reports. Honorary EC member M. Nicolet attended the first session.

a) Matters arising from Division Business Meetings

Roederer asked each Division Chairmen for brief summaries of their Business Meetings excluding the items of resolutions*, the 1979 Assembly, and MAP. Division I reported that mostly scientific matters were discussed, and reported on the Induction Workshop scheduled for 1978. Division II reported the resignation of H. Rishbeth as chairman of the Joint Working Group on Structure and Dynamics of the Thermosphere, Ionosphere and Exosphere. J. V. Evans will be the new chairman. Division III reported the successful conclusion of the activities of the WG on the Geomagnetic Meridian Project, and proposed the creation of a new WG on Composition of the Hot Magnetospheric Plasma. This was approved by the EC members. In this connection it was pointed out that according to the new By-Law No. 2, a change in WG structure of a Division or Commission needs approval by the EC, but that Division or Commission Chairmen are empowered to appoint the leaders of the WG's (By-Law No. 4). Division IV reported no change in structure. Division V recommended C. Sucksdorff to replace P. N. Mayaud who is retiring as co-chairman of Division V. This was accepted. It also recommended deletion of WG 8 on the grounds that its activities were well covered by other bodies. The EC approved. Serson reported on a proposal of Division V that IAGA support a working visit by P. N. Mayaud to as many as possible of the 23 observatories contributing to the Km-index in order to help improve the quality of index scaling through discussions with the observers. Serson suggested that part of the estimated $4000 needed for travel expenses could be provided from the allotment to Division V. Roederer said that the EC takes note of this proposal and will discuss it when the item of finances comes up on its agenda. Fukushima reported that the chairman of the History Commission, Chernosky, wished to fill the vacancy left by the death of D. G. Knapp with H. B. Garrett as Chairman of the Working Group on the American Area, and this was approved.

* The administrative resolution was discussed later during this meeting, although the result is desribed in item XIV in the minutes of EC meeting (pages 35–36).

b) Symposia and Scientific Sessions for the 1979 General Assembly

The meeting turned to consideration of symposia and scientific sessions for the 1979 Assembly. Nicolet stated that as IUGG representative in COSPAR he was keenly interested in our decisions in order to help prevent duplications with COSPAR's 1979 sessions in India. Roederer proposed to turn first to the Union symposia in which IAGA had the leading role (Appendix I). Roederer said that Symposium No. 7, Geophysical Implications of Planetary Studies (GIPS) was a most important one for IAGA: it was the first major, comprehensive IUGG symposium on the planets. He reported that according to the discussions in the EC of IUGG, the emphasis at this symposium was to be on *comparative* planetology: to discuss how learning about the planets can teach us something about the earth. Roederer stated that IAGA should be most gratified that it was given the leading role in this symposium. He asked the Division Chairmen for their recommendations. After a thorough discussion, it was decided that because of the breadth of the symposium it should be divided into three parts, namely solid bodies, atmosphere, and magnetospheres of planets. IAGA will appoint a chairman and two co-chairmen, nominated by the interested Divisions (I, II, III) for the program committee. It was decided to ask D. M. Hunten to serve as chairman and at the same time cover the topic of atmospheres, S. K. Runcorn to serve as cochairman and cover solid bodies, and G. L. Siscoe as co-chairman covering magnetospheres*. The other participating Associations will be invited to appoint members to the program committee. Six half-day sessions were suggested for GIPS, although it was realized that this number might have to be increased.

Other Union symposia in which IAGA has the lead are No. 16, Global Reconstruction and the Geomagnetic Field in the Paleozoic, and No. 17, Electric Conductivity and the Characteristics of the Asthenosphere (with IASPEI sharing the lead), both involving only Division I. At the suggestion of Creer, it was decided to ask M. W. MeElhinny to be convener of No. 16, with A. N. Khramov and D. A. Valencio as co-conveners, and W. D. Parkinson to be the IAGA representative in No. 17.

The next topic of discussion was consideration of Union symposia in which IAGA was a participant (Appendix I). The Division chairmen proposed the following names as IAGA representatives in the program committee: Symposium No. 3: W. F. Stuart; No. 6: to be decided; No. 8: S. K. Banerjee; No. 10: D. Gubbins; No. 15: R. Van der Voo; No. 18: the chairman of the Interdivivisional MAP Commission.** These were approved by the EC. The EC also decided to request of IUGG that IAGA be included as a participant in Union Symposium No. 1; if accepted, J.C.G. Walker should be the IAGA representative.

A long discussion took place when the subject turned to the IAGA Scientific Sessions for Australia. The Division and Commission Chairmen were asked to list the titles of suggested sessions in order of priority, and to indicate the estimated number of half-day sessions for each. Creer stated that the EC cannot allot weights between Divisions. Cole cautioned that many people depended on the acceptance of their papers for travel support and that this was particularly critical for the 1979 Assembly; means of accommodating as many good papers as possible without crowding the sessions had to be found. Roederer

* All three agreed to serve.

** Now the Interdivisional Commission on the Middle Atmosphere.

stated that poster sessions were an effective way, provided that they are not just a collection of second-class papers. Tinsley warned that Division Chairmen needed more time to prepare a program than remains available at the Seattle Assembly. He proposed a meeting of the IAGA ad hoc Program Committee (Division Chairmen and the Secretary General) at the STP–COSPAR Symposium in Innsbruck in 1978. Fälthammar pointed out that Division III was of the opinion that the IMS Symposium should be held separately from IUGG, as originally proposed, and suggested that the invitation from La Trobe University be accepted. The EC agreed.

Roederer informed the EC and the Division Chairmen of his estimate on the number of half-day sessions (HDS) available for each Division, taking into account estimated HDS for Union Symposia (USy), Reporter Review (RR) and Latest Sginifcant Results (LSR) sessions. He also stated that, in view of the many favorable comments from participants on the session program schedule of the Seattle Assembly (in comparison to that of Grenoble), it was advisable to take Seattle as the standard of reference, rather than to consider some arbitrary conversion factor for Grenoble. He reported that within the time span of 10 1/2 days of Seattle, the Divisions had the following number of HDS. Division I: 20; Division II: 28 (counting all Joint Symposia); Division III: 26 (counting JS–U, JS–C, QMM, SA); Division IV: 8; Division V: 8. It was agreed that the "intrinsic overlap factor" of Division II (28/21) and Division III (26/21) was a bit too high; that Division I had no overlap at all; neither did Divisions IV and V. It was pointed out that these numbers do not reveal inter-divisional overlap, which must be minimized at all cost. For instance, all participants in Division IV were interested in Division III; many Division III people also attended Division II Sessions and Symposia; Division V is made up of people from all other Divisions. It was agreed that for Australia where there would be a span of only 19 HDS available for sessions, a total number of 23 HDS per Division, including USy, RR and LSR must not be exceeded. The following preliminary estimates of HDS for USy were made: GIPS (No. 7): 6HDS (2 for Division I interests; 2 for Division II; 2 for Division III); MAP (No. 18): 6HDS (Division II mainly); other (Nos. 6, 8, 10, 15, 17): 2 HDS each (Division I). Assuming the same number of RR and LSR sessions as in Seattle, the following figures came out for HDS available for scientific sessions (*other* than USy, RR and LSR) of the following Divisions: Division I: 8 HDS; Division II: 11 HDS; Division III: 15 HDS.

There was some discussion on the IAGA–SCOSTEP Symposium on IMS Results, proposed in 1976, and approved by the IAGA EC, by SCOSTEP and by the IUGG. Division III has appointed Fälthammar (ex officio), Russell and Troitskaya as IAGA representatives in the program committee; Division II will appoint one representative. Roederer reported that the IMS Steering Committee will not meet until next February or March, but that as chairman of that Steering Committee he will appoint four representatives, among them G. Haerendel and D. J. Williams.

The list of proposed scientific sessions of the Divisions (Appendix II) was tentatively approved. Final approval will come at the time of the next EC meeting in September 1978. Creer thought that the designation "Latest Significant Results" might cause some misunderstanding. He proposed to call these "Open Sessions."

In connection with the role of the Program Committee for the Canberra Assembly, By-Law 16a was analyzed by the EC in the executive session. It was decided to delegate the

responsibility of planning 1979 IAGA Scientific Sessions to the five Division Chairmen and the Secretary General until the EC meets again in September 1978. To this effect, the EC decided to again establish an ad hoc Program Committee, with the Secretary General as Chairman and the Division Chairmen as members, with the charge to prepare a tentative program for the 1979 sessions and report back to the EC before it meets in 1978.

c) Miscellaneous Items

Roederer informed the Division Chairmen about the EC proposal to establish an Interdivisional Commission on MAP*. Tinsley voiced concern that Division II might not be adequately represented on that Commission. Roederer pointed out a weakness in the present By-Laws in that they do not make any distinction between Interdivisional Commissions and Divisions. He thought that it would be appropiate to change the By-Laws in order to make sure that Interdivisional Bodies have representatives appointed by the Divisions involved. He suggested 1979 as an appropiate time to propose such a change in the By-Laws. He assured Tinsley that the EC will recommend to the chairman and vice-chairman of the MAP Commission* that they incorporate members from Divisions II and III and that the Commission leaves to the Divisions all aspects that are strictly their province.

Fukushima reported that the IAMAP Commission on Atmospheric Electricity (ICAE) would like to have a better liaison with IAGA. On their part, R. Manka was appointed as liaison member. The EC agreed that no decision in this matter is necessary: it is a typical task to be passed on to the new Joint IAGA/IAMAP Advisory Body.

Roederer informed the Division Chairmen about the discussion of the Geodynamics Project and its follow-up. Creer mentioned that this was mainly of interest to WG10 of the Geodynamics Commission. He suggested D. A. Valencio as the IAGA representative in the Kisslinger Committee. The EC agreed to appoint Valencio in such capacity.

Appendix I

List of Interdisciplinary Union Symposia

accepted by the Executive Committee of the IUGG
to be organized during the XVII General Assembly

(Associations shown in italic have prime responsibility for the Symposium.)

1. Implication of geophysics on the geochemistry of the oceans, atmosphere and crust. IAPSO, IASPEI, *IAMAP*, IAVCEI, (IAHS), Comm. on Geochemistry.
2. Sea level, ice sheets and climatic variation: IAPSO, IASPEI, IAMAP, *IAHS*.
3. New technologies in geophysical instrumentation (invited papers only: 1/Assoc.): Union (*Bureau*).
4. Problems of coastal and estuarine zones: *IAPSO*, IAMAP, (IAG), IAHS.
5. Origin and nature of the southern oceans: IASPEI, *IAPSO*, IAMAP. (with sub-sessions: ice, water, sediments, plate tectonics, . . .)

* The Conference of Delegates decided the establishment of the Interdivisional Commission on the Middle Atmosphere, instead of MAP.

6. The relationship between variations in the Earth's rotation to other geophysical phenomena: *IAG*, IASPEI, IAPSO, IAMAP, IAGA.
7. Geophysical implications of planetary studies: IAMAP, *IAGA*, IASPEI, IAVCEI, IAG.
8. Evolution of the upper mantle: *IAVCEI*, IASPEI, (ICG), IAGA.
9. Recent crustal movements: *IAG*, IASPEI, (ICG), IAVCEI, IAPSO.
10. Dynamics of core and mantle: IAG, *IASPEI*, IAVCEI, (ICG), IAGA.
11. High pressure physics and chemistry (1 topic): *IASPEI, IAVCEI.*
12. Volcanism and Climate: *IAMAP, IAVCEI*, IAPSO, IAHS.
13. Ocean and Atmospheric Boundary Layers: *IAPSO, IAMAP.*
14. Heat production and generation of magmas: IASPEI, *IAVCEI.*
15. Methods of assessing plate motions: *IASPEI*, IAG, IAGA.
16. Global reconstruction and the geomagnetic field in the Paleozoic: *IAGA*, IASPEI, IAVCEI.
17. Electrical conductivity and the characteristics of the asthenosphere: *IAGA, IASPEI*, IAVCEI.
18. The middle atmosphere: *IAMAP*, IAGA, (SCOSTEP).
19. Geodetic applications to oceanography: *IAG*, IAPSO.
20. Tidal interactions: *IAG, IAPSO* (subject limited).

Appendix II

Suggested Titles of IAGA Sessions for the 1979 General Assembly

(Numbering does not mean the order of priority.)

Division I (Eight titles will be selected from the following list of ten)

1. Mathematical and Physical Aspects of Modelling the Geomagnetic Field and Its Secular Variations (1 half-day sesion)
2. Planetary Dynamo Theory (1)
3. Correlation between Magnetic and Gravity Anomalies (1)
4. Lithospherical Mapping with Magnetic Charts (1)
5. Paleomagnetism of Recent Sediments (1)
6. Multicomponent NRM (Natural Remanent Magnetism) (1)
7. Magnetostratigraphy (1)
8. Tectonomagnetics (1)
9. Rockmagnetism of Fine Particles (1)
10. Geological Applications of Magnetic Anisotropy of Rocks (1)

Division II

1. Dynamics of the Thermosphere and Ionosphere and Effects on the Composition (4)
2. Thermospheric Photochemistry (2)
3. Electromagnetic Coupling within the Atmosphere (1)
4. Non-Solar Ionization Sources in Low Latitudes (2)
5. Ionospheric Irregularities (2)

Division III

1. Symposium on IMS Results (10–14 HDS; with SCOSTEP, partly in Melbourne, previous week)
2. Geomagnetic Pulsations
   a. Observational Tests of Pulsation Theories
   b. Pulsation Generation and Propagation Theory } (4)
   c. Substorm-Associated Pulsations

(d. IMS Multipoint Observations (assumed to be included in IMS Symposium)

3. Non-linear Waves in Geophysical Plasma (with URSI as part of IMS Symposium)
4. Quantitative Description of Magnetospheric Processes (as part of IMS Symposium)
5. Active Experiments in Geophysical Plasma (with COSPAR, URSI in Bangalore, India)

Division IV

1. Solar Wind Interaction with Planetary Atmospheres (with Division II) (2)
2. Multipoint Studies of Evolving Solar Wind Structures (2)
3. Discontinuities, Waves, and Currents in the Solar Wind (2)

Division V

1. "Mayaud" Symposium on Use of Geophysical Indices
2. Workshop on Magnetic Observatory Practice and the Reduction of Secular Variation Observations

Interdivisional WG:

Relation between External and Internal Magnetic Variations:

1. Internal Contributions of the Ionospheric Electrojets
2. Sq, L and Related Phenomena

REPORT ON THE JOINT MEETING OF THE IAGA AND IAMAP EXECUTIVE COMMITTEES

Seattle, Washington, U.S.A.
August 26, 1977, 1800h–1950h

The first joint meeting of the Executive Committees of IAGA and IAMAP was hosted by the President of IAGA and chaired by the President of IAMAP.

President Junge called the meeting to order and asked each participant to introduce him- or herself. The following persons were in attendance: IAGA: Roederer, Weill, Cole, Fukushima, Troitskaya, Ackerman, Alldredge, Bucha, Dessler, Gadsden; IAMAP: Junge, Pisharoty, Ruttenberg, Fritz, Dyer, Hesstvedt, Isono, Zuev.

President Junge opened the discussion with a brief review of the recent history of IAGA-IAMAP relations. He pointed out the good work done by the Ad Hoc Joint Body under Dr. J. B. Gregory on the Joint Symposia and expressed regrets that the proposed formal establishment of a Joint Body with explicit terms of reference did not materialize in 1976. He thought that the fundamental difficulty lay in the difference in structure and meeting schedules of both Associations. In view of this fact, the establishment of an Advisory Body would offer a more realistic approach. This Advisory Body could propose to both EC's venues to coordinate activities in MAP and could suggest subjects and conveners for Joint IAGA/IAMAP Symposia. President Junge thought that, in general, the planning of MAP could serve well to foster a working relationship between the two Associations.

President Junge invited President Roederer to present his views on the matter. Roederer believed that past problems were mostly based on a lack of adequate communication between the two Associations as a result of not having had a chance to listen to each other. He pointed out that this first joint EC meeting was a very significant step to remedy this situation. He reported that the IAGA EC would like to see the development of a good relationship and efficient communication between the two Associations that is independent of personalities. One should indeed realize that both Associations have quite a different modus operandi and that because of this each one needs to take different steps to reach a common goal. While the IAGA EC was not in favor of creating elaborate new structures, such as the Joint Body that had been proposed in 1976, he welcomed President Junge's suggestion of establishing an Advisory Body. He then informed the participants that the IAGA EC had just decided to propose the creation of an Interdivisional Commission on MAP whose chairman and vice-chairman will be the IUGG/IAGA representatives in the interim MAP Steering Committee of SCOSTEP. Furthermore, the IAGA EC had decided to assign to the Chairmen of Divisions II and III and of the new MAP Commission the responsibility for furthering the communications between IAGA and IAMAP, particularly

in coordination of scientific meetings and organization of joint symposia.

President Junge called for a general discussion of these matters. A constructive exchange of opinions followed that led to the following decisions:

1. To establish a IAGA/IAMAP Advisory Body with 3 ex officio members from IAGA (Chairmen of Divisions II and III and Commission on MAP*), and 3 ex officio members from IAMAP (Chairmen of relevant Commissions**). The chairman of the Advisory Body would be elected by the members from among themselves. Most of the work of the Advisory Body would be conducted by correspondence.

2. To assign to the four representatives of IAGA and IAMAP (2 each) in the interim MAP Steering Committee the responsibility of mutually coordinating the activities of both Associations in the MAP program.

3. To instruct the Secretaries General of each Association to place the other Association's EC members on their mailing list to receive Association publications.

President Junge thanked all participants and expressed the hope that joint IAGA/IAMAP EC meetings will be held again during future assemblies.

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* Now established as the Interdivisional Commission on the Middle Atmosphere (see Report on Conference of Delegates, p. 50).

** IAMAP will be represented by the Presidents of the Commissions on Ozone, Radiation, and Atmospheric Chemistry and Global Pollution (with Secretaries authorized to represent them at any meeting which the President could not attend).

REPORT ON THE CONFERENCE OF DELEGATES

Seattle, Washington
September 3, 1977, 0900h–1120h

President Roederer called the Conference of Delegates (CD) to order. Secretary General Fukushima confirmed to the chair that a quorum was present as specified in Statute 19 of the Association (21 Chief Delegates).

The President made a few introductory remarks pointing out the highlights of the Scientific Assembly that had just come to an end. He invited the Delegates to demonstrate by acclamation their appreciation of the most efficient preparatory work done by Secretary Fukushima for this Assembly. The President concluded his introductory remarks by reminding the Delegates of some ground rules for a Conference of Delegates according to the new Statutes and By-Laws put into force on August 22, 1977.

The President turned to the first point of the agenda, namely consideration by the CD of decisions of the Executive Committee (EC), as required by Statute 6.

He reported to the CD on the joint IAGA/IAMAP EC meeting on August 26. In particular, he requested and obtained the concurrence of the CD with the decision to establish a joint IAGA/IAMAP Advisory Body, with 3 ex officio members from IAGA (the Chairmen of Divisions II, III and the proposed Interdivisional Commission on MAP*) and 3 ex officio members from IAMAP (Chairmen of relevant Commissions), and with the responsibility of furthering the communications between the two Associations.

The next item considered was the General Assembly to be held in Canberra, Australia, in December 1979. The President reported that the EC had considered proposals from the Divisions regarding program committees for the various Union Symposia for which IAGA was selected by the IUGG EC as the leading Association. Union Symposium 7, Geophysical Implications of Planetary Studies, will be divided into three parts: solid bodies, atmospheres, and magnetospheres. The EC appointed D. M. Hunten as chairman of the program committee, and S. K. Runcorn and G. L. Siscoe as co-chairmen. For Union Symposium 16, Global Reconstruction and the Geomagnetic Field in the Paleozoic, M. W. McElhinny will be asked to be convener, and A. N. Khramov and D. A. Valencio to be co-conveners. For Union Symposium 17, Electrical Conductivity and the Characteristics of the Asthenosphere, W. D. Parkinson will be asked to be the IAGA representative in the program committee. The CD concurred with these decisions.

Union Symposia in which IAGA will participate have also been considered and the following proposal made for IAGA representatives in the respective program committees

* Established as the Interdivisional Commission on the Middle Atmosphere (see further below).

(for titles of Symposia, see Appendix II): Symposium No. 3: W. F. Stuart; No. 6: to be decided; No. 8: S. K. Banerjee; No. 10: D. Gubbins; No. 15: R. Van der Voo; No. 18: the chairman of the Interdivisional MAP Commission. The representative for No. 6 will be proposed shortly. The President also reported that the EC has decided to request of the Union that IAGA be included as a participant in Union Symposium No. 1; if the Union agrees, Dr. J. C. G. Walker should be the IAGA representative on the program committee. The CD concurred with all of these proposals.

The President reported on the guidelines set by the EC for the organization of IAGA sessions in Canberra: (1) to consider the Seattle Assembly as a standard of reference in terms of maximum number of sessions and tolerance of overlap; (2) to set the maximum number of half-day sessions per Division in Canberra equal to 23; including the Union Symposia of interest to the Division, as well as Reporter Review and Latest Significant Results sessions. The CD concurred. The President informed the CD that the tentative list of IUGG Symposia and IAGA Sessions will be published in the next issue of IAGA News.

The President pointed out that there had been much discussion in Division III and the EC about the IAGA-SCOSTEP Symposium on IMS Results, tentatively scheduled to be held in Melbourne during the week prior to the IUGG Assembly. He said that the EC has decided to accept the kind invitation from La Trobe University which offered its facilities to host this Symposium. Comments from Delegates indicated concern about the fact that some participants would be forced to attend 3 weeks of meetings and the resulting inconveniences. The President reported that the EC was well aware of this problem, and informed the Delegates that an effort would be made to schedule the sessions in Canberra in the most convenient way for Division III participants (e. g., center on Division III during the first week in Canberra, and on Division IV during the second). He also pointed out that the IUGG EC had agreed in principle with IAGA having a pre-Assembly IMS Symposium in Melbourne. The President then put the proposal to hold the Symposium on IMS Results a few days before the General Assembly to a vote of the Delegates. The proposal passed.

The President turned to the next item, appointments made by the EC. He reported that D. A. Valencio was appointed IAGA representative in a Union ad hoc committee chaired by IUGG Bureau member C. Kisslinger in charge of preparing a follow-up program to the Geodynamics Project. Dr. Hiroshi Maeda will be recommended to IUGG to be appointed as IUGG representative on the ICSU Panel on World Data Centers. Drs. L. R. Megill and J. Taubenheim have been asked to serve as IAGA representatives in the Interim MAP Steering Committee of SCOSTEP. The CD concurred with all these appointments.

The President reported that the EC proposed to establish an Interdivisional Commission on MAP, with Megill as chairman and Taubenheim as vice-chairman. As a matter of fact, he said, the chairman and vice-chairman of this Commission would automatically be the IAGA representatives in the MAP Steering Committee and, with their counterparts from IAMAP, would coordinate the activities of both Associations in the MAP project. This latter suggestion was indeed approved at the joint meeting of the EC's of both Associations. The President went on to state that the establishment of a new Interdivisional Commission required an amendment of By-Law No. 1, and invited comments.

Objections were raised from the floor to changing the By-Laws on the grounds that MAP was a program of limited duration and that it would be unwise to change the By-

Laws to establish an Interdivisional Commission dealing with a temporary program. During a lengthy debate, the President was asked for additional information. He stated that (1) By-Laws are rules that can be amended in a more flexible way than Statutes, precisely to allow for appropriate adjustments and readjustments of IAGA structure and function; (2) it had even been proposed to the EC to establish a new Division on the Middle Atmosphere. This last remark prompted a motion from the floor to establish an Interdivisional Commission on the Middle Atmosphere (i. e., deleting the last word, "Program," in the EC proposal). After a short debate, the President put to a vote of the Chief Delegates (Statute No. 23) the motion to amend By-Law No. 1 by adding to the list of Interdivisional Commissions an Interdivisional Commission on the Middle Atmosphere. The motion passed.

The next point of the agenda was the consideration of the Resolutions. The President offered two joint resolutions of thanks. After the passing of a short amendment, both resolutions were adopted unanimously by acclamation (see p. 52 and p. 56).

The President called upon M. Gadsden, Chairman of the Resolutions Committee, to move the adoption of the remaining scientific resolutions and expressed warm thanks to the Resolutions Committee for the diligent work performed during the Seattle Assembly. M. Gadsden also thanked his colleagues on the Committee (P. N. Mayaud, A. Nishida, A. N. Pushkov and T. J. Rosenberg), especially the meticulous work of Dr. Mayaud in checking out the logical consistency of the texts for translation into French. Of the original draft resolutions, Nos. 1–4, 6–14, and 16 passed without discussion; the original text of No. 5 was amended and the amended text passed; No. 15 was objected to; after a discussion it was put to a vote and passed (see pp. 52–60).

The President then informed the Assembly that one draft resolution was received by the EC from the Resolutions Committee but was not accepted as a resolution; the EC felt that it was more appropriate to add it to the instructions to session conveners and chairmen. Objections were raised from the floor to this EC decision. After a lengthy discussion, it was moved and seconded to add Resolution No. 17. Put to a vote, the motion was approved (p. 55. and p. 60).

The President turned to the proposed Administrative Resolution (p. 55 and p. 60), the consideration of which triggered a long debate. He requested the Delegates to abstain from political arguments in the debate and asked them to keep their remarks as short as possible taking into account that the subject under consideration had already been discussed at length in at least three of the Divisions. During the debate, the text of the motion approved by the IUGG Council at the Extraordinary General Assembly in Durham (see Appendix Ia on p. 37) was displayed on the screen.

The following amendments were debated and defeated:

1) From the Chief Delegate of the Federal Republic of Germany: to replace the text (see p. 55) "the IAGA regrets the change in membership status of the Taiwan geophysical community; and affims . . ." by the following text:

the IAGA *expresses its concern about the deletion of* membership of the Taiwan geophysical community as such;

hopes that this action might not be considered as a precedent for future decisions;

and affirms . . .

(Two motions to amend this amendment were also defeated.)

2) From the Chief Delegate of the Republic of Ireland: to delete the text "the IAGA regrets the change in membership status of the Taiwan geophysical community."

The original text of the proposed administrative resolution (Appendix III) was put to a vote of Chief Delegates (Statute No. 14). It passed by 14 affirmative against 6 negative votes (with one abstention).

The President turned to the last item on the agenda concerning the possible termination of SCOSTEP as a special committee in 1980. The EC believed that this important question required very careful study, especially in view of the upcoming MAP project, and the fact that solar-terrestrial programs are likely to continue to be of interest to several Unions and COSPAR. The EC was of the opinion that the ultimate recommendation on whether or how to continue SCOSTEP should come from the participating countries themselves. To allow for the required consultations, the EC is recommending to the President of IUGG that he urge the ICSU Bureau, meeting next week in Budapest, not to take any decision at that time regarding this matter.

Finally, the President reported that the EC would be pleased to accept a kind invitation from the U. K. to hold the 1981 IAGA Scientific Assembly in Edinburgh, and that the dates August 3–15 would be recommended. These dates would allow for reasonable coordination with IAMAP, which would hold its Assembly in Hamburg, August 17–29, 1981.

The President thanked all Delegates for a fair and orderly debate and declared the CD closed.

IAGA RESOLUTIONS

(adopted on 3 September 1977 in Seattle)

IAGA/IAMAP Joint Resolution of Thanks

IAGA and IAMAP express their deep appreciation to Prof. John Gregory and his colleagues on the Ad Hoc IAGA/IAMAP Joint Body for their examination of possible subjects for the IAGA/IAMAP Joint Symposia at this Assembly, their selection of final topics to propose to the two Executive Committees and their suggestions for Conveners. The success of the Seattle Joint IAGA/IAMAP Assembly in airing important topics of current scientific interest and in bringing together a large number of colleagues from around the world is evidence of and testimony to the wisdom of their efforts. The work of the Conveners is also recognized with sincere thanks in bringing to full fruition the proposals of the Joint Body.

IAGA and IAMAP express their deep appreciation to the American Geophysical Union and to the University of Washington for their efficient organization and wonderful hospitality which assured a scientifically productive and personally pleasurable time to all participants of the IAGA/IAMAP Joint Assembly in Seattle.

Resolution No. 1

IAGA, *noting* that personal knowledge and written records of its creation, its early officers and its subsequent progress are being lost as time passes,
encourages people with relevant information concerning the history of the Association to communicate it to the Interdivisional Commission on History, through the Secretary General.

Resolution No. 2

IAGA, *recognizing* that ionosondes continue to have an important role to play in monitoring the Earth s environment,
recommends that a global network of ionosondes should be maintained throughout the 1980's, and that efforts be continued to modernize the equipment in use and to open new observatories at locations essential for research,
and urges that responsible authorities, before deciding to close an observatory, invite comment from the scientific community through the Ionospheric Network Advisory Group of U.R.S.I. on whether the observatory is of special importance.

Resolution No. 3

IAGA, *noting* that in providing vertical profiles of neutral and ionized constituents, sounding

rockets and balloons have special roles to play both by virtue of the short time needed in deciding to launch and because of the inaccessibility of the atmosphere below 120 km to orbiting spacecraft,
recommends that the present level of support for rocket and balloon programmes be maintained, with an appropriate increase in special circumstances such as solar eclipses.

Resolution No. 4

IAGA, *notes* with satisfaction that the Working Group on the Geomagnetic Meridian Project (GMP) has completed its task, which is an important step forward in the study of magnetospheric disturbances,
thanks the members of the Working Group for their efforts
and *recommends* that National Bodies continue observations until 1979 for the International Magnetospheric Study at the places involved in the GMP.

Resolution No. 5

IAGA, *recognizing* the effort put forth in Northern Europe by the U. K., the U.S.S.R. and other countries for recording geomagnetic pulsations,
urges the responsible authorities in those countries to collaborate in preparing a long-term project which will yield both accurate measures of the position and the form of the plasmasphere and information about the variability of the interplanetary medium characteristics.

Resolution No. 6

IAGA, *noting* that the asthenosphere plays an important role in geodynamics and in the study of electrical conductivity of the Earth and that this 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 effort during 1978–1985 on magnetic and magnetotelluric measurements and their comparison with heat flow and seismic measurements.

Resolution No. 7

IAGA, *aware of* the desirability of obtaining digital records at all magnetic observatories
but noting the importance of maintaining observatory standards for monitoring accurately the secular change,
recommends continued operation of the traditional system at least until the digital system has been proven to be equal in performance.

Resolution No. 8

IAGA, *aware of* the increasing use of digital recording magnetometers
but noting the utility of the analogue records, in particular for submission to World Data Centres,

recommends, in addition to production of digital records, the continued production of analogue records, whether by traditional instruments or from digital data.

Resolution No. 9

IAGA, *considering* that determining secular change and other magnetic parameters needs long-term operation of magnetic observatories but may require the movement of an observatory to a new site because of artificial disturbances,
recommends that
(i) repeat stations be set up near each observatory to preserve the secular change record in the event of a change of the observatory base reference,
(ii) when it becomes obvious that an observatory should be moved, plans be made to operate instruments simultaneously at the old and the new sites for a period of at least one year.

Resolution No. 10

IAGA, *considering* that accurate magnetic charts are heavily dependent on the use of worldwide and up-to-date data,
urges that vector survey data (land, sea and air), repeat station observations, observatory annual means, and low-level satellite data be sent to the World Data Centres as promptly as possible.

Resolution No. 11

IAGA, *noting* that the staff of World Data Center A for Solar-Terrestrial Physics has made two extended trips during which magnetograms and hourly-value tables for submission to World Data Centres have been successfully microfilmed at magnetic observatories which had found it difficult to do this,
urges that all the World Data Centres arrange such trips in order to make these data available to the scientific community.

Resolution No. 12

IAGA, *thanks* World Data Center A for Solar-Terrestrial Physics for the yearly publication of AE-indices from 1966 up to, and including, 1974, and for the monthly publication of AE-indices which have been prepared specially for the International Magnetospheric Study, beginning with January 1976,
and urges
(i) contributing stations to maintain the rapid flow of magnetograms necessary for the production of these indices,
(ii) other World Data Centres to participate in the digitization required for the derivation of the indices, both for prompt use during the IMS and for publication in the IAGA Bulletin 32 series,
and continues to urge the establishment of new magnetic observatories to improve the distribution, in both geomagnetic latitude and geomagnetic longitude, of the contributing stations.

Resolution No. 13

IAGA, *considering* the scarcity of magnetic observatories in the Southern Hemisphere and hence the importance of the British Antarctic Survey observatories for monitoring planetary magnetic activity and secular change, and also for studying Sq variations, magnetospheric phenomena and conjugate relationships,
thanks the BAS for maintaining their observatories
and urges that every effort be made to continue this service which is of importance to the scientific community.

Resolution No. 14

IAGA, *recognizing* that optimum benefit from the planned geomagnetic survey by the satellite MAGSAT, expected to be launched in September 1979, can result only if accurate ground-based measurements are carried out at observatories and repeat stations, especially in the regions where they are sparse, in order to obtain improved information on the secular change of the geomagnetic field,
urges its Member Countries to support such measurements.

Resolution No. 15

IAGA, *welcomes* the introduction of a course, "Physics of the Earth", at the International Centre for Theoretical Physics, Trieste,
and suggests that future courses at this Centre might include in addition practical training of personnel for geophysical observatories and surveys.

Resolution No. 16

IAGA, *considering* the interest of global magnetic anomalies,
urges Member Countries to produce national magnetic anomaly maps to lead to the ultimate production of an international magnetic anomaly map using, for comparison, the same scale and the same projection as those of the world geological map.

Resolution No. 17

IAGA, *recognizing* that a prime purpose of its Assemblies should be to 'provide an opportunity, on an international basis, for discussion' (Art. 1 of the Statutes),
urges chairmen or conveners of sessions to take care that speakers, in particular those whose native language is English or French, be understandable by Delegates from other Member Countries.

Administrative Resolution

IAGA, *welcomes* the accession of the People's Republic of China to the Union;
regrets the change in membership status of the Taiwan geophysical community;
and affirms that the Association will continue to welcome members of the Taiwan scientific community as individual participants in the Assemblies of the Association in accordance with By-Law 16c.

RESOLUTIONS DE L'AIGA

(adoptées le 3 septembre 1977 à Seattle)

Résolution AIGA/AIMPA commune de remerciements

L'AIGA et l'AIMPA expriment leur profonde reconnaissance au Professeur J. Gregory et à ses collègues du groupe commun "ad hoc" AIGA/AIMPA pour leur étude des programmes des Symposia communs AIGA/AIMPA pendant cette Assemblée, pour la sélection des sujets qu'ils ont proposée aux deux comités exécutifs et pour les suggestions qu'ils ont faites en ce qui concerne le choix des organisateurs. Le succès de l'Assemblée commune AIGA/AIMPA de Seattle, en permettant à la fois l'étude extensive de sujets d'un grand intérêt scientifique et la rencontre d'un grand nombre de collègues venus du monde entier porte témoignage de leurs efforts et de leur compétence.

L'AIGA et l'AIMPA expriment encore leur profonde reconnaissance à l'American Geophysical Union er à l'Université de Washington pour l'efficacité de l'organisation de l'Assemblée et la chaleureuse hospitalité accordée à tous les participants; elles leur ont permis de travailler avec grand profit au cours d'un séjour très agréable.

Résolution N°1

L'AIGA, *considérant* que les souvenirs personnels aussi bien que les documents écrits concernant la création de l'Association, ses premiers responsables et ses progrès successifs, peuvent s'effacer ou se perdre avec le temps,
encourage tous ceux qui possèdent des informations concernant l'histoire de l'Association à en faire part, par l'intermédiaire du Secrétaire Général, à la Commission Inter-Divisions pour l'Histoire.

Résolution N°2

L'AIGA, *reconnaissant* que les ionosondes continuent à jouer un rôle important dans l'étude expérimentale de l'environnement terrestre,
recommande que soit maintenu un réseau mondial d'ionosondes pendant les années 80, et que soient poursuivis les efforts en vue de moderniser les équipements actuellement utilisés et d'établir de nouveaux observatoires aux endroits essentiels pour la recherche,
et *insiste* pour que les autorités responsables, avant de décider de fermer un observatoire, prennent l'avis de la communauté scientifique, par l'intermédiaire du Conseil du Réseau d'Observatoires Ionosphériques de l'URSI, quant à l'importance de cet observatoire.

Résolution N°3

L'AIGA, *considérant* le rôle important que jouent les ballons et les fusées-sonde dans la détermination des profils verticaux des constituants neutres et ionisés, à la fois par la rapidité avec laquelle il peut être procédé à leur lancement et à cause de l'inaccessibilité des satellites orbitaux aux altitudes inférieures à 120 km,
recommande que soit maintenu à son niveau actuel le soutien apporté aux programmes de ballons et fusées, avec cependant une augmentation de ce soutien lors d'évènements exceptionnels tels que les éclipses de Soleil.

Résolution N°4

L'AIGA, *note* avec satisfaction que le Groupe de Travail sur le Projet Méridien Géomagnétique (GMP) a accompli sa tâche qui a permis un progrès important dans l'étude des perturbations géomagnétiques,
remercie les membres du Groupe de Travail pour leur travail ,
et *recommande* que les Organismes nationaux continuent ces observations pour l'IMS, jusqu'en 1979, aux mêmes endroits que ceux choisis pour le GMP.

Résolution N°5

L'AIGA, *reconnaissant* l'effort accompli en Europe du Nord par la Grande Bretagne, l'U.R.S.S. et d'autres pays pour l'enregistrement des pulsations géomagnétiques,
insiste pour que les autorités responsables de ces pays collaborent dans la préparation d'un projet à long terme, qui devrait produire des mesures précises de la position et de la forme de la plasmasphère aussi bien que donner des informations concernant la variabilité des caractéristiques du milieu inter-planétaire.

Résolution N°6

L'AIGA, *notant* que l'asthénosphère joue un rôle important en géodynamique et dans l'étude de la conductivité électrique de la Terre, et que ce domaine de recherches intéresse le Groupe de Travail 3 de la Division I,
recommande aux Organismes Nationaux de soutenir la création d'un Comité ad hoc pour préparer un programme concernant "La Conductibilité Electrique de l'Asthénosphère (ELAS) en vue d'intensifier, de 1978 à 1985, les mesures magnétiques et magnéto-telluriques et les comparaisons de celles-ci avec les mesures sismiques et de flux solaire.

Résolution N°7

L'AIGA, *conscient* qu'il est souhaitable d'obtenir des enregistrements numériques dans tous les observatoires magnétiques,
mais *notant* l'importance de maintenir la qualité de l'étalon des observatoires pour suivre avec précision la variation séculaire,
recommande de continuer à assurer le fonctionnement du système traditionnel au moins jusqu'à ce que le système numérique ait atteint un niveau égal de performance.

Résolution N°8

L'AIGA, *conscient* de l'usage croissant de magnétomètres à enregistrement numérique, mais *notant* l'utilité des enregistrements analogiques, en particulier pour les communiquer aux Centres Mondiaux de Données,

recommande que, en plus de la réalisation des enregistrements numériques, soit poursuivie celle d'enregistrements analogiques, que ce soit par des instruments classiques ou à partir de ces enregistrements numériques.

Résolution N°9

L'AIGA, *considérant* que la détermination de la variation séculaire et d'autres paramètres magnétiques nécessite une stabilité à long terme du fonctionnement des observatoires magnétiques mais peut exiger le déplacement des instruments sur un nouveau site par suite de perturbations artificielles du site actuel,

recommande

(1) que des stations de répétition soient établies auprès de chaque observatoire afin de sauvegarder l'enregistrement de la variation séculaire au cas où un changement des repères de l'observatoire interviendrait,

(2) que, lorsqu'il devient évident qu'un observatoire aura à être déplacé, des dispositions soient prises pour assurer un fonctionnement simultané des instruments sur l'ancien et le nouveau site pendant au moins un an.

Résolution N°10

L'AIGA, *considérant* que l'élaboration de cartes magnétiques précises dépend fondamentalement de l'utilisation de données provenant du monde entier et tenues à jour,

insiste pour que les données vectorielles des réseaux magnétiques (terre, mer et air), les observations aux stations de répétition, les moyennes annuelles des observatoires et les données de satellite à basse altitude soient envoyées aux Centres Mondiaux de Données aussi rapidement que possible.

Résolution N°11

L'AIGA, *notant* que des membres du World Data Center A for Solar-Terrestrial Physics ont organisé deux missions importantes au cours desquelles ont été microfilmés les magnétogrammes et tableaux de valeurs horaires d observatoires magnétiques qui ne pouvaient envoyer des copies de ces documents aux Centres Mondiaux de Données,

insiste pour que tous les Centres Mondiaux de Données entreprennent de telles missions afin que de tels documents soient mis à la disposition de la communauté scientifique.

Résolution N°12

L'AIGA, *remercie* le World Data Center A for Solar-Terrestrial Physics pour la publication

annuelle des indices AE de 1966 à 1974 inclus, et pour la publication mensuelle de ces mêmes indices qui, préparée spécialement pour l'IMS, a commencé en janvier 1976,
insiste pour que
(1) les stations du réseau AE maintiennent l'envoi rapide des données nécessaires au calcul de ces indices,
(2) les autres Centres Mondiaux de Données participent à la numérisation requise pour la dérivation de ces indices, à la fois pour un usage rapide pendant la durée de l'IMS et pour leur publication dans la série des Bulletins 32 de l'AIGA,
et *continue* d'insister pour que de nouveaux observatoires soient créés afin d'améliorer la distribution, en latitude et longitude géomagnétiques, des stations du réseau AE.

Résolution N°13

L'AIGA, *considérant* la rareté des observatoires magnétiques dans l'hémisphère Sud, et par conséquent l'importance des observatoires du British Antarctic Survey dans cette région pour suivre l'activité magnétique planétaire et la variation séculaire aussi bien que pour l'étude des variations Sq, des phénomènes magnétosphériques et des évènements en des points conjugués,
remercie le British Antarctic Survey de maintenir ces observatoires,
et *insiste* pour que tout effort soit fait afin de poursuivre cette activité d'une très grande importance pour la communauté scientifique.

Résolution N°14

L'AIGA, *considérant* qu'un bénéfice optimal ne pourra être tiré du réseau géomagnétique prévu à l'aide du Satellite MAGSAT dont le lancement doit avoir lieu en septembre 1979, que si des mesures précises au sol sont effectuées dans les observatioires et les stations de répétition, particulièrement dans les régions où elles sont rares, afin d'améliorer la connaissance de la variation séculaire du champ géomagnétique,
insiste pour que les pays membres fournissent le soutien nécessaire à de telles observations.

Résolution N°15

L'AIGA, *apprend avec satisfaction* l'introduction d'un cours de "Physique de la Terre" au Centre International de Physique Théorique de Trieste,
et *suggère* qu'à l'avenir ces cours comprennent aussi une formation pratique de personnel pour les observatoires géophysiques et les mesures en campagne.

Résolution N°16

L'AIGA, *considérant* l'intérêt des anomalies magnétiques à l'échelle mondiale,
insiste pour que les Pays Membres établissent des cartes d'anomalies magné-

tiques à l'échelle nationale en vue de conduire à l'établissement final d'une carte internationale de ces anomalies, à la même échelle et avec la même projection que celles utilisées pour la carte géologique mondiale, ceci afin de permettre leur comparaison.

Résolution N°17

L'AIGA, *reconnaissant* qu'un but essentiel de ses Assemblées est de "permettre, sur le plan international, une discussion des résultats" (Art. 1 des Statuts),
insiste pour que les présidents ou organisateurs des sessions veillent à ce que les orateurs, en particulier ceux dont la langue maternelle est l'anglais ou le français, puissent être compris par les Délégués d'autres Pays Membres.

Résolution Administrative

L'AIGA, *est heureuse d'accueillir* la République Populaire de Chine dans l'Union,
regrette le changement intervenu dans l'appartenance, en tant que membre, de la communauté géophysique de Taiwan,
et *affirme* que l'Association continuera à accueillir les membres de la communauté scientifique de Taiwan en tant que participants à titre individuel aux Assemblées de l'Association en vertu de l'Article 16c du Règlement Intérieur.

REPORTS OF IAGA ORGANIZATINAL UNITS

DIVISION I — INTERNAL MAGNETIC FIELDS
(Chairman: K. M. Creer)

1. Business Meeting at Seattle

The business meeting of Division I was held on 26 August 1977 following the Reporter Review Session, RR-I at which reviews of the activities of each of the six working groups of the Division were read by the respective WG Chairmen (or, in their absence, by the Vice-Chairmen). This set the scene for the business meeting which was devoted mainly to a discussion of the scientific programme for the 1979 IUGG Assembly at Canberra.

1.1 Proposed Titles for IAGA Scientific Sessions at Canberra

Subjects proposed by the various working groups were discussed and titles and convenors were agreed upon as listed below. Subsequently, the IAGA Executive Committee ruled that Division I would be able to run only eight scientific sessions, a reporter review session and two latest significant results sessions. Hence, some of the titles listed below might have to be withdrawn.

WG1 1. Mathematical and physical aspects of modelling the geomagnetic field and its recent secular change (B. R. Leaton, U.K.)

WG2 2. Planetary dynamo theory
(F. H. Busse, U.S.A.)

WG4 3. Correlations between anomalies of potential fields
(R. D. Regan, U.S.A.)

4. Lithological mapping from local anomaly charts
(C. Weber, France; P. J. Hood, Canada)

5. Long wavelength geomagnetic anomalies
(A. Hahn, F.R.G.)

WG5 6. Palaeomagnetism of recent sediments
(R. Thompson, U.K.)

7. Multi-component natural remanent magnetization
(H. Halls, Canada; K. Storetvedt, Norway)

8. Magnetostratigraphy
(N. Opdyke, U.S.A.)

9. Tectonomagnetics
(V. A. Shapiro, U.S.S.R.; M. Johnston, U.S.A.)

WG6 10. Rock magnetism of fine particles
(E. R. Deutsch, Canada; H. Soffel, F.R.G.)

11. Geological applications of the magnetic anisotrophy of rocks
(E. R. Hailwood, U.K.; J-J. Wagner, Switzerland)

1.2 Inter-Association Symposia for Canberra 1979

Interest was expressed in the following inter-association symposia approved for the Canberra Assembly of IUGG and programme committee members* to represent the interests of Division I were nominated for consideration by the IAGA Executive Committee and by convenors of the respective symposia.

JS3 New Technologies in Geophysical Instrumentation
(M. Fuller, U.S.A.)

JS6 Relationships between Variation in the Earth's Rotation and Geophysical Phenomena
(R. G. Currie, USA)

JS7 Geophysical Implication of Planetary Studies
(S. K. Runcorn, U.K.)

JS8 Evolution of the Upper Mantle
(S. Levi, U.S.A.; D. Pechersky, U.S.S.R.)

JS10 Dynamics of Core and Mantle
(M.E. Evans, Canada)

JS15 Methods of Assessing Plate Motion
(R. Van der Voo, U.S.A.)

JS16 Global Reconstruction and the Geomagnetic Field in the Palaeozoic
(M. W. McElhinny, Australia; A. N. Khramov, U.S.S.R.; D. A. Valencio, Argentina)

JS17 Electrical Conductivity and Characteristics of the Earth's Asthenosphere
(W. D. Parkinson, Australia)

1.3 Resolutions

IAGA resolutions were proposed by WGI–3 (with regard to ELAS, an International Programme for the Study of the Electrical Conductivity of the Asthenosphere by the Soviet Geophysical Committee), and by WGI–4 (regarding the compilation of a world magnetic anomaly map). It was agreed to pass them forward for consideration by the IAGA Executive Committee which subsequently adopted them as resolutions no. 6 and no. 16.

1.4 Comments Regarding the Seattle Assembly

While members of Division I were well contented with the general arrangements, they expressed a deep concern that Division Business Meetings had been scheduled to occur before the Business Meetings of the Working Groups. This resulted in working group officers having insufficient opportunity prior to the Divisional Business Meeting to consult their membership. Hence the following resolution was adopted for transmission to and for action by the IAGA Executive Committee:

Division I *recommends* that at future IAGA Assemblies, Working Group Business Meetings be scheduled to occur during the first three days of the assembly, well in advance of the Divisional Business Meetings.

1.5 Division and Working Group Officers

For the period 1977–79 these are:—

Division Chairman: K. M. Creer (U.K.)

Division Vice-Chairmen: T. Yukutake (Japan); D. I. Gough (Canada)

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* There have been some later changes in the members who were finally proposed to IUGG.

WG-1 B. R. Leaton, Chairman; A. N. Pushkov, Vice-Chairman
WG-2 P. H. Roberts, Chairman; D. Gubbins, Vice-Chairman
WG-3 U. Schmucker, Chairman; A. Ádám, Vice-Chairman
WG-5 J. Heirtzler, Chairman; C. C. Weber, Vice-Chairman
WG-5 J. C. Briden, Chairman; D. A. Valencio, Vice-Chairman
WG-6 G. N. Petrova, Chairman; S. K. Banerjee, Vice-Chairman

2. Reports by Working Group Officers

2.1 Working Group I-1: Analyses of Main Field and Secular Variations

B. R. Leaton, Chairman; A. N. Pushkov, Vice-Chairman

2.1(i) *Analyses and Methods*

Following the several major models that were reported on at Grenoble there has been steady work in USA, UK and USSR reported on during the Seattle meeting but between the two Assemblies no major work has been published. There has been an application of global techniques to a regional case in Canada[1]. Models have been used for correlation with climate and with length of day and to establish core motions. A composite model derived from the 1975 US and UK models has been adopted by the International Hydrographic Bureau for use in their international series of navigation charts.

There has continued to be a modest activity in establishing possible periodicities in secular variations[2]. Interest shown at Grenoble has continued in the problem of uncertainities caused in modelling from data sets largely composed of scalar intensity. Of particular note is the work of Kono[3] and of Pill and Turmina[4]. New approaches to the problems of secular change have been reported by Slade-Barker, Whitworth and Peddie.

2.1(ii) *Uses*

The International Geomagnetic Reference Field in both versions has been widely used by theoretical solid earth and exploration geophysicists and as a parameter in ionospheric research and for calculating charged particle trajectories; in general, quite happily, or at least without complaint in most instances. A few examples are given in brief references at the end of this note[5]. URSI has been approached and appears to be quite satisfied with IGRF. Their requirements are less critical than those of the surface geophysicists[6]. The only area where serious trouble has been encountered is Australasia[7]. A large spurious longitude gradient appears in IGRF due almost entirely to errors in the secular change coefficients of IGRF 1965 which imply a more rapid westerly movement of the southern dip-pole than in fact occurred. As IGRF 1975 is continuous with the

1) Dawson and Newitt, Can. J. Earth Sci., **14**, 477.
2) Alldredge, J. Geophys. Res., **81**, 2990 and Phys. Earth Plan. Int., **11**, 18.
3) J. Geomagn. Geolect., **28**, 11.
4) Geomag. i Aeron. **XVII**, 722.
5) Earth, Phys. Sci. Letters **33**, 145; **33**, 310; **33**, 185. Mar. Geophys. Res., **2**, 315; J. Geophys. Res., **82**, 231; Okeanologiia **15**, 95; **16**, 473; Rev. Geophys. Space Phys., **14**, 375; Proc. Jap. Acad., **51**, 580; Geophys. Monogr. AGU **19**, 235; **19**, 253; Geophys. J. Roy. Astr. Soc., **47**, 257.
6) J. W. King, Private communication.
7) Davey, N. Z., J. Geol. Geophys., **19**, 759.

previous representation, these errors remain. For practical purposes a regional reference field (AGRF) has been locally adopted for Australia[8]. IZMIRAN has distributed Issue No. XII of its Summary of Annual Mean Values.

Serious deficiencies in IGRF 1975 were reported in the Workshop at this Assembly (attended by about 45 delegates) and in replies to a previous circular letter. It is now recognized that it is almost certain that a satisfactory IGRF 1980 will not be continuous with IGRF 1975 and users have accepted, with some regret, that a discontinuity is inevitable. There is clearly a need for two types of reference field; one for current use to continue to be called IGRF and similar in form to previous models in the IGRF series of models and a second for research use and to be as accurate as possible and retrospective. The quality of IGRF 1980 will depend critically on the data from MAGSAT, and so it is expected that IGRF 1980 will be adopted at the IVth Scientific Assembly of IAGA in 1981. Some of the difficulty of predicting the geomagnetic field was ascribed to inaccuracies in the data and delay in their dissemination. Strong support was expressed for modification to the ICSU guide for Data Exchange and to the proposed resolution from Division V urging rapid transmittal of hourly values to DDC's.

2.1(iii) *Report on Business Meeting of WGI-1 at Seattle*

WGI-1 met on Friday, 26 August 1977. The attendance was 16 and the highlights are as follows.

(a) WGI-1 recognized that *secular variation* is the worst problem in modelling. It discussed periodicities of internal and external sources, their evaluation and treatment; methods of analysis, evaluation and errors. It agreed that its officers should circularize all observatories to stress urgency in reducing annual values and sending them to WDC's.

(b) WGI-1 discussed ways to meet demand for *two types of reference field.* There was some semantic difficulty with defining 'definitive' so it was suggested that retrospective accurate reference field models be known as 'standard'. It was agreed that successive current references would be predictive models and include a corrective part to change part of each model. With a five year lag, the predictive models would be replaced by corresponding standard models. It was suggested that a note be placed in IAGA News to outline the scheme.

(c) *Annual Value*; WGI-1, recognizing the need for quality data sets of annual values for practical and theoretical use, agreed on the following five points.

(1) IZMIRAN, USA and UK should compare files and resolve differences.

(2) The same three agencies should collaborate in establishing additions and connections to

(I)	Bock and Schumann	up to 1940
(II)	IGS Bulletin	1941 to (say) 1970
(III)	IZMIRAN Series	1971 to date.

(3) IZMIRAN should issue a special number of their series.

(4) The whole data set should be made available on magnetic tape from WDC-A and WDDC-C1.

(5) The data set up to 1940 should be made available from WDC's on microfilm or microfiche.

8) Petkovic, Bureau Mineral Resources Australia Report 190.

(d) *Resolutions*; There were none.

(e) *Symposium for Canberra 1979*

Title: Mathematical and Physical Aspects of Modelling the Geomagnetic Field and its Recent Secular Variation

Convenor: B. R. Leaton

Topics: N-max of model parameters; Standard fields and data sets; Secular variations; Errors; Predictive methods; Periodicities (exterior or interior); Extrapolation to core; Evidence to separate core field and central sources; Connection to magnetospheric models

(f) *Membership*; Although it exceeds the old limit of 12, the WGI-1 would like to add the following members:—

R. Whitworth (Australia), S. P. Srivastava (Canada), R. D. Regan (USA).

All existing members are active.

2.2 Working Group I-2: Theory of Planetary Magnetic Field and Geomagnetic Secular Variation

D. E. Winch, Chairman; P. H. Roberts, Vice-Chairman

2.2 (i) *Report on Research Activity since Grenoble*

Review papers on the dynamo theory of the Earth's magnetic field by Moffat (1976) and by Soward and Roberts (1976) have appeared.

Work on the mean field electrodynamics has continued and the effect has been incorporated into a number of dynamo models. Nonlinear aspects of these processes have received attention. Schussler (1975) and Jeffs (1975) have studied models where α is the function of B^2 and have demonstrated that exponential field growth of the linear theory is eliminated, and that the field equilibrates to a steady (or finitely oscillating) form.

The Malkus-Proctor equilibration mechanism has been further studied by Proctor (1977). Here the α-effect is constant, but the growing mean fields and currents produced by the growing solution of the linear equations, generates fluid motion (and especially zonal shear) that inhibits runaway field growth. Despite doubts cast by Roberts and Stavartsan (1975) it appeared from Proctor's model that the Taylor condition (1965) was ultimately approached at least in his model. In another relevant paper by Busse (1976), it is shown that circumstances exist where the α-effect is enhanced by an ambient magnetic field. Watanabe (1977) has argued that, contrary to popular belief, it is not necessary for the α dynamo to produce toroidal fields greatly in excess of the poloidal. He visualizes a toroidal field of only 30 gauss in the core and a poloidal field of at most 10 gauss.

Many of these ideas on the α-effect stem from induction line turbulent motion. It is possible (though still unproven) that mirror symmetric turbulence could generate a totally chaotic field (i.e. without a mean part). Recent papers on this topic are by Ponquet, Leerat and Frisch, and by Kraichnan. The random wave dynamo of Soward (1976) does generate a mean field. In this model the weakening of the waves by ohmic energy loss is allowed for.

Magnetohydrodynamic dynamo models. Marginal convection in a rapidly rotating sphere containing heat sources (Soward 1977) is known to be asymmetric helical, and theorefore α-effect generating, and confined to a narrow cylinder with generators parallel to Ω, the angular velocity.

Busse (1975) proposed a model of the geodynamo where the fluid is confined to an annulus, and the gravitational field and the top-heavy density distribution are both radial.

He proved dynamo action and demonstrated that the growing solutions of the linear theory were stabilized by the back-reaction of their Lorentz force on the motion.

Busse (1976) took this model further, considering particularly how the addition of a toroidal field within the annulus affected the stability characteristics of the system. He attempted to apply the model to planetary magnetism.

Eltayeb and Kuma (1977) demonstrated clearly that as the field in a magnetohydrodynamic dynamo can exceed the critical maximum amplitude proposed by Busse (1976), it will then 'run away'. They show that it does not equilibrate with the Lorentz forces and Coriolis forces balance. At that stage the motions are not confined to an annulus, but fill the convecting sphere. Their work strongly supports the older view of a strong toroidal field in the core over the newer view of a weak toroidal field.

These questions of toroidal field strength are very important in matters of core energetics, a topic dealt with recently by Gubbins.

The precessional theory of geomagnetism has received a serious and perhaps even fatal blow. Loper (1975) and Rochester, Jacobs, Smylie and Chong (1975) have shown that precessional energy may be squandered in the surface boundary layers of the core rather than being usefully spent creating the geomagnetic field.

2.2 (ii) *Report on Business Meeting of WGI-2 at Seattle*

(a) Changes in Officers

WGI-2 reports that Dr. D. Gubbins (U.K.) was elected as Vice-Chairman, replacing Prof. P. H. Roberts, who rotates into the Chairmanship.

(b) WG Officers and Membership post Seattle

Chairman: P. H. Roberts (U.K.); Vice-Chairman: D. Gubbins (U.K.)

Members: F. H. Busse (U.S.A.), I. A. Eltayeb (Sudan), J. Gilliland (Canada), A. M. Işikara (Turkey), N. Peddie (U.S.A.), W. I. Reilly (New Zealand), A. M. Soward (U.K.). D. Stevenson (Australia), D. E. Winch (Australia).

Members not assigned: L. R. Alldredge (U.S.A.), D. R. Barraclough (U. K.), J. C. Cain (U.S.A.) E. B. Fabiano (U.S.A.), J. C. Gupta (Canada), F. J. Lowes (U.K.), A. Lundbak (Denmark), W. Mundt (GDR), I. Özdogan (Turkey), W. W. Wood (Australia).

2.2 (iii) *Arrangements for the Canberra Assembly*

(2) WGI-2 proposes that a IAGA scientific session entitled "Theory of Planetary Magnetism" be held at the Canberra Assembly with Prof. F. H. Busse as convenor. There should be four invited speakers at Prof. Busse's discretion.

(b) WGI-2 reports that Prof. Yukutake has agreed to be the IAGA representative on the Committee convening the Interassociation symposium proposed by IASPEI: "Dynamics of the Core and Mantle".

2.3 Working Group I-3: Electromagnetic Induction in the Earth and Moon

U. Schmucker, Chairman

2.3 (i) *Report on the Activities of the Working Group since Grenoble 1975*

In 1976 the Working Group organized its Third Workshop on Electromagnetic Induction under the joint sponsorship of IAGA and the Hungarian Academy of Sciences. The Workshop was held from 5 to 10 July in Sopron, Hungary, the local organizing committee being headed by Dr. A. Ádám from the Geodetical and Geophysical Research Institute of the Hungarian Academy of Sciences. A substantial grant to support the travel expenses of participants, which is gratefully acknowledged, was received from the

Secretary General of the IUGG, Professor Melchior.

The Workshop was attended by 130 participants from 24 countries. About 100 papers were read in nine scientific sessions, each of them being introduced by an invited review paper. The proceedings of the Workshop will be published in two special issues of the Acta Geodaetica, Geophysica et Montanistica. The first issue with the review papers has just come off the press; the second issue containing the contributed papers is due to appear later.

During the Grenoble meeting of the IUGG in 1975 the Working Group proposed to hold a symposium on "Geomagnetic Induction by Long-Period Variations in Deep Layers beneath Continents and Oceans" during the IAGA/IAMAP Joint Assembly in 1977 at Seattle. This proposal was accepted by the IAGA Executive Committee and a full day symposium was held on Wednesday, August 24, during this meeting.

2.3 (ii) *Report on Business Meeting of WGI-3 at Seattle*

WGI-3 held its business meeting on Wednesday, August 24, from 20.00 to 22.30.

The first topic discussed was the preparation of an exchange program of numerical modelling techniques in geomagentic induction. For this purpose a set of standard model distributions has been set up for which the induction response functions will be calculated by various workers using different methods. Even though it is realized that there is no substitute for analytical solutions, the convergence of numerical model calculations can be regarded as a necessary, but not sufficient condition for obtaining the correct solution of the considered problem.

The second topic concerned the preparations for the Fourth Workshop to be held from September 7 to 13 in 1978 at Murnau, Oberbayern. It was agreed to have four to six scientific sessions which will consist of two invited reviews only. The remainder of the time shall be devoted to discussions and short prepared presentations from the floor. In addition there will be two to four sessions with contributed papers depending on the number of papers to be received.

The following topics were chosen for six sessions which are to be opened with invited reviews:

1. Induction in the oceans
2. Time variations of inductive response functions due to internal changes of conductivity under crustal stress
3. Relation of mantle conductivity to physical conditions in the asthenosphere
4. Inverse methods
5. Lunar conductivity
6. The application of geomagnetic induction methods at high frequencies to geological problems

A tentative list of review speakers has been prepared to assist the organizing committee in the preparations for the workshop.

The third topic which was discussed concerned a proposal by the Soviet Geophysical Committee to organize an International Program for the study of the electrical conductivity in the asthenosphere on selected trans-continental profiles. It was suggested by the Soviet Geophysical Committee that this programme be conducted under the auspices of Working Group 3 of Division I and that it have the name "ELAS". It was agreed that this proposal is timely and useful to promote the scientific goals of the Working Group and that a IAGA resolution in support of the proposal should be sought. In actually con-

ducting the programme, however, special regard should be given to other geophysical disciplines exploring the dimensions and properties of the asthenosphere.

Finally it was brought to the attention of the audience that a joint IAGA/IASPEI symposium has been scheduled for the IUGG conference at Canberra in 1979 under the topic "Electrical conductivity and characterictis of the asthenosphere". It was noted with regret that the topic was formulated without prior consultation of WGI-3. It appears to be premature to associate the asthenosphere with marked changes in conductivity and it would have been preferable to include the conductivity of the overlying lithosphere as well.

In view of the joint IAGA/IASPEI symposium it was agreed not to call for a special session of the Working Group at the Canberra meeting, provided that the symposium leaves sufficient space for contributed papers on the general theme of geomagnetic induction. The Working Group recommends that Dr. W. D. Parkinson, Hobart, Tasmania, serve as co-convenor of the Symposum to assume a proper representation of the work which is being done by the members and associates of the Working Group.

2.4 Working Group I-4: Magnetic Anomalies

J. R. Heirtzler, Chairman; C. C. Weber, Vice-Chairman

2.4 (i) *Activities since Grenoble 1975*

The activities of this WGI-4 have, since the Grenoble meeting, been concerned with the two symposia which it recommended for this Seattle meeting. These were the symposium on "Long Wavelength Geomagnetic Anomalies" held on 29 August and the symposium on "Relationship of Petrology to Observed Geomagnetic Anomalies" held on 2 September. Both of these subjects are likely to be of continuing interest in the future—the first one especially because of the studies of anomalies from satellite data now being initiated and the second because of precisely located rocks being recovered under the magnetic anomaly strips on the ocean floor.

2.4 (ii) *Report on the Business Meeting of WGI-4 at Seattle*

The business meeting of WGI-4 was held on 29 August, with C.C. Weber acting as Chairman.

Three symposia were proposed for the next IUGG Assembly (Canberra 1979).

(a) *Correlations between anomalies of potential fields*
The aim of this symposium would be to encourage scientists working on methods of interpretation to take into account correlation techniques between gravity and magnetic data. This could be extended to correlations with heat flow data. This symposium should be common with IAG and IASPEI.
Convenor: R. D. Regan (U.S.A.)

(b) *Lithographic mapping from local anomaly maps*
This symposium is a natural prolongation of the symposium on relation of petrology to observed geomagnetic anomalies, held in Seattle. The topic appears to be a major research subject in the near future in resource analysis.
Convenor: C. Weber (France)
Co-convenor: P. Hood (Canada)

(c) *Long wavelength geomagnetic anomalies*
Many more results than those presented at the Seattle meeting are expected by 1979 in this field.
Convenor: A. Hahn (FRG)

Co-convenor: D. Johnson (Australia)

Exchange of data information

(1) This working group insisted upon the necessity to list all national magnetic anomaly maps and their characteristics. The catalogue should mention all maps at a scale smaller than 1/250000. A further task would be to prepare an international geomagnetic map at the same scale as the world geological map.
A steering committee was nominated:
Chairman: J. R. Heirtzler (U.S.A.)
Members: W. Mundt (GDR), S. P. Srivastava (Canada), R. Whitworth (Australia)

(2) In order to improve data exchange the working group urges that a common colour chart should be adapted to get a homogeneous visualization of magnetic anomalies with red for positive anomalies, and blue for negative anomalies, the colour spectrum being used between.

Resolution

The following resolution was proposed for presentation at the final plenary session of the assembly:

IAGA, *considering* the importance of the world geological map, *urges* member countries to produce national magnetic anomaly maps to lead to the ultimate production of an international magnetic anomaly map at the same scale and projection. (A slightly modified wording of this proposed resolution was in fact adopted as resolution no. 16.)

2.5 Working Group I-5: Palaeomagnetism

V. Bucha, Chairman

2.5 (i) *Activities since the Grenoble Assembly 1975*

The attention of WGI-5 was devoted to the following problems.

(a) Studies of fluctuations and reversals of geomagnetic field through palaeomagnetic investigations of lacustrine and marine sediments. Significant results have been obtained for the last 20,000 years from the continents of North America, Europe, Asia and Australia. These studies have helped to make more precise magnetostratigraphic correlations and are now being used by geologists. New results reveal periodicities of geomagnetic changes of 140, 100 and 35–25 thousand years which are close to the periods of the earth's orbital geometry. The polarity reversal time scale has been extended through the Cretaceous, creating a new detailed magnetic stratigraphy and delineates changes in the rates of ocean floor spreading. Short term excursions of the geomagnetic field have been found in both the Kiaman and Brunhes polarity epochs.

(b) Studies of the long-term trend in the geomagnetic field have been concerned with the changes associated with characteristic times of 10^5 to 10^7 years. The persistence of non-dipole features, the shift of mean pole positions not due to plate movements and the spectrum, frequency and symmetry of reversals have been investigated. Changes of reversal frequency and the characteristics of the extensive "quiet intervals" seen both in palaeomagnetic and marine anomaly studies are now looked at closely, both as a guide to crustal history and as a guide to dynamo behaviour. Interest has also increased concerning the behaviour of the geomagnetic field during transitions of polarity. Quaternary and Tertiary

field configuration is also being considered as a source of information about the lower mantle and the fluid core.

(c) Palaeomagnetic research of orogenic belts has been concerned with tectonic overprinting, palaeomagnetic affinities of microplates, structural deformation in major orogenic belts and orogenic cycles and movements as revealed by detailed palaeomagnetic studies. For example, the detailed motions of continental fragments along the western North American plate margin ranging in age from Precambrian to Tertiary have been revealed by palaeomagnetism. The implications of similar microplate movements in the Alpine-Himalayan belt and the complex histories of various Palaeozoic and Precambrian orogenic belts such as the Appalachians, the Caledonides and the Atlas have also been studied.

More and more specialists from other geosciences are utilizing palaeomagnetic results, in particular palaeomagnetic stratigraphic correlations, possible relationships between geomagnetic field changes and climate, continental drift. It is important that general agreement about the interpretation of these palaeomagnetic data should develop as this would enhance the significance of our conclusions as well as making a substantial contribution to the solution of problems in other branches of geoscience.

At the joint symposium with IAMAP JS-C, three papers dealing with correlations between geomagnetic field characteristics and climate-weather changes were included. This opens up new possibilities of application of palaeomagnetic results. A model enabling causes of long and short term solar-terrestrial relationships as well as glaciations to be explained, was suggested.

2.5 (ii) *Report on the Business Meeting of WGI-5 at Seattle*

In order to cover the problems which are capable of solution in the near future the following subjects were suggested for IAGA scientific sessions during the Canberra IUGG Assembly in 1979:—

(a) Palaeomagnetism of recent sediments (convenors: Thompson and Gurarij)

(b) Multicomponent natural remanent magnetization (convenors: Halls and Storetvedt)

(c) Magnetostratigraphy (convenors: Valencio and Pevzner)

Changes in WGI-5 officers

Dr. Bucha's term as chairman having come to an end after a four year term of office, Dr. Briden, the current Vice-Chairman, takes over as Chairman after Seattle. Dr. A. A. Valencio (Argentina) was unanimously elected to be the new Vice-Chairman.

2.6 Working Group I-6: Rock Magnetism

S. K. Banerjee, Acting Chairman (in the absence of the Chairman, G. N. Petrova)

2.6 (i) *Report on Developments in Rock Magnetism during 1975–77*

With the realization that the basis of geodynamics and plate tectonics for periods older than 200 My lies in reliable palaeomagnetic records from the continents, research workers in rock magnetism have turned their attention in the recent past to specific goal-orientated projects and a happy collaboration between palaeomagnetists and rock magnetists has emerged.

The above collaboration has been evident in the publications in rock magnetism since the Grenoble Assembly (1975) and was particularly visible in the scientific session

SI1 on the Origin of Stable Remanence at the Seattle Assembly. A total of 34 papers were read, five of which were invited and covered different major areas. As a whole the papers fell into two categories, (a) studies on synthetic samples and (b) studies on rock specimens from both continents and oceans. The second category had most of the papers and valuable case histories were discussed, which will help the recovery of primary magnetization directions.

The thrust of the smaller scientific session, SI-8 on Rock Magnetism was mainly on (a) viscous remanent magnetization (VRM) which is ubiquitous and affects the magnetic record of both young and older rocks, and (b) on piezomagnetism, whose understanding is essential for a possible magnetic method for earthquake prediction.

2.6 (ii) *Report on Business Meeting of WGI-6 at Seattle*

The Business Meeting of WGI-6 was held on August 24 at 20.00 h and the main results were, the recommendations for two scientific sessions for WGI-6 at Canberra. They are (1) Rock magnetism of fine particles [convenors: H. Soffel (FRG) and E. Deutsch (Canada)], and (2) Magnetic susceptibility anistropy of rocks and their geological applications [convenors: E. Hailwood (U.K.) and J.-J. Wagner (Switzerland)]. In addition S. Levi (U.S.A.) and D. Pechersky (U.S.S.R.) were selected as proposed members of the program committee for Joint Symposium No. 8 at Canberra.

DIVISION II — AERONOMIC PHENOMENA
(Chairman: B. A. Tinsley)

During the last two years much effort has gone into planning the Assembly just concluded in Seattle. A number of symposia were joint with other bodies, representing Division II's wide scope of interest, and attempt to deal comprehensively with all aspects of the aeronomy of the Middle and Upper Atmosphere. There were four Symposia with a total of 17 half day sessions joint with IAMAP on phenomena below 100 km, and a symposium with URSI on Neutral and Ionospheric Models in the Thermosphere (five half-days), and six other half day sessions on various topics.

The subject of planetary atmospheres was dealt with in only a minor way at this meeting in view of the meeting in Ottawa on this subject just prior to the Seattle Assembly. However, we do expect to cover this subject fully in a planned symposium for the December 1979 Assembly in Canberra.

Two reporter review sessions were held near the end of the assembly, and a set of excellent reviews, combined with summaries of meeting highlights, served to bring out the progress being made in all the topics, including some challenges to conventional wisdom that may result in significant revision of current ideas.

DIVISION III — MAGNETOSPHERIC PHENOMENA
(Chairman: C.-G. Fälthammar)

Division III held its (only) Business Meeting on August 24 (starting 4 p.m.). The main results are summarized below.

1. Working Groups

a) WG III-2, the Geomagnetic Meridian Project, has successfully completed its task (cf. Report of Div. III Activities, dated May 5, 1977) and wishes to terminate its activities as a working group, although the observation points established in the GMP effort are expected to remain operative through the IMS. Division III agreed to recommend the EC to terminate the WG. The completion of the GMP was also the subject of a draft resolution (cf. 4 below).

b) Div. III considered an initiative by Dr. R. G. Johnson to establish a WG on the "Composition of the Hot Magnetospheric Plasma". Its main tasks would be to

(i) Identify and tabulate plasma composition measurements that are in progress and those that are being planned. Distribute this information and other related information to interested members of the scientific community via a newlsetter.

(ii) Assist in identifying and encouraging coordinated plasma composition experiments and related supporting experiments.

(iii) Encourage and assist in organizing scientific meetings, symposia etc. to provide a forum for timely dissemination and discussion of magnetospheric plasma composition results.

Division III decided to recommend the EC to establish the proposed WG, leaving the precise formulation of the terms of reference to be submitted by the WG for approval by the Div. III leadership. Assuming the establishment of the WG, Div. III appointed Drs. R. G. Johnson chairman and G. Haerendel vice-chairman (or co-chairman).

c) Dr. R. Gendrin gave a brief report on the operation of the Joint IAGA-URSI WG on Wave Instabilities in Space Plasma, and gave information about the symposium that the WG will organize at the 1978 URSI General Assembly.

2. Rotation of Division Officers

The terms of the present *Division Chairmen* end in 1979 when the new leadership is to be appointed by the EC. Similarly, new *Subdivision Reporters* are to be appointed by the Division in 1979. In preparation for these appointments Div. III Members will be invited to submit nominations.

As the *Working Groups*, unlike the Division and its Subdivisions are, in general, expected to be short-lived, it was felt that a rotation of leadership in the WG's may not always be desirable and should be considered from case to case.

3. Scientific Sessions of IAGA Div. III at IUGG General Assembly, 1979

Of the 20 IUGG Symposia approved by the EC of IUGG, one concerned IAGA Div. III, namely that on "Geophysical Implications of Planetary Studies". Candidates for Div. III representatives on the Program Committee were nominated. After consultation with those concerned, and discussion in the joint meeting of Division Chairmen and

IAGA EC on August 30, the Div. III representative nominated is Dr. G. L. Siscoe.

On the request of the Chairman, Dr. J. G. Roederer described the background of the proposed symposium on IMS results to be sponsored by IAGA and SCOSTEP and to take place in connection with the 1979 IUGG General Assembly. Div. III endorsed the proposed symposium, but among those present at the business meeting there was a slight preference, 20 votes against 16, for having it during the IUGG General Assembly instead of the preceding week as has been proposed.

The Div. III representation in the Program Committee for the IMS-symposium was discussed. Assuming the Division Chairman to be a member Ex Officio, three *additional* members were nominated.

At the joint meeting of Division Chairmen and IAGA's Executive Committee on August 30, the Div. III representation was reduced to a total of three. The final nominations are: 1. Chairman of Div. III, C.-G. Fälthammar, Ex Officio; 2. Dr. V. A. Troitskaya; 3. Dr. C. T. Russell

In addition to the IMS-symposium Div. III proposed the following scientific activities during the IUGG General Assembly:

(i) Reporter Review Sessions

(ii) Latest Significant Results Sessions. The subject matter in these sessions is to be grouped according to topics and considered jointly with material submitted for the IMS Symposium

(iii) A symposium on Active Experiments in Space Plasma. Such a symposium has been proposed to be held in the context of the 1979 COSPAR meeting in Bangalore. Div. III proposes that this be a joint IAGA, COSPAR, URSI symposium and that it be held during the IUGG General Assembly in Canberra. (The proposal has been preceded by informal consultations between representatives of COSPAR WG II and IAGA Div. III leaders. Within IAGA it is expected that the symposium will have the support of Div. II as well.) For IAGA representatives on the Organization Committee Div. III nominated: Dr. R. A. Helliwell, Dr. M. J. Rycroft, Dr. N. Kawashima.

(iv) A joint IAGA/URSI symposium on Non-linear Waves in Geophysical Plasmas, to be organized by the IAGA/URSI Joint WG on Wave Instabilities in Space Plasma.

(v) Scientific Sessions on Geomagnetic Pulsations (especially with emphasis on studies using spaced stations or satellite-ground correlation) had been proposed. There appears to be a considerable demand for such sessions. However, because of the close relation to certain IMS studies, Div. III decided that the question whether this demand should be met within the IMS symposium or separately could be left to be decided jointly by the Program Committee for the IMS Symposium and the Div. III WG on Magnetic Pulsations.

As the Working Group meetings were scheduled after the Div. III business meeting, additional requests were raised later. On the basis of the joint meetings of Division Chairmen and IAGA's Executive Committee on August 30 and 31, and consultations with Working Group Leaders and numerous Div. III Members, several changes were made in the proposed program. The resulting proposal for Div. III activities during the 1979 IUGG General Assembly is shown later.

4. Resolutions

Div. III decided to submit three draft resolutions. The final polishing of the texts was left for the authors to do afterwards in consultation with appropriate persons. The resolutions submitted from Division III were accepted as the IAGA Resolutions No. 4, No. 5 and the Administrative Resolution (shown on pages 53 and 55). In the case of the administrative resolution the final text prepared by the original author in consultation with the President of IAGA represents a major modification.

Proposed IAGA Div. III Activities at the 1979 IUGG Assembly

1. *Union symposia*

   Div. III is primarily interested in symposium 7: Geophysical Implications of Planetary Studies.

   Div. III representative on Program Committee: G. Siscoe.

2. *Business and Working Group meetings*

   At least two business meetings of the Division must be scheduled, with at least one meeting of each WG between the two.

3. *Div. III scientific meetings*

Designation and Convener	*Required no. of half days*
3.1 Reporter Reviews Convener: Division Chairman (C.-G. Fälthammar)	2
3.2 Latest Significant Results Convener: C. T. Russell	3–4
3.3 Symposium on IMS Results Convener: to be appointed IAGA Div. III representatives on Organizing Committee: 1. Div. III Chairman, Ex Officio (C.-G. Fälthammar); 2. C. T. Russell; 3. V. A. Troitskaya	10–14
3.4 Scientific Sessions on Geomagnetic Pulsations a. Observational Tests of Pulsation Theories b. Pulsation Generation and Propagation Theory c. Substorm-Associated Pulsations (d. A session on IMS Multipoint Observations, 2 half days, is assumed to be included in the Symposium on IMS Results) Convener: D. J. Southwood	4
3.5 Symposium on Active Experiments in Geophysical Plasma (joint with COSPAR and URSI, originally suggested for COSPAR at Bangalore, June 1979) Convener: to be appointed. IAGA Div. III representatives: R. A. Helliwell, N. Kawashima and M. J. Rycroft	6–8
3.6 Non-linear Waves in Geophysical Plasma (joint with URSI) Convener: joint IAGA/URSI Working Group on Wave Instabilities in Space Plasmas Part of 3.6 may be accommodated in the symposium on IMS results	2

(3.7 A session on quantitative models, proposed by WG III-3, is assumed to be part of the symposium on IMS Results)

Items 3.1 and 3.2 have been requested by the EC in agreement with general demand. Items 3.3 etc. are listed in order of priority.

DIVISION IV — SOLAR WIND AND INTERPLANETARY MAGNETIC FIELD (Chairman: K. I. Gringauz)

Activity and Business Meetings in Seattle

A Reporter Review Session and three scientific symposia were successfully carried out. All Reporter Reviews (by W. C. Feldman, F. M. Neubauer, C. T. Russell, L. Svalgaard and C. P. Sonnett) were interesting and useful; conveners of Symposia (L. Burlaga, F. Mariani and M. Neugebauer and N. Ness) invited many first class scientists to give papers. All Symposia of Division IV were attended by many scientists.

Two Business meetings of Division IV took place: August 23 and August 25. Some corrections in the membership or Reporter groups were made: Dr. S. Pinter (Czechoslovakia) was appointed one of the reporters on the topic "Waves and discontinuities in the Interplanetary Space", Dr. T. Gombosi (Hungary) on the topic "Solar wind interaction with weakly ionized bodies", Prof. H. Alfvén, according to his will, was replaced as Reporter on topic "Evolution of Solar Systems as deduced from the solar wind data" by Dr. Mendis (USA).

It was decided at the business meetings to present the following proposals of Div. IV symposia items for the Canberra Assembly:

1. *Solar wind interactions with planetary atmospheres* (interdivisional symposium of Divisions II and IV)

   The Chairman of Div. IV has discussed this matter with Div. II Chairman, Dr. B. Tinsley, and it was agreed to organize the above mentioned Interdivisional Symposium with 2 co-conveners representing each Division (1 or 2 half-day sessions).

   Conveners: D. Winningham (USA)
   T. Gombosi (Hungary)

2. *Multi-point studies of evolving solar wind structures*

   Convener: P. C. Hedgecock (UK)

3. *Discontinuities, Waves and Currents in the Solar Wind*

It was noted by Dr. Vasyliunas that as the programs of these symposia could influence the International Solar Wind Conference which is planned to be organized in the Federal Republic of Germany in 1978, the leadership of Division IV must be informed on the program and organization of this conference in order to avoid possible duplication of items. Div. IV decided to ask the IAGA Executive Committee to take care of this problem.

DIVISION V — OBSERVATORIES, INSTRUMENTS, INDICES AND DATA (Chairman: P. H. Serson)

1. Business Meeting at Seattle

The business meeting of Division V was held on 26 August 1977, by which time all the working groups had met in Seattle. The spokesman for each working group in turn preasented (a) a brief report on the activities of his group, (b) suggestions for symposia and scientific sessions for the 1979 Assembly, and (c) resolutions and recommendations proposed for sponsorship by the Division.

Suggestions for the Canberra Assembly

The Division approved the following proposals for the program of the Canberra Assembly:

- Mayaud Symposium on Use of Geophysical Indices (proposed by WG V-6, Convenor L. Svalgaard).
- Workshop on Magnetic Observatory Practice and the Reduction of Secular Variation Observations (proposed by WG's V-1, V-3 and V-10).
- W. F. Stuart was nominated for IAGA representative on the program committee for IUGG Symposium No. 3 (New technologies in geophysical instrumentation).

Resolutions and Recommendations

The Division approved 10 draft resolutions which eventually were adopted as IAGA Resolutions 7 to 15, and the Administrative Resolution.

- The Division approved the adoption of Dr. van Sabben's Three-letter Symbols of Magnetic Stations (IAGA News No. 16, 129–144, 1977).
- The Division agreed to recommend to the Executive Committee the provision of travel funds for Dr. Mayaud to visit the *Km* magnetic observatories in 1978 prior to his retirement.
- It was agreed to prepare a letter for the signature of an appropriate officer of IAGA, addressed to the International Hydrographic Organization and the International Civil Aviation Organization, drawing their attention to Resolution No. 14 and requesting their cooperation.

Changes in Organization

The recommendation of Dr. Sugiura, to dissolve Ad Hoc WG V-8 (Coordination of IMS Ground-based, Balloon and Rocket Experiments), was accepted.

The Division approved the appointment of Dr. T. Saito to replace Dr. Mayaud as Co-Chairman of WG V-6.

2. Reports from Working Groups

Working Group V-1: Magnetic Observatories (Chairman: C. Sucksdorff)

Some years ago magnetic observatory activity was in a crisis. Agencies running observatories planned to close several of them because of the lagging interest of the scientific community in observatory data. Now we can report that observatory data are used more and more both for scientific studies of the secular variation and for practical

purposes like updating magnetic charts. Also information on magnetic variations is widely used for different purposes. Therefore, observatories in developed countries are probably safe now. Unfortunately, the situation is not that good in new and developing countries, where the scientific tradition is often broken or lacking.

The activity of the Working Group on Magnetic Observatories since the Grenoble meeting in 1975 has been the following:

- As decided in Grenoble, the WG prepared a guide for international exchange of observatory data. This was published in IAGA News No. 15.
- Also as decided in Grenoble, the WG has prepared a new list of magnetic observatories, their instrumentation and activity. The list is now in a preliminary form and needs some amendments and updating.
- In addition, the WG, especially Mr. Svendsen, has been in frequent correspondence with several observatories, advising and encouraging them in observatory activities.
- The WG held its business meeting in Seattle 1977 August 23, 19–21.30 o'clock. 19 individuals from 12 countries attended the meeting, six of them being members of the WG. The WG made the following decisions:
  1. The proposed format of the list of magnetic observatories was accepted. The WG decided to recommend the publication by IAGA of the list after updating.
  2. This list should contain only observatories which can be considered permanent and usable for studies of secular variation.
  3. The WG decided to recommend to IAGA the adoption of the observatory mnemonic code prepared by Dr. van Sabben. No number codes were considered necessary, but the data files should include the geographic coordinates of the observatories.
  4. The WG decided to suggest a continuation of the Workshop of Observatory Practice in Canberra 1979.
  5. The WG discussed the one-minute values produced and to be produced in observatories. Some filtering methods were considered desirable to reduce the aliasing effects which were shown to be rather severe in some applications when instantaneous values are used. The matter was considered partly instrumental and was passed to the WG on Magnetic Instruments.
  6. The WG proposed and supported the resolutions eventually adopted as IAGA Resolution Nos. 7, 8 and 9.

Working Group V-2: Meteor Observatories (Chairman: R. G. Roper)

As with my first report as Chairman of this Working Group (presented at the Grenoble IUGG meeting in 1975), most of this report is addressed to radio meteor wind determination. However, one of the reasons why I suggested that the initially proposed group title "Radio Meteor Observatories" be changed to "Meteor Observatories" was that I envisaged the group as serving not only IAGA's self interests, but also as a liaison with other associations and Unions with an interest in meteor astronomy and meteor physics, particularly as these relate to interactions with the earth's atmosphere. In this context, members of WG 2 have participated in a joint IAU/IAGA "Committee on Radar Observations of Meteor Rates and Radiants, and Anomalies at the Base of the Thermosphere". Since the interest of IAU Commission 22 (the original proposers of the Joint Committee) lies solely in the meteor patrol (rates and radiants) area (as reported by

Chairman C. S. L. Keay at the Grenoble Assembly of IAU in August 1976), our input to this committee has been minimal.

However, close ties have been forged with experimenters using other techniques; in particular with the Incoherent Scatter Group, G. 8 of URSI Commission III through the joint Cooperative Tidal Observations of the Lower Thermosphere Program (CTOP), and the Ionospheric Drift Observations Group G. 2 of URSI Commission III who, together with IAGA's Global Radio Meteor Wind Studies Project (GRMWSP), are now using the same observational calendar.

Reports have been received detailing the most recent operations of the Italian CNR Meteor Radar Station at Budrio (45.5°N, 11.7°E)(Dr. F. Verniani) of the imminent completion of an excellently conceived meteor wind radar by the Ionosphere Research Laboratory of the University of Kyoto (Dr. T. Aso).

Communications have been received from Dr. A. Frost (University of New Hampshire) and Dr. D. Rind (Lamont Dougherty Geological Observatory) concerning the use of infrasound recording techniques to deduce the wind field in the lower thermosphere. They are anxious to make comparisons with radio meteor and other lower thermosphere wind determinations.

The URSI/IAGA CTOP venture has resulted in the following papers, detailing results of the first three cooperative periods (August 9–14, 1974; October 13–17, 1975; January 19–23, 1976), which are being considered for publication in the Journal of Atmospheric and Terrestrial Physics:

Roper, R. G., and J. E. Salah, "Preliminary Results from the URSI/IAGA Cooperative Tidal Observations Program (CTOP)".

Harper, R. M., and R. H. Wand, "Coordinated Tidal Observation at Arecibo".

Roper, R. G., "Winds from the Atlanta (34°N, 84°W) Radio Meteor Facility".

Hess, G. C. and M. A. Geller, "Urbana Meteor Radar Observations During GRMWSP/CTOP Periods".

Clark, R., R., "Meteor Wind Data for Global Comparisons".

Wand, R. H., and J. E. Salah, "Tidal Observations at Millstone Hill for the August 1974 and October 1975 Special Periods".

Kingsley, S. P., H. G. Muller, L. Nelson, and A. Scholefield, "Meteor Winds over Sheffield (53°N, 2°W).

Glass, M., R. Bernard, J. L. Fellows and M. Massebeuf, "The French Meteor Radar Facility".

Bernard, R., "Incoherent Scatter Results for Coordinated Special Intervals at St. Santin, France".

Baggaley, W. J., and E. M. Poulter, "Radio Meteor Wind Facility at Christchurch, New Zealand".

With the publication of the SCOSTEP Middle Atmosphere Program (MAP) Planning Document (available from the Aeronomy Laboratory, Department of Electrical Engineering, Illinois, Urbana, Illinois 61801 U.S.A.), which calls for greatly increased cooperation between experimenters using ground based, in situ and satellite techniques, an even greater need exists for such collaborative endeavours as GRMWSP and CTOP.

At the Working Group meeting held in Seattle on August 23, 1977, it was decided that the objectives of CTOP could best be served in 1978 by having all stations concentrate on one long recording interval instead of several short intervals. All stations are encou-

raged to gather a continuous time series of data from June 1 to June 14, 1978 inclusive.

Notice was given by Dr. Glass, of the operation of the French meteor radar at Arecibo during 1978. Close cooperation is to be maintained with the meteor radars operating at Atlanta and Durhan to study variations in mesopause circulation with latitude along a similar longitude.

Archiving of radio meteor wind data at the Asheville, North Carolina World Data Centre was discussed, and will be pursued further by the Chairman.

No special symposia are proposed for the Canberra Assembly. The Working Group believes its interests will be adequately served by the joint IAGA/IAMAP Symposium on the Middle Atmosphere.

Working Group V-3: Geomagentic Instruments and Standards (Chairman: F. W. Stuart)

Working Group V-3 met in the evening of August 24th. Ten individuals representing 10 countries attended. Only three of these (including the Chairman) were members of the official Working Group.

The Chairman remarked that the attendance seemed to reflect his impression that there was not a great deal of interest in the development of instruments at this time. He reported that correspondence with WG members in the last two years had not shown any interesting instrumental work to be in hand. A personal interpretation is that general financial stress in most countries has been suppressing research activity in this field.

Two areas of responsibility have been identified:

. to assist in the selection of new magnetometer systems for observatory, repeat and survey work with particular emphasis on ease of operation and operation in extreme climates.

. to advise on the procedure for the use of these instruments.

In view of the range of problems encountered in these two subjects, the WG recommended in the first place that Dr. Wienert's excellent book should be used as a basic reference. The WG undertook to compile a list of instruments currently in use, together with summary comments by their operators on such headings as sensitivity, reliability, comparative ease or difficulty in use. Information for this list will be collected by WG members and, hopefully, in 1979 some effort will be made to collate facts and views about each type. When this is completed, it is hoped that IAGA may be persuaded to publish the list as a booklet.

There was a great deal of discussion about problems of aliasing in recorded digital data, with regard to routine observatory observations. It was concluded that the subject was too complex for any general advice to be issued, but that the WG would be prepared to act as a forum for further examination of the subject.

WG V-3 decided to support V-1 in the request for a continuation of the Observatory Workshop in 1979.

F. Primdahl and W. F. Stuart were nominated as possible members of the IUGG programme committee for Canberra.

The WG discussed the form of Division V and agreed that the present structure is the best type for the responsibilities of the Division. It was noted that although geographical representation was desirable in WG's, non-participating members should be replaceable in an ad-hoc way, by the Chairman in consultation with the Division Chairman.

Working Group V-4: Optical Calibration Standards (Chairman: R. A. Pastiels)

During the Grenoble meeting of Working Group V-4, a basis for its action was defined: "By the circulation of several well calibrated radio-luminescent sources, interested laboratories have the opportunity to check their spectro radio metric scale, for airglow and auroral measurements". To perform this task, the first step is to have in hand some good sources and the second, to do the absolute calibration of some item, before and after circulation.

Actually, it is not easy to obtain such radio isotope-phosphor sources. A number of laboratories are using carbon 19 (C14) sources, that were manufactured many years ago, according to a National Bureau of Standards (Boulder) design. The manufacturer will no longer supply them. Dr. Gadsden of the University of Aberdeen has one of these, which was used in earlier intercalibaration projects. The Max-Planck-Institut at Lindau (Dr. Lauche) has carbon-14 and strontium-90 sources. The Tromsø standard is krypton excited. Drs. Heurist and Marette at the "Intitut d'Astrophysique de Paris" are using a tritium excited source. Tungsten sources are more reliable in some ways, but are not easily transportable, with heavy control equipment, nor usable in space-borne equipment.

The most difficult step is the absolute calibration. One can purchase calibrated tungsten lamps, but this then requires a diffusive screen of known reflectance and angular scattering characteristics. The use of a screen also lowers the flux. But the total reduction of flux must be very large and well known.

Since the Grenoble meeting, the working group has arranged a first attempt at calibration, through the Max-Planck-Institut sources, involving,

B. Holback (Uppsala Ionospheric Observatory)
M. Torr (University of Michigan)
J. Christophe and G. Weill (Institut d'Astrophysique, Paris)
M. Heurist and G. Marett (Institut d'Astrophysique)
R. Pastiels (Institut d'Aeronomie Spatiale, Bruxelles).

The results expressed in emission rate (R/Å) as a function of wavelength are within a band of $\pm 40\%$, but with progressive variations in this band. At some important wavelength the spread is $\pm 20\%$. The analysis suggests that these errors are due to systematic effects.

Another observation of the absolute necessity to do this general check was given by Dr. M. Torr during our business meeting. Using the global airglow measurements taken by the Atmosphere Explorer–C satellite, she was able to make comparisons with ground-based observatories. Taking account of the necessary corrections, she finds a spread of 1 to 6, relative to the mean, in the measurements made by the world network.

But the way is open to improvements: firstly we must do better relative spectroradiometric calibrations, with double monochromators, especially for tungsten sources, or with very well studied interference filters. A precision of $\pm 10\%$ or ultimately $\pm 5\%$ may be expected.

After this step, an absolute calibration at some wavelength of normalization must be done, using a bureau of standard care of calibration. It seems to me that the precision shall be of the same order of $\pm 10\%$.

During this achievement it is useful to exchange and circulate sources with centres having calibration equipment, using later, correction factors following the progress of the

absolute calibrations.

A very good solution has been worked out by Dr. M. Torr and P. B. Hays, with the realization of a very precise, stable and easily transportable filter photometer.

An announcement was made prior to the Seattle meeting, that this photometer could do calibrations for people bringing sources to the meeting. About 8 sources were calibrated at Seattle. It is expected that this kind of facility will be present at every IAGA meeting.

Finally I should like to ask you to note that the work of our working group is also directly applicable to workers in astronomy and meteorology, by the fact that many of our members are involved in working groups of these fields. This is in the best interest of all our international scientific associations.

Working Group V-5: Magnetic Surveys and Charts (Chairman: D. R. Barraclough)

Earlier this year Mr. E. B. Fabiano resigned the Chairmanship of the Working Group because of pressure of other work. Since the co-chairman, Dr. P. M. McGregor, was unable to attend the Seattle meeting, Mr. Fabiano was succeeded by Mr. D. R. Barraclough.

From the results of a questionnaire distributed about two years ago, 44 countries are known to be active in the production of national magnetic charts or the magnetic surveying of their territories or, in a majority of cases, in both. World magnetic charts continue to be produced by the United Kingdom, the United States and the U.S.S.R. The U.S. Navy project MAGNET continues to perform vector aeromagnetic surveys in various parts of the world and the Russian R. V. Zarya is active in surveying the magnetic field components at sea.

Since the Grenoble meeting, members of the Working Group have been involved in the organization of Session SV-2—Techniques and Evaluations of Recent Magnetic Charts and Models, which took place on August 31st at the Seattle Assembly. A tentative start was made on the compilation of the bibliography of charts and methods of chart production which was suggested at the Grenoble meeting. An attempt has been made to update the results of the 1975 questionnaire and some replies have been received to date.

The Working Group met during the evening of August 24th; 17 people were present of whom 6 were official members of the group. The meeting expressed its thanks to Mr. Fabiano for his hard work during the period of his Chairmanship.

The uses to which national charts are put were discussed and it seems that there is a continuing need for such charts for use in the traditional areas of navigation, geological interpretation and deviation of data for inclusion on topographical maps.

The relationship between national charts and world charts was discussed. The former are always useful for checking the accuracy of the predictive world charts but, to be useful in the production of new world charts, the importance of the publication of the numerical data on which the national charts are based, was stressed. The importance of the prompt distribution of such data via the World Data Centres was also emphasized.

Dr. R. A. Langel of NASA gave a very informative description of the MAGSAT project which will be of primary importance for the next series of world charts for 1980.0.

Since 1975.5, 15 sets of national magnetic charts are known to have been produced by agencies in 11 countries; at least 8 countries have plans to produce charts before 1980. A total of 401 repeat stations are known to have been reoccupied in 12 countries

since 1975.5.

It was decided to co-opt two new members into the Working Group, preferably representing countries in Africa (Dr. Barsczus has moved to Tahiti recently) and in South America. Dr. R. C. de Godoy of Brazil has since agreed to serve as a member.

It was decided that a guide explaining how to produce magnetic charts would be very useful, particularly in the developing countries, and a small subcommittee consisting of Messrs. Dawson and Fabiano and Dr. Mundt was asked to undertake this.

The Working Group proposed the resolution eventually adopted as IAGA Resolution No. 10.

Working Group V-6: Geophysical Indices (Chairman: J. V. Lincoln)

Six members from Australia, U.S., France and Netherlands attended the meeting on 24 August, 1977, and two other members from Spain and Japan sent representatives. In all, 25 delegates from 12 countries were present. Two resolutions were adopted by Division V and by IAGA (Resolutions 12 and 13). Several other actions were taken.

An endorsement by Division V was forwarded to the Executive Committee requesting travel funds for Dr. Mayaud to visit the *Km* observatories in 1978, prior to his retirement, in order to improve the quality of the *K* scalings for these important geomagnetic indices.

New 3-letter symbols for the magnetic observatories prepared by Dr. van Sabben were approved. A note will be published in the IAGA News. The list will be sent to all magnetic observatories for comment before being adopted on 1 January, 1978. Amendments and additions to the list will be made hereafter by World Data Center A for Solar-Terrestrial Physics, NOAA, Boulder, Col., 80303, U.S.A.

It was decided that observatories no longer need to send their *K*-indices to the International Service of Geomagnetic Indices at De Bilt but only to one of the World Data Centers.

The distribution of the IAGA Bulletins No. 32 was discussed. It was decided to include an insert with the next issue to be returned if the recipient wishes to continue on the free mailing list. Possible extra dissemination by World Data Center A for Solar-Terrestrial Physics was considered.

A note will be published in IAGA News indicating the importance of all observatories reporting ssc to Observatorio del Ebro for selection of the ssc to be published in IAGA Bulletin 32.

The Contents of IAGA Series of Bulletins 12 and 32 will also be published in IAGA News to facilitate their use.

A summary of past, present and proposed geophysical indices as prepared by J. V. Lincoln was endorsed for publication in IAGA News.

An IAGA Symposium on "Use, Quality and Evaluation of Geophysical Indices" was proposed for the Canberra 1979 Assembly honouring Dr. P. N. Mayaud, who is retiring in 1978 from his very active role in the preparation and study of geomagnetic indices. L. Svalgaard has been asked to be the convenor.

The Working Group endorsed the monthly bulletining of provisional three-hourly indices *Kn*, *Ks* and *Km* and related daily indices *An*, *As*, *Am* published by the Institut de Physique du Globe de Paris and urged their prompt dissemination. Anyone can request these bulletins from the Institut de Physique du Globe, 4 place Jussieu, 75230 Paris CEDEX 5, France.

Dr. Cardus suggested that observers reporting sfe use two letters, one for clarity of event, and other for quality. The Working Group suggested that Dr. Romañá could establish such rules and write to the magnetic observatories concerning their use.

Thanks were expressed to several of the Working Group for the preparation of the recommended geomagnetic indices: Dr. Siebert for *Kp*, *Ap*, *Cp* and quiet and distrubed days; Dr. Mayaud for *Kn*, *Ks*, *Km* and '*aa*'; Dr. Sugiura for *Dst*; Dr. van Sabben, Director of the International Service of Geomagnetic Indices, for his editorship of the IAGA Bulletin 32 and the Special Bulletins 39 and 40, as well as preparation of the new 3-letter symbols for magnetic observatories.

To replace Dr. Mayaud as Co-Chairman, Dr. T. Saito of Japan was nominated. Mme. Berthelier of Institut de Physique du Globe will replace Dr. Mayaud on the Working Group.

Working Group V-7: Collection and Dissemination of Data (Co. Chairman: H. Maeda)

Seventeen delegates from seven countries attended the meeting of Working Group V-7 on 23 August 1977. In the absence of Chairman V. P. Golovkov, H. Maeda took the chair.

It was noted that the collection and dissmenination of data from rockets, satellites and temporary observatories plays an important and urgent role in the International Magnetospheric Study. Reports to the Working Group by spokesmen for the World Data Centre A for Rockets and Satellites, World Data Centre A for Solar-Terrestrial Physics, and the Space Environment Laboratory at Boulder indicated that adequate arrangements for collecting and storing IMS data have been organized. Rapid dissemination of data in various forms on request is also planned.

The problem of standard formats for the exchange of data on magnetic tape was again discussed. Because of different computers at various institutions in different countries, standardization appears to be difficult at present. No agreement had been reached on the details of the flexible tape format proposed at Grenoble (IAGA Bulletin 37, p. 91, 1975). Hardly any institutions are using the IAGA format for one-minute values on magnetic tape adopted at Kyoto in 1973 (IAGA News No. 15, p. 88, 1976). Although it is obviously too late for the IMS, the Working Group agreed that efforts must be continued to find acceptable international magnetic tape formats for the 1980's.

Although approximately 40 magnetic observatories are recording digital values directly on magnetic tape, fewer than 15 of them are depositing digital values in World Data Centres. World Data Centre A for Solar-Terrestrial Physics is digitizing magnetograms at one-minute intervals from 7 or 8 magnetic observatories for the derivation of indices. There is still a great need for the digitization of analogue data as part of the IMS program.

At present, most of the data on geomagnetism and aeronomy in World Data Centres is on microfilm. In recent years, however, microfiche techniques have been developed which promise important advantages for filing large amounts of data. Two disadvantages of microfiche were pointed out. First, microfiche equipment is not available in the USSR and Eastern Europe. Secondly, no microfiche enlarger now available will produce a print of a magnetogram at the original scale, as is required for digitizing. Noting the success of two microfilming trips, recently organized by World Data Center A for Solar-Terrestrial Physics, in collecting data from magnetic observatories, the Working Group drafted a resolution which was eventually adopted as IAGA Resolution No. 11.

The collection of geomagnetic data relating to solid-earth research was discussed in connection with the revision of the Guide to International Data Exchange, published by the UCSU Panel on World Data Centres. A small panel appointed by the Working Group recommended that the following be added to the section of the Guide entitled Magnetic Measurements:

I. *Satellite Data*
   a. participating countries should send low-altitude satellite measurements to one of the WDC's, preferably on machine-readable format.
   b. WDC's should routinely exchange inventories of all low-altitude satellite data received.
   c. data are to be exchanged between data centres on request.

II. *Observatory Annual Means*
   a. annual means should be sent to one of the WDC's as rapidly as possible. Values which are preliminary should be labelled as such.
   b. all annual mean data received by a WDC are to be routinely exchanged with the other WDC's.

III. *Repeat Station Data*
   a. participating countries should send available repeat station measurements to one of the WDC's as rapidly as possible.
   b. WDC's should routinely exchange all repeat station data received.

IV. *Vector Survey Data*
   a. participating countries should send available airborne, land and marine vector survey measurements to one of the WDC's, preferably in machine-readable forms.
   b. summarized data are to be exchanged between data centres on request.

Working Group V-8: (ad hoc): Coordination of IMS Ground-Based Balloon and Rocket Experiments (Chairman: M. Sugiura)

In the IMS planning the coordination of IMS projects was the responsibility of the IMS Steering Committee under SCOSTEP. However, until about the beginning of the IMS there was not enough assurance that the work of coordination could be performed efficiently in the absence of a central coordination office with the required facilities. For the coordination of satellite experiments the Satellite Situation Centre had been established and it began its initial operation in 1975. However, there was no counterpart of SSC for the coordination of the ground-based, balloon and rocket experiments. One attempt to set up an IMS coordination office in Vienna failed in the spring of 1975. Thus at the time of the Grenoble Assembly it was desirable to be prepared to use the existing IAGA organization for the coordination of the IMS experiments in the event of no central coordination office being established.

However, through the effort of the IMS Steering Committee, U.S. IMS panel and NOAA, the Temporary IMS Central Information Exchange Office was established in Boulder in 1976 and soon it proved its significance in the coordination of the IMS experiments. This information exchange office was made the full-scale IMS CIE office from its initial temporary status in the spring of 1977. The European coordination centre was set up at Meudon by Dr. Paul Simon and began its activity in 1976. The Soviet Union established their IMS organization with Dr. Migulin and Dr. Zhulin as representatives.

Likewise many nations have established similar organizational structures for the IMS coordination.

Thus the mechanism for coordination of the IMS experiments can now be considered as being nearly complete and adequate. Therefore I feel that the Working Group on coordination of IMS experiments can now be terminated.

Even if this Working Group is terminated many individuals who are actively engaged in the coordination of IMS experiments are members of IAGA. Therefore the termination of the Working Group does not imply a disassociation with IAGA from the IMS coordination. Indeed, Dr. Gordon Rostoker and this reporter have actively worked for the establishment of the coordination mechanism through the IMS Steering Committee and will continue their activity in this area. As for the future—in the post IMS period—it is stressed that there is strong need for coordination efforts for the magnetic and other observations associated with Division V.

Working Group V-10: Ground-Based Measurements for Satellite Geomagnetic Surveys (Chairman: D. Voppel)

In accorance with a decision made at Grenoble, Working Group V-10 was established at the end of 1976, with the following members:

D. R. Barraclough (U.K.)
H. G. Barsczus (Tahiti)
M. Casaverde (Peru)
Sh. Sh. Dolginov (U.S.S.R.)
E. Dawson (Canada)
M. Fahim (Egypt)
R. A. Langel (U.S.A.)
P. M. McGregor (Australia)
D. R. K. Rao (India)
G. Scheepers (South Africa)
R. Schlich (France)
C. Sucksdorff (Finland)
D. Voppel (F.R.G.)
T. Yukutake (Japan)

Eleven persons, including 6 members, attended the meeting of the Working Group on 25 August. Discussion during the meeting and by previous correspondence is summarized as follows:

1. The Working Group recommended the establishment of magnetic stations supplementing the world network of magnetic observatories, in order to obtain more accurate information on the secular variation and thus derive maximum benefit from satellite magnetic surveys. D. R. Barraclough presented a provisional list of about 30 locations where such supplementary observations are required. The Working Group drafted a resolution which was eventually adopted as IAGA Resolution No. 14.

2. Since the proposed secular variation stations are to be located far from existing magnetic observatories, the reduction of observatories for time variations presents a special problem. Simple correction according to the variation recorded at the nearest observatory will not provide the required accuracy. It is recommended that a portable variometer be operated in the vicinity of the secular variation station whenever possible ("first order" station). If no variometer is available, observations should be continued over an interval of at least 12 hours in order to obtain an approximation to a daily mean, or quiet night value ("second order" station). The Working Group proposed that a workshop on the reduction of secular variation observations at isolated sites be included in plans for the next meeting of IAGA.

3. The Working Group proposed that support for the secular variation measurements be enlisted from other international organizations, and recommended that an officer

of IAGA write to the International Hydrographic Organization in Monaco and the International Civil Aviation Organization in Montreal pointing out the necessity of secular variation measurements at isolated points to provide accurate information for navigation charts.

4. R. A. Langel reported that the magnetic survey satellite MAGSAT is scheduled for launching in September, 1979. The Working Group decided that its next activities would be

(a) to discuss further and approve the list of proposed secular variation stations,
(b) to send a questionnaire to the institutions concerned to learn whether they will be able to occupy the stations with suitable instrumentation or whether assistance from other countries is required, and
(c) to endeavour to make alternate arrangements where a country is unable to occupy magnetic stations in its own territory, by providing help with instruments and observers from other countries.

Topic V-1: Geophysical Alerts and Forecasts (G. R. Heckman reporting for D. J. Williams)

A. *The International Ursigram and World Days Service (IUWDS)*

The IUWDS Regional Warning Centers (RWC) provide warnings and forecasts of solar-geomagnetic activity and maintain a daily international exchange of coded data for the use of scientists in their area. These services are obtained by contacting the appropriate RWC. An up-to-date list of the regional warning centers is appended to this report.

B. *New "Quick-Look" Data*

New methods of display for new or recently obtained geophysical data are being developed at Boulder, and they will provide realtime or near-realtime data for the scientific community in general and especially for IMS participants.

The data so displayed will be disseminated by two primary methods. They are:

1. The SELDADS (Space Environment Laboratory Data and Acquisition Display System) from which data are available to anyone with a computer terminal and who can call Boulder (information contact: C. Hornback, NOAA, Boulder, Col., 80303; telphone 303–494–1000 ext. 3780. For a more complete description of SELDADS, see D. J. Williams, NOAA Technical Report ERL 357-SEL 37).
2. The "Primary Report and Forecast of Solar-Geophysical Activity" (PRSGA) published weekly at Boulder. (G. Heckman, NOAA, Boulder, Col., 80303). Data published in the weekly are received by subscribers 3–10 days after the time of observation.

The data are:

1. *SYNCMAG PATROL*: Magnetograms from the Space Environment Monitors on the SMS/GEOS satellites will be displayed on a continuous 24-hour basis. The magnetic field component parallel to the satellite spin axis for each day will be plotted superimposed upon a quiet day curve as a baseline. Two satellites, one at W75° longitude and one at W135° longitude will be displayed simultaneously. The continuous record will be published in the PRSGA.

2. *IMS Magnetometer Chain*: The 25-station North American magnetometer chain will be read out through the SELDADS system. Realtime stacked magnetograms will be available to SELDADS users and selected events will be published in the PRSGA.

3. *Substorm Catalog*: The SEL group at Boulder will compile a catalog of substorm events. Initially, the identification will be made from the SYNCMAG patrol. As the North American IMS chains come on line, they will also be included in the data base used for substorm identification. The catalog will contain a list of substorm times and a set of parameters not yet fully determined for each substorm. Because the data to be used cover only the western hemisphere, the list is not intended to be comprehensive. The catalog will be published in the PRSGA.

4. *Satellite Particle Data*: Satellite particle data are available in the SELDADS as follows:

a. *Polar Orbit Data*
   Present (NOAA5): protons $\geq$10 MeV; electrons $\geq$140 keV.
   Planned (TIROS-N, 1979): protons 300 ev-800 MeV; electrons $\geq$300 ev; alpha particles $\geq$640 MeV

b. *Synchronous Orbit Data*
   SMS/GEOS: protons 0.8 MeV-500 MeV; electrons $\geq$2 MeV; alpha particles particles $\geq$640 MeV

Selected events from these data will also be published in the PRSGA.

IUWDS REGIONAL WARNING CENTERS

World-Warning-Agency Boulder. Attn: G. Heckman, Space Environment Services Center, NOAA, Boulder, Col., 80303, U.S.A.
Telex: 045897 SOLTERWARN, Telephone: 303–499–100 Ext. 3171.

RWC-Western Europe-Paris. Attn: P. Simon, Ursigrammes, DASOP, Observatoire, 92190 Meudon, France.
Telex: 200590 CNETOBS X MEUDON, Telephone: 0277530 Ext. 595.

RWC-Western Europe-Darmstadt. Attn: TH. Damboldt, Forschungsinstitut der DBP, P.O. Box 800, 6100 Darmstadt, FRG.
Telex: 0419291 IONO D, Telephone: (06151) 83–2530 or 2533.

ARWC-Czechosolvakia. Attn: P. Triska, Czechoslovak Academy of Sciences, Geophysical Institute, Ionospheric Department, 14131 Praha 4, Czechoslovakia.
Telex: 11346 IONP C, Telephone: 762548.

RWC-Eurasia. Attn: RWC Moscow, Hydrometeorological Service of USSR, Glebovskaya 20 b, MOSCOW B-258, USSR.
Telex: 7614 ZEMLJA SU

ARWC-India. Attn: B.M. Reddy, c/o National Physical Laboratory, Delhi 12, India.
Telex: ND 522 CSIR, Telephone: 585298, 582045.

RWC-Western Pacific. Attn: T. Takiguchi, Radio Research Laboratories, Ministry of Posts and Telecommunications, 2–1, Nukui-Kitamachi 4-chome, Koganei-shi, Tokyo, 184, Japan.
Telex: 2832611 DEMPA, Telephone: 0423–21–1211.

RWC-Australia and Antarctica. Attn: F. E. Cook, IUDWS RWC, Ionospheric Prediction Service, P.O. Box 702, Darlinghurst, N.S.W. 2010, Australia.

Telex: 20663 IPSO, Telephone: 2698615.

ARWC-Warsaw, Attn: A. Klos, Heliogeophysical Prediction Service, Space Research Centre of Polish Academy of Science, PKiN, P.O.B. 25, 00-901 Warszawa, Poland.
Telex: 814730 COGPAN PL, Telephone: 36 28 85.

INTERDIVISIONAL COMMISSION ON ANTARCTIC RESEARCH (Chairman: T. Nagata)

The scientific sessions on "Interim Results of Antarctic IMS" were held in the morning and afternoon of August 23, and 14 papers were presented to the two sessions. Highlights of the sessions were the coordinated measurements of auroral substorms by ground-based networks, sounding rockets and satellites. Particularly, the VLF auroral hiss phenomena have been clarified in fair detail. The proceedings of these sessions will be published in an appropiate form in accordance with the request of the majority of speakers.

As for the session(s) of this Committee at the IAGA assembly in Australia in 1979, this Committee wishes to have a session in the general IMS symposium. Although the majority of contributions from this Committee may be included in various disciplinary sessions for the general IMS results, several members of the Committee expressed their strong hope that a session will be devoted to the Antarctic regional results of IMS. This would be because the Antarctic IMS is specifically supported by SCAR.

INTERDIVISIONAL COMMISSION ON HISTORY (Chairman: E. J. Chernosky)

The session on "Geomagnetic and Aeronomic Studies of Historical Importance" was held on the afternoon of August 27. A brief business meeting following this session noted that a resolution to urge compilation of IAGA history had been submitted previously because of the earlier deadline. The death of *Dr. David G. Knapp* on February 8, 1976, and *Dr. Mitsuo Keimatsu*, a researcher on historical auroral and earthquake data on July 3, 1976, were observed with deep regret. The obituaries have been prepared by K. L. Svendsen and N. Fukushima respectively. Two devoted wives who unselfishly supported their scientist-husbands were taken from us also; Mrs. Julius (Ilse) Bartels on August 9, 1977 and Mrs. Edwin (Katharine) Chernosky on December 3, 1976.

It was agreed to ask Dr. H. B. Garrett (Air Force Geophysics Laboratory) to fill the vacancy of Chairman of the Working Group No. 1 on the American Area. Appointment of a co-chairman for each of the Working Groups in the History Commission was also discussed. Consideration is being given to interested persons who can be active in the

organizational structure. Suggestions or nominations for persons that have an active interest in the work of the History Commission will be welcomed.

Dr. N. Pushkov, the organizer and co-chairman of the History Commission tendered his resignation, which hopefully will be able to be withdrawn as his health improves. His retirement would be regretted by all who know him.

To look forward to the Canberra Assembly in 1979 those with knowledge of the development of the various disciplines in IAGA, particularly in the Asian-Pacific Area, are urged to communicate with Dr. B. N. Bhargava (and also Dr. N. Fukushima).

INTERDIVISIONAL WORKING GROUP ON RELATIONS BETWEEN EXTERNAL AND INTERNAL MAGNETIC VARIATIONS (Chairman: A. A. Ashour)

The Business Meeting of this Interdivisional Working Group was called to order at 12 noon on August 29, 1977 by the Chairman, after the scientific session on "Relation between External and Internal Magnetic Variations". Scientists interested in receiving information on the activities of the Working Group and who are not at present on the mailing list were invited to send their names and addresses to the Chairman.

Discussion on the future of the Interdivisional Working Group led to the decision to continue its operation for the present. Two special scientific sessions were proposed for the next IAGA meeting in Australia.

1. Internal Contributions of the Ionospheric Electrojets
   (Conveners: S. Matsushita, W. H. Campbell)
2. *Sq*, *L* and Related Phenomena
   (Conveners: S. R. C. Malin, J. Untiedt)

REPORTS OF OTHER IAGA BODIES

JOINT WORKING GROUP OF IAGA DIVISIONS II AND III ON THE AURORAL OVAL AND ITS EXTENSION INTO SPACE

This Working Group (Chairman: B. Hultqvist; Vice-Chairman: C. T. Russell) has, at present about 160 members. Four newsletters (Nos. 4–7 in September 1975, February 1976, December 1976, and June 1977) have been issued to members since the Grenoble Assembly, and four symposia were organized by this Working Group during the IAGA Seattle Assembly. They were SIII3a on Timing Substorm Events, SIII3b on Rapid Auroral Fluctuations and Associated Phenomena, SIII3c on Electromagnetic and Electrostatic Instabilities on Auroral Field Lines, and SIII3d on Mechanism for Auroral Structures. C. T. Russell was the convener for these sessions and also for the Division III Latest Significant Results Sessions at Seattle.

July 1977, B. Hultqvist

IAGA/URSI JOINT WORKING GROUP ON STRUCTURE AND DYNAMICS OF THE THERMOSPHERE, IONOSPHERE AND EXOSPHERE

During the past year a special group has been formed to consider the question of future world-wide scientific needs for ionosondes after the IMS, i. e. in the 1980's. The group has 15 members, widely distributed geographically and in their specialist interests. The group was asked to consider certain specific questions and to make general comments on the subject. At the time of writing, members' contributions had been received and a draft report was prepared by me. The substantive report was presented in time for the Seattle Assembly. A short paper outlining the most topical questions in ionospheric physics within the JWG's field of competence, and incorporating opinions from numerous workers in the field, was published in July 1976 (J. Atmos. Terr. Phys. **38**, 775).

Research in the fields of interest to the JWG is proceeding world wide in a very satisfactory way. Necessary coordination is being carried out through the IMS mechanisms and specialized groups, such as those on drifts and incoherent scatter. At present, therefore, there is little work for the JWG to do. I foresee that, towards the end of the IMS, it will be desirable for a competent group to conduct a general scientific review of the JWG's field of interest. The object of this review will be to define important research topics for the 1980's. The JWG is the obvious body to supervise this work.

In the meantime the appropiate IAGA and URSI officers might like to consider:

(a) Whether the JWG should take a particular interest in promoting scientific work, within its own field of competence, in developing countries. If so, appropiate officers should be appointed.

(b) What liaison should be established with the URSI study group on future ionospheric research, chaired by J. W. King.

In any event I wish to retire from the chairmanship of the JWG. Having completed the report on ionosondes (para. 1), I think the time is now. The new chairman to be chosen by IAGA and URSI will then have adequate time to organize the review task suggested in paragraph 2.

July 1977, H. Rishbeth

Change in Chairmanship: Following the 1977 IAGA/IAMAP General Scientific Assembly in Seattle, Washington, U. S. A., John V. Evans of the Lincoln Laboratory, M. I. T., Lexington, Massachusetts 02173, U. S. A., became chairman of this Joint Working Group.

Recent Activities: As part of the IAGA/IAMAP General Scientific Assembly in Seattle, a three-day Symposium (JS–U) was organized on the subject of the Working Group's field under the title "Recent Advances in Neutral and Ionospheric Models in the Thermosphere". The convener was J. V. Evans (U. S. A.) and the program committee included A. Hedin (U. S. A.), P. Bauer (France), H. Volland (FR. Germany).

Planned Activities: The forthcoming URSI General Assembly in Helsinki, Finland provides the next opportunity for scientists interested in the field of the JWG to exchange ideas. Within the Commission G Symposium on "Radio Waves and the Ionosphere" will be sessions on the topic "Ionosphere Structure and Dynamics". Some 35 papers have been submitted to the meeting on this topic.

Future Activities: The object of Risbeth's review (in paragraph 2 of the above report) will be to define important research topics for the 1980's. The JWG is the obvious body to supervise this work. Such discussions have begun within the United States in an effort to plan for the future of ground-based, balloon and rocket studies of the atmosphere in the 1980's and will culminate in a National Academy of Sciences study on this topic in July 1978. Some reports of this work are planned at the URSI General Assembly in Helsinki within the Commission G Symposium on "Radio Waves and the Ionosphere", under the topic "Future Directions for Ionospheric Research". It is hoped that this process can continue and will lead to the development of plans for the post IMS period, focussing on a broad attack on the dynamics of the atmosphere at all levels and closely coupled to the proposed Middle Atmosphere Program (MAP).

24 May 1978, J. V. Evans

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

The considerable interest of aeronomers in this joint Working Group was reflected in the response to a questionnaire circulated by the Chairman of IAGA Division II, Dr. B. A. Tinsley, following the establishment of this and other joint working groups. The initial membership of the Working Group was drawn from members previously involved with the URSI Commission 3 Working Group 3.5 on "Production and loss of ionization, including flare effects" and IAGA Division II Topic 2 on "Solar fluxes and photochemistry of ionized and neutral constituents, including excited species". Additional members were then chosen with regard to their particular expertise or national representation. The present membership consists of L. Thomas (Chairman), A. D. Danilov (Vice-chairman), T. Tohmatsu (Vice-chairman, deceased), A. C. Aikin, J. S. Belrose, S. A. Bowhill, E. E. Ferguson, D. F. Heath, G. Kockarts, D. Krankowsky, A. P. Mitra, A. F. Nagy, C. R. Philbrick, G. C. Reid, W. Swider, J. Taubenheim, and M. N. Vlasov.

The first formal duty of the Working Group was to help organise the IAGA Division II/URSI Commission III one-day Symposium on "Solar Fluxes and Photochemistry" held as part of the IUGG General Assembly at Grenoble during 25 August to 6 September 1975. Four sessions were arranged: The intensities of solar radiations and their interactions with atmospheric gases; Ionospheric measurements and their interpretation; Ion and neutral composition measurements; Theoretical models. A total of 22 review and contributed papers were presented in what proved to be a successful and stimulating meeting. Some of the review papers presented were published as part of a special issue of the Journal of Atmospheric and Terrestrial Physics (Vol 38, No. 8, 791–895, 1976) develoted to Photochemical and Transport Processes in the Upper Atmosphere.

The first meeting of the Working Group was held at Grenoble on 27 August 1975. Consideration was given to future meetings relevant to the subject of the Working Group, particularly the two-day symposium on "Minor constituents and excited species" recommended by COSPAR Working Group 4 to be held in conjunction with the 1976 COSPAR meeting at Philadelphia, and the planning meeting for the Middle Atmosphere Programme (MAP) to be held in Urbana, Illinois during June 1976. Among the particular scientific topics also considered by the Working Group was the need for continuing solar flux measure-

ments during the 1980's. It was considered that a coordinated programme of monitoring experiments on automatic satellites and calibration experiments on SPACELAB was very desirable. Attention was also drawn to the transfer of interest to the stratosphere by a number of groups previously active in *D* region studies. The present and future plans of groups still engaged in these latter studies were discussed, and it was agreed that there was a continuing need for investigations directed towards an understanding of the aeronomy of the *D* region and its role in radio-wave communications and navigation. A brief review was given by Dr. D. U. Rusch, University of Michigan, of the fourteen experiments mounted on the Atmospheric Explorer (AE) series of satellites and of some of the major results derived from AE-C. The plans for depositing the AE data in World Data Centres for access by the international scientific community were described.

The subsequent business of the Working Group has been performed largely by correspondence, although groups of members have met at times of international symposia. Members have played very active parts in organising and participating in the planning of the MAP meeting at Urbana, Illinois and the symposium on "Ions in the middle atmosphere – chemical, physical and electrical aspects" held as part of the IAGA/IAMAP Scientific Assembly in Seattle during 22 August–3 September 1977.

June 1978, L. Thomas

IAGA/URSI JOINT WORKING GROUP ON WAVE INSTABILITIES IN SPACE PLASMA

In view of the fact that only one of the co-chairmen was able to attend the meeting in Seattle, it was felt that the purpose of the meeting should be to make suggestions concerning the activities of the WG which could be considered later by the co-chairmen.

1. *W. G. Activities*

(a) It was felt that there is a definite need for the WG to arrange appropiate sessions at international conferences. While it might be desirable to organize a conference completely devoted to the interests of the WG it was considered that there are too many conferences already and that it is preferable to organize sessions on appropiate topics at conferences already planned. The main disadvantage of this approach is that only a few topics of interest to the WG can be arranged at any one conference.

(b) It was suggested that a mailing list be compiled so that interested people could be kept informed of the WG's activities. A regular newsletter is not appropiate for this WG, but information on relevant conferences could be circulated.

2. *URSI Meeting, Helsinki, 1978*

The meeting considered that the proposal of D. Papadopoulos (letter of 4 May 1976) as modified by R. Gendrin (letter of 6 July 1977) would be the minimum desirable, i.e. a two day symposium held within URSI and organized around the topics of (a) Anomalous resistance, (b) Parametric effects excited by radio waves, (c) Plasma resonances.

The following suggestions were made at the meeting, i.e.

(i) Topic (a) should be titled "Plasma Turbulence" and its subheadings include "anomalous resistance" and "in the solar wind".

(ii) URSI Commission G should be asked to help organize topic (b).

(iii) Advertising and topic names should be such as to attract laboratory plasma physicists.

(iv) The topics "bow shock" and "reconnection" should be reconsidered if they are not included in the STP meeting scheduled in May-June 1978 in Innsbruck.

3. *IUGG General Assembly, Canberra, 1979*

Divisions II and III of IAGA are requesting that scientific sessions be held on (a) Ionospheric Irregularities, and (b) Non-Linear Waves in Geophysical Plasmas. They have requested the WG to organize these sessions.

At this time it is more likely that topic (a) will be approved by the IAGA Executive Committee as it is higher on Division II's list. However, there will be a symposium on the IMS held in conjunction with IUGG. Hence it is likely that if (a) is accepted as a topic for Canberra, high latitude observations could be incorporated into the IMS symposium making room for topic (b). Of course such details are purely conjecture at this stage but we need to be aware of the possibility.

August 1977, P. L. Dyson

IAGA INTERNAL STRUCTURE
for the Period of 1977–1979

EXECUTIVE COMMITTEE

President:	Juan G. Roederer,	Geophysical Institite, University of Alaska, Fairbanks, Alaska 99701, U.S.A.
Vice-Presidents:	Gilbert M. Weill,	Atmospheric Luminescence Laboratory Institut d'Astrophysique de Paris, 98 bis Blvd Arago, 75014 Paris, France.
	Keith D. Cole,	Division of Space Physics La Trobe University Bundoora, Victoria 3083, Australia.
Secretary General:	Naoshi Fukushima,	Geophysics Research Laboratory University of Tokyo, Tokyo 113, Japan.

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M. Nicolet, External Geophysics, Brussels University, 30, Avenue Den Doorn, B-1180 Brussels, Belgium.
T. Nagata, National Institute of Polar Research, Kaga 1–9–10, Itabashi-ku, Tokyo 173, Japan.

DIVISION I. INTERNAL MAGNETIC FIELDS

Chairman: K. M. Creer, Department of Geophysics, University of Edinburgh, James Clerk Maxwell Building, Mayfield Road, Edinburgh EH9 3JZ, U.K.

Vice-Chairmen: T. Yukutake, Earthquake Research Institute, University of Tokyo, Tokyo 113, Japan.
D. I. Gough, Department of Physics, University of Alberta, Edmonton, Alberta T6G 2E1, Canada.

Working Group I–1. **Analysis of the Main Field and Secular Variations**

Chairman: B. R. Leaton, Geomagnetism Unit, Institute of Geological Sciences, Murchison House, West Mains Road, Edinburgh EH9 3LA, U.K.

Vice-Chairman: A. N. Pushkov, IZMIRAN, P/O Akademgorodok, Moscow Region 142092, U.S.S.R.

Working Group I–2. **Theory of Planetary Magnetic Fields and Geomagnetic Secular Variation**

Chairman: P. H. Roberts, School of Mathematics, The University, Newcastle upon Tyne NE1 7RU, U.K.

Vice-Chairman: D. Gubbins, Department of Geodesy and Geophysics, The University, Midingley Rise, Midingley Road, Cambridge CB3 0EZ, U.K.

Working Group I–3. **Electromagnetic Induction and Electrical Conductivity (earth and moon)**

Chairman: U. Schmucker, Institut für Geophysik, Universität Göttingen, Herzberger Landstrasse 180, D-34 Göttingen, F. R. Germany.

Vice-Chairman: A. Ádám, Geophysical Research Laboratory of Hungaria, P.O. Box 9, H-9401 Sopron, Hungary.

Working Group I–4. **Magnetic Anomalies (land and sea)**

Chairman: J. R. Heirtzler, Department of Geology and Geophysics, Woods Hole Oceanographic Institute, Woods Hole, Mass. 02543, U.S.A.

Vice-Chairman: C. C. Weber, BRGM, B. P. 6009, 45018 Orleans Cedex, France.

Working Group I–5. **Paleomagnetism**

Chairman: J. C. Briden, Department of Earth Sciences, Leeds University, Leeds, LS3 9JT, U.K.

Vice-Chairman: D. A. Valencio, Facultad de Ciencias Exactas, Universidad de Buenos Aires, Ciudad Universitaria, Buenos Aires, Argentina.

Working Group I–6. **Rock Magnetism**

Chairman: G. N. Petrova, Institute of Physics of the Earth, Academy of Sciences of USSR, Gruzinskaya 10B, Moscow 117242, U.S.S.R.

Vice-Chairman: S. K. Banerjee, Department of Geology ad Geophyics, University of California, Berkeley, CA 94720, U.S.A.

DIVISION II. AERONOMIC PHENOMENA

Chairman: B. A. Tinsley, The University of Texas at Dallas, P.O. Box 688, Mail Stop FO 2.2, Richardson, Texas 75080, U.S.A.

Co-Chairmen: M. Ackerman, Institute for Aeronomy, 3 Avenue Circulaire, B-1180 Brussels, Belgium.

H. Rishbeth, Appleton Laboratory, Ditton Park, Slough 3L3 9JX, U.K.

A. Vallance-Jones, Division of Radio and Electrical Engineering, National Research Council, Ottawa K1A 0R8, Canada.

Topic II–1. **Structure and Dynamics of the Thermosphere, Ionosphere and Exosphere**

Reporters: G. Kockarts, Institute for Aeronomy, 3 Avenue Circulaire, B-1180 Brussels, Belgium.

H. Kohl, Max-Planck-Institut für Aeronomie, D-3411 Katlenburg-

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H. Rishbeth, Appleton Laboratory, Ditton Park, Slough SL3 9JX, U.K.

Topic II–2. **Neutral and Ion Chemistry and Solar Fluxes**

Reporters: A. D. Danilov, Institute of Applied Physics, Hydrometeorological Service, Moscow, U.S.S.R.

L. Thomas, Appleton Laboratory, Ditton Park, Slough SL3 9JX, U.K.

T. Tohmatsu, Geophysics Research Laboratory, University of Tokyo, Tokyo 113, Japan. (deceased)

Topic II–3. **Atmospheric Quantal Emission, Including Auroral Processes and Airglow**

Reporters: J. C. Gerard, Institut d'Astrophysique, Université de Liège, Avenue de Cointe 5, B-4200 Cointe-Ougrée, Belgium.

M. H. Rees, Geophysical Institute, University of Alaska, Fairbanks, Alaska 99701, U.S.A.

G. G. Shepherd, Centre for Research in Experimental Space Science, York University, 4700 Keele St., Downsview 463, Ontario, Canada.

Topic II–4. **Ionospheric Irregularities, Including Small Scale Auroral Structures**

Reporters: T. N. Davis, Geophysical Institute, University of Alaska, Fairbanks, Alaska 99701, U.S.A.

P. L. Dyson, School of Physical Science, La Trobe University, Bundoora, Victoria 3083, Australia.

R. S. Unwin, Geophysical Observatory, P.O. Box 2111, Christchurch, New Zealand.

Topic II–5. **Ionosphere-Magnetosphere Interactions, Including Large Scale Auroral Structures**

Reporters: L. P. Block, Department of Mechanics, Royal Institute of Technology, S-100 44 Stockholm 70, Sweden.

R. J. Hoch, Sigma Research Inc., 2952 George Washington Way, Richland, Washington 99352, U.S.A.

A. F. Nagy, Space Physics Research Laboratory, University of Michigan, Ann Arbor, Michigan 48105, U.S.A.

Topic II–6. **Stratosphere-Mesosphere-Ionosphere Interactions**

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J. B. Gregory, Institute of Space and Atmospheric Studies, University of Saskatchewan, Saskatoon, Sask. S7N 0W0 Canada.

C. F. Sechrist, Jr., Aeronomy Laboratory, Dept. of Elec. Engr., University of Illinois, Urbana, IL 61801, U.S.A.

Topic II–7. **Aeronomy of Other Planetary Atmospheres**

Reporters: D. M. Hunten, Lunar and Planetary Laboratory, University of Arizona, Tucson, Arizona 85721, U.S.A.

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G. E. Thomas, LASP Space Science Bldg., D135, University of Colorado, Boulder, Colorado 80302, U.S.A.

Topic II–8. **Laboratory Experiments of Aeronomical Interest**

Reporters: D. C. Cartwright, Theoretical Division, Los Alamos Sci. Lab., Los Alamos, NM 87544, U.S.A.
H. I. Schiff, Room 307, Petrie Science Building, York University, 4700 Keele Str., Downsview 463, Ontario, Canada.
B. A. Thrush, Physical Chemistry Department, Lansfield Road, Cambridge, England, U.K.

DIVISION III. MAGNETOSPHERIC PHENOMENA

Chairman: C.-G. Fälthammar, Department of Plasma Physics, Royal Institute of Technology, S-100 44 Stockholm 70, Sweden.

Co-Chairmen: R. Gendrin, Group de Recherches Ionosphériques, CNET-CNRS-IPG, 3 Avenue de la Republique, 92131 Issy-les-Moulineaux, France.
T. Obayashi, Institute of Space and Aeronautical Science, University of Tokyo, Tokyo 153, Japan.
D. J. Williams, NOAA Research Laboratories, Boulder, Colorado 80303, U.S.A.

Topic III–1. **Magnetic Field, Electric Fields and Current Systems Including Ground Observations**
Reporter: G. Rostoker, Killam Earth Sciences, University of Alberta, Edmonton, Alberta T6G 2E1, Canada.

Topic III–2. **Magnetosheath, Magnetospheric Boundary and Plasma Penetration**
Reporter: W. J. Heikkila, Center for Space Studies (MS: FO 2.2), University of Texas at Dallas, P.O. Box 688, Richardson, Texas 75080, U.S.A.

Topic III–3. **Distribution and Properties of Magnetospheric Plasmas**
Reporter: V. M. Vasyliunas, Max-Planck-Institut für Aeronomie, D-3411 Katlenburg-Lindau 3, Fed. Rep. Germany

Topic III–4. **Energetic Particle Populations Includng Cosmic Ray Entry**
Reporter: L. J. Lanzerotti, Geophysics Group, Bell Laboratories, 600 Mountain Avenue, Murray Hill, NJ 07974, U.S.A.

Topic III–5. **Magnetic Oscillations, Waves and Wave-Particle Interactions**
Reporter: D. J. Southwood, Physics Department, Imperial College, London SW7 2AZ, U.K.

Topic III–6. **Magnetic Storms and Substorms, Including Aurora-Magnetospheric Relations**
Reporter: S.-I. Akasofu, Geophysical Institute, University of Alaska, Fairbanks, Alaska 99701, U.S.A.

Topic III–7. **Magnetosphere-Ionosphere Interactions**
Reporter: R. Boström, Uppsala Ionospheric Observatory, S-755 90 Uppsala, Sweden.

Topic III–8. **Magnetospheres of Other Planets**
Reporter: F. V. Coroniti, Department of Physics, University of California, Los Angeles, California 90024, U.S.A.

Topic III–9. **Laboratory Experiments of Magnetospheric Interest**
Reporter: N. Kawashima, Institute of Space and Aeronautical Science, University of Tokyo, Tokyo 153, Japan.

Working Group III–1. **Magnetic Pulsations**

Co-Chairmen: B. J. Fraser, Department of Physics, The University of Newcastle, Newcastle, N.S.W. 2308, Australia.
F. Glangeaud, Centre d'Etude des Phénomènes Aléatoires et Géophysiques, B.P. 15, 38040 Grenoble Cedex, France.

Working Group III–2. **Composition of the Hot Magnetospheric Plasma**
Chairman: R. G. Johnson, Lockheed Palo Alto Res. Lab., Department 52–10, Bldg. 205, 3251 Hanover Str., Palo Alto, CA 94304, U.S.A.
Co-Chairman: G. Haerendel, Institut für Extraterrestrische Physik, Max-Planck-Institut für Physik und Astrophysik, 8046 Garching bei München, Fed. Rep. Germany.

Working Group III–3. **Quantitative Magnetospheric Models**
Chairman: W. P. Olson, Space Sciences Dept., McDonnell Douglas Astr. Co., 5301 Bolsa Ave., Huntington Beach, CA 92647, U.S.A.

DIVISION IV. SOLAR WIND AND INTERPLANETARY MAGNETIC FIELD

Chairman: K. I. Gringauz, Space Research Institute, Profsoyuznaya 88, Moscow 117810, U.S.S.R.
Co-Chairmen: P. C. Hedgecock, Physics Department, Imperial College, South Kensington, London SW7 2AZ, U.K.
N. F. Ness, NASA/GSFC, Code 690, Greenbelt, Md. 20771, U.S.A.

Topic IV–1. **Large Scale Characteristics of the Interplanetary Medium**
Correspondent: W. C. Feldman, Los Alamos Scientific Laboratory, University of California, Los Alamos, NM 87544, U.S.A.

Topic IV–2. **Waves, Discontinuities and Shocks in the Interplanetary Plasma**
Reporters: F. M. Neubauer, Institut für Geophysik, TU Braunschweig, Mendelssohn Str. 1, D-33 Braunschweig, Fed. Rep. Germany.
S. Pinter, Geophysical Institute of the Slovak Academy, 947 01 Hurbanovo, Czechoslovakia.

Topic IV–3. **Solar Wind Interaction with Unmagnetized or Weakly Magnetized Bodies**
Correspondents: S. Dolginov, IZMIRAN, P/O Akademgorodok, Moscow Region, 142092, U.S.S.R.
C. T. Russell, UCLA Space Science Center, Los Angeles, Calif. 90024, U.S.A.
M. K. Wallis, Mathematical Institute, 24 St. Giles, Oxford, U.K.
T. Gombosi, Department of Cosmic Rays, Research Institute of Physics, P.O. Box 49, H-1525 Budapest 114, Hungary.

Topic IV–4. **Solar Activity, Interplanetary Dynamics and Terrestrial Disturbances**
Reporter: L. Svalgaard, Danish Meteorological Institute, Lyngbyvej 100, DK-2100 Copenhagen, Denmark.
Correspondent: S. M. Mansurov, IZMIRAN, P/O Akademgorodok, Moscow Region, 142092, U.S.S.R.

Topic IV–5. **Evolution of the Sun and Solar System as Deduced from Solar Wind Observations**
Correspondents: C. P. Sonett, Lunar and Planetary Laboratory, University of Arizona,

Tucson, Arizona 85721, U.S.A.

J. Geiss, Physikalisches Institut, Universität Bern, Sidlerstraße 5, CH-3012 Bern, Switzerland.

A. Mendis, APIS University of California San Diego, La Jolla, California 92037, U.S.A.

DIVISION V. OBSERVATORIES, INSTRUMENTS, INDICES AND DATA

Chairman: P. H. Serson, Earth Physics Branch, Dept. of EMR, Ottawa K1A 0E4, Canada.

Co-Chairmen: C. Sucksdorff, Division of Geomagnetism, Finnish Meteorological Institute, P.O. Box 503, 00101 Helsinki, Finland.

R. Pastiels, Aeronomy Institute, 3 Avenue Circulaire, B-1180 Brussels, Belgium.

M. Sugiura, NASA-GSFC, Code 625, Greenbelt, Md. 20771, U.S.A.

Working Group V–1. **Magnetic Observatories**

Chairman: C. Sucksdorff, Division of Geomagnetism, Finnish Meteorological Institute, P.O. Box 503, 00101 Helsinki, Finland.

Co-Chairman: K. L. Svendsen, SEDSD (D62), EDS-NOAA, Boulder, Colorado 80302, U.S.A.

Working Group V–2. **Meteor Observatories**

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PROGRAM AND HIGHLIGHTS OF THE SCIENTIFIC SESSIONS

Joint IAGA/IAMAP Symposia

JS A ELECTRIC CURRENTS AND ATMOSPHERIC MOTIONS IN THE LOWER THERMOSPHERE (Covener: R. G. Roper; Co-convener: S. Kato)

To attempt to do justice to a review of a symposium in which nearly fifty papers were presented is, in the space available here, impossible. The interested reader is referred to the programs/abstracts in E⊕S for August 1977. The scales of the phenomena discussed extended from interplanetary (the influence of the sun on *E* region currents) to miniscule (dissipation of dynamic energy at the small scale end of the atmospheric turbulence spectrum). The importance of the presence of electric fields in the interpretation of current/atmospheric motion interactions was emphasized again and again. The work being done on theoretical modelling is encouraging, although experimenters would like to have more definitive statements from theoreticians on the kind of measurements which would be most valuable as input in furthering the modelling process.

As commented on by at least one of the ionospheric physicists present (are ionospheric physicists an endangered species? The title is not often used these days) it is gratifying to see a resurgence of interest in the *Sq* current system. For this I believe we must thank the magnetospheric types who, although they have not been successful in demonstrating their original hypothesis that the magnetosphere is responsible for *all* currents and fields present in the lower thermosphere, have at least been able to show that significant modulation of these systems by magnetospheric processes is possible, and does, in fact, occur. Some consternation was apparent (among the aforementioned ionospheric physicists) when some satellite results were presented which showed the presence of a well established equatorial electrojet, but the complete absence of any *Sq* current system. This result does need further investigation—ground based experiments are emphatic in their contention that the *Sq* current system never "goes away"!

One thing which was quite obvious to anyone attending these sessions was the multiplicity of techniques being used to investigate and describe the electrodynamics of the lower thermosphere. Even a young fellow like myself can remember the days when the only tools available were the measurement of surface magnetism, and reliance on radio propagation, with some highly speculative (but often ingenious) interpretation. Now,

with the continuing use of such tools, plus more sophisticated ground based experiments, coupled with satellite observations, an almost unbelievable amount of data which can be applied to a description of the lower thermosphere and its interactions with the atmosphere both below and above, is becoming available. However, the most efficient use of such data, and the furtherance of the models which need such data to establish boundary conditions and confirm model validity, is going to require considerable coordination. It is hoped that this symposium has, in a relatively small way, forged some links which can be expanded, through such programs as the IMS and MAP, into a description of the real world of the lower thermosphere.

The papers actually presented are shown below.

Part 1. August 23, a.m., Room: Kane 130, Chairman: J. C. Cain

A. D. Richmond: Ionospheric Wind Dynamo Theory: A Review (Invited paper, Jl).

J. M. Forbes, H. B. Garrett: Solar Tidal Wind Structures and the E Region Dynamo (Invited paper, J2).

H. Volland: An Atmospheric Hydromagnetic Dynamo (Invited paper, J3).

S. Kato: Electric Field Production by the Dynamo (Invited paper, J4).

M. Blanc: Relationship of Plasma Drifts to Lower Thermospheric Currents (An Incoherent Scatter Perspective) (Invited paper, J5).

D. N. Anderson, A. D. Richmond, R. A. Heelis: Ionospheric Dynamo Effects at Low Latitudes: Coupling among Wings, Electric Fields, and Electron Density Variations (J6).

Part 2. August 23, p.m., Room: Kane 130, Chairman: S. Kato

R. M. Harper (read by J.C.G. Walker): A Comparison of Ionospheric Currents, Magnetic Variations, and Electric Fields at Arecibo (J7).

D. Rees: Mid-Latitude Winds and Electric Fields in the Lower Thermosphere and Their Relationship with the Global *Sq* Ionospheric Currents System (J8).

H. F. Bated: The Circulation of the Polar Cap Thermosphere (J9).

S. Matsushita: Interplanetary Magnetic Fields and Lower Thermospheric Currents and Motions (Invited paper, J10).

W. P. Olson: Magnetospheric Modulation of Lower Thermospheric Current Systems (Invited paper, J11).

J. C. Cain: A Review of Magnetic Field Fluctuations Observed above the Ionosphere (Invited paper, J12).

W. H. Campbell: A Review of Surface Geomagnetic Responses to Ionospheric Currents (Invited paper, J13).

N. Fukushima: Electric Potential Difference between Conjugate Points in Middle Latitudes Caused by Asymmetric Dynamo in the Ionosphere (J14).

Part 3. August 24 a.m., Room: Kane 130, Chairman: S. Matsushita

T.-I. Kitamura: On an Origin of Long Period (Several Days) Geomagnetic Fluctuations (J16).

D. E. Winch: Spherical Harmonic Analysis of Transient Geomagnetic Variations, 1964–1965 (J17).

P. N. Mayaud: Special and Abnormal Features of the Magnetic Regular Daily Variation S_R (Invited paper, J18).

S. V. Venkateswaran, R. T. Marriott: The Equatorial Electrojet and Counter-Electrojet (Invited paper, J19).

N. W. Spencer, G. R. Carigna, W. B. Hanson: N_2 Temperature and Winds from AE – In Situ Evidence of Neutral Dynamics (J20).

D. Rees: Seasonal Variations of the Dynamics of the Lower Thermosphere in Response to Solar Heating and Geomagnetic Activity (J21).

P. A. Bernhardt, D. A. Antoniadis, A. V. da Rosa: Determination of Lunar Tidal Winds From Simultaneous Measurements of the Geomagnetic Field and the Ionospheric Electron Content (J22).

J. M. Faynot (read by M. Blanc): Tidal Dependence of *E* Region Equatorial Shear Layers (J23).

L. G. Smith, K. L. Miller: Sporadic-E Layers and Unstable Wind Shears (J24).

L. Krivsky, V. Bucha: Auroral Electrojet and Flare Activity (J26).

Part 4. August 24 p.m., Room: Kane 130, Chairman: R. G. Roper

M. A. Geller: Planetary Waves (Invited paper, J27).

M. Glass, R. Bernard, J. L. Fellous, M. Massebeuf: The Zonal Circulation at Meteor Altitudes (Invited paper, J28).

A. H. Manson, C. E. Meek: Gravity Waves in the Lower Thermosphere at 35°S (South Australia) (J29).

R. J. Stening, A. H. Manson, C. E. Meek, D. G. Stephenson: Tidal Winds from 60 to 110 km at Saskatoon, Canada (52°N) (J30).

J. B. Gregory, A. H. Manson: Atmospheric Circulation, 60–110 km Autumn-Winter-Spring, 1974–75, at 52°N, 107°W (J31).

A. D. Belmont, G. D. Nastrom: Long-Period Waves in Mesospheric Winds at Saskatoon (52°N) (J32).

Yu. D. Iljichev, Yu. I. Portnyagin: Schemes of the Global Latitude-Height Cross Sections of the Wind Field up to 100 km (J33).

M. Glass: Coordinated Meteor Wind Measurements (Invited paper, J34).

G. Hernandez, R. G. Roper: A Comparison between Radio Meteor and Airglow Winds (J35).

D. Rind: Lower Thermosphere Tidal Effects and Circulations Observed with Natural Sound (J36).

R. J. Hung, R. E. Smith: Speculation of the Dynamics of Severe Storms through the Study of Thermospheric-Tropospheric Coupling (J37).

Part 5. August 31 a.m., Room: Kane 110, Chairman: M. Glass

P. Bauer: Incoherent Scatter Observations of Lower Thermospheric Tidal Motions (Invited paper, J39).

R. M. Harper: Tidal Winds at a Low Latitude Station for Solar Cycle Minimum Conditions (J40).

R. R. Clark, R. H. Wand: Tidal Comparisons between Incoherent Scatter and Meteor Wind Measurements (J41).

I. A. Lysenko, A. D. Orlyanskii, Yu. I. Portnyagin: Results of Wind Velocity Measurements at Middle Latitudes by the Meteor Radar Method (J42).

M. A. Petrosyantz, L. A. Minina, Yu. I. Portnyagin: Circular Systems in the Mesosphere of the Northern Hemisphere (J43).

E. S. Kazimirovsky, V. D. Kokourov: The Dynamics of the Lower Thermosphere (Invited paper, J44).

L. A. Andreeva, L. A. Katasev (read by Yu. I. Portnyagin): Peculiarities of Wind Behavior in the Lower Thermosphere of the Polar Region under Quiet and Disturbed Conditions (J45).

A. Ebel: Scales of Macroturbulence in the Atmosphere around 100 km Altitude (J46).

S. P. Zimmerman: Microturbulence Parameters in the Upper Atmosphere.

JS B MINOR NEUTRAL CONSTITUENTS IN THE MIDDLE ATMOSPHERE—CHEMISTRY AND TRANSPORT (Convener: H. U. Dütsch; Co-convener: D. M. Hunten)

This three day symposium included the discussion of possible consequences of ozone variations and the connection between stratosphere and mesosphere with special consideration of solar variability; much of the time was devoted to recent observational results on the trace gases forming the photochemical system around ozone as a central substance and to modeling this system under the influence of transport processes.

The theories on possible consequences of changes in the ozone layer are still rather tentative. While reasonably well established general ideas of radiatively induced changes in temperature from the ground to the stratopause are available and do not indicate large climatic changes at the surface, the dynamical consequences, i. e. the feedback of the expected alteration of stratospheric circulation to the troposphere, are still largely in the dark. Much has also yet to be done to further illuminate the possible biological consequences.

Satellite and also rocket observations of the last 10–15 years provide increasing evidence of solar variability in the UV, which, with decreasing amplitide, extends up to the 300 nm region on a short-term basis (solar rotation) as well as within the solar cycle. First ideas on possible influences on the ozone layer were presented. Improved knowledge of the absorption spectra together with the inclusion of scattering processes allows also a more accurate determination of the various dissociation rates. There are indications of a possible influence of thermospheric NO-production on the ozone layer due to downward transport.

A wide range of techniques was developed during the past few years to measure a wealth of trace substances, some of them to quite low concentrations (ppt range or even less for some radicals). A few species like H_2O_2, $ClCNO_2$ or HNO_4 have not yet become measurable. Long lived substances originating from the troposphere like N_2O or fluorocarbons show in the stratosphere sloping surfaces towards the pole indicating their main input into the stratosphere to occur through the tropical tropopause. The precision of the measurements of fluorocarbons has not yet reached, but seems to approach, the point where monitoring over a considerable number of years including measurements of interhemispheric differences in the tropopause, might indicate whether there are or not appreciable sinks in that layer. Although the ozone distribution is by far the best known of all the trace substances, the available observations are still far from being adequate for use in quantitatively combining observations with photochemical models especially over the tropics and the southern hemisphere. Satellite observations of ozone and many of the other trace species are coming into use and are very promising for the near future, with the exception that most of them do not give enough information on the lower stratosphere.

Combining modeling with the improved observations is providing increasing insight into the mechanisms working in the stratosphere with respect to photochemistry and transport. As was to be expected, it is found that one single vertical profile of the vertical mixing coefficient cannot fit the observations of all different trace substances. Increasing use is therefore made of two dimensional models, but is still hampered by the fact that the necessary parameterization is yet far from being quantitatively known in the stratosphere.

Results from 3-D models were also discussed and gave interesting insight into the interrelation between chemistry and transport; until now, however, it has not been possible to combine them with the full chemistry.

It has become clear from the results presented here that in the near future it should become possible to do specific measurements of many interrelated trace gases at one time, which will allow a much improved testing of photochemical models and thus of the current ideas of possible anthropogenic damage to the ozone layer.

The program of this joint symposium was as follows.

Part 1. Possible Consequences of Ozone Variations, Biological and Climatological
August 25 a.m., Room: Kane 130, Chairman: J. Friend

R. E. Dickenson: Current State of Estimating Possible Climatic Consequences of Ozone Variations (Invited paper, J49).

E. Scott: Statistical Model of Skin Cancer (Invited paper, J50).

J. Lee: Varieties of Human Skin Tumors and Their Relationship to Sunlight (Invited paper, J51).

M. M. Caldwell: Atmospheric Ozone Reduction: Implications for Terrestrial Vegetation (Invited paper, J52).

D. S. Nachtwey: Potential Biological Consequences of Ozone-Layer Reduction (Invited paper, J53).

K. H. Grasnick: About the UV Radiation Reaching the Ground (J54).

Part 2. Connection between Stratosphere and Mesosphere and the Influence of Solar Variability
August 25, p.m., Room: Kane 130, Chairman: M. Nicolet

M. Nicolet: Solar Ultraviolet Radiation and Photodissociation Processes from the Mesopause to the Stratopause (Invited paper, J55).

C. A. Barth: Changes in Mesospheric Ozone: Theory and Experiment (Invited paper, J56).

D. F. Heath, B. W. Guenther: Extended Observations of Ultraviolet Solar Spectral Irradiance from Space (J57).

V. V. Koshelev: Latitudinal Variations of Neutral Component Densities at Heights 30–150 km (J58).

C. G. Justus, K. K. Mani: A Model for the Simulation of Turbulent and Eddy Diffusion Processes at Heights of 0–65 km (J59).

L. R. Megill, K. Montierth, J. S. Randhawa, K. D. Baker: Measurement of Scattered U.V. in the Stratosphere (J60).

F. Arnold, D. Krankowsky: Enhanced Nitric Oxide in the Lower Thermosphere and Mesosphere at High Latitudes (J61).

F. Arnold, W. Joss, D. Krankowsky: Mass Spectrometric Measurements of Atomic Oxygen in the Lower Thermosphere and Upper Mesosphere (J62).

R. G. Williams, M. J. Rycroft, A. G. Theorbald: Calculations of a Physical Mechanism which may be Important in Relating Active Regions on the Sun and the Interplanetary Magnetic Field Sector Structure to the Observed Changes of Vorticity in the Winter Northern Hemisphere (J63).

Part 3. Model Calculations Involving Stratospheric Dynamics and Transport
August 26, a.m., Room: Kane 130, Chairman: R. A. Craig

J. D. Mahlman: Application of General Circulation Models to the Stratospheric Transport Problems (Invited paper, J64).

D. M. Cunnold, F. N. Alyea, R. G. Prinn: The Application of Limited-Resolution Chemical-

Dynamical Models to the Simulation of Atmospheric Chemistry (Invited paper, J65).

J. R. McAfee, P. Crutzen, A. L. Schmeltekopf: Stratospheric Eddy Diffusion Coefficients from Nitrous Oxide Measurements (J66).

J. S. Chang, D. J. Wuebbles: Fully Diurnal Averaged Model of the Stratosphere (J67).

R. P. Turco, R. C. Whitten: Sensitivity of Calculated Minor Species Concentrations to Diurnal Variations (J68).

J. A. Pyle: Some Experiments with a Two-Dimensional, Time-Dependent Model of the Atmosphere below 80 km (J69).

R. G. Prinn, D. M. Cunnold, G. Moore: Mechanisms Involved in Large-Scale Eddy Transport of Ozone in the Lower Stratosphere (J70).

G. Brasseur, M. Bertin: The Action of Chlorine and Nitrogen Compounds on the Ozone Layer as Given by a Zonally Averaged 2-D Model (J71).

I. L. Karol, V. V. Babanova, A. A. Kiselev, L. A. Romanovskaya: Numerical Models of Global Transport of Freons in the Atmosphere and Assessment of Their Effect on Ozone (J72).

R. K. R. Vupputuri: The Structure of the Natural Stratosphere and the Impact of Chlorofluoromethanes on the Ozone Layer Investigated in a 2-D Time Dependent Model (J73).

L. B. Callis, J. E. Nealy: Studies of Natural and Perturbed Stratosphere in the Presence of UV Variability (J74).

Part 4. Sensitivity of the Ozone Layer to the Changes in Extraterrestrial, Climatic, and Anthropogenic Factors

August 26, p.m., Room: Kane 130, Chairman: P. Crutzen

R. S. Stolarski, D. M. Butler: The Effect of Volcanic Eruption on Stratospheric Minor Constituent Chemistry (Invited paper, J75).

P. J. Crutzen: An Attempt to Reconstruct the Composition of the Pre-Industrial Atmosphere (J76).

D. M. Butler: Input Sensitivity Study of a Stratospheric Photochemistry Model (J77).

J. S. Chang, W. H. Duewer: New Theoretical Estimate of the Effect of Past Nuclear Test on Ozone (J78).

F. M. Luther, W. H. Duewer: Effect of Changes in Stratospheric Water Vapor Abundance on Predicted Ozone Reductions (J79).

J. C. G. Walker: The Early History of Oxygen and Ozone in the Atmosphere (Invited paper, J80).

J. S Levine, P. B. Hays, J. C. G. Walker: The Variability of Stratospheric Species of Geological Times (J81).

R. S. Stolarski: Increase in Nitrogen Fixation Rate since 1900 and Its Effect on Tropospheric N_2O and Stratospheric Ozone (J82).

L. Glatt, G. F. Widhopf, L. Callis: A Two-Dimensional Investigation of the Effect of the Injection of NO_x and H_2O etc. (J83).

W. J. Borucki, R. C. Whitten, V. R. Watson, H. T. Woodward, C. A. Riegel, L. A. Capone: Predicted Latitude and Season-Dependent Ozone Reductions due to Chlorofluoromethanes (J84).

R. P. Turco, O. B. Toon, R. C. Whitten: A One-Dimensional Model Study of the Stratospheric Aerosol Layer (J85).

J. E. Nealy, T. R. Augstsson: A One-Dimensional Steady-State Calculation of Physico-Chemical Effects Produced by Anthropogenic and Natural Chlorine Compounds in the Stratosphere (Reserve paper, J86).

F. M. Luther, D. J. Wuebbles: Effect of Multiple Scattering on Ozone Reduction by NO_x and CFM's (Reserve paper, J87).

Part 5. Observational Results on Trace Substances

August 27, a.m. and p.m., Room: Kane 130, Chairman: M. Ackerman

D. Ehhalt: Measurements of Minor Species in the Middle Atmosphere by in Situ Sampling (Invited paper, J88).

T. Itoh, E. Sagawa, T. Iguchi: Mass Spectrometric Observation of SO_2 in the Stratosphere after the Eruption of the Fuego Volcano (J89).

K. H. Käselau, H. K. Paetzold: Comparisons between Aerosol-Concentration, Water Vapor, and Ozone between 4 and 35 km (J90).

K. H. Käselau: New Results of Aitken-Nuclei-Measurements in the Atmosphere (J91).

B. J. Tyson, J. A. Arvesen: Interhemispheric Gradients of CF_2Cl_2, $CFCl_3$, CCl_4 and N_2O (J92.)

A. L. Schmeltekopf, E. E. Ferguson: Stratospheric Measurements of N_2O, F_{11} and F_{12} (J93).

P. Fabian, V. Schmidt, W. Seiler, K. H. Weiler: Simultaneously Measured Vertical Profiles of H_2, CH_4, CO, CO_2 F-11, F-12, NO and O_3 in the Mid-Latitude Stratosphere (J94).

D. Mihelcić, D. H. Ehhalt, G. F. Kulessa, U. Schmidt: Measurements of Free Radicals in the Atmosphere by Matrix Isolation and Electron Spin Resonance (J95).

J. F. Vedder, B. J. Tyson, R. B. Brewer, C. A. Bortnott: Lower Stratosphere Measurements of Minor Constituents (J96).

J. H. Park: Optical Measurements of Minor Constituents in the Middle Atmosphere (J97).

V. I. Astakhov, N. V. Vanin: A Solar Heterodyne Radiometer for the Determination of the Altitudinal Profiles of Atmospheric Gases (J98).

L. R. Megill, W. Abdou, D. Murcray, A. Goldman: Measurement of Photochemically Active Minor Species near Twilight (J99).

J. T. Houghton, J. R. Drummond, G. D. Peskett, C. D. Rodgers, M. J. Wale, E. J. Williamson: Measurement of Minor Constituents in the Stratosphere and Mesosphere – A Satellite Experiment (J100).

W. G. Mankin: Simultaneous Measurement of the Latitude Variation of Ozone and Other Trace Gases above 12 km (J101).

A. Girard, J. Besson, R. Giraudet, L. Gramont: Correlated Seasonal and Climatic Variations of Trace Constituents in the Low Stratosphere (J102).

J. E. Harries: On Measurements of Stratospheric Composition Using Far and Mid-Infrared Techniques (J103).

D. G. Murcray, A. Goldman, J. J. Kosters, W. J. Williams, D. E. Snider: Height Profiles of Photochemically Significant Stratospheric Constituents Derived from Emission Spectra (J104).

J. R. Drummond, J. T. Houghton, R. F. Jarnot, H. K. Roscoe: Simultaneous Diurnal Measurements of NO/NO_2 in the Range 20–40 km (J105).

M. Ackerman: Stratospheric Methane – Measurements and Predictions (J106).

Part 6. Observational Results on Atmospheric Ozone

August 27 p.m., Room: Kane 130, Chairman: C. D. Walshaw

J. London, S. J. Oltmans: The Global Distribution of Total Ozone Variations during the Fifteen Year Period 1957–72 (J107).

A. Khrguian: Ozone Vatiations of Great and Small Scale (J108).

R. E. Basher, A. C. Holland: Long Term Intercomparison of New Zealand Filter and Dobson Total Ozone Spectrophotometers (J109).

H. U. Dütsch: Seasonal Variation of the Vertical Ozone Distribution over the Globe (J110).

A. J. Krueger, D. U. Wright, G. M. Foster: Observation of Seasonal Characteristics of Upper Stratospheric Ozone (J111).

T. Tohmatsu, T. Watanabe, T. Ogawa: Seasonal Variation of Ozone in the Middle Atmosphere Measured by Using Sounding Rockets (J112).

G. D. Nastrom, A. D. Belmont: Ozone Variability near the Tropopause (J113).

S. V. Solonin, V. V. Osetchkin: Aircraft Investigations of Atmospheric Ozone Concentration over the U.S.S.R. (J114).

K. Moe: The Quasi-Biennial Oscillation in Stratospheric Ozone (J115).

D. F. Heath, B. M. Schlesinger: Global Ozone Variations from the Backscattered Ultraviolet (BUV) Experiment on Nimbus 4 (J116).

A. J. Miller, B. Korty, D. F. Heath: Comparison of Backscatter Ultraviolet (BUV) Ozone Fields with Dobson Spectrophotometer Measurements (J117).

D. F. Heath, B. Guenther, E. Hilsenrath: Preliminary Results on Tropical Ozone Distributions Inferred from the Backscatter Ultraviolet Experiment on Atmosphere Explorer E (J118).

H. W. Ellsaesser: What Meteorological Observations can Tell Us about Catalytic Ozone Destruction (Reserve paper, J119).

J. G. Randhawa: A Miniature Sensor for the Measurement of Ozone in the Upper Atmosphere (Reserve paper, J120).

P. D. Falconer, J. D. Holdeman: The Application of Routine, Commercial Aircraft Measurements in Establishing a Tropospheric Ozone Budget (Reserve paper J120A).

JS C INFLUENCE OF SOLAR ACTIVITY AND GEOMAGNETIC CHANGES ON WEATHER AND CLIMATE (Convener: F. S. Johnson; Co-convener: E. R. Mustel)

The main emphasis in Joint Symposium C held at the IAGA/IAMAP General Assemblies in August 1977 was on mechanisms that might be involved in the connection between weather and solar activity or geomagnetic changes. It is clear that the most popular concept among symposium participants involved ozone changes, usually as influenced by nitrogen oxide chemistry. However, changes in solar ultraviolet flux, changes in the electrical properties of the atmopshere, and even small periodic (27 day) changes in the solar constant, were concepts that also received attention.

A considerable quantity of evidence has now been gathered by many scientists around the world demonstrating the existence of connections between (a) solar phenomena (ranging from short-lived events such as sector boundary crossings, solar flares, and the 27-day solar rotations to long-lasting phenomena such as the 11-year and 22-year solar cycles) and (b) various aspects of the weather such as tropospheric pressure and circulation patterns, temperature and rainfall. Some of the now established sun-weather relationships appear to be not only statistically significant, but also of practical importance in that they include meteorologically significant variations of parameters such as the zonal index and the occurrence of blocking anticyclones. Several authors have claimed that relationships also exist between the weather and geomagnetic variations on various time scales; the reality of these relationships has yet to be proved and, indeed, it is not yet clear whether, if they are real, they result from geomagnetic influences on the weather or vice-versa.

The solar-cycle variation in galactic cosmic radiation modulates NO_x (i.e., NO and NO_2) production in the atmosphere, and this is believed to produce a solar-cycle variation in total ozone. Solar-flare proton events sporadically produce NO_x and reduce ozone.

Precipitation of radiation belt particles during magnetic disturbances provides still another means of producing additonal NO_x. Thus ozone amounts on earth are expected to vary both with the solar cycle and with the solar flares that eject energetic protons or that produce geomagnetic disturbances. Just how changes in ozone amount can lead to changes in weather remains speculative, although several candidate mechanisms exist; ozone changes should lead to changes in the thermal structure of the stratosphere and hence in the radiation balance of the lower atmosphere, in the wind patterns of the upper stratosphere, and in the reflective properties of the stratosphere for upward propagating waves that originate in the troposphere.

The relative popularity of the concept that ozone changes constitute a vital link in sun-weather relationships does not mean that the concept is without difficulties. *Zinn*, using a one-dimensional model, found that the changes in thermal structure associated with ozone changes caused by cosmic radiation changes were too small to be credible as a factor in influencing weather. He considered changes in solar ultraviolet radiation at a level described by *Heath* (1% at 295 nm increasing to 5% at 175 nm) to be more promising for production of a change in the thermal structure of the stratosphere. *Theobald, Rycroft*, and *Williams* considered the combined effects of solar ultraviolet changes on ozone and on thermal structure and found these to be of possible significance, although still rather small. However, the uncertainties in the models are such that the possibility of ozone changes as a link in the relationship should continue to be regarded seriously.

Markson considered the possibility that the overall electrical structure of the atmosphere might be changed as a result of ionization changes in the atmosphere due to changes in cosmic radiation or solar flare protons. The change in electrical structure might in turn affect thunderstorm development and cloud formation. Though not much discussed at this symposium, the possibility of modulation effects on cirrus clouds remains a candidate mechanism for relating weather to solar events.

Mitchell reported new results showing that the double sunspot cycle influences the occurrence of droughts in the U.S.A., and suggesting that short-term geomagnetic variations and the solar cycle both modify the circulation of the troposphere and stratosphere in various ways. The double sunspot (twenty-two year) cycle in weather is especially puzzling, as no mechanism by which the atmosphere can discriminate between successive eleven-year sunspot cycles has been identified.

The program for JS C was as follows.

Part 1. August 29 a.m., Room: Kane 130, Chairmen: E. R. Mustel and F. S. Johnson

E. P. Borisenkov: Energetic Aspects of Solar Activity Effect in Weather and Climate (Invited paper, J121).

J. Zinn: Computations of Solar Cyclic Variations of Temperature and Pressure in the Polar Stratosphere (J121).

A. G. Theobald, M. J. Rycroft, R. G. Williams: Calculation of the Effects of Variations of Solar Cosmic Rays and UV Radiation on the Middle Atmosphere (J125).

R. M. Thorne: The Potential Role of Relativistic Radiation Belt Electron Precipitation as a Natural Destruction Mechanism for Stratospheric Ozone (J126).

J. Hampson: A Model for Iterative Interaction between Atmospheric Chemistry, Heating and Circulation to Explain Perturbation of Weather and Climate by Solar Activity and Anthropogenic Change (J127).

Part 2. August 29, p.m., Room: Kane 130, Chairmen: A. Belmont and J. B. Gregory

J. M. Mitchell, C. W. Stockton: Long-Term Sun-Climate Relationships (Invited paper, J128).

V. Bucha: Mechanism of Solar-Terrestrial Relations, Climate and Weather Changes (Invited paper, J129).

L. C. Hale: Particulate Transport through the Mesosphere and Stratosphere (J130).

H. Volland, M. Hantel: Planetary Waves Generated by the Rotating Sun (J131).

R. Markson: Mechanism for Solar Control of Atmospheric Electrification and Weather (J132).

J. R. Bates: Stratospheric Influence on Heat Transfer by Ultra-Long Stationary Waves in the Troposphere – A Mechanism for Climate Change (J133).

M. A. Geller, S. K. Avery: Calculations of Solar Activity Effects on Planetary Wave Propagation (J134).

Part 3 (Poster session). August 30 a.m., Room: Kane, Walker-Ames

E. R. Mustel: The Morphological Properties of Solar-Atmospheric Effects (Invited paper, J135).

S. K. Banerjee, S. Lund, N. Eyster-Smith, H. E. Wright, A. Long: Correlation between Paleoclimate and Paleomagnetism for the Last 9,300 Years (J136).

G. M. Brown, J. I. John: Solar Cycle Influences in Tropospheric Circulation (J137).

M. F. Larsen: M. C. Kelley, B. B. Balsley, N. Cianos: Theoretical and Experimental Studies of Auroral/Meteorological Interaction in the Alaskan Sector (J141).

D. E. Olson: Solar Cycle Variation in the Air-Earth Density (J143).

C. Sawyer, R. Olson: A Comparison of Sector Boundaries, High-Speed Streams and Flares as They Affect Atmospheric Vorticity (J144).

S. Ramarkrishna, D. F. Heath: Temperature Changes Associated With Geomagnetic Activity at Wallops Island (J146).

R. Reiter: Solar Events Increase the Frequency of Stratospheric Intrusions (J147).

R. Reiter: The Electric Potential of the Ionosphere as Controlled by the Solar Magnetic Sector Structure (J148).

R. Seshamani: Role of the Mesosphere in Linkages between Solar Activity and Lower Atmospheric Phenomena (J149).

B. J. Srivastava: Solar-Magnetic-Climatic Cycles in Indian Data (J150).

E. V. Vorobjeva: Space-Time Structure of Some Long Period Variations in Meteorological and Geophysical Parameters and Their Relation with Geomagnetic Activity (J152).

J. M. Wilcox, P. H. Scherrer, L. Svalgaard, E. K. Gustafson: Morphology of a Sun-Weather Effect (J153).

A collection of extended summaries of contributed papers presented at JS C was compiled in February 1978 with the assistance of Dr. F. S. Johnson (convener of JS C) and A. D. Blamont (President of IAMAP Commission on the Upper Atmosphere). It was published by, and is available from, S. Ruttenberg (Secretary General of IAMAP, National Center for Atmospheric Research, P.O. Box 3000, Boulder, Colorado 80307, U.S.A.) at the price of $2.00 including book rate postage. The papers included in this collection are: J121, J126, J129, J131, J132, J134, J136, J137, J144 and J153.

JS D IONS IN THE MIDDLE ATMOSPHERE — CHEMICAL, PHYSICAL AND ELECTRICAL ASPECTS (Convener: A. W. Castleman, Jr.; Co-conveners: A. D. Danilov, L. Thomas)

The main concern of this IAGA/IAMAP Joint Symposium (cosponsored also by URSI) was the recent knowledge of the positive and negative ion concentrations and atmospheric composition in the height range of 12-120 km. Attention was paid especially to experimental and theoretical studies of these ions, to relevant laboratory measurements, and to the roles of ions in atmospheric electricity and aerosol chemistry. The program planned for this 3 half-day symposium was as follows.

Part 1. Laboratory and Field Measurements
August 31 a.m., Room: Kane 130, Chairman: A. W. Castleman

E. E. Ferguson: Laboratory Measurements of Positive and Negative Ion Reactions (J154).
J. T. Moseley, P. C. Cosby, J. R. Peterson: Laboratory Measurements of Photodissociation and Photodetachment Cross Sections of Atmospheric Ions (J155).
R. Thurman, L. Stoddard, J. L. Kassner, Jr.: Experimental and Theoretical Studies of the Mobilities of Cluster Ions in an Argon-Water Vapor Environment (J156).
A. D. Danilov: Ion Composition of Mesosphere and Lower Thermosphere (Invited paper, 157).
R. A. Goldberg, J. P. Stegman, G. Witt: Near Simultaneous Measurements of Neutral and Ionic Sodium in the High Latitude Summer Mesosphere (J158).
F. Arnold: Measurements of Ion Composition in the Stratosphere and Mesosphere (Invited paper, 159).
J. D. Mitchell, R. O. Olsen, K. J. Ho: Positive Ions in the High-Latitude Middle Atmosphere (J160).
G. M. Martynkevich, E. D. Byuro, A. P. Shadeev: Experimental Evidence of Atmospheric Orgin of H_2O^+ Ions Registered on Board MP-12 Rockets (J161).

Part 2. Modeling of the Middle Atmosphere
August 31 p.m., Room: Kane 130, Chairman: A. D. Danilov

G. C. Reid: Theoretical Models of Ion Composition (Invited paper, J162).
F. E. Niles, M. G. Heaps: Effects of Photons on Middle Atmospheric Ions (J163).
V. V. Koshelev: Ion Structure and Phenomenon of Region-*D* Winter Anomaly (J165).
F. Arnold, E. Zettwitz: A Global Model of the *D* Region (J166).
M. G. Heaps, F. E. Niles: The 1979 Solar Eclipse and Validation of *D* Region Models (J167).
N. Nath, C.S.G.K. Setty: Unified *D* Region Ion-Composition Models (J168).
R. P. Turco: Chlorine Negative Ions in the *D* Region (J169).
Uy. L. Truttse, K. N. Serafimov, M. M. Gogoshev: Red Oxygen Emission and Total Electron Content in *F* Region of Ionosphere at Night (J170).
D. K. Chakrabarty, P. Chakrabarty, G. Witt: Positive Ion Composition at High Latitude Mesopause Region during Summer (J171).

Part 3. Processes Influencing the Distribution of Ions

September 1 a.m., Room: Kane 130, Chairman: L. Thomas

W. Swider: Processes Determining the Height Distributions of Metallic Ions (Invited paper, J172).

P. Chakrabarty, D. K. Chakrabarty, H. Derblom: Loss Mechanism of Metal Ions in *E* Region (J173).

A. W. Castleman, Jr.: The Influence of Heterogeneous Processes on Atmospheric Ions (Invited paper, J174).

K. H. Käselau, W. Gringel, H. Röhrs: Comparison between Aerosol-Concentration and Air-Conductivity between 4 and 20 km Altitude (J175).

J. Podzimek: Possible Effect of Aitken Nuclei Concentration on the Ionization Balance in the Lower Stratosphere (J176).

A. M. Dixon, S. G. Jennings: Combination Coefficients of Small Positive Ions with Sub-Micrometer Aerosol Particles (J177).

M. Gadsden: The Size Distribution of Noctilucent Cloud Particles (J178).

S. Israelsson: Spectra of Time-Fluctuations and Mobilities of Small Ions in the Atmosphere (J180).

IAGA Sessions

REPORTER REVIEW SESSION OF DIVISION I

August 26 p.m., Room: Kane 120, Chairman: K. M. Creer

B. R. Leaton, A. N. Pushkov: Analysis of the Main Field and Secular Variation.
D. E. Winch, P. H. Roberts: Theory of Planetary Magnetic Fields and Geomagnetic Secular Variations.
U. Schmucker, A. Ádám: Electromagnetic Induction and Electrical Conductivity (Earth and Moon).
J. R. Heirtzler, C. C. Weber: Magnetic Anomalies (Land and Sea).
V. Bucha, J. C. Briden: Paleomagnetism.
C. G. Petrova, S. K. Banjerjee: Rock Magnetism.

REPORTER REVIEW SESSIONS OF DIVISION II

Part 1. September 1 p.m., Room: Kane 130, Chairman: B. A. Tinsley

P. Bauer: Highlights of JS-U; Neutral and Ionospheric Models in the Thermosphere.
G. E. Thomas: Highlights of SIII, and Review of Planetary Exospheres.
L. Thomas: Highlights of JS-D; Ions in the Middle Atmosphere.
A. D. Danilov: Review of Neutral and Ion Chemistry.
T. Tohmatsu: Recent Rocket and Airglow Results Concerning Neutral and Ion Chemistry.
M. H. Rees, J .C. Gerard, G. G. Shepherd: Review on Atmospheric Quantal Emissions.
P. L. Dyson: Review on Ionospheric Irregularities.

Part 2. September 2 a.m., Room: Kane 130, Chairman: B. A. Tinsley

L. P. Block, A. Nagy: Review on Ionosphere-Magnetosphere Interactions.
M. Ackerman: Solar Fluxes Important in Stratosphere-Mesosphere-Ionosphere Interactions.
J. B. Gregory: Dynamics of the Stratosphere-Mesosphere-Ionosphere.
C. F. Sechrist: Neutral and Ion Chemistry related to Stratosphere-Mesosphere-Ionosphere Interactions.
D. M. Hunten: Review of Planetary Atmospheres.
D. C. Cartwright: Review of Laboratory Experiments of Aeronomic Interest.

REPORTER REVIEW SESSIONS OF DIVISION III

Part 1. August 24 a.m., Room: Kane 120, Chairman: C.-G. Fälthammar

G. Rostoker: Magnetic Field, Electric Field and Current Systems, Including Ground Observations.
V. M. Vasyliunas: Distribution and Properties of Magnetospheric Plasmas.
W. J. Heikkila: Magnetosheath, Magnetospheric Boundary and Plasma Penetration.
L. J. Lanzerotti: Energetic Particle Populations Including Cosmic Ray Entry.
S.-I. Akasofu: Magnetic Storms and Substorms, Including Aurora-Magnetospheric Relations.

Part 2. August 24 p.m., Room: Kane 120, Chairman: C.-G. Fälthammar

R. Boström: Magnetosphere-Ionosphere Interactions.
D. J. Southwood: Magnetic Oscillations, Waves and Wave-Particle Interactions.
F. V. Coroniti: Magnetospheres of Other Planets.

REPORTER REVIEW SESSION OF DIVISION IV

August 23 p.m., Room: Kane 120, Chairman: K. I. Gringauz

W. C. Feldman: Large Scale Characteristics of the Interplanetary Medium.
F. M. Neubauer: Waves, Discontinuities and Shocks in the Interplanetary Plasma (GA63).
C. T. Russell: Reporter Review on Weakly Magnetized Planets (GA64).
L. Svalgaard: Solar Activity, Interplanetary Dynamics and Terrestrial Disturbances.
C. P. Sonett: The Early Solar Wind and Possible Heating of Planets.

REPORTER REVIEW SESSION OF DIVISION V

August 26, a.m., Room: Smith 120, Chairman: P. H. Serson

C. Sucksdorff: Magnetic Observatories.
R. G. Roper: Meteor Observatories.
W. F. Stuart: Geomagnetic Instruments and Standards.
R. A. Pastiels: Optical Calibration Standards.
E. B. Fabiano: Magnetic Surveys and Charts.
J. V. Lincoln: Geophysical Indices.
H. Maeda: Collection and Dissemination of Data.
M. Sugiura: Coordination of IMS Ground-Based, Balloon and Rocket Experiments.
D. Voppel: Ground-Based Measurements for Satellite Geomagnetic Surveys.
G. R. Heckman (for D. J. Williams): Geophysical Alerts and Forecasts.

JS-U RECENT ADVANCES IN NEUTRAL AND IONOSPHERIC MODELS IN THE THERMOSPHERE (Convener: J. V. Evans)

The Symposium occupied five sessions dealing, respectively, with Thermospheric Structure, Midlatitude Dynamics, High Latitude Dynamics, Ionosphere Models and Results Important to Ionospheric Modeling. The list of papers actually presented and the highlight in each session are summarized below.

Part 1. Global Models of Thermospheric Structure
August 25 a.m., Room: Kane 120, Chairman: J. V. Evans

A. E. Hedin: The Development of the Mass Spectrometer and Incoherent Scatter Model (Invited paper, GA1).

U. von Zahn: Empirical Models of Global Thermospheric Composition and Temperature during Geomagnetically Quiet Times, Based on ESRO 4 Gas Analyzer Data (Invited paper, GA2).

S. Zimmerman: A One-Dimensional Model Atmosphere Utilizing Measured Transport Coefficients.

F. Barlier, C. Berger, J. L. Falin, G. Kockarts, G. Thuillier: Comparison between a New Three Dimensional Thermospheric Model Based on Satellite Drag Data and Other Models Based on Mass Spectrometer Measurements or Optical Measurements (GA4).

P. Blum, K. Schuchardt, U. von Zahn: Models of the Neutral Atmosphere Based on Turbopause Height and Exospheric Temperature Variations (GA5).

P. Blum, K. Schuchardt: A Semi-Theoretical Global Model of the Eddy Diffusion Coefficient Based on Satellite Data (GA6).

W. L. Oliver: Models of Neutral Temperature Structure from Incoherent Scatter Radar Measurements (GA7).

D. Alcayde, J. Fontanari, P. Bauer, R. Bernard: Long Term Modelling of Thermospheric Parameters at 45°N (GA8).

E. S. Oran, D. F. Strobel: Theoretical Investigations of Ionospheric Oxygen and Nitrogen Densities (GA9).

Y. Kato, N. Onishi, K. Hirao: Exospheric Temperature Derived from Orbital Decay of Japanese Satellite 'Taiyo' and Influence of Solar and Geomagnetic Activities on Its Temperature Changes (GA10).

The first session was largely devoted to reports on the empirical global models of the thermosphere (*Hedin* on the MSIS model, *von Zahn* on the ESRO 4 model, *Barbier et al.* on a new model based on drag and optical data). The combined use of satellite-borne mass spectrometer composition data and ground-based incoherent scatter temperature data has permitted very detailed empirical models to be constructed that describe the thermosphere as functions of time, $F_{10.7}$, K_p and other indices. These models provide a good basis from which to examine disturbed or other anomalous behaviour. Evidence is accumulating for the existence of longitudinal (as distinct from local time) variations in the thermosphere at high latitudes, even at quiet times, and the inclusion of these features represents one likely extension of the present models.

The first session also included papers by *Blum and Schuchardt* that attempted to

explain the observed seasonal variations of thermospheric composition in terms of (about 15 km) changes in the height of the turbopause. The view that mean meridional winds rather than turbopause altitude changes are the principal agent in producing the seasonal composition was advanced in the second session by *Mayr* and by *Roble*, both of whom have developed detailed theoretical models of the solar EUV and auroral driven circulation.

Part 2. Midlatitude Thermospheric Dynamics
August 25 p.m., Room: Kane 120, Chairman: A. E. Hedin

H. Volland: The Representation of Thermospheric Density, Temperature and Wind Variations in Terms of Tidal Waves (Invited paper, GA11).
H. B. Garrett, J. M. Forbes: Three-Dimensional Model of the Thermosphere Tidal Structure (GA12).
R. M. Harper: Thermospheric Tidal Oscillations at Low Latitudes for Solar Cycle Minimum Conditions (GA13).
R. H. Wand: Incoherent Scatter Observations of Semidiurnal Tidal Winds in the Lower Thermosphere at Midlatitudes (GA14).
H. G. Mayr: Present Understanding of Upper Atmosphere Dynamics (Invited paper, GA15).
R. G. Roble: Theoretical Models for Global Thermospheric Dynamics (Invited paper, GA16).
B. A. Emery: Comparison of Average Annual Circulations above Millstone Hill (GA17).

The extention of the current models to lower altitudes represents another important way in which they can be improved, and the second session dealt with the question of what can be learned from the theory of atmospheric tides. *Volland* reviewed existing theory while others (*Harper, Wand, Garrett* and *Forbes*) attempted to fit the theory to observations of tidal winds and temperature variations gathered by ground-based incoherent scatter radar. The character of the propagating tides in the thermosphere, (where they are damped by viscosity and ion-drag) can be described by Hough-mode "extensions". High order modes (e.g. the 2, 4 or 2, 5), that are generated through the coupling with lower order ones (e.g. 2,2) via background winds in the mesosphere, appear to be present. Thus, the theory leaves open the amplitude of the Hough-mode extensions, which must be established from observations. Unfortunately, the behaviour of the propagating tides seems so variable (perhaps because of variations in the background winds) that a complete model cannot be constructed from the available observations despite the fact that the important modes now have been identified.

Part 3. High-Latitude Thermospheric Dynamics
August 26 a.m., Room: Kane 120, Chairman: H. Volland

P. M. Banks: Heat and Momentum Sources at High Latitudes (Invited paper, GA19).
J. M. Straus: Dynamics of the Thermosphere at High Latitudes (Invited paper, GA20).
R. G. Roble, R. E. Dickinson, E. C. Ridley: Response of the Mean Meridional Circulation in the Thermosphere to Geomagnetic Substorms (GA21).
K. Moe, M. M. Moe, J. E. Riedel: A Thermospheric Model Based on Solar and Magnetospheric Energy Sources (GA22).
H. G. Mayr, I. Harris: Electric Field Momentum Source Signatures in the Thermospheric Densities (GA23).
M. H. Rees, R. G. Roble: Auroral Substorm Effects on Thermospheric Nitric Oxide and Atomic

Nitrogen (GA24).

J. S. Nisbet, L. Gardner: Temperatures and Densities in the Polar Thermosphere (GA25).

G. M. Martynkevich, E. D. Byuro: Ar/N_2 and O/N_2 Ratios as Results and Criteria of Disturbance Degree in the Lower Thermosphere of Middle and High Latitudes (GA26).

N. N. Klimov, N. A. Sutyrin: The Estimate of Magnetospheric Electric Field Influence on the Oxygen Distribution in the Thermosphere (GA27).

The third session dealt with the role of auroral zone processes in providing heat and momentum to the atmosphere at high latitudes. The importance of the heating of the atmosphere (by particle precipitation and the auroral electrojet) as well as momentum transfer from ions set in motion by the large electric fields, was reviewed by *Banks*. The air is set in motion both as a consequence of the heating as well as by the ions moving under the influence of magnetospheric electric fields, and *Straus* described results from the first completely self-consistent attempt to model both effects acting in steady state, while *Klimov and Sutyrin* described the composition changes that should result. It is believed that the total energy input from auroral processes can be, at times, equal to or exceed that from solar EUV. Even at quiet times, auroral zone heating remains important, because it occurs over a limited area of the earth's surface near the poles and thus greatly influences meridional transport. *Roble et al.* described the changes in the mean meridional circulation they expect to result as the high latitude heating increases. While some general ideas exist concerning how the heat deposited at high latitudes is redistributed over the globe (via the winds, planetary and gravity waves), the variability and scale involved makes it difficult to test these and greatly improved observational methods seem to be needed. This same variability also renders it difficult to construct useful high latitude density models using the presently available indices (*AE* and *Kp*) which have poor temporal and spatial resolution.

Part 4. Models of the Ionosphere

August 27 a.m., Room: Kane 120, Chairman: J. V. Evans

K. Rauer, D. Bilitza, S. Ramakrishnan: Goals and Status of the International Reference Ionosphere (Invited paper, GA28).

W. Köhnlein: Electron Density Models of the Ionosphere (Invited paper, GA29).

K. A. Pfitzer, W. P. Olson: Semi-Empirical Models of Neutral and Electron Densities in the Thermosphere (GA30.)

L. H. Brace, R. F. Theis, H. G. Mayr: Empirical Models of the Ionosphere from ISIS-1 and ISIS-2 Satellites (GA31).

G. M. Khocholava: On Modeling Abnormally Increased Ionization in the F-Region of Ionosphere at Middle Latitudes (GA32).

W. Köhnlein, W. J. Raitt: Empirical Model of the Equatorial F2-Layer as Deduced from Electron Density Data of ESRO-1 and ESRO-4 (GA33).

W. L. Oliver: Models of F1 Region Ion Composition from Incoherent Scatter Radar Measurements (GA34).

H. A. Taylor, Jr., H. G. Mayr, S. L. Hsieh: A Global Empirical Model of Ion Composition from OGO-6 (GA45).

P. D. Perrault, R. R. Vondrak: Morphology of the High-Latitude Ionosphere (GA37).

In the fourth session, efforts to develop empirical models of the ionosphere were discussed. *Rawer et al.* described the work on the International Reference Ionosphere,

which will provide vertical profiles of electron density, electron and ion temperature and ion composition for selected times, seasons and parts of the sunspot cycle at a limited number of latitudes and is based on a wide variety of data sources. Other authors (e.g. *Brace et al., Taylor et al., Köhnlein and Raitt, Oliver*) described global or local empirical models for a smaller number of parameters that represented the results gathered with a particular sensor. *Pfitzer and Olson* described a very ambitious attempt to model the electron and neutral densities in the thermosphere from photochemical theory using a model of the neutral atmosphere as input. In sum, it seems that global models of the ionosphere are not presently at the same state as those for the thermosphere, in part because more parameters are involved, and, in part, because of its less regular behaviour. There is, for example, a greater degree of spatial structure associated with such features as the equatorial anomaly, the trough, etc., as well as the combination of magnetic and solar control to be included. Despite these difficulties, efforts continue to produce useful detailed models.

Part 5. New Results Bearing on Ionospheric Modeling
August 27, p.m., Room: Kane 120, Chairman: P. Bauer

H. E. Hinteregger: Changes of Solar EUV Spectrum from April 1974 to April 1977 Observed from AE-C and AE-E (Invited paper, GA38).

R. W. Schunk: Mathematical Difficulties Associated with Modeling the Earth's Ionosphere and Neutral Atmosphere (Invited paper, GA39).

W. R. Hoegy: Ambient Electron Heating Rate (GA40).

Yu. K. Chasovitin, V. B. Shushkova: Model of the Effective Recombination Coefficient (GA41).

G. A. Zherebtsov: High-Latitude Ionospheric Drifts during Substorms.

M. R. Torr, D. G. Torr, H. C. Brinton, L. H. Brace, N. W. Spencer, W. B. Hanson, J. H. Hoffman, A. O. Nier: Diurnal Variation of Ion Concentrations in the F1 Layer of the Ionosphere (GA43).

T. Yonezawa: The Standard Electron Density Profile in the F2 Region—The Effects of Various Factors such as Vertical Drift Motion of Electrons and Ions at Infinity, Difference in Plasma and Neutral Temperatures, and Thermal Diffusion (GA44).

W. Becker: The Midlatitude Invariance of the Lindau Standard Profile of the Ionosphere and the Solar Cycle Control of Its Standardizing Parameters (GA45).

L. A. Schepkin, A. V. Vinitskiy: Seasonal Variations of Thermospheric Gas Composition at Northern Hemisphere in 1976 on the Base of Ionospheric Data (GA46).

A. G. Khantadze, R. G. Gachechiladze: The Analytical Model of the Nighttime Stationary Ionospheric F-Region (GA47).

M. A. Koen, G. V. Khazanov, G. M. Khocholava: On the Mechanism of Pre-Sunrise Increase of Ionization in Winter F-Region of Ionosphere at Middle Latitudes (GA48).

In the fifth session, *Hinteregger* presented results of the solar EUV obtained over the period 1974–1977 with the AE-C and AE-E satellites. He introduced the disquieting thought that relationships established between, say, exospheric temperature and $F_{10.7}$ may be valid only over one solar cycle and an entirely new dependence may hold in the next cycle. *Schunk* reviewed some of the theoretical difficulties involved in the development of mathematical models of the ionosphere such as the inapplicability of the Navier Stokes equations in situations where the collision rate is low or the flow rate is high. Other authors (*Hoegy, Torr et al., Chasovitin and Shushkova*) presented results on rates or rate coefficients for ionospheric processes deduced from recent laboratory or ionospheric ob-

servations while another group of papers (*Yonezawa, Khantadze and Gachechiladze, Koen et al.*) dealt with explaining particular features of the behaviour of the ionosphere.

In sum, progress seems greatest in developing models and theory for the thermosphere in its steady state and this seems likely to continue in the forseeable future. The transient behaviour of the atmosphere in response to large energy inputs at high latitudes remains poorly understood and there seems no assurance that the requisite measurements will be made. Explanations exist for many of the anomalous features of the behaviour of the ionosphere (sometimes more than one) and numerical modeling to examine specific aspects remains a fruitful endeavour. Detailed empirical global models of all the ionospheric quantities of possible interest probably are beyond our present capability, and may have to be tackled by combining ionospheric theory with the empirical neutral atmosphere models (as by *Pfitzer and Olson*).

Authors of the review papers have been urged to submit them to "Reviews of Geophysics and Space Physics" for possible publication in a single issue.

ODC SYMPOSIUM ON OPPORTUNITIES IN GEOMAGNETISM AND AERONOMY FOR DEVELOPING COUNTRIES (Convener: A. A. Ashour, Co-convener: J. G. Roederer)

This symposium was planned to focus on the relevance of the disciplines of geomagnetism and aeronomy to pure and applied research, higher education and technology in developing countries, especially with reference to (1) cost-effective research topics and methods specific to the geography or location of a given country; (2) potential benefits in the areas of technology and education; (3) needs in terms of personnel, equipment, university curricula, etc.; (4) specific recommendations on how to implement the development of local and regional programs in geomagnetism and aeronomy.

The symposium was very successful, and the papers presented have been summarized and published in mimeographed form by the University of Denver, Colorado, U.S.A. Copies may be obtained from Juan G. Roederer, Geophysical Institute, University of Alaska, Fairbanks, Alaska 99701, U.S.A. The symposium was financially supported by the Lloyd Berkner Memorial Fund of the American Geophysical Union.

August 22 a.m., Room: Kane 220, Chairmen: A. A. Ashour, J. G. Roederer

A. A. Ashour: Introductory Remarks

J. G. Roederer: The Development of Basic and Applied Research: Role of the Universities in Developing Countries.

M. J. Moravcsik: Science and Scientific Higher Education in Developing Countries: Seven Tasks for Geoscientists.

A. Brock: The Choice of Research Topics for Developing Countries.

C. A. Onwumechili: Aspects of the Practice of Geomagnetism and Aeronomy in Developing Countries.

E. Ajakaiye: Possibilities for Geomagnetic Studies in Equatorial Countries.
F. A. Morse: Invitation to Join EQUION, a Study of the Equatorial Ionosphere.
O. Awe: Opportunities for Regional Programs in Aeronomy in West Africa.
E. Oni: From the Crust to the Mantle in Nigeria.
B. J. Srivastava: Challenges and Opportunities in Geomagnetism in India.
J. M. da Costa: International Cooperation and the Development of the Geomagnetism Studies in Brazil.
M. Krs: Discussion of the Use of Regional Magnetic Maps and a Proposal to Develop Paleomagnetic Laboratories for the Countries of the Wider Region of the Red Sea.

MNS LABORATORY STUDIES RELATED TO AERONOMY, AND OTHER TOPICS IN AERONOMY (Special Session in Honor of Marcel Nicolet) (Convener: D. R. Bates; Co-convener: H. I. Schiff)

On August 22, 1977, a.m., the Convener, *D. R. Bates*, opened the Symposium, the first IAGA had arranged to honour an individual. *Schiff* spoke on the role of nitrogen oxides in stratospheric chemistry, describing recent laboratory measurements relating to the subject and drawing particular attention to the great influence Marcel Nicolet has had and continues to have on it. *Thrush* discussed laboratory studies of hydrogen species. He recalled that importance in atmospheric chemistry of the 'odd' hydrogen species, H, HO, and HO_2 was first recognized in 1950 by Bates and Nicolet but that their reactions are the least well understood of the processes involved in the destruction of stratospheric ozone (odd oxygen). In addition to the direct catalytic removal of odd oxygen, they control the efficiencies of the NO_x and Cl_x cycles by converting active NO_2 into HNO_3 and inactive HCl into active Cl. He described laboratory methods in which the rate of reaction of H, HO and HO_2 are determined from direct observation of these species. *Kaufman* gave an account of recent research in his group and compared the results with other findings, where available. The reactions were studied by the discharge-flow technique using vacuum ultraviolet resonance fluorescence detection of Cl-atoms. They included the two primary, ozone-removing chain steps $Cl+O_3 \rightarrow ClO+O_2$ and $ClO+O \rightarrow Cl+O_2$ as well as four other major reactions such as $ClO+NO \rightarrow Cl+NO_2$, $Cl+Ch_4 \rightarrow HCl+CH_3$, $ClO+NO_2+M \rightarrow ClONO_2+M$, and $HCl+OH \rightarrow Cl+H_2O$. All reactions were studied over temperature ranges from near 200°K to well above 300°K. *Castleman* discussed heterogeneous chemical reactions and their importance in aeronomy where they may occur on aerosols and dust particles.

On August 23, 1977, a.m., the Co-convener, *H. I. Schiff*, first paid tribute to the work of Marcel Nicolet. *Swider* gave nitric oxide profiles deduced from an analysis of ion composition data between 105 and 85 km. He reported that the concentration of nitric oxide appears to vary from 1×10^8 cm^{-3} near 100 km to about 2×10^6 cm^{-3} near 85 km for mid- and low-latitudes under various sunspot numbers and seasons except for winter. Two mid-latitude cases in December had concentrations of 10^9 cm^{-3} at 100 km. *Teitelbaum*

and *Petitdidier* stated that the average diurnal variation of the λ5577 intensity may be accounted for by atmospheric tides. High space time resolution measurements gave the energy corresponding to fluctuations with periods between 2 and 15 minutes. The systematic diurnal variation of this energy relative to the total emission energy is in accord with other results concerning short period gravity waves and turbulence. *Cartwright and Trajmar* gave normalized differential and integral cross sections for electron impact excitation of N_2 and O_2 to numerous states. *Wisemberg, Vanlaethem-Meuree and Simon* discussed UV absorption measurements at temperatures between 220°K and 300°K for some compounds of interest in the Cl_2-O_3 chemistry. Attention was focussed on the 175–230 nm wavelength interval. Close to threshold variations up to 30% can occur in the stratospheric temperature range. *Anderson and Magitan* gave the results of *in situ* observations of the radicals OH, Cl, ClO, $O(^3P)$ and O_3 in the stratosphere. *Roederer*, the President, said IAGA is an organization run by active scientists for active scientists and for those who strive to become active. This is the spirit to which Marcel Nicolet has contributed to much. He was a key figure in the transition from the International Association of Terrestrial Magnetism and Electricity to the present IAGA. Marcel Nicolet is not only a creator of science (indeed the content of aeronomy has largely been created by him) but he knows and exercises his responsibility towards others, towards fellow scientists, towards participating countries and organizations. *Bates* dwelt briefly on Marcel Nicolet's integrity and sense of duty; his leadership; his proven ability at public affairs; his generosity and thoughtfulness; his effervescent nature; his humour and skill as a raconteur. Turning to him as a scientist he said he owes his success *in part* to a remarkably retentive memory in which he has systematically stored a wide knowledge of aeronomy and related sciences; *in part* to a highly sensitive ear for the first faint grating of conflicting evidence. The combination enables him to focus his acute physical insight on a problem at the rewarding early stage. Moreover he has the tenacity to return to and pursue a problem if later developments show that it is more tangled than originally supposed as so often happens in aeronomy. Professor Bates chose to describe in some detail Marcel Nicolet's first major contribution—his 1945 work on the origin of *D* ionization. His success, compared with his contemporaries, was the more remarkable because, owing to the war, he had had almost no access to recent literature on the subject. After a series of slides showing him in company with well known scientists the session closed with one of Marcel and Alice Nicolet. The prolonged applause with which this was greeted demonstrated clearly the depth of the feeling of affection and respect for him.

The programme of this Marcel Nicolet Session was as follows:

Part 1. August 22 a.m., Room: Kane 120, Chairman: D. R. Bates

H. I. Schiff: The Role of Nitrogen Oxides in Stratospheric Chemistry (Invited paper, GA49).

B. A. Thrush: Laboratory Studies of the Reactions of Hydrogen Species Important in Aeronomy (Invited paper, GA50).

F. Kaufman: Chlorine Reactions (Invited paper, GA51).

A. W. Castleman: Heterogeneous Chemical Reactions and Their Importance to Aeronomy (Invited paper, GA52).

Part 2. August 23 a.m., Room: Kane 120, Chairman: H. I. Schiff

W. Swider: Nitric Oxide in the Lower Thermosphere and Upper Mesosphere (GA53).

H. Teitelbaum, M. Petitdidier: 557,7 NM Airglow and Dynamical Processes near 100 km Altitude (GA54).

D. C. Cartwright: Cross Sections for Electron Impact Excitation of N_2 and O_2 (GA55).

J. Wisemberg, N. Vanlaethem-Meuree, P. C. Simon: Ultraviolet Absorption Measurements of Halocarbons and other Minor Constituents of Stratospheric Interest: About the Significance and Consequences of Temperature Effects (GA56).

J. G. Anderson, J. J. Magitan: Free Radicals in the Stratosphere: The in situ Observations of OH, Cl, ClO, $O(^3P)$ and O_3 (GA56A).

J. G. Roederer: Marcel Nicolet and the Spirit of IAGA.

D. R. Bates: Professor Marcel Nicolet.

SI1 STABLE REMANENT MAGNETIZATION: ORIGIN AND ALTERATION EFFECTS (Convener: D. J. Dunlop, Co-conveners: E. E. Larson and C. Radhakrishnamurty)

With the realization that the basis of geodynamics and plate tectonics for periods older than 200 m.y. lies in reliable paleomagnetic records from the continents, research workers in rock magnetism have turned their attention in the recent past to specific goal-orientated projects and a happy collaboration between paleomagnetists and rock magnetists has emerged. The above collaboration has been evident in the publications in rock magnetism since the Grenoble Assembly (1975) and was particularly visible in the special session SI-1 on the Origin of Stable Remanence in the Seattle Assembly, which was held in two parts, as shown below.

Part 1. August 22 a.m., Room: Smith 120, Chairmen: D. J. Dunlop and C. Radhakrishnamurty

M. E. Evans: Intergrowths and Ultrafine Oxide Particles as a Source of Paleomagnetic Signal (Invited, paper, GA208).

D. J. Dunlop: Sub-domain Magnetic Moments with Pseudo-single-domain Properties—A Source of Stable TRM? (Invited paper, GA209).

G. Pullaiah: ARM and Its Stability in Synthetic Magnetite Powders (GA210).

D. Biquand, C. Plessard, M. Prévot: L'Aimantation Rémanente Visqueuse des Roches: Mise en Evidence, Stabilité et Origine (Invited paper, GA211).

S. M. Cisowski, M. Fuller: Magnetic Effects of Shock Waves on Natural Materials (GA212).

H. C. Halls: The Paleomagnetic Signature of a Complex Meteorite Impact Structure, Slate Islands, Lake Superior (GA213).

S. Levi, S. K. Banerjee: Magnetization of the Ocean Crust: Evidence from DSDP Cores and Ophiolite Complexes (Invited paper, GA214).

U. Bleil, N. Petersen: The Oxidation State of Ocean Floor Basalts from the Atlantic and Its Relation to Magnetic Properties (GA215).

R. T. Merrill: The Effects Chemical Changes Have on Remanent Magnetization (Invited paper, GA216).

S. K. Banerjee, M. Yoshida: Observation of Stable CRM on Oxidation of Magnetite—Influences of Grain Size and Temperature (GA217).

J. L. Roy, P. L. Lapointe, W. A. Morris: The Potential Omnipresence of Chemical Remanent

Magnetization (GA218).

R. Thompson: Origin of Stable Remanence in Limnic Deposits (GA219).

E. C. Jowett, G. W. Pearce: Detrital Remanent Magnetization of Modern Lime Muds from the Florida Keys (GA221).

C. Amerigian, N. D. Watkins: Paleoenvironmental Control of Primary and Secondary Components of Magnetization in the East Berlin Formation of Connecticut (GA222).

Part 2. August 31 a.m., Room: Smith 120, Chairman: R. T. Merrill

E. R. Deutsch, C. Radhakrishnamurty: How to Distinguish Very Fine Single-Domain From Multi-Domain Magnetite in Rocks (GA224).

G. N. Petrova: The Identification of Primary Magnetization in Ancient Rocks (GA225).

M. O. McWilliams, A. Kröner, M. W. McElhinny: Thermal and Chemical Overprinting in the Damara Belt, Southwest Africa (GA226).

H. C. Palmer, H. C. Halls, L. J. Pesonen: Paleomagnetic Investigations on Keweenawan Conglomerate Pebbles (GA227).

L. J. Pesonen, H. C. Halls: Keweenawan Asymmetric Reversal—Secondary Component or Polar Wandering? (GA228).

C. E. Helsley: Time of Origin of the Magnetization of Red Sediments: Field Evidence (GA229).

B. H. Keating, C. E. Helsley: Origin and Alteration of Stable Remanence in Continental (Non-Red) Sediments from the Lance Formation, Southeastern Wyoming (GA230).

J. J. Hus, R. Geeraerts: Paleomagnetic Investigation of Late Pleistocene Continental Deposits Occurring in Belgium (GA231).

B. Cain, J. Donahue, M. Payne, H. B. Rollins, V. A. Schmidt, S. Shulik: Preliminary Paleomagnetic Results from Pennsylvanian Conemaugh Group Sediments in Southwestern Pennsylvania (GA232).

G. E. Morgan: Possible Inclination Error due to Compaction in Sediments from DSDP Site 398 (GA233).

P. C. Henshaw, Jr., R. T. Merrill: A Mechanism for CRM Acquisition in Pelagic Sediments (GA 234).

J. E. T. Channell, W. Lowrie: Rock Magnetic Properties of Some Pelagic Limestones from Italy (GA235).

C. Radhakrishnamurty, S. D. Likhite, P. W. Sahasrabudhe: In Situ Magnetic Measurements on Igneous Rock Bodies (GA236).

K. Hoffman, R. Day: Separation of Multi-Remanence Components Through a Demagnetization 'Difference Vector' Technique (GA237).

K. P. Games, R. L. Wilson: The Magnitude of the Archaeomagnetic Field, Deduced from Mud Bricks (GA238).

The presented papers include five invited papers covering different major areas. As a whole the papers fell into two categories, (a) studies on synthetic samples and (b) studies on rock specimens from both continents and oceans. The second category had most of the papers and valuable case histories were discussed, which will help the recovery of primary magnetization directions.

From the number of papers which dealt with the origin of stable magnetization of sediments and its alteration with time, it can be concluded that the area of sedimentary magnetization will be an important and productive one in the near future. Applications of such studies can be made in areas as diverse as intra-plate tectonics to the extension of magnetic polarity time scales to times older than, say, 150 million years.

SI2 TECTONOMAGNETICS AND SMALL SCALE SECULAR VARIATIONS: OBSERVATION AND THEORY (Convener: V. A. Shapiro, Co-convener: M. J. S. Johnston)

This proved to be quite an exciting symposium with a good balance of papers and at least some concensus in the results from several similar experiments reported from different countries. The papers actually presented were as follows.

Part 1. August 23 a.m., Room: Smith 120, Chairmen: V. A. Shapiro and M. Johnston

R. J. Phillips, I. K. Reddy, J. H. Whitcomb: Investigations into the Relationship Between Resistivity Changes and Tectonic Activity in Southern California (GA240).

R. D. Kurtz, E. R. Niblett: Time-Dependence of Magnetotelluric Fields in a Tectonically Active Region in Eastern Canada (GA241).

V. A. Shapiro, A. N. Pushkov, K. A. Abdullabekov: The Geomagnetic Investigations in the Seismoactive Regions of the Middle Asia (GA242).

B. E. Smith, M. J. S. Johnston, R. O. Burford, R. J. Mueller: Magnetic Field Changes, Earthquakes and Creep Events Along the San Andreas Fault, 1974–1977 (GA243).

V. A. Shapiro, K. A. Abdullabekov: The Observation of Seismomagnetic Effect During the Gazly 17 May 1976 Earthquake (GA244).

M. J. S. Johnston: Local Magnetic Field Variations and Shear Stress Changes on the San Andreas Fault (GA 245).

E. J. Infer: A Search for Tectonomagnetic Effects: Preliminary Results From a Three-Compoent Magnetometer Network near Hollister, California (GA246).

R. S. Carmichael: Depth Calculation of Piezomagnetic Stress Effect for Earthquake Prediction (GA247).

R. H. Ware, P. L. Bender: Noise Reduction Techniques for Use in Determining Local Geomagnetic Field Changes (GA248).

J. Revol, R. Day, M. Fuller: Laboratory Magnetic Observations on Magnetite and Rocks Stressed to Failure—Relation to Earthquake Prediction (GA249).

Part 2. August 23 p.m., Room: Smith 120, Chairmen: V. A. Shapiro and M. Johnston

S. Pike, T. Henyey: The Application of a Cryogenic Magnetometer to the Laboratory Measurement of the Tectonomagnetic Effect of Rocks Along the San Andreas Fault, California (GA250).

J. Miyakoshi, A. Suzuki: Geomagnetic Induction Study of the Seismically Active Fault Along the Southwestern Coast of the Sea of Japan (GA251).

N. A. Ivanov, S. I. Maximovskich, V. A. Shapiro: The Method of High-Precision Ground Survey of Geomagnetic Field Total Force T for Secular Variation Anomalies Exploration and Investigation (GA252).

W. Mundt: Recent Secular Change of the Geomagnetic Components in GDR (GA253).

V. A. Shapiro, V. A. Pjankov: Geomagnetic Field Secular Variation Anomalies and Modern Geodynamic Processes in the Urals (GA254).

V. A. Shapiro, V. A. Pjankov: Electric Conductivity Changes in the Secular Variation Anomaly Zones in the Urals (GA255).

N. Sumitomo: Secular Variation Anomalies and Tectonomagnetism in Japan (GA256).
G. F. Hinton: A Chandler Term in the Geomagnetic Field (GA257).

The papers naturally fall into three main groups: (1) Observation, interpretation and limitations in the measurements of local and regional magnetic fields; (2) Magnetotelluric experiments and results; (3) Laboratory experiments of the effects of stress on the magnetic properties of rocks.

The measurement resolution for estimates of electrical conductivity in seismically active regions in Canada, U.S.A. and U.S.S.R. based on magnetotelluric measurements appears to be about 3%. Temporal changes apparently associated with earthquakes are not yet clear in these data.

There are also a few clear observations of local magnetic changes exceeding a few nT associated with earthquakes and tectonic activity. Magnetic changes apparently related to tectonic activity were reported from GDR, U.S.S.R., Japan and U.S.A. Estimates of crustal stress variations likely to produce these effects were surprisingly similar and generally in the range of 2 to 20 bars. A notable negative result was reported from the U.S.S.R. for the Gazly earthquake ($M>7$). No change exceeding 0.1 nT apparently occurred during this event.

The effects of deviatoric stress on the magnetic properties of a rock sample containing multidomain magnetic material was reported to be large but quite complex by several different researchers. Single domain material appears to have a more uniform behaviour. A surprising identification of a Chandler Wobble term in the geomagnetic spectrum was reported and resulted in some discussion of its origin.

Publication of papers presented in this symposium is planned for a special issue of the Journal of Geomagnetism and Geoelectricity.

SI3 REPRESENTATION OF GEOMAGNETIC FIELD AND RECENT SECULAR VARIATION (Convener: B. R. Leaton)

Papers actually presented to this session were as follows:

August 25 a.m., Room: Smith 120, Chairman: B. R. Leaton

R. L. Wilson, C. R. Johnson, A. G. MacCormack, D. R. Barraclough: A Geomagnetic Test of Maxwell's Equations (GA259).
F. S. Barker: Modeling the Geomagnetic Secular Field as a Multilinear Functional on the Spherical Harmonic Space and Its Predictive Results (GA260).
N. W. Peddie: Modeling the Geomagnetic Field with the Fields of Unconstrained Dipoles and Circular Current Loops (GA261).
H. Nevanlinna: A Dipole Model of the Geomagnetic Secular Variation in Eurasia (GA262).
D. R. Barraclough, J. M. Harwood, B. R. Leaton, S. R. C. Malin: A Definitive Model of the Geomagnetic Field for Epoch 1965 (GA264).
A. I. Greshina, V. I. Kolesova, L. S. Lysenko, V. I. Pochtarev, M. A. Efendieva (presented by A. N. Pushkov): World Magnetic Charts for the Epoch of 1975 (GA265).

Wilson seemed happy to report that, on the basis of present experimental knowledge of the geomagnetic field, there is no evidence to suggest a need to modify Maxwell's equations; at least for experiments within the scale of the Earth. A corollary is that the rest mass of the photon is less than 2×10^{-51} kg.

Although claiming no physical basis for his treatment, *Barker* showed that the end of the vector having, as components, normalized spherical harmonics to degree and order 4, moved in a smooth dynamic way over the period 1901 to 1970. Prediction beyond 1970 using this model appears significantly better than those using the components individually.

Peddie gave the results of fitting the Geomagnetic Field for 1975 with up to 4 unconstrained dipoles or current loops. Current loops appear slightly more effective than dipoles for representing the field, perhaps more physical and certainly more efficient than a spherical harmonic fit. There are marked differences in the parameters of the principal loop on passing from a 1-loop to a 2-loop model.

Nevanlinna pointed out that field changes over Eurasia for the period 1965–1975 can be represented well by a variable dipole and that it is situated quite near to the large Z-anomaly in Central Asia. He suggested a connection between the two phenomena.

Barraclough emphasized the importance of accuracy in field models derived from near-surface data, considered the significance of extrapolating to the core, showed the improvement for this purpose of the reported model over earlier prediction models, but even so, the model could not be used meaningfully beyond $n=m=4$. The deduced horizontal core motions were shown.

Pushkov outlined the detail of compiling the USSR 1975 World Charts; in particular that data were, in general, averaged over 100×100 km squares. For regions south of latitude 40°S, data are too sparse for the process, so here values synthesized from a model of Kosmos-321 results were used. A scheme was described for evaluating the characteristic wavelengths of crustal anomalies and their effect on World models was considered.

SI4 GEOMAGNETIC INDUCTION BY LONG-PERIOD VARIATIONS IN DEEP LAYERS BENEATH CONTINENTS AND OCEANS (Convener: U. Schmucker)

Part 1. Ocean Floor and Island Observations, Theory
August 24 a.m., Room: Smith 120, Chairman: U. Schmucker

J. H. Filloux: Observations of Very Low Frequency Electromagnetic Signals in the Ocean (Invited review, GA268).

M. L. Richards: Electromagnetic Response of Long Submarine Cables to Geomagnetic Daily Variations and Tidal Motions (GA269).

C. S. Cox, J. H. Filloux, D. I. Gough, J. C. Larsen, K. A. Peohls, R. P. Von Herzen, R. Winter: Atlantic Lithosphere Sounding (GA270).

J. H. Filloux: North Pacific Magnetotelluric Experiments: Seafloor Instrumentation, Soundings and Discussion (GA271).

W. Nienaber, H. W. Dosso, L. K. Law, V. Ramaswamy, F. W. Jones: Electromagnetic Induction in the Ocean Surrounding Vancouver Island (GA272).

R. C. Hewson-Browne, P. C. Kendall: First Order Solutions of Oceanic Induction Problems (GA273).

B. A. Hobbs: Electromagnetic Induction in a Thin Non-Uniformly Conducting Ocean by Sq (GA274).

G. Fischer, P.-A. Schnegg, K. D. Usadel: Response of an Ocean Coast to E-Polarization Induction (GA275).

C. R. Brewitt-Taylor, P. B. Johns: Diakoptic Solution of Induction Problems (GA276).

G. Fansleau, L. Ballani: On the Separation of Geotectonic and Geoelectric Parameters of a Source Region (GA277).

Part 2. Long-Period Studies and the Deep Structure of Earth and Moon, Short-Period Studies and Local Anomalies
August 24 p.m., Room: Smith 120, Chairman: C. S. Cox

W. D. Parkinson: Induction by *Sq* (Invited review, GA278).

J. C. Larsen: Conductivity Structure Beneath Tuscon, Arizona (GA279).

U. Schmucker: Electromagnetic Response of *Sq* and *Dst* Variations at Mid-Latitude Observatories (GA281).

J. F. Devane: Electrical Conductivity Profiles and Upper Mantle Structure (GA282).

A. Ádám: Connection Between the Electric Conductivity Increase Due to the Phase Transition and Heat Flow (GA283).
(GA284).

C. W. Parkin, P. Dyal, W. D. Daily: Electrical Conductivity of the Lunar Crust and Interior (GA284).

M. Işikara: Long-Period Variations of the Geomagnetic Field and Inferences about Deep Conductivities of the Earth.

N. A. Cochrane, J. A. Wright: Geomagnetic Sounding of an Ancient Plate Margin in the Canadian Applachians (GA287).

L. K. Law, D. R. Auld, J. R. Booker: Geomagnetic Variation Results Across Western Washington and British Columbia (GA288).

A. G. Jones, V. R. S. Hutton: A Magnetotelluric and Magnetovariational Study of the Eskalemuir Anomaly, S. Scotland (GA 289).

The morning session began with an invited review paper by *Filloux* on magnetic and magnetotelluric observations at the bottom of the sea. Long-term stability of the electric signal can be obtained with the use of Ag-AgCl electrodes of high purity, connected by a salt-water bridge rather than by wire to avoid leakage to the seawater. For magnetic recordings torsion-fibre instruments have been found to be superior over other types of magnetometers.

In the following three papers first results were presented from new magnetotelluric soundings in the Pacific and Atlantic Oceans. Response values in the period range from 15 minutes to 24 hours reveal a conspicuously different conductivity distribution for these oceanic sites when compared to continents. High conductivities of 0.1 S/m seem to exist throughout the upper mantle. They begin at 60 km and possibly indicate here the base of the oceanic lithosphere. A paper on local studies around Vancouver Island demonstrated the importance of current channeling in narrow straits, connecting large bodies of seawater. The following five papers dealt with the theory of EM induction in oceans and

other multidimensional conductivity structures.

Parkinson opened the afternoon session with an invited paper on global induction by *Sq*. It was followed by three papers on local and regional induction studies in the frequency range of *Sq* and *Dst*. These papers revealed that surprisingly large differences of the EM-response can occur from site to site. They reflect a laterally inhomogenous zone of low conductivity (0.01 S/m) down to 600–800 km below continents where the well established increase to 1 S/m occurs. There are faint indications for an intermediate zone of moderately high conductivity of about 0.1 S/m. The implications of this zone for the thermal state of the mantle was then discussed in a fourth paper and compared to inferences from heatflow observations.

New knowledge about the conductivity of the moon comes from a combined evaluation of toroidal and poloidal magnetic source fields as was shown in the next contribution. Below 80 km depth a sharp increase of conductivity from 10^{-6} S/m to 10^{-2} S/m appears now to be well established with little evidence for any further complications. Back on Earth again, the response to solar-cycle variations was reported to indicate conductivities of 10 S/m at 1500 km depth.

In conclusion three papers were read on local studies, using relatively high frequency variations. A shallow zone of high conductivity was found to cross Newfoundland parallel to the continental shelfs and connected to the eastern margin of the Atlantic, when this ocean opened up in mesozoic times. From the Cascade Mountains a relationship was reported between volcanic zones and zones of anomalous conductivity; from Scotland an effect of the great Upland fault on the pattern of induction arrows. The Working Group I-3 has been invited to publish the proceedings of the symposium in a special issue of the Journal of Geomagnetism and Geoelectricity.

SI5 PLANETARY CORE THEORY AND GEOMAGNETIC SECULAR VARIATION (Convener: P. H. Roberts)

Part 1. Secular Variation, Moon and Planets
August 27 a.m., Room: Kane 210, Chairman: P. H. Roberts

A. Cox: The Paleomagnetic Record of Secular Variation (Invited paper, GA290).

T. Yukutake: Secular Variation in the Axisymmetric and the Non-Axisymmetric Components of the Geomagnetic Field (GA291).

E. R. Benton: On Non-Diffusive Fluid Motion at the Core-Mantle Boundary Implied by Surface Observations of the Geomagnetic Field at Two Epochs (GA292).

W. W. Wood: Westward Drift (GA293).

S. K. Runcorn: The Lunar Dynamo (GA294).

D. J. Stevenson: Which Planets Have Dynamos? (GA295).

Part 2. Dynamo Theory, Core Properties and Energy Sources
August 27 p.m., Room: Kane 210, Chairman: P. H. Roberts

A. M. Soward: Convection-Driven Dynamos (Invited paper, GA296).

F. H. Busse, J. B. Rundle: Recent Developments in the Theory of the Geodynamo (GA297).

R. W. James, D. E. Winch: Anti-Dynamo Theorems (GA298).
D. J. Stevenson: Turbulent Core Convection and Non-Linear Reversing Dynamos (GA299).
J. M. Gilliland: Thermal and Electrical Properties of the Earth's Outer Core (GA300).
D. Gubbins: Energy Source for the Earth's Dynamo (GA301).
D. E. Loper, P. H. Roberts: A Discussion of the Gravitationally-Powered Dynamo (GA302).

The proceedings of this full day session broke naturally into four parts. The first of these, on the secular variation, commenced with an invited lecture by *Cox* who surveyed and interpreted the known facts about the past geomagnetic field obtained by palaeomagnetic methods. He divided the field into a part varying on a time scale of about 10^4 years and one varying on a 10^3 year time scale. The former he associated with a dipole field, though with a *non*-central dipole. The implied longlived lack of symmetry might, he thought, be attributable to deviations in core structure from spherical symmetry, other magnetic evidence for which he also surveyed. He further discussed field excursions and field reversals, and advised caution in accepting all claims made for the former. He felt that the non-dipole field probably charged little during a reversal of the dipole, an event which takes the earth four or five thousand years to complete.

Yukutake argued the advantages of dividing the field into axisymmetric parts, rather than in the traditional dipole and non-dipole parts. He showed how the asymmetric fields, and especially the equatorial dipole, could be represented by a westward moving wave and a wave of similar amplitude stationary or moving slowly to the East. He gave reasons for believing that the lifetime of features of the asymmetric field might generally be much shorter than for the axisymmetric field. (In a poster display, *Gilliland* gave reasons why the dipole moment of the Earth may be sensitive to forcing experienced by the upper core.) *Benton* next described recent work on the interpretation of the secular variation by the motion of the field lines frozen-in to the fluid surface of the core as it moves. Assumptions, obstacles and new results were described, and in particular Bjerknes' theorem which should apply on every zero-Z curve on the core surface in a gravitationally stirred core. The next speaker, *Wood*, discussed MAC waves, postulated originally by Braginsky (1964) both as a significant component of the secular variation and as a basic ingredient of the field generation mechanism. Wood demonstrated a broad class of situation in which as many of these waves drifted to the East as to the West.

The second segment of the session was on the Moon and Planets. From the correlation of the remanent magnetization of Moon rocks with their age, *Runcorn* deduced evidence for a strong internally generated linear field early in the Moon's history. Assuming a field of about 45 gauss in a conductivity of 10^6 mho/m driven by convection, he deduced an initial power input of 10^{12}W. From the decline of the linear field with time, he speculated that this energy came from short-lived radioactivity, conceivably from superheavy elements. Next *Stevenson* surveyed the internal structure, global magnetism and internal energy sources of the planets and their larger satellites. He felt that the absence of a Venusian field was not necessarily because of its slow rotation component with the Earth, but might be attributed to its small, but significantly different internal structure. He also speculated on the existence of dynamos in Uranus, Neptune and Ganymede.

Soward opened the third part of the meeting, on dynamo theory, with an invited talk on the convection-driven dynamo, the simplest (though still complicated) example of a magnetohydrodynamic dynamo model, i.e. one for which both the electromagnetic *and*

hydrodynamic equations are solved. A key parameter is $\lambda = B^2/\mu\rho\Omega\eta$ (B core field strength, μ permeability, ρ density, Ω angular velocity, η magnetic diffusivity) which varies from 10^{-2} to 10^2 depending on whether $B=3$ or 300 gauss. Marginal convective stability in the presence of a field defines a modified Rayleigh number that can at first increase with λ, but which eventually reaches a global minimum when $\lambda=O(1)$. Such stability analyses cannot readily be incorporated into the dynamo problem except for small λ. Recent work suggests however that, if for some reason λ increases beyond a small critical value, it may spontaneously increase to O(1) values through dynamo action. Recent suggestions of small core fields may therefore have to be abandoned in favour of the older view of strong toroidal fields. Soward emphasized however, that this conclusion is premature in view of the current lack of an $\lambda=O(1)$ dynamo model.

Next *Busse* presented a new study of his own earliest magnetohydrodynamic dynamo model. This demonstrated that the model could become unstable to a finite amplitude oscillation. This might be not unrelated to observed dipole oscillations of the geomagnetic field described by Cox in the first lecture. *Winch* reported a joint search by *James* and himself for anti-dynamo theorems using the well-known formulation of Bullard and Gellman for spherical kinematic dynamos. In his second lecture, *Stevenson* presented a heuristic theory for turbulent convection in a rotating fluid in a magnetic field. It was supposed that amplitudes are limited by shear instabilities, and that the predominant modes are those transporting most heat for given temperature contrast. He located two families of solutions, one rotation dominated and the other having Lorentz and Coriolis forces equally dominant. He claimed that the velocity for the latter is too small, and too lacking in helicity, to be regenerative.

The final part of the program was devoted to core properties and energetics. The free electrons made a significant contribution to the properties of the core newly calculated by *Gilliland*. He obtained a Grüneisen parameter of 1.0 ± 0.1 in the core, and an electrical conductivity that increases from 5.5×10^5 mho/m at the mantle-core boundary to 7×10^5 mho/m at the surface of the inner core. There seemed to be significant changes in the thermal conductivity across the core, but the heat flux down the adiabat into the mantle appeared to be about 5×10^{12}W. *Gubbins* estimated the power delivered to the core from various sources (tides, precession, radioactivity, etc.) and its availability in driving core motions. He confirmed by mathematical reasoning the 1963 claim by Braginsky that non-thermal convection would drive core motions with nearly 100% efficiency, making it a good candidate for the dynamo driving mechanism. Non-thermal convection describes motions driven by gravitational release of energy (excluding that due to hydrostatic contraction and diffusion between components) when iron solidifies onto the inner core during the cooling of the Earth. That this source is able to maintain fields of several hundred gauss against ohmic losses was emphasized by *Roberts*, speaking on behalf of himself and *Loper*. Roberts also showed that, if the heat flux into the mantle is sufficiently large, a slurry layer should be present above the inner core. He emphasized also that the heat flux from the core could be less than that conducted down the adiabat, the difference being pumped *downwards* by non-thermal convection.

SI6 LONG WAVELENGTH GEOMAGNETIC ANOMALIES (Convener: A. Hahn)

August 29 p.m., Room: Smith 120, Chairman: A. Hahn

Z. A. Krutikhovskaya, I. K. Pashkevich: Long-Wavelength Magnetic Anomalies as a Source of Information about Deep Crustal Structure (Invited paper, GA303).

R. A. Langel, M. A. Mayhew, R. L. Coles: Long-Wavelength Geomagnetic Anomalies over Western Canada (GA304).

M. A. Mayhew: Inversion of Satellite Magnetic Data (GA305).

R. D. Regan: Interpretation of the Bangui Anomaly, West Africa.

D. R. Barraclough: A Search for Long Wavelength Anomalies in the North Atlantic (Invited paper, GA306).

J. C. Cain: The Core-Crustal Separation (GA307).

A. N. Pushkov: A Consideration of Residual Anomalies Obtained by Using Analytical Models of the Earth's Field up to the Order $n=22$.

R. A. Langel, R. D. Regan: MAGSAT: Future Tool for Measuring Long Wavelength Geomagnetic Anomalies (GA308).

In three papers airborne survey results were presented.

1. Area of the Ukranian Shield: After subtracting a 12th order model from the measured T-values and continuation upwards to 10 km, the anomalies were interpreted as being produced by the crystalline basement, using a configuration based in part on seismic investigations, whereby different blocks of the basement were assumed to have different amounts of magnetization. The Moho-discontinuity being the lower boundary of these basement blocks proved to be clearly correlated to the magnetic anomalies over several 100 km of profiles (*Krutikhovskaya* and *Pashkevich*).

2. Area between 50°–86°N and 220°–260°E in Northern Canada: The anomalies of an aeromagnetic survey of this area were continued upward to 500 km for comparison with the measurements obtained by the OGO 2, 4 and 6 satellites. It was shown that even in this real polar region it is possible to eliminate the strong disturbances of the ionosphere to such a degree that the remaining satellite data were in satisfactory agreement with aeromagnetic survey data (*Langel, Mayhew, Coles*).

3. North Atlantic: Shipborne and airborne data were combined to provide average field values for the areas of $1° \times 1°$. After subtraction of a 12th order model the anomalies were contoured in a preliminary way. Wavelengths near the short wavelength end of the 100–3000 km filter window which was applied were obviously predominant. Detailed studies of the obtained data shall follow (*Barraclough*).

A method for the interpretation of single anomalies or of groups of few anomalies in satellite data anomaly maps was demonstrated in several examples. The results are magnetization distributions in a crust of constant thickness (*Mayhew*). The results corresponded in many cases to geological features. A special model, constructed from geologically plausible assumptions for the Bangui anomaly in Central Africa was demonstrated as well (*Regan*).

The reference field which must be subtracted from magnetic measurements in order

to eliminate the contributions produced by the earth's core and to make visible the crustal anomalies as much as possible was considered by means of a study of its amplitude spectrum and by subtracting field models up to the 22nd order from the given data. It was shown that the amplitude spectrum can only give a hint to the appropriate separation of the contributions of core and crust. Further investigations which take into consideration geological facts and the secular variation must be put in as well (*Cain*, with additional contribution by *Pushkov*).

An outline of the specifications for the following MAGSAT survey was given. The perigee of its orbit is planned to be at 350 km height. This should yield a considerably better resolution than was possible with the OGO satellites (*Langel* and *Regan*).

SI7 LONG-TERM TRENDS IN THE GEOMAGNETIC FIELDS (Convener: R. L. Wilson, Co-convener: F. J. Lowes)

This session was held in two parts as shown below.

Part 1. August 30 a.m., Room: Smith 120, Chairman: F. J. Lowes

A. Cox: Frequency and Symmetry of Geomagnetic Reversals (Invited paper, GA309).

C. Laj, D. Nordemann, Y. Pomeau: Correlation Function Analysis of Geomagnetic Field Reversals (GA310).

C. Amerigian, N. D. Watkins: Systematic Behaviour of the Geomagnetic Field in Iceland During Periods Characterized by Low Latitude Virtual Geomagnetic Poles (GA311).

E. A. Hailwood: Late Palaeozoic and Early Mesozoic Geomagnetic Field Configuration (GA312).

R. T. Merrill, M. W. McElhinny: Anomalies in the Time-Averaged Paleomagnetic Field and Their Implications for the Lower Mantle (GA313).

R. L. Wilson, A. E. Mussett: A Sudden Persistent Shift of the Icelandic Palaeomagnetic Pole Position (GA314).

Part 2. August 30 p.m., Room: Smith 120, Chairman: R. L. Wilson

F. J. Lowes: A Geophysicist Looks at Dynamo Theory (Invited paper, GA315).

L. A. Dengler: Spectral Analyses of Paleomagnetic Time Series (GA316).

B. H. Keating, C. E. Helsley: Nature of the "Cretaceous Quiet Interval" (GA317).

S. C. Cande, J. L. LaBrecque, R. L. Larson: Marine Magnetic Anomaly Data From the Jurassic and Cretaceous Quiet Zones: Implications for Long Period Intensity Variations of the Paleomagnetic Field (GA318).

C. E. Helsley: Long-Term Variations Recorded in Continental Red Sediments (GA319).

S. C. Cande: Is the Anomalous Skewness of Marine Magnetic Anomalies Related to Long Period Intensity Variations of the Paleomagnetic Field? (GA320).

J. E. T. Channell, W. Lowrie: Early Cretaceous Geomagnetic Polarity: a Preliminary Reversal Sequence Measured in Limestones from the Vicentian (Southern) Alps (GA80).

W. Alvarez, W. Lowrie: Late Cretaceous Geomagnetic Polarity: Confirmation of the Gubbio Section in a Check Section near Moria, Italy (GA81).

Long term trends in the behaviour of the geomagnetic field have been seen both in its spatial geometry, and in its time variation. Both of these kinds of observations are leading to interpretations in terms of slowly changing behaviour of the fluid in the core, and slowly changing interactions between the core and the mantle. Further there are now suggestions that the normal and reversed magnetic fields are not identical. It is also becoming clear that the non-dipole features of the time-averaged geomagnetic field have not necessarily been the same throughout geological time, although the non-dipole features certainly seem to be fairly constant over the last several million years.

The introduction of SQUID magnetometers has led to completely new sources of information of considerable reliability, such as long detailed sequences of red sandstone or of limestones. We may expect a tremendous flood of detailed information of the behaviour of the geomganetic field over phanerozoic time during the next decade.

Sea-floor anomalies are also contributing to behavioural analyses of the geomagnetic field. The suggestion has been made that the magnetic field strength is strongest immediately after a polarity reversal and then gradually decreases until the subsequent polarity reversal.

This rising tide of results about the nature of the magnetic field itself, rather than about plate tectonics, is leading us into an area of very difficult interpretation, wherein we are trying to infer the structure of the mantle and core as a function of time which would permit us to understand our results. It is clear that we are going to have to link our results with the known structure of the earth from seismological observations, but when it comes to the distant past there will be no such possibility. The additional complication of plate movement will hinder much of the paleomagnetic field behaviour interpretation also.

SI8 ROCKMAGNETISM (Convener: G. N. Petrova, Co-convener: S. K. Banerjee)

The program originally scheduled for SI-8 was severely hampered by the absence of several contributors who were unfortunately unable to attend the Seattle Assembly.
The most interesting results presented at the meeting were:

1) Experimental verification that slow time-dependent viscous remanent magnetization (VRM) is potentially a very important source of noise in the paleomagnetic signal recorded in rocks. The first attempts at studying this problem are now being made, mainly using Deep Sea Drilling Project samples, with important implications for smooth or quiet zones in marine magnetic anomaly sequences.

2) The second highlight of the meeting dealt with new laboratory experiments in order to obtain the critical parameters needed to predict earthquakes by magnetic means.

A slightly unrelated, *but very important* datum was the report that the revised age of Laschamp lava flows in France (which have recorded a recent field reversal) is between 30,000 and 40,000 years and not around 20,000 years as previously believed.

Actual papers presented are shown below.

August 31 p.m., Room: Smith 120, Chairmen: S. K. Banerjee and M. E. Evans

W. Lowrie, D. V. Kent: Remagnetization of the Magnetic Source Layer by VRM Acquisition: A Possible Explanation of Some Oceanic Magnetic Quiet Zones (GA 323).

C. Plessard, L. Daly: Quelques Aspects de la Viscosité Magnétique des Basaltes Sous-Marins (GA324).

C. Radhakrishnamurty, S. D. Likhite, E. R. Deutsch, G. S. Murthy: Nature of Magnetic Grains in Basalts and Implications for Paleomagnetism (GA325).

D. Nordemann, D. Laj, J. Danon: Magnetic Properties of the Laschamp Lava (Chaine des Puys, France) (GA326).

K. M. Storetvedt, C. M. Carmichael, A. Hayatsu, H. C. Palmer: Superimposed Magnetizations of the Duncansby Volcanic Neck, Scotland.

A. G. Zvegintsev: On the Self-Reversal of Rock Magnetization (GA328).

A. A. Nulman, V. A. Shapiro, N. A. Ivanov: The Magnetic Susceptibility of Magnetite in the Variable Field Under the Cyclic Change of Hydrostatic Pressure (GA329).

T. Nagata: The Hysteresis of Piezomagnetization of Rocks (GA330).

N. Niitsuma: Zonal Magnetization Model and Depth Lag of NRM in Deep-Sea Sediments (GA331).

W. O. Sayre, E. A. Hailwood: Magnetic Remanence and Susceptibility Anistrophy of North Atlantic Early Tertiary Sediments Drilled on Ipod Leg 48 (GA332).

S. Tonger (given by A. M. Işikara): Some Palaeomagnetic Results from Galatian Massif of the North Anatolian Fault Zone.

P. Wasilewski: Microstructure Composition and Magnetization of FeNi Spheres (GA335).

P. Dyal, W. D. Daily, W. A. Barker, C. W. Parkin: A Thermoelectric Model for the Origin of Lunar Magnetism (GA337).

SI9 PALEOMAGNETISM IN OROGENIC BELTS (Convener: R. Van der Voo)

The session consisted of the following 21 papers presented in two parts. They ranged in geographic coverage from North and South America to Asia. Most major orogenic belts were represented: the western North American Cordillera, the Andes, the Appalachians, the Caledonides, the Atlas, and the Mediterranean-Himalaya belt, as well as a few examples of Precambrian belts.

Part 1. September 1 a.m., Room: Smith 120, Chairman: R. Van der Voo

R. Van der Voo: Introduction by convener.

B. R. Lienert, P. Wasilewski: Magnetic Change Associated with Serpentinization (GA338).

M. E. Beck, Jr., P. W. Plumley, C. D. Durr: Microcontinental Tectonics in the Western North American Cordillera (GA339).

D. T. A. Symons: Analysis of Paleomagnetic Data from the Canadian Cordillera: Geotectonic Implicitations (GA340).

E. Irving: Statistical Determination of Standard APM Paths and the Tectonics of the Western Cordillera of North America (GA341).

D. B. Stone: Paleomagnetism and Continental Accretion in Alaska (GA342).

J. W. Hilhouse: Paleomagnetism of the Triassic Nikolai Greenstone McCarthy Quadrangle, Alaska (GA343).

M. Jones, R. Van der Voo, M. Churkin, Jr., G. D. Eberlein: Paleozoic Paleomagnetic Results from the Alexander Terrane of Southeastern Alaska (GA344).

R. Simpson, A. Cox: Tectonic Rotation of the Oregon Coast Range, NW United States (GA345).

D. A. Valencio: The Paleomagnetism and K/Ar Age of Upper Carboniferous Rocks from Andacollo, Prov. of Neuquen, Argentina (GA446).

Part 2. September 1 p.m., Room: Smith 120, Chairmen: W. Lowrie and T. A. Symons

G. E. Morgan: Paleomagnetism of Slowly Cooled Precambrian Metamorphic Terrains (GA348).

E. J. Schwarz: Paleomagnetism of Proterozoic Rocks of the Circum-Ungava Fold Belt (GA349).

G. S. Murthy, K. V. Rao: Paleomagnetism of the Anorthositic Rocks from Vossestrand, Central Norway (GA351).

P. L. Lapointe, J. L. Roy: Paleomagnetism in the Appalachians (GA352).

R. Van der Voo, D. R. Watts, R. B. French: Characteristic and Remagnetization Directions from three Paleozoic Redbed Sequences in the Central Appalachians (GA353).

D. V. Kent, N. D. Opdyke: Discordant Devonian and Mississippian Paleomagnetic Poles for North America as Evidence for two Paleozoic Plates (GA354).

L. Daly, J. P. Pozzi, J. R. Lanceolot: Rélations Entre des Ages Radiométriques et les Phases d'Aimantation des Roches Infracambriennes et Précambriennes de l'Anti-Atlas Marocain (GA355).

S. A. Vincenz, M. Jelenska, J. Kruczyk, M. Kadziako-Hofmokl, K. Birdenmajor: Magnetization of some Mesozoic Diabases of South Spitsbergen, Svalbard Archipelado (GA356).

E. R. Deutsch, K. V. Rao: Paleomagnetism of Mesozoic Lamprophyres from Central Newfoundland (GA357).

J. E. T. Channell, W. Lowrie, W. Alvarez, F. Medizza: Paleomagnetism and Tectonics in Umbria, Italy (GA358).

M. Bina, M. Prevot, A. Motamed, L. Daly: Paleomagnetic Evidence for a Large Rotation of Central Elburz Since Eocene Time (GA359).

The morning part of the session had a very nice collection of papers on the western Cordillera of North America. Most workers presented their results in terms of past movements relative to the North American craton; one-time coupling between continental microplates and the past or present Pacific plates was a recurrent theme in the interpretations.

The Mediterranean-Himalaya belt has been similarly interpreted in terms of microplates, and some new evidence was presented here. The Mediterranean microplates appear to have been the result of the convergence of the major continents, Africa and Eurasia, and they present a rather complicated pattern. On the other hand, the western North American microplates appear to have undergone more simple and mostly northward relative movements, as a result of the interaction between the North American plate and the

Pacific oceanic plates.

Remagnetization was frequently cited as a problem in the paleomagnetic studies, though sometimes secondary magnetic overprinting, e.g., in slowly cooled metamorphic terranes, has some very useful and interesting applications. Carefully applied demagnetization techniques (AF, thermal, chemical) are necessary to unravel the often very complex magnetic histories of rocks in orogenic belts.

SI10 RELATION OF PETROLOGY TO OBSERVED GEOMAGNETIC ANOMALIES (Convener: P. Hood)

The objective of Session SI10 was to attempt to obtain a better understanding of the relationship between observed geomagnetic anomalies and the petrology, magnetic properties, metamorphic history and geometry of their causative bodies. The session was arranged as shown below by the Program Committee consisting of P. Hood, C. Weber, M. Ozima, R. I. Wilson and P. T. Taylor.

Part 1. September 2 a.m., Room: Smith 120, Chairmen: P. T. Taylor and R. L. Wilson

P. Hood: Introductory Remarks.

S. E. Haggerty: Magnetic Mineralogy: A Review (Invited review, GA360).

D. W. Strangway: Magnetic Anomalies and Magnetic Properties in Continental Regions (Invited review, GA361).

H. P. Johnson, J. M. Hall: The Magnetic Mineralogy of Oceanic Submarine Basalts and Its Relationship with Linear Magnetic Anomalies (Invited review, GA363).

C. Weber: Donnees Petrologiques en Relation avec L'Anomalie Magnétique du Bassin de Paris Interpretée Comme Liee à un Rift Continental Antehercynien (GA465).

Part 2. September 2 p.m., Room: Smith 120, Chairman: C. Weber

M. Aubert, L. Daly: Interpretation de la Plus Intense Anomalie Magnétique Mesurée en France à 3 km d'Altitude (GA364).

R. D. Frohlich, W. C. Schwab: The Study of a Magnetic Anomaly Caused by Granite Magnetization in Southern New England (GA366).

R. D. Regan, B. D. Marsh: Geologic Implications of the Bangui Magnetic Anomaly (GA467).

N. A. Ivanov, S. I. Maximovskih, V. A. Pjankov, V. A. Shapiro, V. A. Alfutov, A. V. Chursin, I. G. Khalymbadja: Aero and Ground Magnetic Survey for Fault Tectonics Investigation in the Baikal Rift Zone (GA368).

Z. A. Krutikhovskaya, I. M. Solina, N. M. Bondareva, S. M. Podolyanko (presented by V. A. Shapiro): Relation of Magnetic Properties of the Rocks of the Ukranian Shield to their Composition and Metamorphism (GA369).

S. P. Srivastava, R. K. H. Falconer, R. T. Haworth, J. W. Pierce, M. J. Clark, D. B. Clarke: Correlation between Magnetic Anomalies and the Bedrocks in the Offshore Regions of Eastern Canada (GA370).

A. Lecaille, M. Prevot, R. Hekinian: Relationship between Petrology and Magnetism of Basaltic Rocks from the Mid-Atlantic Ridge near 36°50′N (GA371).

J. Segawa: Magnetic Anomalies and their Relationships to the Mafic Belts along the Margins of Northeast Honshu, Japan (GA372).

P. R. Vogt, R. H. Feden: High Amplitude Sea-Floor Spreading-Type Magnetic Lineations near Some Hot Spots and along Fracture Zones: Evidence for Highly Magnetized Fe-Ti Basalt? (GA374).

A. Hahn, W. Bosum: How do the Four Large-Scale Tectonic Units within the Federal Republic of Germany show up in the Aeromagnetic Survey?

The morning papers consisted of three invited papers and the afternoon papers dealt with both continental and oceanic studies. *Haggerty* commenced the session with a comprehensive review of magnetic mineralogy in igneous, metamorphic and sedimentary rocks which is dominated by phases in the systems FeO-Fe_2O_3-TiO_2 and Fe-Ni-S. He postulated that the higher magnetization of the lower crustal rocks may be due to the formation of free iron which has a Curie temperature of 770°C produced by serpentinization. *Strangway* reviewed the magnetic properties of continental rocks and the anomalies produced by various types of rock formations such as intrusives, and the striking effect that metamorphism can play in modifying the magnetic properties of rock formations. *Johnson* and *Hall* then outlined the role that high titanium magnetite, which is the ubiquitous dominant magnetic mineral in oceanic tholeiite basalts, plays in forming the characteristic linear magnetic anomalies associated with sea-floor spreading. Low temperature oxidation of the titanomagnetite results in cation deficient forms resulting in a reduction of their remanent magnetization and consequently in the amplitude of the concomitant magnetic anomalies. The last paper of the morning was presented by *Weber* who had interpreted the magnetic anomaly associated with the Paris Basin as being due to a basic eruptive associated with rifting between 280 and 320 MY.

The first paper in the afternoon by *Aubert and Daly* described the interpretation of a 400 nT anomaly measured at 3 km altitude northwest of the Massif Central. The causative gabbroic body contained approximately 9% magnetite which resulted in a magnetization of 3 A/m. *Frohlich and Schwab* investigated the cause of an aeromagnetic anomaly of 60 nT amplitude over the 600 MY Scituate granite gneiss of southern New England. Ground investigations and modelling showed that the magnetized body dipped 38° NW and that the induced magnetization predominated. *Regan and Marsh* have modelled the Bangui magnetic anomaly in West Africa using satellite, aeromagnetic and ground survey data; they concluded that it is produced by a deeply-buried crustal body underlying the Central African Republic which is perhaps unrelated to the surface geology. *Shapiro et al.* used aeromagnetic and ground magnetic survey data to delineate the fault dislocations of the Baikal Rift Zone in central USSR. *Krutikhovskaya et al.* studied the magnetic properties of the igneous rocks of the Ukrainian Shield particularly with regard to the effect of metamorphism. It was concluded that there was a general tendency for an increase in magnetization with increasing basicity, metamorphic grade and age with Archean rocks metamorphosed to the granulite and amphibolite facies prodcuing the most intense anomalies.

Srivastava et al. found that the 2500 nT anomalies found off NE Newfoundland, which have a minimum wavelength of 1 km, are indicative of the location of rooted ophiolites. *Lecaille et al.* concluded that the differences in remanent magnetization intensity encountered between the various types of basalt recovered from the Rift Valley of the

Famous area on the Mid-Atlantic Ridge was due to the size variation of the contained titanomagnetites. *Segawa* studied the elongated pattern of magnetic anomalies which occur along the margins of NE Honshu in Japan and found that they were due to buried mafic belts, possibly orphiolitic formations, which originated in aborted interarc basins, or to continental volcanism. *Vogt and Feden* tabulated the areas of high amplitude oceanic magnetic anomalies which are due to FeTi-enriched basalts with a high remanent magnetization; a review of pertinent geochemical, rock magnetic and deep-tow profile data led to the conclusion that these anomalous zones are associated with fracture zones which occur near hot spots.

The final paper by *Hahn and Bosum* demonstrated how the four large tectonic units underlying the Federal Republic of Germany may be delineated by their aeromagnetic expression; the most intense anomalies are observed over the most metamorphosed rocks.

WI1 WORKSHOP ON THE INTERNATIONAL GEOMAGNETIC REFERENCE FIELD (Convener: B. R. Leaton)

August 25 p.m., Room: Smith 120, Chairman: B. R. Leaton

The following four papers were presented in the first part as a basis for discussion:

S. P. Srivastava: Goodness of fit of IGRF to the High Density Magnetic Survey Data in the Offshore Regions of Eastern Canada (GA375).

E. Dawson, L. R. Newitt: IGRF Comparisons (GA376).

R. Whitworth, J. J. Petkovic: A Method of Determining Spherical Harmonic Coefficients for Secular Variation (GA477).

R. D. Regan: Geomagnetic Field Model Needs of the Geophysics Exploration Community (GA378).

By a comparison with the annual means of over 100 magnetic observatories, *Dawson* demonstrated errors exceeding 20 nT per year in IGRF 1975 over large parts of the world and large discrepancies between IGRF 1965 and IGRF 1975. These errors in secular change continue to make worse the initial errors in the Main Field representation. The practical difficulties were described by *Srivastava* for the offshore regions of Eastern Canada. Here secular change was the worst offender in making it hard to connect surveys in neighbouring regions made a decade apart. *Whitworth* pointed out that the situation in Australia was even more critical and it had been necessary to reject IGRF and use instead a locally derived model. He described a method of piece-wise fitting to observatory means not only giving results superior to IGRF but also having the merit of being self-correcting. *Regan* put the case for exploration geophysicists that a new more accurate reference field be devised as accurate as possible, valid back to 1945 and that $n=m=8$ gives insufficient detail to satisfactorily delineate crustal anomalies.

The discussion was initiated by *Leaton* with a brief report of replies to his circular letter to individual and institutional users of IGRF. The findings derived from this, the papers presented and the ensuing discussion may be summarized as follows:

a) Some users find IGRF 1975 or even IGRF 1965 satisfactory, either because accuracy is not critical or perhaps of ignorance of the errors.
b) Some ionospheric physicists find it more appropriate to use a particular model best suited to their purpose and where there is little purpose in using an international standard.
c) There is a substantial body of users for whom IGRF has proved unsatisfactory and the situation is getting progressively worse. The worst affected include oceanographers and exploration physicists.
d) Theoretical geophysicists require the highest accuracy in a model, although recognizing that it must be retrospective.
e) Most users are now inured to the fact that any new reference field must be a new formulation, even though it is certain to be discontinuous with IGRF 1975.

It is suggested that the new reference field take the form of a set of parameters valid for at least 20 years. For the first 15 years the model should be as accurate as possible. Due to semantic difficulties over the meaning of 'definitive', it is suggested that this part of the model be termed 'standard'. The last five years of the model will necessarily be predictive, particularly with respect to secular change and in course of time will be corrected as necessary to become part of the 'standard' model. The details of how to achieve this aim will be discussed in Canberra and derivation will follow publication of MAGSAT data.

LSR-I LATEST SIGNIFICANT RESULTS SESSIONS OF DIVISION I (Convener: K. M. Creer)

Part 1. August 29, a.m., Room: Smith 120, Chairman: K. M. Creer

S. Lund, S. K. Banerjee, S. Levi, N. Eyster-Smith, E. E. Wright, Jr., A. Long: High Resolution Paleomagnetic Fluctuations from Minnesota—Correlations with Paleomagnetic Data (HA65).

R. Dodson, R. Day, J. R. Dunn, M. Fuller, T. Henyey, W. Kean: Continuous Records of Secular Variation (GA66).

C. E. Barton, M. W. McElhinny: Secular Variation in Southeast Australia over the Past 15,000 Years (GA69).

K. M. Creer, P. W. Readman, R. Thompson, T. E. Hogg, S. Papamarinopoulos, J. Stober, G. Turner: Secular Variations Obtained from European Lake Sediments (GA70).

D. C. Engebretson, M. E. Beck, Jr., G. M. Petrie: A New Method for Analysis of Directional Data Sets and Applications to Paleosecular Variation Studies (GA71).

K. M. Creer, T. E. Hogg: Synthetic Geomagnetic Long Period Secular Variation Plots Obtained from an Oscillating Radial Dipole Model (GA72).

P. Rigotti, V. A. Schmidt: Triassic-Jurassic Secular Variation as Recorded by the Palisades Sill, New Jersey, U.S.A. (GA73).

N. Orbay, S. Tonger, A. M. Işikara: Some Paleomagnetic Results from the North Anatolian Fault Zone.

C. Radhakrishnamurty: Magnetic Properties of Basalts (GA76).

All of these papers were concerned with the recovery of the record of geomagnetic secular variations and all but GA73 dealt with Recent Sediments. It is clear that important advances have been made in the techniques of obtaining sedimentary cores especially from the bottoms of lakes and of measuring the remanent magnetism and other properties of these unconsolidated sediments, both on unopened cores and on sub-samples taken from them. Following on the work of this LSR session, the proposal that an IAGA scientific session on the magnetization of Recent Sediments be held during the IAGA 1979 Assembly in Canberra was accepted by WGI-5 at their business meeting.

Part 2. August 24 a.m., Room: Kane 110, Chairman: R. Thompson

V. Bucha: Changes in the Geomagnetic Field during the Last 2.4 Million Years (GA77).
S. K. Runcorn: Theory of the Irregular Changes in the Length of the Day.
J.-J. Wagner, I. Hedley, M. Delaloye, M. Vuagnat: The Magnetic Anisotropy of a Sheeted Complex (GA81).
D. A. Valencio: Long and Short-Term Trends in the Geomagnetic Field During the Late Palaeozoic and Early Mesozoic (GA82).
P. K. S. Raja: Palaeomagnetism of the Cenozoic Volcanic Rocks from East Africa (GA83).
M. O. McWilliams, M. W. McElhinny, A. Kroner: Upper Proterozoic Palaeomagnetism of Australia and Africa (GA85).

None of these papers fitted easily into the titled sessions and all authors welcomed the opportunity to present them in an LSR session.

SII1 EFFECTS OF NONTHERMAL PROCESSES ON ESCAPE AND STRUCTURE OF ATMOSPHERES OF PLANETS AND SATELLITES (The Terrestrial Exosphere; The Moon; Venus and Mars) (Convener: G. E. Thomas)

This session focussed largely on the problems of the exospheres of Earth and Venus. In particular, it is now clear to many of us that the outer atmospheres of both of these planets are in fact *dominated* by the presence of escape processes other than Jeans escape. This report is only on the highlights of the topics that were discussed in this IAGA meeting. Also, with respect to our current understanding of planetary exospheres, this report will be incomplete. The convener said nothing about the outer planets nor of Mars but depended upon *Hanson*'s review of the results from the Viking experiments (GA448 in SIII 2). The papers actually presented are as follows.

August 29 a.m., Room: Kane 120, Chairman: G. E. Thomas

A. Vidal-Madjar, G. E. Thomas: The Terrestrial Hydrogen Problem (Invited paper, GA379).
R. W. Carlson: The Terrestrial Helium Problem: History and Recent Advances (Invited paper, GA380).

B. A. Tinsley: Effects of Charge Exchange of H and H^+ on the Distributions in the Exosphere (GA381).

L. J. Maher: The Diurnal and Solar Cycle Variation in Charge Exchange Induced Hydrogen Escape Flux (GA382).

G. E. Thomas, A. Vidal-Madjar: Evidence for Loss of Hydrogen at High Latitudes: The Polar Wind (GA383).

W. D. Daily, W. A. Barker, P. Dyal, C. W. Parkin: Ionosphere and Atmosphere of the Moon in the Geomagnetic Tail (GA384).

J. L. Bertaux, J. Blamont, M. Marcelin, V. G. Kurt, H. H, Romanova, A. S. Smirnov: Non-Thermal Hydrogen Population Observed in the Upper Atmosphere of Venus with Venera-9 and -10 (Invited paper, GA385).

S. Kumar, A. L. Broadfoot: Mariner 10 Measurements of Non-Thermal Hydrogen on Venus (Invited paper, GA386).

M. K. Wallis: Exospheric Density and Escape Fluxes of Atomic Oxygen Isotopes (GA387).

Starting with the terrestrial exosphere, the importance of a non-thermal escape mechanism became apparent from several lines of evidence. *Vidal-Madjar* reviewed the observational evidence in detail that has accumulated in the past few years from satellite measurements of exospheric hydrogen. There appear to be two mechanisms of importance: (1) charge exchange of hot plasmaspheric protons with cooler atomic hydrogen resulting in fast-moving neutrals that are capable of escaping the earth's gravity, and (2) the polar wind outflow of light ions at high latitudes, which constitutes a sink of atmospheric hydrogen.

Vidal-Madjar pointed out that the signature of these processes should be present in the global distribution of hydrogen in the exosphere. Indeed, recent satellite evidence has revealed some very startling departures of high-altitude ($z > 500$ km) hydrogen from the classical picture of a smoothly varying distribution of hydrogen that depends inversely on the global temperature distribution. He showed recent results from the OGO-6 satellite which indicates several striking differences from the classical picture. The most apparent are the deep morning 'trough' somewhat preceding the sunrise terminator at all seasons; and the high latitude depletion at both poles at all seasons. Plasmaspheric charge exchange processes may be responsible for moving hydrogen out of the early morning regions and into the dayside, but these need to be incorporated into a more complete model. Polar wind could be responsible for the latitudinal gradients, provided the outflow is near the limiting fluxes (a few times $10^8 cm^{-2} sec^{-1}$) and extends down to about 60° in latitude. However, *Thomas and Vidal-Madjar* suggested that the seasonal and latitudinal variations of the mesospheric production of H may also be important in determining the latitudinal gradient. The fact that the summer-time densities at the pole exceed the winter-time deviations seems to require alternative explanation, since the polar wind loss should be greatest at the summer pole.

The helium budget has been a long-standing and yet unsolved problem. With the inclusion of all the possible mechanisms, including charge exchange, polar wind, wind-induced escape etc., *Carlson* showed that in fact we may have sufficient outflow to account for the input from the earth's crust. Thus at long last, we may have the answer to this vexing problem.

Turning to the planet Venus, we heard reports from two different groups who measured the hydrogen corona of Venus. The Mariner 10 ultraviolet spectrometer measured the

altitude distribution of hydrogen in 1972, and found a "hot" component with a temperature consistent with that found in 1965 by the Mariner 5 experiment. In 1975, the spacecraft Venera 9 was placed into orbit around Venus. On board was an ultraviolet photometer with a hydrogen absorption cell which has provided new information about the hydrogen corona. In addition to confirming an increasing scale height with altitude from the photometric measurements of limb brightness, this experiment also showed that the width of the *Lα* line itself broadened as a function of altitude. This new evidence definitely establishes the extra component as being non-thermal (there might have been lingering doubt as to whether the second component might be due to something other than a change in the velocity distribution).

The hot atoms occur in a region that is not far from an extension of the bowshock measured by solar wind instruments on board Venera 9. However, recombination of the measured plasma densities is capable of providing only 5 Rayleighs of signal as compared to the approximately 100 Rayleighs observed. *Bertaux* speculated that the observed atoms may be in satellite orbits about the planet. Satellite atoms could be placed into orbits from charge exchange within the plasmasphere even from the nightside of the planet.

Exospheric escape mechanisms are of great importance to studies of planetary evolution. As an example, *Wallis* discussed the fractionation that might result as a consequence of the ^{16}O isotope escaping from Mars more rapidly than ^{18}O, due to the suprathermal energies given to the O atoms during O_2^+ recombination. The absence of this fractionation in the Viking mass spectrometer data has previously suggested that the oxygen isotope regulation is not provided by escape, but rather by an equilibrium cycle with a reservoir within the planet itself. However, *Wallis*' calculations indicated an oxygen escape flux only half of earlier estimates (McElroy and Yung, 1976, Planet. Space Sci. **24**, 1107), which implies that only a minor oxygen isotope separation on Mars is expected, in agreement with the Viking results. *Wallis* also obtained relative escape rates of ^{15}N and ^{14}N, due to N_2^+ recombination, from which he estimated (using Viking data for the ^{14}N ^{15}N depletion) a primeval nitrogen content on Mars in the range 0.4–1.4 mbar.

As *Sagan* remarked in his banquet lecture on August 31, since the terrestrial exospheric escape mechanisms in the past may have profoundly affected the evolution of life, we should all be "emotionally involved" in the study of planetary exospheres. As we uncover new mechanisms of escape, we become aware of their possible importance in the evolution of planetary atmospheres. After all, the atmosphere from the lower troposphere to the outer exosphere is a system in itself. Changes at one boundary can, over the course of time, be reflected in changes at the other. We should be cautious in overemphasizing the artificial boundaries that exist between the various 'spheres', and remind ourselves of the inter-relationships of the various parts of the atmosphere with one another, and in turn with the biosphere.

SII2 AERONOMIC IMPLICATIONS OF SOME LARGE-SCALE CIRCULATION FEATURES (Convener: C. F. Sechrist, Jr.)

September 2 p.m., Room: Kane 110, Chairman: C. F. Sechrist, Jr.

D. W. Rusch: Spatial Variations of Minor Neutral Constituents in the Upper Atmosphere (GA490).

C. A. Reber: Global Morphology of Minor Neutral Constituents and the Effects of Atmospheric Dynamics (GA391).

G. Megie: Laser Radar Studies of Atmospheric Sodium and Potassium

D. Offermann: Atmospheric Conditions during the Western European Winter Anomaly Campaign (GA394).

D. S. Wratt: Planetary-Scale Waves in the Stratosphere and Electron-Density Changes in the Mesosphere Above a Midlatitude Station (GA395).

C. E. Meek, A. H. Manson: Simultaneous Measurements of Neutral Winds and Ionization, 70–100 km, at 52°N, 107°W (Saskatoon, Canada) (GA396).

P. Bencze (presented by J. Verö): Height Variations of Wind Shear during Stratospheric Warmings Deduced from Ionospheric Sporadic E (GA397).

A. Ebel: Effects of Transport Processes in the Upper Mesosphere and Lower Thermosphere (GA398).

Reber stated that OGO-6 annual helium variations in the thermosphere at 450 km can be reproduced by a meridional wind circulation and temperature model (MSIS). The model was developed from measurements made by several satellite and incoherent scatter radars. Similar empirical modelling techniques can be applied to total ozone measurements from satellites and to Nimbus temperature data (ISIS).

Megie introduced the results of his laser measurements of Na and K. He fount that the K layer is 1.3 km below the Na layer (photometric techniques indicate several km); K is constant seasonally; Na has a peak in winter; and meteors provide a source during summer. Another source in winter is terrestrial and at high latitude. *Witt* obtained 5 times as much Na over Europe compared to the Western Hemisphere shown by airglow measurements. *Gadsden* pointed out that terrestrial source aerosols from sea water do not have the right Na/K ratio.

Offerman mentioned that the West European anomaly campaign in January 1976 was an example of the type of program needed for MAP. It was quiet, with no events and therefore a meteorological source of anomaly. It used rockets in Spain, meteor winds in France, plus magnetometers, ionosondes, photometers, etc. There were 22 experimental groups, and 38 experiments. It concentrated on temperature results from the campaign. The anomaly was always associated with a 50 to 55 km vertical wavelength temperature wave producing heating at 80 km. This is a necessary but not sufficient condition. Was it possibly winds? Unfortunately, the meridional wind was in the wrong direction to bring nitric oxide from the polar regions. O^+ was considered. The vertical transport of nitric oxide is currently being investigated. A correlation was found among surface pressure fluctuations, temperature at 80 km, 5577 Å airglow radiance, and 10 mb temperature.

Wratt stated that simple long term meridional circulation is unable to explain winter

anomaly as transport of nitric oxide from the pole. Day-by-day variations (as measured by meteor wind radar) show significantly better correlations. Planetary waves can possibly provide the necessary transports from below.

Meek and Manson found that enhanced electron densities appear to *lead* southward wind. There was no explanation. The variability of electron density at Saskatoon was probably due to particle precipitation. One event shows a magnetic storm associated with southward winds and an increase in electron density, but there was still a possible particle precipitation effect.

Bencze (presented by Verö) found the stratospheric warmings influence the *E*-layer f_0E, up to 130 km.

Ebel pointed out the climatological features of the mesopause-thermopause height range. These incuded the November effect, equinoctial anomaly at low latitudes (c.f. winter anomaly), electron density deficit between 20° and 40° N, and vertical and horizontal eddy diffusion coefficients. He looked for probabilities of a maximum in nitric oxide at 10° N. He found that large vertical winds ($\pm$20 cm/sec) are inherent in satisfying model criteria on a long term, climatological timescale.

LSR-II LATEST SIGNIFICANT RESULTS SESSIONS OF DIVISION II (Convener: B. A. Tinsley)

Part 1. August 26 a.m., Room: Kane 210, Chairman: J. C. Gerard

M. Gadsden: Upper Atmosphere Wind from Airglow Measurements (GA87).

H. Kamiyama, S. Okano: Doppler Temperature of Oxygen Green and Red Lines in Aurora (GA88).

W. K. Peterson, J. P. Doering, T. A. Potemra: Conjugate Photoelectron Fluxes Observed on Atmosphere Explorer C (GA89).

P. D. Feldman: Conjugate Photoelectron Excitation of the Ultraviolet Oxygen Twilight Airglow (GA90).

A. B. Christensen, M. H. Rees, G. J. Romick, G. G. Sivjee, A. J. Cunningham: Auroral and Laboratory Studies of Permitted Atomic Oxygen Emissions (GA91).

C. D. Anger, J. S. Murphee, A. W. Harrison: Instantaneous Hemispheric Auroral Particle Energy Deposition as Determined by Optical Emissions (GA92).

J. S. Prasad, J. S. Kim: Response of the Neutral Atmosphere to Heating Associated with Mid-latitude 6300 Å Red Arcs (GA93).

J. S. Prasad, J. S. Kim: Observation of Soft Electron Fluxes during 6300 Å Red Arc Events (GA94).

J. S. Prasad, J. S. Kim: Magnetospheric Heat Fluxes during the Times of 6300 Å Red Arc Events (GA95).

D. Offermann, K. U. Grossmann: Spectral Measurement of Atmospheric 63 μ Emission during a Geomagnetic Distrubance (GA96).

W. Benesch: Infrared Electronic Emission of N_2 and N_2^+: The Infrared Afterglow and Meinel Systems (GA97).

J. S. Murphee, C. D. Anger: Calculation of the Instantaneous Boundary of Auroral Emissions (GA98).

E. Young: Excited NO^+ in Aurorae (GA99).

Two papers discussed the use of high resolution measurements of optical emissions as a tool to determine winds or temperatures in the lower thermosphere.

Conjugate photoelectron energy spectra measured by the photoelectron spectrometer on the AE-C satellite were reported. Evidence for excitation of OI 1304 and 1356 A lines by conjugate photoelectrons was also discussed.

One paper showed that both laboratory and auroral observations indicate that the intensity ratio OI 7990 A/OI 989 A is much smaller than predicted by theoretical calculations.

Two papers based on the ISIS-2 auroral scanning photometer measurements were given. These observations allow the morphology of the precipitation and the total precipitated energy to be determined.

A group of three papers discussed various aspects of SAR-arc events and magnetospheric conditions prevailing during their occurrence.

Measurements of the OI 63μ emission profile indicate a high intensity of this emission, considerably enhanced over predictions for quiet conditions.

Finally, two papers reported recent results on some N_2, N_2^+ and NO^+ excited states. Optical emissions from these metastable states may be expected in the infrared auroral spectrum.

Part 2. August 26 p.m., Room: Kane 210, Chairman: B. A. Tinsley

D. Krankowsky, W. Joes, P. Lämmerzahl: Day-to-Night Variations of Atomic Nitrogen in the Thermosphere from Measurements of the Neutral and Ion Mass Spectronometer on Aeros-B (GA100).

J. S. Shirke, S. N. Pradhan: Geomagnetic Control of Mesospheric Nitric Oxide as Evidenced from Low Altitude Partial Reflection Studies (GA101).

J. P. McClure, W. B. Hanson, E. J. Webber, J. Buchau, J. Aarons, S. Basu: Coordinated Observations of Equatorial F-Region Irregularities (GA102).

B. Madhusudana Rao, B. R. Rao: Some Observations on Spread F Using Phase Path Technique (GA103).

E. A. Essex, D. W. Cornelius: Ionospheric HF Doppler Observations during the October 1976 Total Eclipse over South Eastern Australia (GA105).

A. D. Richmond: The Nature of Gravity Wave Ducting in the Thermosphere (GA106).

A. G. Khantadze, R. G. Gachechiladze: The Perturbations in the Night-Time Nonstationary Ionospheric F-Region due to the Gravitational Waves (GA107).

P. M. Vila: Morning Modulation of the Equatorial F2 Layer by Thermospheric Zonal Winds through the Luni-Solar Tide (GA108).

T. Okuzawa: Spectral Characteristics of the HF-Doppler Signals of the F-Region Ionosphere over Central Japan (GA109).

D. R. McDiarmid, A. G. McNamara: Radio Aurora in the Dayside Auroral Oval, I. Relation to Field-Aligned Currents and Energetic Particles (GA111).

D. R. McDiarmid, G. Rostoker, A. G. McNamara: Radio Aurora in the Dayside Auroral Oval, 2. Relationship to Ionospheric Current Flow (GA112).

K. D. Baker, J. C. Ulwick, J. Clark: Rocket Measurements of Electron Density Irregularities in the Auroral Zone (GA113).

Part 2 of the LSR-II session included a number of up-to-date papers on thermospheric and ionospheric variations. This session was notable for demonstrating the variety of different techniques that can be brought to bear to obtain data on composition in the thermosphere and mesosphere, waves in the neutral and ionized upper atmosphere, and instabilities in both the equatorial and auroral zone ionospheres.

ECE WORKSHOP ON THE EQUATORIAL COUNTER ELECTROJET (Convener: R. G. Rastogi)

This workshop was planned after negotiation between the convener of the JS-A symposium and the IAGA Division II chairman, to present a group of papers on the equatorial electrojet and counter electrojet, which were originally submitted to the JS-A symposium on "Electric Current and Atmospheric Motion in the Lower Thermosphere". Through this arrangement this subject was effectively discussed. The papers presented are as follows.

August 27 p.m., Room: Smith 120, Chairman: R. G. Rastogi

R. G. Rastogi: On the Simultaneous Existence of Two Current Systems in the Equatorial Electrojet Region (GA116).

S. Sampath, T. S. G. Sastry: Results from In-Situ Measurements of Ionospheric Currents in the Equatorial Region (GA117).

R. F. Woodman, R. G. Rastogi, C. Calderon: Solar Cycle Effects on the Electric Fields in the Equatorial Ionosphere (GA119).

R. G. Rastogi: Plasma Irregularities in the Ionospheric E Region over the Magnetic Equator (GA120).

J. W. MacDougall: Ionospheric Current Systems Deduced from Equatorial Electrojet Variations by Covariance Analysis (GA121).

R. P. Kane: Some Characteristics of the Equatorial Electrojet in Ethiopia (East Africa) (GA122).

S. Sampath, T. S. G. Sastry: AC Electric Fields in the Equatorial Electrojet Region (GA123).

The vertical *F* region drift measurements by VHF incoherent scatter radar at Jicamarca provide a very useful technique to study the east-west electric field over the magnetic equator. *Calderon* showed that the average value of the noontime electric field over the dip equator does not have any significant solar cycle effects. The pre-sunset increase in the electric field was shown to be characteristic of the high sunspot periods only. The equatorial counter electrojet seen in the magnetograms were shown to be associated with the reversal of the horizontal electric field over the equator. These results showed that the long term changes in the equatorial electrojet currents are primarily due to the changes in the ionospheric conductivities or the plasma density while the short period changes are due to the east-west electric field.

Sastry described the results of several rocket borne magnetometer experiments over the magnetic equator in India. Although the peak current varied appreciably from one

flight to another, the vertical profiles of the currents were consistently the same. One of the important results from these experiments has been that the height of peak current density was significantly different from the theoretically calculated height of the peak Cowling conductivity. Evidence was presented for the presence of an AC electric field in the spectrum band 10–120 Hz between 85–130 km.

Rastogi showed that the *q*-type of sporadic *E* layer as seen on the ionograms or the type II irregularities seen on the VHF backscatter radar over the dip equator is a very sensitive index to monitor the E-W electric field at 100 km altitude. These irregularities were shown to disappear within a minute after the reversal of the electric field (when ΔH at the equator becomes less than ΔH at a non-equatorial station), although ΔH at the equatorial station may be significantly positive. These events of counter electrojet, when ΔH over the equator is positive, was suggested to be due to the superimposition of two current systems over the equator, one due to the *Sq* field flowing eastward during the day at about 107 km and another due to non-*Sq* field flowing either eastward or westward at 100 km. The slow and long lasting reversals of the electric fields were suggested to be of lunar tidal origin while sudden and comparatively shorter period reversals were suggested to be of magnetospheric origin associated with the polar disturbances. Some of these events were clearly shown to be associated with the reversals of the Interplanetary Magnetic Field from a southward to a northward direction imposing an additional $-v \times B_y$ electric field.

MacDougall discussed the problem of non-correlation of the equatorial electrojet current with the remainder of the *Sq* current system. Using the coveriance analysis technique, he separated out the currents due to different sources like electrojet current, *Sq* current, lunar current, non-ionospheric current and others. He concluded that the electrojet current differs significantly from the standard *Sq* current system.

Kane described the analysis of the data from a very close network of ground magnetometers operated in the equatorial electrojet region in Ethiopia. The daily variation patterns near the zero dip have enhanced magnitude but do not bear a constant proportionality to the patterns just outside the electrojet influence. The latitudinal profiles of the counter electrojet events were shown to be asymmetric with the dip equator; the region of maximum effect being sometimes signficantly shifted from the dip equator. The magnitudes of SSC were also enhanced at the equator during the daytime but the ratio of enhancement was not proportional to the electrojet strength. These analyses indicated a complex structure of the equatorial electrojet current having currents at different altitudes with different latitudinal profiles not necessarily centered at the dip equator.

The discussions following the presentations pointed to the effects of induced currents, ocean effects and the non-ionospheric currents in the equatorial electrojet current as estimated from ground magnetometer records. A closer study of the low-latitude ionospheric currents was emphasized to be undertaken in future to isolate the various sources and the relationship with other geophysical events. Since the equatorial electrojet is very sensitive to the changes of horizontal electric fields and is little affected by precipitation of energetic particles, the ionospheric magnetospheric coupling would be effectively clarified through the study of equatorial electrojet phenomena.

SIII1a PENETRATION OF MAGNETOSPHERIC ELECTRIC FIELDS TO LOW *L*-VALUES (Convener: K. D. Cole)

August 26 p.m., Room: Kane 220, Chairman: H. Volland

K. D. Cole: Introduction to Symposia SIII1a, 1b, 1c.

R. G. Rastogi: Penetration of Electric Fields of Solar Wind Origin to Low L-Values (Invited Review, GA400).

Yu. I. Galperin, N. N. Ponomarev, A. G. Zosimova: Equatorial Ionospheric Anomaly and Interplanetary Magnetic Field (GA401).

M. Blanc: Observation of Storm- and Substorm-Associated Electric Fields at L=1.8 with the French Incoherent Scatter Facility (GA404).

C. Gonzales, B. Fejer, M. C. Kelley, R. Woodman: Simultaneous Electric Field Measurements at the Auroral Zone and the Equator during Disturbed Conditions (GA405).

Yu. A. Kopytenko, Yu. P. Novikov, O. M. Raspopov, A. B. Pashin: Space-Time Distribution of Geomagnetic Pulsation Amplitude during a Geomagnetic Storm (GA406).

C. G. Park: Whistler Observations of Substorm Electric Fields in the Plasmasphere (GA416).

D. J. Southwood: The Role of Plasma Pressure in Magnetospheric Convection (GA407).

H. Volland: An Improved Model of Global Magnetospheric Electric Fields (GA408).

N. C. Mehta, P. M. Banks: Ionospheric Solutions of the Current Continuity (GA417).

H. Maeda, T. Araki, K. Maekawa, T. Kikuchi: Transmission of Polar Electric Field to Low Latitudes (GA409).

Poster Session

J. R. Benbrook, E. A. Bering, W. R. Sheldon, C. R. Liles: High-Altitude Balloon Electric Field Measurements at Low L Values (GA415).

K. D. Cole, B. J. Watkins, L. L. Smith, E. Kleckner: Effect of Electric Fields on SAR-ARC (GA411).

Yu. A. Kopytenko, Yu. P. Novikov, O. M. Raspopov, E. E. Titova: The Determination of the Electric Field near the Plasmapause from the Data on Geomagnetic Pulsations and VLF Emission (GA412).

M. I. Pudovkin: Nature of the Electric Fields in the Magnetosphere and Ionosphere of the Earth (GA410).

R. G. Rastogi: The Response of the Equatorial Ionosphere to Polar Substorms (GA413).

C. S. Wang, J. S. Kim: Plasmaspheric Oscillations (GA414).

While the electric polarization field due to the dynamo action of tidal winds at thermosphere heights is reasonably well understood, at least in medium latitudes, the same is not true for electric fields of magnetospheric region. In particular, it is still not known how they penetrate to lower *L*-values or even to equatorial regions. In this session, evidence has been presented about a coupling between the equatorial electrojet and events within the auroral zones, or within the interplanetary medium (GA400; GA401; GA405). *Maeda* (GA409) made a theoretical study concerning the propagation of electric fields of magnetosphereic origin down to low *L*-values. *Blanc* (GA404) reported on observations at medium latitudes ($L=1.8$) during geomagnetic activity and associated the electric field measurements with auroral events. In a model of the electric convection field (GA408), it was shown that this field decays toward lower latitudes proportionally to $1/\sin^2\theta$ where

θ is the polar distance. In an interesting theoretical paper, *Southwood* (GA407), explained the shielding effect of the magnetosphere against the electric convection field in terms of the influence of the pressure of hot plasma on the field and currents.

In summary, the general global spatial and temporal structure of the electric fields of magnetospheric origin is reasonably well known. Their origin is only partly understood. Coupling to the equatorial regions is still an open question.

SIII1b HEAVY IONS OF IONOSPHERIC ORIGIN IN THE MAGNETOSPHERE (Convener: K. D. Cole)

August 27 a.m., Room: Kane 220, Chairman: R. G. Johnson

E. G. Shelley: Energetic Heavy Ions of Ionospheric Origin in the Magnetosphere (Invited review, GA418).

W. B. Hanson, M. E. Summers, P. Bythrow, R. A. Heelis: Vertical Fluxes of Heavy Ions Observed in the High Latitude Ionosphere by the Atmosphere Explorers (GA426).

R. Prange: Observation of Field Aligned Soft Ions in the Near Equatorial Ionosphere (GA424).

D. M. Klumpar: Accelerated Ionospheric Ions Within the High Latitude Ionosphere (GA425).

H. Balsiger, P. Eberhardt, J. Geiss, A. Ghielmetti, H. Rosenbauer, D. T. Young: Magnetospheric Ion Composition Between 0 and 16 KEV per Charge During Magnetically Quiet Periods ($K_p \leqq 2$) (GA421).

D. T. Young, H. Rosenbauer, J. Geiss, P. Eberhardt, H. Balsiger: Effect of Magnetic Disturbance on Ion Composition in the Magnetosphere (GA422).

R. G. Johnson, R. D. Sharp, E. G. Shelley: Observation of Ions of Ionospheric Origin in the Storm-Time Ring Current (GA419).

T. A. Fritz, W. N. Spjeldvik, B. Wilken: Megaelectronvolt Oxygen Ions: A Major Radiation Belt Constituent (GA428).

P. H. Smith, N. K. Bewtra, R. A. Hoffman: Inferences of Oxygen and Helium Ions in the Magnetosphere (GA420).

A. Roux, C. de Villedary, R. Gendrin, R. E. Horita: The Role of Proton Generated Hydromagnetic Waves on Helium Heating (GA423).

E. Ungstrup: A Theory for the Production of the Energetic Heavy Ions Observed in the Outer Magnetosphere.

W. N. Spjeldvik, T. A. Fritz: The Charge State Test for Sources of Radiation Belt Ions: An Analysis (GA429).

J. W. Freeman, T. W. Hill, H. K. Hills, P. H. Reiff, D. A. Hardy: Circulation Mechanisms Responsible for O^+ Ions in Remote Parts of the Magnetosphere (GA427).

It was evident from the papers presented and from the large audience at this session that investigations relating to the ionospheric origin of the hot magnetospheric plasma are receiving increased attention. Energetic (0.5–16 keV) ion composition results from the S3-3 spacecraft were presented which showed energetic O^+ and H^+ ions frequently streaming upward from the ionosphere at high latitudes during both magnetically quiet and active periods. The ionosphere also appears to be a major source of ions for the storm-time ring current. Large fluxes of O^+ ions were observed in the ring current with

the S3–3 satellite during the main phases of three geomagnetic storms. The O^+ number density exceeded the H^+ number density in the 0.5–16 keV range at $L=3$ to 4 for altitudes of 5000–7000 km.

Preliminary ion composition results in the 0–16 keV range were presented from the ion mass spectrometer aboard the GEOS satellite. Examples of energetic (0.1 to 16 keV) ion mass spectra showed the presence of H^+, He^+, He^{2+} and O^+ ions. The mass spectra for the thermal and near-thermal components (0–100 keV) showed unexpectedly large quantities of O^{2+} and He^{2+} ions. It was evident from the examples presented that an excellent set of data on the plasma composition in the equatorial regions is now being acquired.

Evidence was presented that upward streaming ions are originating at relatively low altitudes in the ionosphere. Observations on the ISIS-2 satellite showed ions with energies typically up to a few hundred eV moving upward in the pitch angle range 90° to 130°. Large vertical fluxes ($10^8\ cm^{-2}\ sec^{-1}$) of O^+ ions were reported from the Atmospheric Explorer satellites at high latitudes and at altitudes above 300 km.

From the ATS-6 satellite at geosynchronous altitude, ions heavier than helium ions (interpreted as oxygen ions), were found to be more abundant than both protons and helium at energies above 600 keV per ion. Enhancement of these ions during substorms was interpreted as evidence that the substorm process could energize ions to MeV energies.

The role of charge exchange processes in altering the composition of the energetic ion fluxes in the magnetosphere was presented in two papers. These processes appear to be important for both the inner and outer regions of the magnetosphere. Evidence for O^+ and He^+ in the recovery phases of magnetic storms, based on the charge exchange analysis of the total ion decay rates measured on the Explorer 45 satellite, was presented.

Theoretical models for accelerating ionospheric ions by an electrostatic ion cyclotron instability, for heating helium ions by proton-generated hydromagnetic waves, and for accelerating plasmaspheric ions at the dayside magnetopause were presented.

SIII1c THERMOSPHERIC AND IONOSPHERIC COMPOSITION CHANGES CAUSED BY MAGNETOSPHERIC PROCESSES (Convener: K. D. Cole)

August 27 p.m., Room: Kane 220, Chairman: H. A. Taylor

W. J. Raitt: Positive Ion Changes in the Thermosphere during Magnetic Storms (Invited review, GA430).

H. A. Taylor, Jr., J. M. Grebowsky, H. C. Brinton, L. Brance, R. Hoffman, B. H. Blackwell: Mid to High Latitude Ion Drifts and Associated Composition Changes (GA431).

V. S. Krishna, W. B. Hanson, E. L. Breig: Simultaneous Observations of High Latitude Ion Drift and Composition Changes (GA435).

J. D. Kelly, V. B. Wickwar: Changes in the Auroral Zone Ionosphere during Particle Precipitation and Joule Heating Events Observed with the Chatanika Radar (GA433).

L. V. Zelenkova: Changing of Neutral and Ion Compositions in the Lower High-Latitude Ionosphere during Ionospheric Disturbances (GA436).

Yu. I. Galperin, Yu. V. Lissakov, L. M. Nicolaenko, V. M. Sinitsin, V. L. Khalipov, J. Crasnier, J.-A. Sauvaud: Diffuse Auroral Zone and the Polar Cliff of the F-Region Main Trough-Coordinated Measurements (GA437).

Yu. A. Romanovskii: Neutral and Ion Composition Disturbance in the F2 Ionospheric Region during Magnetic Storm (GA439).

R. W. Spiro, R. A. Heelis, W. B. Hanson: Implications of the Penetration of the Magnetospheric Convection Electric Field into the Mid-Latitude Trough (GA434).

J. B. Reagan, R. C. Gunton, R. E. Meyerott: Ionospheric and Neutral Composition Changes During the Intense Solar Particle Events of August 1972 (GA432).

K. M. Kotadia: Winter Anomaly in the Disturbed Ionospheric F-Region (GA438).

This session concentrated upon mid to high latitude evidence of the effects of magnetospheric processes upon thermospheric and ionospheric changes.

Because the signatures of ionization depletions continue to be useful indicators of both dynamic and energetic consequences of magnetospheric influence upon the composition of ions and neutrals, considerable emphasis was placed upon the description and interpretation of trough-like structure observed in the atomic ions O^+, H^+, N^+, associated with abrupt enhancements in the heavier ions NO^+ and O_2^+.

Though not strictly a new observation, considerable support was given to the view that pronounced ionization depletions are often associated with enhancements and sharp reversals in the horizontal ion drift, consistent with earlier work suggesting the importance of drift enhancements in ion temperature and associated increases in the reaction rates involving losses in $n(O^+)$ through

$$O^+ + NO \rightarrow NO^+ + O$$

$$O^+ + O_2 \rightarrow O_2^+ + O$$

noted previously by Schunk and others.

Observations of horizontal ion drifts of the order of 1 km/sec were shown to be linked with enhancements in T_i of 1000°K or more, and with abrupt increases in $n(NO^+)$ of more than an order of magnitude. The picture of the drift-dynamic link between the magnetosphere and the composition was further detailed by results indicating a link between interplanetary magnetic field structure and polarity phasing and the modification of ion drift patterns and associated composition depletions and enhancements. Such a link would indicate the possibility of important changes in magnetosphere-ionosphere coupling as the character of the IMF changes during a solar cycle.

Further emphasis was given to the attempt to describe ionization trough-producing mechanisms, in the form of statements of the importance of soft electron precipitation in forming the rather steep poleward recovery in ionization, which forms the high altitude edge of the mid-latitude trough(s). Both satellite and ground-based radar results were cited, indicating the persistence of this magnetospheric input (or link) in affecting the trough-like composition change.

The scope of the session was further broadened by the discussion of the observed and calculated effects of solar-particle-event energy input for the modification of ion and neutral chemistry below 100 km. Pronounced changes in the water cluster ion composition and associated calculated changes in the concentrations of NO, O, and O_3 were shown to be linked with such magnetic storm effects.

Overall, the content of the session emphasized the dual importance of *dynamic and*

energetic processes either induced by, or linked with magnetospheric fields and particles as drivers of perturbations seen in the mid to high-latitude regions. While the effects of ion drifts and neutral winds are significant within the thermosphere-ionosphere system, the role of particles, both for producing ionization and for inducing important chemical and temperature changes was emphasized in this interesting session.

SIII 2 PLANETARY MAGNETOSPHERES — HOW DO THEY COMPARE? (Convener: C. F. Kennel; Co-convener: A. A. Galeev)

The purpose of this session was to put magnetospheres in the general context of cosmic plasma systems. Studies were emphasized in the comparison of the magnetospheres of Earth, Jupiter and Mercury, the solar wind interaction with Mars, the heliosphere and magnetospheres of radiogalaxies and neutron stars. The program planned for this 3 half-day session was as follows.

Part 1. August 30 a.m., Room: Kane 120, Chairman: W. I. Axford

W. I. Axford, H. U. Keller: The Heliosphere (Invited paper, GA440).
F. Busse: Planetary Magnetism (Invited paper, GA441).
G. L. Siscoe: Comparative Magnetospheres (Invited paper, GA442).
R. Sunyaev: Magnetospheres of Neutron Stars (Invited paper, GA443).

Part 2. August 30 p.m., Room: Kane 120, Chairman: G. Haerendel

J. R. Spreiter, S. S. Stahara, D. S, Chaussee, B. C. Trudinger: An Automated Computational Procedure for Calculation of Solar Wind Flow Aroun Planetary Magnetospheres (GA444).
C. T. Russell: Interaction of the Solar Wind with Mercury, Venus and Mars: The Varieties of Magnetospheric Experience (Invited paper, GA445).
R. H. Manka, F. C. Michel, J. W. Freeman, J. L. Benson, P. H. Reiff: Non-Magnetospheric Solar Wind Interaction: The Moon (GA446).
O. L. Vaisberg, V. N. Smirnov: Solar Wind Interaction with Martian Magnetosphere (Invited paper, GA447).
W. B. Hanson: Mars—Recent Viking Results (Invited paper, GA448).
K. I. Gringauz, M. I. Verigin, T. K. Breus, A. P. Remizov: Plasma Mantle in the Tails of the Martian and Earth's Magnetospheres (Invited paper, GA449).
Y. C. Whang: Model Magnetosphere of Mercury (GA450).
S. P. Christon, J. A. Simpson: Impulsive Acceleration of Charged Particles in the Magnetospheres of Mercury, Earth and Jupiter (Invited peper, GA451).

Part 3. August 31 p.m., Room: Kane 120, Chairman: A. A. Galeev

I. I. Alekseev: Energy Transfer into the Magnetosphere (GA452).
A. A. Galeev: Plasma Processes Important to Magnetospheric Physics (Invited paper, GA453).

G. Haerendel: Interaction of the Solar Wind with the Earth's Magnetosphere (Invited paper, GA454).
T. Saito, H. Oya, T. Sakurai: Three Types of Planetary Magnetospheres Classified by Dynamical Topology (GA455).
A. J. Dessler: Jupiter's Magnetosphere (Invited paper, GA456).
M. G. Kivelson, P. J. Coleman, Jr., L. Froidevaux, R. L. Rosenberg: Magnetic Signatures of Plasma in the Jovian Magnetosphere (GA457).
J. LeMaire: Impulsive Penetration of Filamentary Plasma Elements into the Magnetospheres of Earth and Jupiter (GA458).
A. Nishida, S. Machida: Transport of Heat in the Jovian Plasmasphere (GA459).
S. Shawhan: Radio Emission from the Planets (Invited paper, GA460).
H. Oya, A. Morioka: Effect of Turbulent Region of Interplanetary Magnetic Field on Jovian Decametric Radio Emissions from the Main Source (GA461).

SIII3a TIMING SUBSTORM EVENTS (Convener: C. T. Russell)

Part 1 (Timing Substorm Events). August 29 a.m., Room: Kane 220, Chairmen: J. L. Burch and E. W. Hones, Jr.

C. T. Russell: Introductory Remarks.
S.-I. Akasofu: The Onset of Magnetospheric Substorms (Invited paper, GA462).
R. J. Pellinen, W. J. Heikkila: Observations of Auroral Breakup (GA463).
G. Rostoker, J. V. Olson: The Use of Pi2 Micropulsations in the Timing of Substorm Onsets and Intensifications (Invited paper, GA464).
R. R. Heacock: Pulsation Signatures of Substorm Onsets (GA465).
T. Sakurai, T. Saito, H. Oya: Low-Latitude Pi2 Pulsations as a Sensitive Indicator of Substorm Onset (GA466).
B. L. Shirman, B. A. Undzenkov, V. A. Shapiro: Determining Substorm Onsets in Geomagnetic D-Perturbation Data (GA468).
I. Nielsen, R. A. Greenwald, W. I. Axford: Temporal and Spatial Developments in Radar Aurora Following Intense "Spikes" in Ionospheric Absorption (GA469).
A. Nishida: Development of the Magnetospheric Substorm (Invited paper, GA470).
E. W. Hones, Jr.: Some Initial Signs in the Plasma Sheet of Substorm Onset (GA471).

Akasofu presented an invited paper in which he stressed the need for a common definition of the substorm onset time ($T=0$). He showed a number of examples in which substorm onset times determined from magnetograms and Pi2 oscillations were preceded by the onset of auroral breakup. Then he showed an interesting TV movie of an auroral breakup and suggested that substorm onset time be determined from auroral observations. Pi2 oscillations can be important, in Akasofu's opinion, in obtaining the exact onset time if it is already known to an accuracy of about five minutes.

A paper by *Pellinen and Heikkila* presented observations of an auroral fading which occurs a few minutes before breakup. First noticed in ISIS photometer data when the satellite was spinning in a cartwheel mode, the phenomenon has since been observed in

all sky camera data, in 97 MHz auroral backscatter radar data, and in micropulsation activity. In a typical sequence, an arc moves southward, brightening steadily. Fading then occurs, followed by auroral breakup.

Three papers followed on the identification of substorm onset time by Pi2 oscillations. In an invited review, *Rostoker* asserted that when a Pi2 onset can be identified accurately, it will also be a good indication of substorm onset time. He stressed that, while substorms can be detected within about one time zone either side of a Pi2 observation point, these data, as well as all magnetometer data, respond to integrated effects of near and distant phenomena. Auroral imaging, if available, on an appropiate time scale will without doubt, be the best type of data for determining substorm onset. Contributed papers by *Heacock and Sakurai* demonstrated the value of Pi2 observations in determining substorm onset. While *Heacock* stressed the response of Pi2 activity to auroral features passing overhead, *Sakurai* suggested that low-latitude Pi2 observations can give global coverage, particularly if at least four stations, each separated by 90 degrees of longitude, are in operation.

Shapiro discussed the merits of the *D*-perturbation as an indicator of substorm onset. *D*-bays in the evening sector are positive and have constant form along a geomagnetic meridian. They are to be due mainly to field-aligned currents, so the substorm onset determined from them should be consistent with onset of particle precipitation from the outer magnetosphere.

Nielsen reported observations of very brief intense absorption of cosmic radio noise made with a high time resolution (about 1/4 sec) riometer having a narrow beam antenna. These absorption "spikes" occur near the onset of large negative magnetic bays. They probably signify very low localized intense ionization patches in the *D*-region and some have been correlated with brief intense pulses of electrons observed with the ATS-6 satellite.

Nishida reviewed evidence that a substorm involves reconnection of magnetotail field lines at a near-earth ($X_{SM} \sim -15\ R_E$) neutral line. A brief burst of energetic electrons ($E_e > 200$ keV) is observed at substorm onset by a satellite suitably located in the plasma sheet. This is thought to be due to acceleration by inductive electric fields at the neutral line. The evolution of intensity of the electron flux in the burst may signify the development of a closed magnetic loop structure in the plasma sheet.

Hones reported that substorm onset at earth coincides closely (within ~ 1 minute) with the following phenomena at $X_{SM} \sim -30 R_E$ in the plasma sheet: a) onset of tailward plasma flow; b) sharp enhancement of >200 keV electron flux; c) onset of brief (1–2 min.) northward excursion of tail magnetic fields. The energetic electrons are initially isotropic but ~ 5 to 10 minutes after substorm onset they start streaming tailward, indicating opening of magnetic field lines. These features suggest the formation of a closed magnetic loop structure, a "plasmoid", in the plasma sheet at substorm onset and its ejection from the tail a few minutes later.

Part 2. (Substorms, the IMF and Geomagnetic Activity). August 29 p.m.,
Room: Kane 220, Chairmen: S.-I. Akasofu and J. Feynman

K. Lassen, C. Danielsen: Quiet-Time Pattern of Auroral Arcs for Different Directions of the Interplanetary Magnetic Field in the Y-Z Plane (GA473).

C. R. Clauer, R. L. McPherron: On the Relationship of the Partial Ring Current to Substorms

and the IMF (GA474).

T. R. Sanderson, U. Fahleson, A. Gonfalone, B. Holback, R. Lundin, C. Reeve: The Timing of Substorms Associated with an Interplanetary Magnetic Field Sector Boundary Crossing (GA475).

T. Watanabe, T. Oguti, K. Hayashi, K. Tsuruda, R. E. Horita: Magnetic Pulsations and Auroral Displays during the Expansion Phase of a Substorm of September 18, 1976 (GA478).

M. N. Caan, D. H. Fairfield, E. W. Hones, Jr.: Geometry and Properties of Magnetic Reconnection Within the Plasma Sheet (GA480).

W. J. Heikkila, R. J. Pellinen and P. O. Welling: Energization of Charged Particles to High Energies by an Induced Substorm Electric Field Within the Magnetotail (GA482).

K. Maezawa, A. Nishida: Inferences of Solar Wind Velocity from Geomagnetic Indices (GA485).

J. Meyer, D. Damaske: Geomagnetic Evidence for Large Scale Magnetotail Current Systems (GA486).

R. Rajaram: On the Theory of the Polarity Independent Component of the Semiannual Variation (GA487).

B. N. Bhargava, G. K. Rangarajan: Sector Polarity of the IMF and Seasonal Variation in the Equatorial Magnetic Field (GA488).

E. I. Kataja: The Diurnal Variation of Magnetic Activity at Sodankylä (GA489).

Lassen and Danielsen examined one thousand auroral arcs observed by all sky cameras. They reported sun-aligned arcs developing which become the dominating system for greater positive IMF B_z. Differences in the systems of arcs also occurred according to the sign of the B_y component. *Clauer and McPherron* studied the relationship of the partial ring current to substorms and the IMF and found that individual case studies suggest the size of the partial ring current is better correlated with southward B_z than with substorm size. *Sanderson* reported on substorms occurring during periods of southward B_z using data from ground-based magnetometers and rocket flights. *Watanabe* examined the morphology of micropulsations as observed by their observatory network over central Canada during a substorm event on September 18, 1976. They suggested that an injection of plasma pushed the field lines causing the observed Pi1 and Pi2 pulsations.

Plasma flows and magnetic field B_z observations in the tail at about 25 to 30 R_E using IMP 6 data were discussed by *Caan et al.* They found periods of extreme southward dipping of the tail field associated with anti-earthward flows. However, tail events were observed containing both sunward and anti-sunward flows for both northward and southward fields. Periods of large variation of field orientation and small field magnitude were associated with strong flows.

Heikkila described the results of a model calculation of energization of protons to at least 1 MeV in the magnetotail. A growing disturbance in the neutral sheet was used to calculate perturbation magnetic and electric fields. The most efficient energizing mechanism is a two step process, with an initial linear acceleration along a neutral line up to moderate energies followed by betatron acceleration.

Maezawa and Nishida used AL and AU indices to infer solar wind velocities. They found that the correlation coefficient between 3 hourly values of AL/AU and the solar wind velocity was 0.6. From this they estimate the daily values of the wind velocities during the presatellite era, back to 1959. *Meyer and Damaske* modelled the earth's magnetic field by using a superposition of the core field and the field due to the magnetotail current system. They found that there should then be a 12 month variation in geomagnetic

activity in each hemisphere. They found such a variation in both the K_n and K_s indices. The phase differed from that expected from their model by a few days, which they suggested was due to the aberration of the solar wind which had been neglected.

Bhargava and Rangarajam, reporting on an analysis of 17 years of data from equatorial magnetic stations found a seasonal variation which was dependent on the direction (toward or away from the sun) of the interplanetary magnetic field. *Rajaram* examined the Kelvin-Helmholtz instability at the magnetopause as a cause of the semiannual variation of geomagnetic activity, and *Kataja* reported on the diurnal variation of geomagnetic activity at Sodankylä. The most disturbed period is local midnight and the quietest time is between 0900 and 1000 LT.

SIII3b RAPID AURORAL FLUCTUATIONS AND ASSOCIATED PHENOMENA (Convener: C. T. Russell)

Part 1. August 31 a.m., Room: Kane 220, Chairmen: T. N. Davis and T. J. Rosenberg

T. Oguti: Observations of Rapid Auroral Fluctuations (Invited paper, GA491).

H. C. Stenbaek-Nielsen, T. J. Halliman, T. N. Davis: Pulsating Auroras Observed with a Stereo-TV System (GA492).

F. T. Berkey, N. R. Parsons: Time Sequence Analysis of Flickering Auroras; Auroral Brightness Fluctuations in Quiet Auroral Features; Wave Motion Near the Equatorward Boundary of the Auroral Oval (GA493, 494, 495).

W. H. Campbell: A Review of the Association of Geomagnetic Field Fluctuations with Auroral Luminosity (Invited paper, GA497).

R. Gendrin, S. Perraut, F. Glangeaud, G. Weill: Substorm Forerunners (GA498).

T. Oguti, T. Watanabe, K. Tsuruda, D. Hayashi, R. E. Horita: Magnetic Pulsations During a Recovery Phase of a Substorm (GA500).

A. M. Lyatskaya, W. B. Lyatsky, Yu. P. Maltsev: Two kinds of Current-Precipitation Interaction (GA501).

F. Küppers, J. Heller: Geomagnetic Pulsations in the Auroral Zone for Frequencies from 1.5 to 5 mHz (GA502).

Oguti began the session by presenting the view that there are many varieties of deformational changes in auroras, a fundamental deformation being the splitting apart and subsequent folding of active arcs. Along with the presentation of examples of auroral deformations in television data, Oguti showed an example of close correlation between groups of auroral pulsations and VLF chorus. *Stenback-Nielsen* presented determinations of auroral heights and vertical extents using a stereo-TV system with a 10 km baseline. Their results indicate that pulsating auroral forms are lower than concurrently existing non-pulsating forms and that at least some pulsating auroras have extremely limited height extent, perhaps so limited as to be unexplainable by precipitation of even monoenergetic electrons.

Berkey described his work with *Parsons* on a new technique for obtaining spectral information from imaging data on auroras. They find quasi-periodic variations of 7 to 10 sec. period in the diffuse background auroral emission during the substorm recovery phase. In flickering aurora, they report that the main power in the fluctuation is in the range 8 to 12 Hz, a somewhat broader range than reported earlier.

An invited review by *Campbell* traced for over 100 years the interesting observational history of the association between variations in auroral luminosity and the geomagnetic field. This and other papers and related discussions stressed the need for continuing and improving upon simultaneous observation of auroral fluctuations and related phenomena.

Gendrin reported apparent substorm forerunners observed in auroral and VLF emissions and in ULF magnetic variations which were observed at an auroral zone station between local times 1700–2300. Tentatively, they identified these forerunners, ranging from 10 to 25 minutes, as indicating onsets of activity elsewhere. *Watanabe* described observations of magnetic pulsations at an array of stations in Canada. For fluctuations of a few tens of seconds period they found correlated wave forms at stations up to several hundred kilometers apart, but not so for the shorter period fluctuations. *Lyatskaya* suggested two instability mechanisms involving the effects of ionospheric currents on particle precipation which would cause spatially periodic precipitation structures and geomagnetic pulsations with periods 1–5 minutes. Finally, *Küppers and Heller* reported on observations of long-period magnetic pulsations using a dense array of stations in Scandinavia.

Part 2. August 31 p.m., Room: Kane 220, Chairmen: V. A. Troitskaya and W. R. Sheldon

G. K. Parks: Microburst Precipitation Phenomena (Invited paper, GA503).

G. H. Nakano, W. L. Imhof, J. B. Reagan: Coherent Microburst Electron Precipitation Measured from a Satellite (GA504).

H. Trefall, D. J. Williams: Time-Structure of Post-Midnight Energetic Electron Precipitation (GA505).

J. C. Foster, G. S. Stiles, J. R. Doupnik: Fast E-Region Density Modulation Associated with Pulsating Aurora (GA506).

F. S. Mozer, E. G. Fontheim: Low Altitude Particle Acceleration Region Deduced from Time-Dependent Observation of Auroral Structures (GA507).

T. J. Rosenberg, K. Marthinsen, J. A. Holtet, A. Egeland, D. L. Carpenter: Evidence of the Common Origin of Electron Microbursts and VLF Chorus (GA509).

H. Leverenz, J. L. Roeder, W. R. Sheldon, E. A. Bering, J. R. Benbrook, J. Lavergnat: Correlative Effects of VLF Chorus Activity and Electron Precipitation near the Plasmapause (GA510).

E. A. Bering, T. J. Rosenberg, D. Detrick, J. R. Benbrook, D. L. Matthews, W. R. Sheldon: Some Aspects of the Interrelationship of Magnetospheric Substorm Associated Particle Precipitation and Thunderstorm Electric Fields (GA511).

K. Tsuruda, T. Oguti, K. Hayashi, T. Watanabe, R. E. Horita, S. Kokubun: VLF Hiss and Auroral Activities in the Auroral Zone (GA512).

K. Hayashi, K. Tsuruda, S. Kokubun, T. Oguti, R. E. Horita, T. Watanabe: Arrival Direction of VLF Emissions and Corresponding Activities in Aurora and Geomagnetic Pulsations (GA513).

Yu. V. Golikov, N. G. Kleimenova, G. I. Korotova, A. M. Soroka, E. E. Titova: The Relationship Between Auroral Hiss, Pi2 Geomagnetic Pulsations and Aurora (GA514).

O. M. Raspopov, I. N. Kapuskin, V. S. Smirnov: The Modulation of the Emission of the Combination Frequencies by the Geomagnetic Pulsations (GA516).

A. M. Novikov, Yu. G. Shafer, R. F. Zhdanov: Small Scale Spatial Inhomogeneities in X-ray Fluxes in Auroral Structure (GA553).

The second half of this session, which concentrated on experimental investigations (ground-based, balloon, rocket, and satellite) of small-scale auroral zone phenomena, began with a review of X-ray microburst observations by *Parks*. The session included discussions of pulsating aurorae and electron precipitation in conjunction with geomagnetic pulsations, VLF chorus, VLF hiss and thunderstorms. Apparently new results included *Foster*'s report on density variations in the lower ionosphere induced by pulsating aurorae and *Bering*'s report on the relationship of thunderstorm activity to electron precipitation. One paper was transferred from SIII 3d, i.e. "Small-Scale Spatial Inhomogenities in X-ray Fluxes in the Stratosphere", by *Novikov, Shafer and Zhdanov*. One paper included a great deal of information not in the abstract: *Smirnov* reported the results of an active experiment where a ground-based 3.5 MHz transmitter operating at 9.5 MW was beamed vertically and modulated at 2.5 kHz; the induced VLF (2.5 kHz) from the ionosphere above the transmitter was observed by a receiver 80 km from the transmitter.

The session seemed to be remarkably free of instances where the oral presentation served to increase the entropy of the abstract.

SIII3c ELECTROMAGNETIC AND ELECTROSTATIC INSTABILITIES ON AURORAL FIELD LINES (Convener: C. T. Russell)

September 1 a.m., Room: Kane 220, Chairmen: M. Ashour-Abdalla and D. J. Southwood

M. C. Kelley: Observations of Electrostatic Waves on Auroral Field Lines (Invited paper, GA519).

M. Ashour-Abdalla, C. F. Kennel, R. M. Thorne: Cyclotron Harmonic Instabilities as a Cause of Diffuse Ion and Electron Aurora (Invited paper, GA521).

D. A. Gurnett: Observations of Electromagnetic Waves on Auroral Field Lines (Invited paper, GA522).

M. L. Kaiser, J. K. Alexander: Observational Characteristics of Terrestrial Kilometric Radiation (GA523).

J. L. Green, D. A. Gurnett: A Determination of the Polarization of Terrestrial Kilometric Radiation (GA524).

J. Maggs: Theory of Electromagnetic Waves on Auroral Field Lines (Invited paper, GA525).

D. Jones: Significance for Terrestrial Kilometric and Jovian Decametric Radiations of Convective Beam Amplification of Waves (GA526).

P. Palmadesso: Computer Simulations of Processes on Auroral Field Lines (Invited paper, GA528).

E. Ungstrup, W. J. Heikkila, D. Klumpar: Acceleration of Ions by Electrostatic Ion-Cyclotron

Waves in the Lower Protonosphere (GA529).

T. J. Hallinan, H. C. Stenbaek-Nielsen, J. R. Winkler: The Echo IV Electron Beam Experiment: Television Observation of Artificial Auroral Streaks Indicating Strong Beam Interactions in the High Latitude Magnetosphere (GA530).

Kelley's review emphasized electrostatic phenomena detected at relatively low altitude. Magnetospheric flow turbulence, found to have a power law spectra with a break near auroral scale wavelength, ionospheric instabilities due to the neutral atmosphere interacting with convection, and lastly Ba release data and S3–3 data in the region of $\sim$6000 km altitude showing evidence of shock/soliton structure were described. *Ashour-Abdalla* reviewed electron and ion cyclotron electrostatic turbulence as a candidate to explain diffuse aurora. Crucial in the theory is the cold electron temperature $\sim$100 eV on auroral field lines at the equator. Experimental evidence is still lacking. *Gurnett* then reviewed auroral hiss, narrow band ELF emissions near 200–300 Hz seen in conjunction with it, and auroral kilometric radiation. The ELF noise is associated with inverted V events as is the VLF noise. The source of upgoing hiss remains a question.

Terrestrial kilometric radiation (TKR) was taken up by *Kaiser*. Using RAE–2 and IMP–6 data, he noted that the earth has an active hemisphere (15–03LT). There is a three order of magnitude change in power with increased activity. Sources at times can be 20 R_E in altitude.

Green noted continuum radiation cutoff at the local plasma frequency close to the upper cutoff of auroral hiss while TKR commonly exhibits a cutoff of f_e suggesting *R-X* mode propagation. No cutoff is seen in local evening which he interpreted as indicating closeness to the source.

Maggs discussed a variety of beam generated waves. Commonly theoretical TKR generation mechanisms involve generation of electrostatic modes then conversion to electromagnetic waves. Maggs reviewed theories emphasizing a quiet and disturbed arc model. In the quiet model the whistler and UHR noise is generated but the beam is little disturbed. In the strong model the beam is strongly modified and solitons can form and radiate.

Jones reported on TKR and Jovian decametric radiation. He presented a common mechanism which involves wave-wave interactions. Briefly, Jones found that by allowing the waves to propagate on iso-ionic surfaces, (and since their group velocity is small), the conditions for growth were optimal.

Palmadesso presented results from a numerical simulation. He argued that analytical solutions were difficult and thus one was forced to go to computer simulation. He discussed the oscillating two stream instability, the anomalous resistivity effects and beam driven whistle turbulence (the anomalous cyclotron resonance instability).

Ungstrup pointed out that the ISIS-2 observation of dense field-aligned beams of electrons in regions of low density plasma imply that the topside ionosphere is unstable to the electrostatic ion cyclotron instability at altitudes $\sim$500–1000 km. He suggested that the field-aligned beams of oxygen observed on S3–3 were due to the fact that the O^+ ions would go unstable first, and then be accelerated by $E_{\parallel}$.

Stenbaek-Nielsen reported on the Echo IV rocket borne electron accelerator. Some beams were injected so as to magnetically mirror in the southern hemisphere and to precipitate into the atmosphere in the northern hemisphere. These did not produce visible

streaks. Different width streaks in the TV image were observed for downward injected beams. The difference in width did not appear to be due to any experimental effect and the cause of the anomalous broadening is still unknown.

SIII3d MECHANISMS FOR FORMATION OF AURORAL STRUCTURES (Convener: C. T. Russell)

Part 1. September 1 p.m., Room: Kane 220, Chairmen: R. Carovillano and B. Hultqvist

T. N. Davis: Observed Microstructure of Auroral Forms (Invited paper, GA531).
H, Anderson: Birkeland Currents and Auroral Structure (Invited paper, GA532).
F. S. Mozer: Relationships of Electric Fields to Auroral Forms (Invited paper, GA533).
J. L. Burch, J. D. Winningham: The Relationship of Particle Precipitation to Auroral Forms (Invited paper, GA534).
S. B. Mende: Photometric Investigation of Precipitating Particle Dynamics (Invited paper, GA535).
C.-G. Fälthammar: Generation Mechanisms for Magnetic-Field-Aligned Electric Fields in the Magnetosphere (Invited paper, GA537).
G. Atkinson: Auroral Currents and Auroral Arcs (Invited paper, GA546).
D. W. Swift: Acceleration Mechanisms for Auroral Electrons (Invited paper, GA538).
J. S. Levine, D. B. Ilic, F. W. Crawford: Laboratory Observations of Plasma Double Layers (GA539).

The present status of the quickly developing research field concerning the microstructure of the aurora was reviewed by *Davis*. Whereas progress is being made in the understanding of features associated with velocity shear, the pulsating aurora and the black aurora are not at all understood at present.

Birkeland currents show many different geometries with the upgoing current being located sometimes at the edges and sometimes in the center of an arc. The upgoing current has been found to be on the equatorward side in some events and on the poleward in others. *Anderson* reviewed this field and reported that simple current sheet geometries have also been found in complex auroral break-up situations.

Mozer reported on his measurements of electrostatic fields on the S3–3 satellite in the altitude range of 2000–8000 km. He has now seen many more narrower so-called shock regions than he had reported earlier, which, when projected down to auroral heights, had horizontal dimensions of hundreds of meters and which he thought gave rise to auroral arcs in the atmosphere. He also reported that the very high parallel electric field values were not representative for his measurements.

The relations between rocket and satellite observations of auroral particles was discussed by *Burch*, who concluded that most but not all inconsistencies are now resolved. For the future we need higher time resolution on satellite experiments and more sounding rocket measurements of high accuracy and completeness.

Mende reported on ground-based photometric observations of sub-visual and visual

auroras and relationships between auroral features and magnetospheric properties. Subvisual auroras are shown in the 6300 Å line to be essentially a continuous feature of the auroral zone and correspond to soft electron precipitation from the plasma sheet. Hard electrons are shown in the 4278 Å line and relate to more intense arcs superposed in the diffuse aurora. These arcs intensify at times of particle injection events observed in conjuncy on the ATS-5 satellite. Recent data in the all-sky format was shown on the new TV color system.

Fälthammar reviewed theories in the generation of field-aligned currents in the magnetosphere. Processes discussed included the collisionless thermoelectric effect; magnetic mirrroring (which may be important at times of large Birkeland currents); and the formation of double layers. The latter process seems to have the most promise for generating large parallel electric fields ($\simeq$0.25–0.50 V/m) as observed by *Mozer*.

Atkinson reviewed theories of auroral arc formation from magnetospheric electric fields and particles. A fundamental point of each theory is specification of the driving force required to energize auroral particles and to drive the observed electric fields. No current theory is fully satisfactory in explaining observations. *Atkinson* discussed the conditions to be satisfied by the electric equipotentials in arcs with a finite east-west extent and showed several possible configurations; these are independent of the parallel electric field or finite conductivity. Meridional cross-sections exhibited the usual V-shaped potentials but the east-west fields varied along the arc. In all cases, the convective flow was toward a lower magnetic stress lending to the new conclusion that arcs are the direct result of energy transfer from magnetic field to plasma at boundaries between sheared magnetic field. This appears to be a general process and is an alternative energy source to merging. It occurs in any magnetized plasma in which the conductivity becomes finite locally.

Swift reviewed theories on acceleration mechanisms of electrons that would produce structured auroral forms. Basic properties of current-driven laminar electrostatic shocks in a magnetized plasma were discussed, including double-layers, oblique shocks, and V-shocks, and applications made to the magnetosphere.

Levine presented results on the generation of stationary double-layers in collisionless laboratory plasmas in the absence of a magnetic field.

Part 2. September 2 a.m., Room: Kane 220, Chairmen: R. Arnoldy and P. Reiff

W. Lennartsson: On Space Charge Effects Associated with the Magnetic Mirroring of Auroral Electrons (GA541).

T. Sato: Theory of Conjugate Auroral Arcs (GA544).

A. Hruska: Magnetic Field-Aligned Electric Currents and Fields in the Magnetosphere and Precipitation of Particles (GA545).

B. Hultqvist, H. Borg: Observations of Energetic Ions in Inverted V Events (GA546).

L. R. Lyons, R. Lundin, D. S. Evans: Well-Defined Relations Common to Three Rocket Flights over Discrete Auroral Arcs (GA547).

K. Stasienicz, W. G. Fontheim and R. A. Hoffman: Characteristic Properties of Auroral Electron Precipitation Spectra (GA548).

A. D. Johnstone, J. J. Sojka, D. A. Bryant, D. S. Hall: Particle Fluxes at High Altitudes over an Auroral Arc (GA549).

P. B. Dusenbery, P. L. Kaufmann: Electrostatic Wave Instabilities in an Auroral Plasma (GA550).

A. Miura, T. Sato: Shear Instability and Rotational Deformation of Auroral Arcs (GA551).

W. L. Imhof, J. B. Reagan, E. E. Gaines: Fine Scale Spatial Structure in the Pitch Angle Distributions of Energetic Particles near the Midnight Trapping Boundary (GA552).

R. Arnoldy: The Relationship between Field-Aligned Current Carried by Suprathermal Electrons and the Auroral Arc.

This session was an interesting assortment of contributed papers on auroral structures, in contrast to the review papers in Part 1. The papers divided easily into experimental and theoretical. However, good balance was maintained as the theoretical papers compared their results with experimental data and the experimental papers tried to fit their data into theoretical framework.

Lennartsson emphasized the importance of the mirror force on self-consistent models of particle fluxes, currents and potentials on auroral field lines. In some cases, the problem was overspecified and could only be solved by introduction of discontinuities in the electrostatic potential resembling double layers. *Sato* presented two theoretical papers—one concerned with the overall system of field-aligned currents in conjugate arcs, and one, with *Miura*, dealing with the growth of "curls" in auroral arcs. In both cases he was able to match observations given reasonable assumptions on local electric fields. He emphasized that numerical integration gave an effective viscosity about a factor of five lower than quasilinear theory. *Hruska* used Chen-Goldberger-Low theory, adding cold plasma to obtain strong localized $E_{\parallel}$'s. *Dusenbery and Kaufmann* showed that even at low (250 km) altitudes, the observed electron distribution was unstable to upper-hybrid waves with a wavelength of ~ 1 m and a growth time of 0.02 second.

The experimental papers presented not only electron, but ion observations in auroral arcs. *Hultqvist and Borg* showed that strong field-aligned 6-kev ion fluxes occur at the edges of arcs, isotropizing near the center. They interpreted this finding as evidence for a possible downward parallel electric field caused by electron bombardment above the satellite altitude (1000 km). A similar result was presented by *Johnstone et al.*, who showed anticoincidence between ions and electrons except in the center of a strong arc where ions were observed at the same time the electron peak was flattened.

Electron observations in arcs were led off by *Arnoldy*, who showed that the largest field-aligned current carried by (10 ev to 25 kev) suprathermal electrons reside near the edges of auroral arcs. The current in the center was reduced due to backscattered electrons. In a comment, *Evans* pointed out the currents due to particles below 10 eV could still be an important correction. *Lyons* showed an interesting result—that the electron energy flux, which should be proportional to IV, the electron flux times the potential drop, was actually proportional to V^2, implying a linear relationship (and probably a caused relationship) between I and V. The constant of proportionality was higher inside the arc than just north of it, perhaps showing higher resistivity along the auroral field lines. *Fontheim* presented preliminary results of fitting auroral electron spectra to several superposed distribution functions. He confirmed *Burch*'s result that electron heating occurs in auroral acceleration regions. Lastly, *Imhof, Reagan and Gaines* showed that the —40 kev "anistropy boundary" so often used as the limit of closed field-lines actually spans a range of L-shells, with higher rigidity particles isotropizing at lower L-shells than lower rigidity particles. At each energy, fluxes at the isotropy boundary were about a factor of two higher than the trapped fluxes just equatorward.

QMM QUANTITATIVE MAGNETOSPHERIC MODELS (Convener: W. P. Olson)

A half-day session was held as shown below, under the leadership of the IAGA Working Group III-3 on Quantitative Magnetospheric Models. This Working Group has the following aims: (1) to maintain up to date listing of existing available quantitative magnetospheric models; (2) to communicate information related to data sets useful for the development of empirical models and the testing of quantitative models; (3) to provide a standard set of procedures that can be used to test the accuracy of quantitative magnetic and electric field models with respect to desired magnetospheric features; (4) to make recommendations concerning the content of features to be included in future models; (5) to document problems of model makers and model users.

August 27 a.m., Room: Smith 120, Chairman: W. P. Olson

W. P. Olson: An Overview of the Quantitative Magnetospheric Modeling Problem (QMM1).

S. S. Stahara, J. R. Spreiter: Development of Computational Procedures for Routine Calculation of Solar Wind Flows Around Planetary Magneto/Ionospheres (QMM3).

G. K. Mukherjee, R. Rajaram: Motion of Charged Particles in the Mead-Fairfield Magnetic Model (GA684, QMM4).

H. Volland: Models of Global Geoelectric Fields (QMM5).

M. Harel, R. A. Wolf: Model Calculation of Electric Fields in the Magnetosphere (QMM6).

K. A. Pfitzer, W. P. Olson: Summary of MDAC Quantitative Models (QMM7).

C. T. Russell: Coffee Break (QMM8).

M Candidi: Possible Model Inputs from GEOS Experiments.

G.-H. Voigt: Is It Necessary to Incorporate the Interplanetary Magnetic Field into Quantitative Magnetospheric Models? (QMM11).

J. C. Kosik: Testing and Modelling the Magnetosphere with Active Experiments (QMM12).

E. C. Whipple, Jr.: Modeling of the Low-Energy Particle Environment at and near Geosynchronous Orbit.

H. B. Garrett: Joint AF/NASA Efforts in Modeling the Geosynchronous Environment.

H. I. West, Jr., R. M. Buck, M. G. Kivelson: On the Configuration of the Magnetotail near Midnight during Quiet and Weakly Disturbed Periods (QMM15).

J. Birn: Selfconsistent Quantitative Model of the Quiet Magnetotail in Three Dimensions.

At the QMM session, two new magnetic field models were presented (*Voigt*—which includes coupling with the interplanetary magnetic field and *Olson and Pfitzer*—which includes tilt effects and is more accurate than their 1974 model). *Sugiura* presented a new test for magnetic field models. (His ΔB contours have been one of the best tests in the past—which he now claims most models comply with.) The new parameter is ΔI, the angle between the dipole (main) field and the total field (including the contribution from the magnetospheric currents). In the tail region ΔI is observed to be especially large. However, most models at present do not produce ΔI contours similar to observations because the observed field is more "tail like" even during quiet times than the models suggest.

Two papers were presented on electric field models (*Volland* and *Harel*) and two were

presented on charged particle models (*Whipple* and *Garrett*). Thus the magnetic field is no longer the center of attention in the quantitative modelling community.

LSR-III LATEST SIGNIFICANT RESULTS SESSIONS OF DIVISION III (Convener: C. T. Russell)

Since so many papers for different subjects were submitted to LSR-III, the following five sessions were held after classifying all the contributed papers, i.e.

α. S3-3 Measurement, VLF and Particle Precipitation.
β. Currents and Electric Fields.
γ. Magnetic Pulsations, I.
δ. Magnetic Pulsations, II.
ε. Active Experiments, Radar and Radio Auroral Studies.

The reports for these five sessions are summarized below separately.

α. S3-3 MEASUREMENT, VLF AND PARTICLE PRECIPITATION.

August 25 a.m., Room: Kane 220, Chairman: C. T. Russell

C. T. Russell: Introductory Remarks.

J. F. Fennell, P. F. Mizera, D. R. Croley: Auroral Particle Distributions at High and Low Altitudes (GA124).

P. Mizera, J. F. Fennell, A. L. Vampola: Correlated Charged Particle and Electric Field Measurements (GA125).

A. Ghielmetti, E. G. Shelley, R. G. Johnson, R. D. Sharp: The Morphology of Upward-Flowing Field-Aligned Energetic Ion Fluxes (GA126).

J. B. Cladis, R. D. Sharp: Distribution of Electrostatic Potential Along Magnetic Field Inferred from Observations of Electron and Ion Fluxes (GA127).

Y. T. Chiu, M. Schulz: Formation of the Ionospheric Trough as a Result of Self-Consistent Particle and Parallel Electrostatic Field Distributions in the Auroral Region (GA128).

E. G. Shelley, R. D. Sharp, R. G. Johnson: Observations of Ions of Solar Wind Origin in the Inner Magnetosphere (GA129).

W. A. Kolasinki, P. F. Mizera, J. F. Fennell: Charged Particle Measurements from the S3-3 Satellite: Aerospace Experiment (GA130).

N. G. Kleimenova, Yu. P. Novikov, N. A. Smirnova, J. M. Holtet: The Spectral Changing of VLF Chorus During Substorm Development (GA132).

A. V. Zakharov, N. F. Pisarenko, N. I., Fedorova (presented by Y. I. Galperin): Energetic Electrons' Diffusion in the Plasmasphere as a Result of their Interaction with Cyclotron Waves (GA134).

J. Etcheto, M. Petit: Preliminary Results from GEOS Resonance Sounder.

A. Pederson, A. Gonfalone, R. Grard: First Results from the DC Electric Field Experiment on the ESA/GEOS Satellite.

I. B. Iversen, M. M. Madsen, S. Ullaland, K. Brømstad, J. Bjordal: Electric Field and X-ray Measurements with Balloons during a Magnetic Storm.

M. Mambo, I. Nagano: The Electron Density Profile in the Lower Ionosphere by VLF Observation on the Ground (GA136).

V. N. Alexeyev, Yu. A. Nadubovich: Background 6300 Å Emission Luminescence in Subauroral Regions (GA137).

G. G. Shepherd, J. D. Winningham, F. E. Bunn, F. W. Thirkettle: Empirical Dependence of 6300 Å Emission Rate on Electron Energy and Energy Flux in Aurora (GA138).

V. P. Samsonov, V. A. Velichko, V. G. Vasilyeva: Variations of Auroral Altitudes in Some Emissions as a Function of Latitude and Substorm Phase (GA140).

The session began with a review of the S3–3 mission by *Fennell*. The spacecraft with an apogee of 800 km and an inclination of 97° has a comprehensive set of particles and field experiments. This orbit has never before been explored with such instrumentation and the results were quite surprising. *Fennell* also discussed the ion beams observed coming out of the ionosphere by the Aerospace instruments. *Mizera* followed with a summary of the correlations between intense electric field structures and these ion beams. *Ghielmetti* discussed some of the Lockheed electron and ion mass spectrometer data. Large fluxes of H^+ and O^+ ions are frequently found streaming out of the ionosphere with energies of up to 16 kev.

Cladis attempted to model the electric potential distribution along field lines responsible for these beams. He finds a rather smooth potential distribution and does not infer the presence of double layers. *Chiu* described a joint model with *Schulz* of a self-consistent particle and parallel electric field distributions that was consistent with the ionospheric trough and the S3–3 results. As if not to leave the impression that the magnetosphere was filled with ions of ionospheric origin, *Shelley* presented evidence of He^{++} ions of solar wind origin at L-values as low as 5.5. The above papers were presented in a poster session together with a montage of the low energy charged particle measurements. Many of those present then went to the poster session and questioned the S3–3 experiments in depth.

The second half of the session began with a paper by *Kleimenova et al.* who showed evidence for an increase of the high frequency limit of VLF chorus during substorm development and suggested that this indicated an inward motion of the chorus generation region. *Galperin* then presented results of *Kakharov and colleagues* obtained on Intercosmos 5 and Cosmos 348. The spectrum of precipitating electrons was found to contain a peak whose energy was a function of L-value from $L=2$ to 4.5 and which corresponded to a VLF noise maximum. *Petit* followed with a presentation of the first results of the ƆEOS resonance sounder. They find resonances up to the 29th harmonic of the electron gyro-frequency, Bernstein mode resonances and oblique echoes. A theoretical discussion of the determination of the electron density profile by VLF observations on the ground was then presented by *Mambo*.

The next part of the program discussed auroral emissions. *Nadubovich* reported on the background 6300 Å emissions observed in North Yakutia. *Shepherd* discussed the empirical dependence of 6300 Å emission rate on electron energy and energy flux in aurora. He finds that 0.06 to 0.3 kev fluxes correlate best with 6300 Å. *Samsonov* discussed the variation of auroral altitudes with substorm phase.

In a second paper on initial GEOS results *Pederson* discussed the measurements with

the electric field experiment. Under the proper plasma conditions he feels the experiment is working properly. He readily measures ULF waves. Often he sees turbulent fields and sometimes "supercorotation" fields past dusk. Finally *Iversen* reported on balloon measurements of electric fields and X-rays during a magnetic storm.

The general consensus after the meeting was that the combination of short papers on the S3-3 results and their more detailed exposition in the following poster session was a great success. The fact that the poster session ran in parallel to the end of the oral presentations was regrettable, but the topical diversity of the two parts of the program avoided serious inconvenience to the participants. The authors were, in fact, quite pleased with the results of the experiment with the poster session. Even though there were fewer in attendance at the poster session than at the oral presentations, the authors knew that their work had been exposed to a wide audience in the oral sessions and that these were the people who were really interested in their work.

β. CURRENTS AND ELECTRIC FIELDS

August 25 p.m., Room: Kane 220, Chairmen: G. Atkinson and N. U. Crooker

H. W. Kroehl, A. D, Richmond, Y. Kamide: Magnetic Potential Patterns in the Northern Hemisphere During the Storm of 26–28 March 1976 (GA144).

R. A. Greenwald, E. Nielsen: Radar Auroral Flow Associated with the Harang Discontinuity (GA145).

F. Küppers, W. Baumjohann, J. Untiedt, W. D. Pelster: The North-Scandinavian Magnetometer Array with Station Spacings Less than 200 km (GA146).

W. Baumjohann, G. Gustafsson, F. Küppers: Large-Amplitude Rapid Magnetic Variations during a Substorm (GA148).

J. Wilhjelm, E. Friis-Christensen, T. A. Potemra: Relations between Ionospheric and Field-Aligned Currents in the Dayside Cusp (GA149).

T. Iijima, R. Fujii, T. A. Potemra: Field-Aligned Currents in the Southern Dayside Cusp Observed by Triad (GA150).

T. Iijima, T. A. Potemra: Statistical Characteristics of Field-Aligned Currents in the Harang Discontinuity during Substorms (GA151).

B. Theile: Interpretation of Magnetic Field Data in Terms of Field-Aligned Currents (GA153).

M. Sugiura, T. A. Potemra: A Field-Aligned Current Model Consistent with Triad Magnetometer Data and with Electric Field Observations (GA155).

J. K. Walker, J. A. Koehler, I. Robertson, A. Sil, A. Vallance Jones: Field-Aligned Currents and Instability Regions above Auroral Arcs (GA156).

D. M. Klumpar: Relationships between Particle Fluxes and Magnetic Field Perturbations Associated with Field-Aligned Currents (GA157).

N. A. Saflekos, T. A. Potemra, W. K. Peterson, J. P. Doering: Simultaneous Observations of Transverse Magnetic Distrubances and Auroral Electron Precipitation from the Triad and AE-C Spacecraft (GA158).

K. Kawasaki, J. D. Winningham, J. R. Burrows, G. Rostoker, J. Kisabeth: Field-Aligned Current Flow near the Dusk Meridian Associated with the Eastward Auroral Electrojet (GA159).

J. D. Winningham, K. Kawasaki, G. Rostoker: Definition of Electrojet Borders and Field-Aligned Currents Using Energetic Electron Spectra (GA160).

J. H. Allen, C. C. Abston, L. D. Morris: Provisional AE(7) Indices for 1976 (GA161).

J. Solomon: A Simple Model for the Convection of Electrons during the Recovery Phase of a

Substorm: Consequences with Respect to the Energy and Pitch-Angle Distribution Functions (GA163).

M. Harel, R. A. Wolf, H. K. Hills: Model Calculation of Magnetospheric Convection Including Precipitation and Time-Dependent Magnetic Fields (GA164).

Yu. I. Galperin, V. A. Gladishev, N. V. Jorjio, R. A. Kovrazhkin, J. Crasnier, J.-A. Sauvaud: Convection Induced Adiabatic Acceleration of Plasmasheet Protons as Observed Above Auroral Proton Band (GA165).

T. S. Jørgensen, I. S. Mikkelsen, K. Lassen, G. Haerendel, E. Rieger, A. Valenzuela, F. S. Mozer, M. Temerin, B. Holbach, L. Bjorn: Electric Fields in the Dayside Auroral Oval (GA166).

P. M. Kintner, M. C. Kelley: Evidence for Two Dimensional Fluid Turbulence in the Magnetosphere (GA167).

M. Roy, R. Rajaram: Magnetospheric Electric Field and the Time Dependent Ring Current (GA168).

Details of field-aligned and ionospheric current patterns and associated electric fields observed by further study of existing data sets and by multi-instrument observation techniques were presented. *Iijima and co-workers* have given better definition to the complicated field-aligned flow patterns in the dayside cusp region and in the Harang discontinuity region with further analysis of the Triad Magnetometer data. Total electron drift velocity vectors have been obtained in the Harang discontinuity region by *Greenwald and Nielsen* from simultaneous radar observations at two locations. *Kroehl and co-workers* have perfected a technique for computing worldwide magnetic potential patterns from magnetograms from 53 observatories and are able to construct movies of storm disturbances.

Küppers described the capabilities of the dense network of magnetometers in Scandinavia for obtaining detailed patterns of disturbance fields with excellent resolution both in space and time. An example of an unusual event of large-amplitude, rapid field fluctuations observed with the network was discussed by *Baumjohann*. *Wilhjelm and co-workers* have correlated the direction and location of the dayside cusp currents as determined from Triad measurements with the sign and location of the DPY polar cap currents as determined from a chain of magnetometers in Greenland and find their results consistent with IMF control. Simultaneous magnetic field and soft electron flux measurements from ISIS-2 presented by *Klumpar* indicate that often the fluxes are high enough for the electrons to be the charge carriers for the current producing the observed magnetic disturbances. With the aid of models, details of field-aligned currents associated with fine scale auroral features have been deduced from field and plasma rocket observations by *Walker and colleagues*. They find examples of highly intense current sheets above auroral curls which have little magnetic effect on the ground. *Theile* and *Sugiura and Potemra* have developed models which aid in the understanding of satellite magnetometer measurements in terms of field-aligned current systems and in the understanding of the physical processes which produce the currents.

Simultaneous observations of TRIAD and AE-C in disturbed conditions by *Saflekos and co-workers* showed that particle fluxes in the magnetosphere were sufficient to account for field-aligned currents at low altitudes. Comparisons of ISIS satellite data with ground magnetometer data by *Kawasaki and co-workers* led to the conclusions that the stronger northern part of the electrojet occurs in regions of precipitation from the central part of the plasma sheet (characterized by stable precipitation) and the southern weaker part

occurs in regions with little precipitation. Examination by *Galperin* of proton energies using data from the AUREOLE 1 satellite showed that energies of protons in the region of proton precipitation correlate well with the equatorial magnetic field strength of the particular field-line. However current magnetic field models are not sufficiently accurate to distinguish between Fermi and betatron acceleration from energy measurements alone. Rocket measurements reported by *Jǿrgensen* of electric fields inside the forenoon auroral oval showed: i) drifts toward noon in three out of four cases, ii) inverse correlations between electric field strength and precipitation, iii) that the magnetometers below were affected principally by Hall currents.

Kintner and Kelley showed that measurements from balloons and satellite showed electric field spectra consistent with energy input at a scale-size corresponding to auroral folds and curls and cascade to higher and lower scale sizes. *Harel* reported that the Rice University computer study of magnetospheric flows has been extended to include electron precipitation both in terms of pressure loss in the magnetosphere and ionospheric conductivity increase. The major difference in the results from previous studies was the difference in penetration depth of protons and electrons into the magnetosphere.

A poster session was held in the evening of August 26 on the topic of electric currents in the auroral oval. Those speakers who had presented papers on this topic at the August 25 afternoon session and who had been assigned only five minutes for presentation of their papers, were now given an hour and a half for detailed discussions with those participants who desired further information. Despite the lateness of the hour and the over 24-hour delay between the oral and poster presentations, a good crowd of enthusiasts showed up at the poster session. As with the previous poster session, the authors and their audience were quite pleased with the results of the combined oral presentation and the poster session. Many requested that we plan such sessions at future meetings.

γ. MAGNETIC PULSATIONS, I.

August 26 a.m., Room: Kane 220, Chairmen: C. W. Arthur and B. J. Fraser

B. Fraser: Introductory Remarks.

V. A. Troitskaya, F. Z. Feigin, E. T. Matveeva: Geomagnetic Pulations $Pc1_b$ at High Latitudes (GA169).

B. J. Fraser: Ionospheric Waveguide Propagation of Pc1 Pulsations in the Polar Cap and Middle Latitudes (GA170).

F. Glangeaud, J. L. Lacoume, R. Gendrin, S. Perraut, C. de Villedary, V. A. Troitskaya: Study of the Coherency Functions between ULF Signals Recorded at Two Pairs of Conjugate Stations (GA171).

R. R. Heacock: Satellite-Ground Comparisons of Type Pi1–2 (Broadband) Pulsation Activity (GA172).

C. W. Arthur, R. L. McPherron, W. J. Hughes: A Statistical Study of Pc3 Magnetic Pulsations at Synchronous Orbit (GA173).

C. G. Maclennan, L. J. Lanzerotti, C. Evans: Pulsations 15–33 mHz in Geomagnetic Field and Ionosphere Absorption at Siple Station ($L \sim 4$) Antarctica (GA174).

M. R. Warner, D. Orr: Time of Flight Calculations of High Latitude Geomagnetic Pulsations (GA175).

R. S. Newton, D. J. Southwood, W. J. Hughes: Damping of Geomagnetic Pulsations by the Ionosphere (GA176).

E. Maple: The Polarization of Geomagnetic Pulsations (0.24 to 48 Minute Periods) at a Sub-Auroral Zone Station (GA178).

O. M. Raspopov, L. T. Afanasjeva: The Correlation between the Generation of Geomagnetic Pulsations Pc5 and the Appearance of Plasma Inhomogeneities in the Morning Region of the Magnetosphere during Substorms (GA180).

T. Miles, H. W. Dosso: A Laboratory Scaled Model Study of Magnetic Fields Induced by Ocean Waves (GA181).

In the area of Pcl research, GA169 reported the new phenomenon of extremely large amplitude Pcl signals of short duration observed only in the polar cap region. These are not a frequent phenomenon and occurrences maximize near local noon. Considering the more regularly structured Pcl emissions, GA170 showed that signals may propagate in the ionospheric waveguide simultaneously to both polar cap and low latitudes during local nighttime. The asymmetry in the times of arrival of Pcl emissions at conjugate stations was reported by GA171, to differ from half the bounce period by 5–10% but extreme phase stability was observed along the magnetospheric path. The statistical characteristics of Pc3 at synchronous orbit (GA173) are consistent with a field-line resonance excited by a surface wave generated at the magnetopause and requires no special density gradient. Simultaneous observations of pulsations and riometer absorption (GA174) concluded that particle precipitation depends on hemisphere effects and differences in ionospheric conductivities must exist between conjugate areas.

In paper GA175, typical standing wave periods of magnetic pulsations were calculated for different latitudes and local times using a magnetic field model and several plasma models. A number of observations revealed HM waves whose locations and periods are consistent with ducting in detached plasma. A significant sink of geomagnetic pulsation energy due to Joule dissipation in the ionosphere was discussed in GA176. The pulsation damping rates are strongly dependent on ionospheric conductivity. Very low conductivities change the ionospheric boundary condition from close to "fixed-end" type to a "free-end" one which precludes observation of a signal on the ground. Paper GA180 reported that the appearance of electron fluxes (E—60 kev) in the morning region at Electron 4 is accompanied by the generation of Pc5 in the auroral zone with the magnitude of Pc5 directly dependent on the intensity of particle fluxes.

δ. MAGNETIC PULSATIONS, II.

August 26 evening, Room: Kane 220, Chairmen: C. W. Arthur and B. J. Fraser

J. Verö, L. Holló: Convection between Geomagnetic Pulsations and Interplanetary Magnetic Field (GA182).

E. W. Greenstadt, J. V. Olson: Correlation of Geomagnetic Pulsation Noise in the 10 to 150-Second Period Range with Concentration of IMF Orientations near the Sun-Earth Line (GA183).

D. R. K. Rao, G. K. Rangarajan: Influence of IMF Polarity on Magnetic Pulsation Activity at Low Latitudes (GA184).

H. J. Singer, C. T. Russell, M. G. Kivelson: Satellite and Ground Station Evidence for the Control of Pc3, 4 Activity by the Solar Wind Velocity (GA185).

W. J. Hughes, R. L. McPherron, J. N. Barfield, B. Mauk: Geomagnetic Pulsations Observed Simultaneously on Three Geostationary Satellites (GA186).

J. V. Olson, G. Rostoker: Longitudinal Phase Variations of Pc4–5 Micropulsations (GA187).
D. C. Webb, L. J. Lanzerotti, D. Orr: Hydromagnetic Wave Observations at Large Longitudinal Separations (GA188).
D. C. Webb, D. Orr: A Study of ULF Geomagnetic Power Spectra at Conjugate Points (GA189).

Papers GA182-GA185 all dealt with the correlation of pulsation activity to interplanetary magnetic field (IMF) parameters. A number of relationships were reported, but at the present time, the complexity of the phenomena is still the controlling factor in producing quite variable results. A large number of possible relationships are being tested. Paper GA186 described a Pc4 observed simultaneously by three geostationary satellites and concluded that it was a compressional guided-mode Alfvén wave, probably caused by bounce resonance of energetic ions. A study of longitudinal phase variations of Pc4-5 (GA187) found that the azimuthal wave number was a function of frequency which implied that the apparent phase speed is independent of wave period in line with the Kelvin-Helmholtz mechanism. Activity was shown to occur simultaneously at stations well spaced in longitude (GA188), suggesting a relationship to the radial field direction.

ε. ACTIVE EXPERIMENTS, RADAR AND RADIO AURORAL STUDIES

September 2 p.m., Room: Kane 220, Chairman: O. de la Beaujardiere

W. R. Sheldon, E. A. Bering, J. R. Benbrook, H. Leverenz, J. L. Roeder, T. M. Tarasova, H. Reme, A. St. Marc, F. Cambou, Yu. Ya. Rouzhin, I. A. Khulin: Simultaneous Observations of Telemetry Disturbances at Kerguelen and Enhanced Auroral Activity in the Arkhangel Region during the ARAKS Experiment (GA190).
J. L. Roeder, H. Leverenz, W. R. Sheldon, E. A. Bering, J. R. Benbrook: Measurements of the High-Altitude X-Ray Flux During the ARAKS Experiment (GA191).
P. J. Kellogg, S. J. Monson: Rocket and Ground-Based Observations of Plasma-wave Radiation Generated by Natural and Artificial Electron Beams (GA192).
K. G. Holmgren, E. A. Bering, R. Boström, U. V. Fahleson, T. B. Jones, M. C. Kelley, R. Lundin: An Active Release Experiment in the Auroral Ionosphere (GA193).
R. Lundin, G. Holmgren: Rocket Observations of Particle Precipitation Triggered by an Ionized Cesium-Cloud Release (GA194).
P. M. Kintner, M. C. Kelley, G. Holmgren, U. V. Fahleson: Plasma Wave Results from Trigger (GA195).
R. R. Vondrak: The Latitudinal Extent of Auroral Acceleration Regions (GA196).
O. de la Beaujardiere, R. R. Vondrak: Configuration of Electric Fields, Currents and Electrostatic Potential around an Auroral Arc (GA197).
J. C. Foster, G. S. Stiles, J. R. Doupnlk, L. A. Peterson: Ionospheric Response to a Very Large REP (GA198).
G. S. Stiles, J. C. Foster, J. R. Doupnik: Large Ion Velocities in the Vicinity of an Evening Auroral Arc (GA199).
R. T. Tsunoda, R. R. Vondrak: Magnetospheric-Ionospheric Coupling Studies with the Chatanika and Homer Radars (GA200).
W. Baumjohann, R. A. Greenwald, F. Küppers: Joint Magnetometer Array and Backscatter Radar Observations of Auroral Currents in Northern Scandinavia (GA201).
C. L. Rino: Evidence of Sheet-Like Irregularity Structures in the Diffuse Aurora (GA202).
O. de la Beaujardiere, M. D. Cousins, C. L. Rino: Observations of the Equatorward Boundary of the Diffuse Aurora (GA203).

In the first paper of the session, *Sheldon* discussed the Araks experiment in which a 27-kV, 0.5 Å electron beam was fired from above Kerguelen to the conjugate region. The main point of the discussion was a series of telemetry dropouts which were associated with the gun beam on. While no definitive explanation was given, it was pointed out that the rocket exhaust ion trail was able to link the rocket to the ionosphere and subsequent wave generation possibly caused the telemetry problems. *Roeder et al.* reported on rocket-borne X-ray observations obtained during the Araks experiment. X-ray levels were measured at $\geqq 5$, $\geqq 15$, $\geqq 30$, and $\geqq 50$ kV. No measureable X-rays were seen. It was mentioned that some indication of problems was observed in that the Araks gun current pulses were eratic.

Kellogg and Monson reported on the observations of short spikes and longer bursts of plasma wave radiation associated with the injection of 40-kV electrons. Waves at 2.96 MHz and near the second harmonic of the electron gyrofrequency were observed to be generated by the short spikes of injected electrons at altitudes of 165 to 195 km. Radiation at relativistic gyrofrequency of the beam with no doppler shifts were observed during the longer bursts of 40-kV electron injection.

Boström gave a general overview of an ionospheric perturbation and diagnostic payload called "Trigger" flown out of Esrange, Kiruna, Sweden. A Cesium release enhanced the ionospheric conductivity by approximately a factor of ten within a 2-km diameter cloud at an altitude of 165 km. Electric field, electron density, charged particle, and radio effects were observed following the release. *Lundin and Holmgren* presented charged particle observations obtained during the Trigger experiment. Field-aligned fluxes of 2-kV electrons and positive ions were seen following the Cesium release. The 80-kV data from a solid state detector was somewhat questionable due to the observation of a large detector noise increase following the Cesium release. However, prior to the noise increase, a response from the solid-state detector instrument gave indications that some were energetic particles and were also associated with the Cesium release. *Kintner* presented results from an electric field probe during the "Trigger" experiment. Less than 5 milliseconds after the Cesium release a broadband burst of radiation with a spectral density of f^{-1} was observed. One to three seconds following the burst, signals from one to two kHz, spin modulated at twice the spin period, with no perpendicular electric field were observed. An interpretation given for these results was that some of the Cesium from the ion cloud blew back over the rocket and in the presence of ambient O^+ formed an ion-ion streaming interaction.

The last part of the session consisted of 8 papers dealing with the wideband satellite and radar experiments (backscatter radar and the Chatanika incoherent scatter radar).

The newly operational backscatter radar in Trondheim (Norway) was used jointly with the northern Scandinavia array of 32 magnetometers. *Baumjohann and Greenwald* confirmed an earlier result that the eastward electrojet region is mapped by the backscatter radar echoes. The electrojet directions determined from the magnetometer array and the radar were in agreement in the eastward electrojet region, but not in the westward electrojet region. A flow of field-aligned currents is a possible explanation for this disagreement.

Vondrak related on the time evolution, during a substorm, of the differential energy spectra of auroral electrons. The energetic (1–30 keV) electrons spectra are computed from the ionization profiles measured with the Chatanika incoherent scatter radar. In the example shown, an inverted "V" type acceletarion was present at the poleward edge

of the diffuse aurora before the substorm occurred but it was not observed at the time the auroral arc dimmed (just prior to the substorm onset), nor during the expansive phase of the substorm. *De la Beaujardiere and Vondrak* studied the variation of the electric field and field-aligned current around a quiet premidnight arc. The northward electric field was reduced within the arc, an upward field-aligned current flowed above the arc, and a return current of approximately the same magnitude was observed on the poleward side of the arc. A configuration of the electrostatic equipotential lines around the arc was derived, which was consistent with the observed variation in the ionospheric potential and with the inverted "V" accelerating potential.

Stiles, Foster and Doupnik presented another example of the variation of the electric field as an arc drifted in the Chatanika radar beam. The northward field was reduced from 100 mV/m to 40 mV/m and the E-W field shifted from 160 mV/m westward direction to an eastward direction. The energy deposited by Joule heating reached 180 ergs/cm^{2}s within the arc. A relativistic electron precipitation event on January 28, 1977 was observed from a chain of riometers and the Chatanika radar data. *Doupnik, Foster and Stiles* found that the precipitation covered as much as 10° in latitude. The riometer absorption reached 10 dB. Significant ionization was measured as low as 60 km altitude. A 110 min. periodicity indicates that the injected particles were $\geqq$80 keV.

Tsunoda and Vondrak described a series of experiments in which radar measurements of ionospheric parameters were compared to simultaneous observations by satellite experiments. A comparison of ISIS scanning photometer data and auroral backscatter data showed that the Homer radar can be used to map out the instantaneous location of the diffuse aurora. Data from the Chatanika radar showed the reversal of the eastward electric field at the northern portion of the auroral oval. Since May 1976, routine nightly observations have been made using the polar-orbiting Wideband satellite at Poker Flat, Alaska. *Rino* reported that in a large number of the passes (spanning early evening to early morning periods) pronounced but isolated phase scintillation enhancements occurred. In the majority of these events enhancements occur precisely at the point of the *L*-shell intersection of the propagation path. This indicates that the irregularities are sheet-like structures distributed along *L*-shells.

Some of the results from coordinated experiments between Wideband satellite and the Chatanika radar were reported by *de la Beaujardiere, Cousins and Rino*. They indicate that discrete arcs are accompanied by intense phase scintillation, but little amplitude scintillation. On occasion there is, at the equatorward boundary of the diffuse aurora, a local maximum in the total electron content accompanied by a large phase and amplitude scintillation enhancement. This bounbary feature also corresponds to an enhancement in the *F*-region ionization.

SIV1 DEPENDENCE OF CORONAL AND SOLAR WIND STRUCTURE ON SOLAR MAGNETIC FIELDS (Convener: L. F. Burlaga)

Part 1. August 24 a.m., Room: Kane 210, Chairman: L. F. Burlaga

R. M. Broussard, J. H. Underwood, N. R. Sheeley, R. Tousey: Coronal Holes and Their Solar Wind Associations Throughout the Past Sunspot Cycle (GA555).

N. R. Sheeley, Jr., J. W. Harvey: Coronal Holes during the New Sunspot Cycle (GA556).

L. Svalgaard, T. L. Duvall: Large-scale Organization of Solar Magnetic Fields at the Recent Minimum of the Sunspot Cycle (GA557).

L. F. Burlaga, N. F. Ness, F. Mariani, B. Bavassano, V. Villante: Relations Between Interplanetary Magnetic Fields and Coronal Holes (GA558).

R. H. Levine: Models of Open Coronal Magnetic Structures and Their Relation to Solar Wind Phenomena (GA559).

G. W. Pneuman: Modulation of Solar Wind Properties by Coronal Magnetic Fields (GA560).

W. Riesebieter, F. W. Neubauer: Three-dimensional Solar Wind Model (GA561).

Part 2. August 24 p.m., Room: Kane 210, Chairman: L. F. Burlaga

P. H. Scherrer, L. Svalgaard: The Correlation of Mean Solar Magnetic Field Strength and Recurrent Geomagnetic Activity (GA562).

C. Sawyer, S. F. Hansen, R. T. Hansen: High-Speed Streams and Magnetic Structure (GA563).

K. W. Behannon: Magnetic Characteristics of Interplanetary Sector Boundaries (GA564).

F. M. Neubauer, E. Lammers, G. Musmann: HELIOS Observations of Interplanetary Magnetic Fields near the Solar Equator and Their Relationship to Solar Features (GA565).

M. Schulz: Configuration of Solar and Interplanetary "Sector" Boundaries (GA566).

Broussard, Underwood, Sheeley and Tousey showed that recurrent interplanetary streams were associated with coronal holes *throughout* the last solar cycle. They found that polar coronal holes were absent during solar maximum and were largest just prior to solar minumum. *Sheeley and Harvey* showed that during 1976–1977 coronal holes had the following characteristics: 1) they were relatively small, 2) they did *not* occur near the ecliptic, 3) their magnetic polarity was the same as the corresponding polar field polarity, 4) they occurred near active regions, and 5) their recurrence period was 29 days. *Svalgaard and Duvall* described the evolution of the solar magnetic field pattern beginning in May 1976 (rotations 1641 to 1656). Magnetic configurations with the size of coronal holes evolved rapidly, but the underlying sector pattern persisted throughout the interval. The authors concluded that the underlying sector pattern is more basic than coronal holes. *Burlaga, Ness, Mariani, Bavassano and Villante* discussed a coronal-hole associated stream observed by HELIOS at 0.3 AU. They showed that the longitudinal width of the stream was three times that of the coronal hole, presumably due to the divergence of field lines from the coronal hole. They also showed that the stream was bounded on one side by a very thin shear layer in which there was a magnetic pressure pulse. *Levine* discussed potential field extrapolations of the solar magnetic field and concluded that 1) open field lines do not cover the entire area of a coronal hole, 2) active regions are a significant source of open field lines, and 3) the speed of a stream varies inversely with the divergence of

the magnetic field lines. *Pneuman* discussed a model of flow along open magnetic field lines from a polar coronal hole. A best fit to measurements to the density profile gave $B_0=3$G, $n_0=3\times10^7$ cm^{-3}, and $T_0=2\times10^6$ at the centre of the coronal hole, with $B\sim\cos^4\theta$. He found that the addition of up to 10^6 erg/s in the region $\leqq 3R_\odot$ did not significantly increase the speed at 1 AU, and he concluded that some other mechanism such as wave momentum accelerates the solar wind to high speeds. *Riesebieter and Neubauer* presented a 3-D extrapolation of the solar fields observed near March 1, 1975, and a calculation of the associated 3-D stream and sector patterns. They found basically two streams in the ecliptic, in agreement with HELIOS observations. The streams were separated by a sector boundary whose shape agreed with the observed pattern of high coronal densities under closed magnetic field lines. They predicted a high stream at the south pole at that time. *Scherrer and Svalgaard* showed that there is a good correlation between the daily mean solar magnetic field and geomagnetic activity measured by *C*9 or *am*. This correlation persists even in the absence of equatorial coronal holes.

A series of papers discussed aspects of the interplanetary magnetic sector structure. *Sawyer, Hansen and Hansen* presented evidence that the sector pattern is more complex at low latitudes than at high latitudes. *Behannon* described the internal structure of several sector boundaries between 1 AU and 0.5 AU. In some cases the boundary was very thin, while in other cases it was very broad with a complex microstructure which included several directional discontinuities and depressions in magnetic intensity. *Neubauer, Lammers and Musmann* investigated the inclinations of two sector boundaries observed by HELIOS. They found a 70° inclination with respect to the ecliptic for one boundary, and an inclination between 29° and 65° for another, more complex boundary near 0.5 AU. *Schulz* presented a magneto*static* model of the structure of a sector boundary. He found a "ballerina" shape with an amplitude of 26° in latitude for a source surface at $2R_\odot$ and an amplitude of 15° for a source surface at $4R_\odot$.

SIV2 RADIAL AND LATITUDINAL GRADIENTS OF THE SOLAR WIND (Convener: M. Neugebauer, Co-convener: F. Mariani)

Part 1. August 25 a.m., Room: Kane 210, Chairman: F. Mariani

R. Woo: Radial Dependence of Solar Wind Properties Deduced from Spacecraft Radio Scattering Measurements (GA567).

G. Bourgois, W. A. Coles, S. L. Scott: Scintillation Observations near the Sun (GA568).

H. Rosenbauer, R. Schwenn, E. Marsch, B. Meyer, W. Pilipp, W. Voges: Differences between Fast and Slow Solar Wind as Derived from Proton Parameters between 0.3 and 1 AU (GA569).

E. Marsch, W. G. Pillpp, H. Miggenrieder, H. Rosenbauer, R. Schwenn, K.-H. Mühlhauser: Electron Characteristics in the Solar Wind between 1 AU and 0.3 AU as Deduced from Helios Observations (GA570).

K. W. Ogilvie, J. D. Scudder: Solar Wind Electron Parameters Measured on Mariner 10 between 0.85 and 0.45 AU (GA571).

H. Gruenwaldt, H. Rosenbauer: Expansion Parameters for Low Energy Solar Wind Stream of April 1972 (GA572).

S. Nerney: Theoretical Studies of Latitudinal and Radial Gradients in the Solar Wind (GA573).

K. W. Behannon: Radial Gradient in the Interplanetary Magnetic Field as Observed by Mariner 10 (GA574).

K. U. Denskat, F. M. Neubauer, R. Schwenn: Observations of Microscale Fluctuations in the Interplanetary Medium by Helios 1 near Perihelion (GA575).

E. J. Smith: Radial Variations of the Interplanetary Magnetic Field as Observed by Pioneer 10 and 11 (GA576).

An average estimated audience of 40 to 50 people attended the session. A number of questions and comments followed each paper. Some details are now given about the papers and their main conclusions.

Woo (GA567) showed a smooth variation of solar wind velocity from about 25 km/s at 1.7 $R_\odot$ to 350 km/s at $R_\odot$, consistent with the theoretical profiles based on two-fluid coronal expansion models of solar corona.

Bourgois, Coles and Scott (GA568) obtained information on the spatial structure of the solar wind at 10–80 $R_\odot$, which is often anistropic. Large fluctuations of the spatial structure are seen. Also large temporal changes occur in a single day.

Marsh et al. (GA570) showed that the average electron temperatures and heat fluxes tend to increase when bulk velocities of the solar wind decrease. Temperature anistropy becomes larger at higher velocity. This anistropy has been associated with an anistropy of the electron distribution function.

According to *Ogilvie and Scudder* (GA571), suprathermal electrons are present at any distance between 0.45 and 0.85 A.U. Large fluctuations of either halo or core temperatures are observed. Halo density was strongly fluctuating with maxima coincident with sector boundaries. Also, regions of increased density and temperature were observed, associated with solar streams. The interpretation has been given that the observed variations reflect different conditions present in the upper corona where the individual flux tubes are generated.

Mass spectra of solar wind have been studied by *Gruenwaldt and Rosenbauer* (GA572) at 1 A.U. during the April 1972 event. Velocities of ions up to the iron ions were the same to within 1%. Also, ion temperatures up to oxygen and mass flow densities are essentially the same. With a simple model of total ion and electron pressures, it has been possible to derive a value of $\gamma = 1.14 \pm 0.2$ for the heat ratio.

Nerney (GA573) made a theoretical study of latitudinal distribution of mass and magnetic fluxes of solar wind far away from the sun for symmetric and latitude-variable solar corona. In the first case equatorial divergence may occur; in the second case the line of symmetry can be moved as high as $\pm 30°$ in latitude. Temperature variations are possible at different distances from the sun due to very different boundary conditions (different heat conduction, in particular).

An extensive set of data from Mariner 10 between 0.46 and 1 A.U. was presented by *Behannon* (GA574), showing that an average radial variation of radial field component is that predicted by current models. Stronger variability occurs for the transversal component. The predicted r^{-1} variation is still possible, however. Also, directional discontinuities show a radial variation like $r^{-1.3}$. Strong fluctuations of all the above variations are observed at different times, which may also be an additional effect of solar helio-

graphic latitude variation of the solar corona.

Radial variations of field observations at large heliocentric distances (up to 9 A.U.) were presented by *Smith* (GA576). Generally speaking, the values predicted by current theories are obtained. The need to distinguish between quiet and disturbed regions was pointed out. Significant latitudinal differences have been observed comparing Pioneer 10 and 11 data, which may help to determine the shape of sector boundaries. Preliminary results favour a boundary model elongated nearly parallel to the equatorial plane.

A variety of field and particle observations is convincingly showing how non-spherically symmetric the solar wind is. Careful consideration of longitudinal, latitudinal and temporal variations will play an important role in the next few years.

Part 2. August 25 p.m., Room: Kane 210, Chairman: M. Neugebauer

J. T. Gosling, J. R. Asbridge, S. J. Bame, W. C. Feldman: Solar Wind Interfaces: Fluid Properties (GA577).

S. J. Bame, J. R. Asbridge, S. C. Feldman, J. R. Gosling: Solar Wind Stream Interfaces: Kinetic Properties (GA578).

R. Schwenn, H. Rosenbauer, K. H. Mühlhauser: Stream Boundaries in the Solar Wind Between 0.3 and 1 AU (GA579).

E. J. Smith, B. T. Tsurutani, R. L. Rosenberg: Observations of the Interplanetary Sector Structure up to Heliographic Latitudes of 16°: Pioneer 11 (GA581).

N. A. Lotova, J. V. Chashey: The Nature of Time Rearrangement of the Interplanetary Scintillations Pattern (GA582).

W. A. Coles, J. K. Harmon: Calibration of Ecliptic IPS Velocities and Latitude Variation of the Solar Wind Velocity (GA583).

B. J. Rickett, D. G. Sime: The Distribution of Solar Wind Speed in Heliographic Latitude and Longitude Observed with IPS (GA584).

E. J. Rhodes, Jr., E. J. Smith: Simultaneous Observations of Latitude-Longitude Structure in the Solar Wind and on the Sun (GA585).

This session dealt with solar wind stream boundaries and latitude variations. *Gosling, Asbridge, Bame, and Feldman* reported on observations of stream interfaces by IMP 6, 7 and 8 at 1 AU. They observed compression, large shear, and strong ion and electron heating at discontinuities where a slow, dense gas is overtaken by a faster, more tenuous gas which often has a different relative abundance of helium. They associated the forces due to the pressure ridges centred on these discontinuities with flattening of initially steep (nearly step-function) velocity gradients on the leading edges of high velocity streams. Such a flattening between 0.3 and 1 AU was observed by HELIOS and reported at this meeting by *Schwenn, Rosenbauer and Mühlhauser*. Analysis of three years of HELIOS 1 and 2 data shows that the velocity structure on the leading edge of streams is steeper closer to the sun, with an average longitudinal gradient of approximately 70 km/sec/deg between 0.3 and 0.5 AU. *Schwenn et al.* also reported latitudinal gradients of $\sim$50 km/sec/deg at the north and south edges of high velocity streams. There are indications of a greater frequency of *discontinuous* stream interfaces at 1 AU than at 0.3 AU, which would mean that these tangential discontinuities are formed en route rather than originating at the sun.

Smith, Tsurutani and Rosenberg reported that PIONEER 11 results at heliographic latitudes above 16° showed a disappearance of the sector structure consistent with a nearly

equatorial orientation of sector boundaries and with the existence of a current sheet which extends to large heliocentric distances and is inclined only slightly to the solar equator. The current in this sheet has a radial component and the authors suggest that the return current is carried by distributed solar wind currents at high latitudes.

A report by *Lotova and Chashey* described large, rapid variations in the IPS diffraction pattern which were interpreted as being caused by the inclusion of the contributions to the pattern from several streams with different velocities. Other reports of IPS observations were given by *Coles and Harmon* and by *Rickett and Simes*. This group compared in-ecliptic IPS observations of solar wind velocity with IMP observations at 1 AU. In general, the correlation between the two sets of measurements was high, with the best fit generally being obtained when the effects of the variation of solar wind density along the ray path were accounted for by an inverse square dependence of density on heliocentric distance. IPS observations of the latitudes and longitudes of high velocity streams correlate well with regions of low white-light coronal emission. Yearly averages of IPS data indicate steeper latitude gradients of the solar wind velocity in 1976 and 1977 (January-July) than in 1974 and 1975 when coronal holes were observed in equatorial latitudes.

Finally, by mapping solar wind velocity data back to the sun and comparing the results with maps of EUV emission and the photospheric magnetic field, *Rhodes and Smith* concluded that some of the high velocity streams observed just prior to the last solar activity maximum were emitted from open coronal field structures with low EUV emission. Their results also suggest that the solar wind observed at that time originated near the solar equator.

SIV3 SOLAR WIND INTERACTION WITH VENUS (Convener: K. I. Gringauz, Co-convener: N. F. Ness)

This session was devoted to a retrospective, as well as a contemporary view of the observational results and theoretical models relevant to the problem of solar wind interaction with Venus. The following papers were presented.

August 29 p.m., Room: Hewitt 310, Chairman: N. F. Ness

Sh. Sh. Dolginov, Ye. G. Yeroshenko: Magnetic Field Early Results (Venera 4) (GA586).

T. K. Breus, K. I. Gringaus: Early Plasma Measurements near Venus—Venera-4 (1976) and Venera 6 (1969) (GA587).

A. J. Lazurus, R. E. Shefer, H. S. Bridge: A Retrospective Look at Plasma Observations from the Mariner 5 Venus Encounter (GA588).

L. Davis, Jr.: Magnetic Field: Early Results from Mariner 5 (GA589).

R. P. Lepping, K. W. Behannon: Mariner 10 Magnetic Field Results at Venus (GA590).

K. W. Ogilvie, C. Yeates, G. Siscoe: Electron Observations in Venus' Wake and Their Interpretation (GA591).

M. K. Wallis: Theory of Solar Wind Interaction with Venus (GA592).

H. Pérez de Tejada, M. Dryer, M. Wallis: Finitely-Conducting MHD Viscous Boundary Layer for the Venusian Ionopause (GA593).

P. A. Cloutier, R. E. Daniell, Jr.: The Interface between Solar Wind and Planetary Atmospheres (GA595).

C. T. Russell: On the Evidence for an Intrinsic Magnetic Moment of Venus (GA596).

D. M. Butler, R. S. Stolarski: Solar Wind Effects on Photoelectrons in the Venus Dayside Ionosphere (GA597).

M I. Verigin, K. I. Gringauz, T. Gombosi, T. K. Breus, V. V. Bezrukikh, A. P. Remizov, G. I. Volkov, Yu. V. Andrianov: Plasma near Venus from the Venera 9 and 10 Wide-Angle Analyzer Data (GA598).

S. A. Romanov, V. N. Smirnov, O. L. Vaisberg: On the Nature of Solar Wind Venus Intercaction (GA599).

Sh. Sh. Dolginov, Ye. G. Yeroshenko, L. N. Khuzgov, V. A. Sharova, V. B. Buzin: Magnetic Fields in the Close Vicinity of Venus According to the Venera 9 and 10 Data (GA600).

S. J. Bauer: The Ionosphere of Venus (GA601).

K. I. Gringauz, M. I. Verigin, T. K. Breus, T. Gombosi: The Interaction of Solar Wind Electrons in the Optical Umbra of Venus with the Planetary Atmosphere—The Origin of the Night-time Ionosphere (GA602).

Round Table Discussion—S. J. Bauer, A. J. Dessler, K. I. Gringauz, N. F. Ness, C. T. Russell.

The highlight of the session was the detailed presentation by *Gringauz, Vaisberg and Pushkov* (on behalf of *Dolginov, Yeroshenko and Zhuzgov*) of their recent scientific results obtained from the extended suite of observations obtained by the Venera 9 and 10 spacecraft. In summary, they reported that a well developed, readily identified, detached bow shock is always observed and in positions with less variability than when compared to Earth and Mars. There is a high level of turbulence in the transition region and the magnetopause and bow shock positions agree with the hydrodynamic calculations of direct interaction with the ionosphere. There appears to be a plasma magnetic tail with the boundary layer observed out to $6R_v$. There does exist, however, some controversy over whether or not the observed magnetic field is due solely to an induced magnetosphere associated with the solar wind interaction with the ionosphere of Venus. The interpretation of the magnetic field data from Veneras 9 and 10 is in some dispute amongst the principal investigators themselves. There is no question that if any intrinsic magnetic field exists, it is extremely small and difficult to observe at satellite altitudes. The existence of any such intrinsic magnetic field of the planet creates considerable problems in understanding the observations of the night-time ionosphere of the planet. Hence, the consensus was that there exists primarily an induced magnetosphere at Venus. There are no plans for joint publication of these scientific papers although preprints of certain of them were distributed to the audience (especially those from the USSR) and therefore they can be expected to appear in the journal literature in the near future.

LSR IV LATEST SIGNIFICANT RESULTS SESSION OF DIVISION IV (Convener: H. S. Bridge)

The first paper has now appeared in the Journal of Geophysical Research, **82**, 3649 (1977). The authors asked why slow MHD shocks are seldom seen in the interplanetary

medium. They pointed out that the slow shock should follow fast shocks and thus propagate into a shocked medium in which (they demonstrate) the slow shock slows, broadens into a slow wave, and merges into the contact discontinuity to become a tangential discontinuity. They showed the confirming results of a numerical simulation of a MHD shock ensemble.

The second paper considered momentary (~1 minute) decreases in the magnitude of the interplanetary field. The authors showed that the plasma parameters observed at the time of the dips imply that the dips can survive for a reasonable length of time despite eventual destruction by the tearing mode instability.

The scheduled paper by *Gombosi et al.* could not be presented because difficult travel arrangements caused the speaker to arrive after the session ended. The paper by *Mikirova and Pereyaslova* (GA 606) was withdrawn.

August 24 p.m., Room: Kane 210, Chairman: A. J. Lazarus

P. Rosenau, S. T. Suess: Slow Shocks in the Interplanetary Medium (GA603).

B. Bavassano, M. Dobrowolny, F. Mariani: Structure of Magnetic Dips in the Solar Wind (GA604).

T. Gombosi, K. Kecskemety, Yu. I. Logachev, I. A. Savenko, A. J. Somogyi, V. G. Stolpovskii: Connection between the Energetic Particle Background and the Fluctuations of the Parameters of Interplanetary Medium Measured onboard the Prognoz-4 Satellite (GA605).

N. A. Mikirova, N. K. Pereyaslova: Effect of Coronal Fields on Particularities of Distribution of Protons from the Solar Bursts (GA606).

SV1 MAGNETIC OBSERVATORY PRACTICE (Convener: W. F. Stuart)

In three sessions of the observatory workshop 18 papers were presented covering much of the wide range of problems which affect observatory practice and also the use of observatory data. In addition a two hour panel discussion allowed many subjects not covered by the formal presentations to be tackled.

Notable were the descriptions of new recording magnetometers and the effectiveness of recently installed digital observatories. Baseline control and its relationship to absolute measurements was discussed in the context of instrumentation, site preparation and secular change modelling. Difficulties encountered in changes of observatory site for the location of new observatories was described.

The workshop showed that there was a strong feeling by both observers and users of observatory data that worldwide standardization of data output was the target. The longstanding format of analogue recordings and tables of mean values should undoubtedly be continued but supplemented by digitally recorded data which could be made rapidly available to the research community. The prospect of rapidly sampled digital data was

encouraged by some of the current research activities which suggest that geomagnetic pulsations may be in regular use as observatory produced indices of magnetosphere and interplanetary medium dynamics.

Part 1 (Routine Observations). August 20 p.m., Room: Kane 110,
Chairman: F. W. Stuart

K. A. Wienert: Errors of Data Obtained from Magnetograph Records (GA607).

E. K. Lauridsen: A Long Time Recorder for Photographic Records of Geomagnetic Variations (GA608).

L. R. Wilson: Automated Magnetic Observatories (GA609).

R. C. de Godoy, F. S. Soares, J. T. Ferreira: The Operation and Data Reduction of Brasilian Magnetic Observatories (GA610).

J. B. Townshend: Improvements in Magnetic Observatory Consturction and Operation in Permafrost Areas (GA611).

J. H. Allen, C. C. Abston, L. D. Morris: Use of Auroral Zone Observatory Records in Deriving AE Indices (GA612).

K. Svendsen: Maintaining a Uniform Standard of Magnetic Observations (GA614).

C. Sucksdorff: Geomagnetic Routine Observations (GA613).

Part 2 (Absolute Measurements). August 30 a.m., Room: Kane 110,
Chairman: F. W. Stuart

H. Voppel: On the Absolute Accuracy of Direct Reading Proton Magnetometers (GA615).

M. Sugiura: Uses of Magnetic Observatory Data: A Review and a Proposal for Coordination with Satellite Experiments (GA616).

E. K. Lauridsen: Some Effects Influencing the Accuracy of Measurements with the QHM (GA617).

E. I. Kataja: Vector Proton Magnetometer Observatory Practice (GA618).

N. A. Ivanov, L. N. Ivanova, V. A. Shapiro: The Investigation of Secular Variations in the Vicinity of Sverdlovsk Magnetic Observatory (GA619).

D. R. Barraclough: The Use of Observatory Data for Charts and Secular Variation (GA620).

Part 3 (Instruments). August 30 p.m., Room: Kane 110,
Chairman: F. W. Stuart

P. H. Serson: Digital Recording and Telemetry of Magnetic Observatory Data (GA621).

V. Auster, K. Lengring, W. Mundt: The Digital Wide-Band Recording System at Niemegk Observatory (GA622).

R. D. Russell, T. Watanabe: A Proposal for a Bridge Method for the Calibration of Geomagnetic Sensors (GA625).

T.-I. Kitamura, O. Saka, M. Ishizu, R. Hasuo, T. Iijima: Measurements of Geomagnetic Micro-fluctuations by the Squid Magnetometer (GA626).

SV2 TECHNIQUES AND EVALUATIONS OF RECENT MAGNETIC CHARTS AND MODELS (Convener: L. R. Alldredge)

August 31 a.m., Room: Kane 120, Chairman: L. R. Alldredge

D. R. Barraclough: Magnetic Charts from the United Kingdom (Invited paper, GA627).

A. N. Pushkov, V. A. Kolesova, T. A. Chernova: Representation of the Main Geomagnetic Field Using Analytical Models (Invited paper, GA628).

E. B. Fabiano, N. W. Peddie: The Magnetic Charts of the United States—Epoch 1975.0 (Invited paper, GA629).

W. Mundt: Relationship between Approximation Error and Objective Construction of Magnetic Charts (GA630).

S. Utashiro: On the Magnetic Charts in the Adjacent Seas of Japan in 1975 (GA631).

F. S. Barker, N. J. O'Neill: Differences between the U.S. and U.K. Models of the Geomagnetic Field (Epoch 1975), and Recent Project MAGNET Vector Surveys in the Southern Hemisphere (GA632).

E. Dawson, L. R. Newitt: Recent Magnetic Secular Variation in Canada (GA633).

All of the seven scheduled papers were delivered as scheduled. Since this session did not represent any policy making group no decisions were made, but during the period which followed the papers, the following topics were discussed:

a) maximum order and degree of spherical harmonic coefficients that should be used in models.
b) the value in following the motions and characteristics of deep secular variation foci.
c) stochastic methods in the determination of secular variation.

SV 3 FILTERING METHODS APPLIED TO GEOMAGNETIC DATA (Convener: A. W. Green, Jr.)

Part 1. September 1 a.m., Room: Kane 120, Chairman: A. W. Green, Jr.

A. W. Green, Jr.: Analog and Digital Filtering Operations in the Time and Frequency Domains (Review paper, GA634).

J. L. Lacoume: Different Approaches of Spectral Analysis (Invited paper, GA635).

A. J. Owens: Filters for De-Trending and Smoothing Random Data (GA637).

A. J. Surkan, D. M. Tsou, M. Okada, L. J. Lanzerotti, C. G. MacLennon: Dct Waveform Reconstruction Techniques for Compression of Magnetometer Data (GA639).

F. Glangeaud, J. L. Lacoume, C. Turcat: Diagonalization of Cross Power Spectral Matrix Application to Electromagnetic Waves in the Magnetosphere (GA650).

R. Gendrin, C. de Villedary: Unambiguous Determination of Fine Structures in Complex Time-Varying Signals (GA641).

K. Kodera, R. Gendrin, C. de Villedary: Complex Representation of a Time-Varying Two-

Components Signal: Application to Polarization Studies (GA642).

N. Cornilleau-Wehrlin, G. Loisier, R. Gendrin: Application of the Complex Representation of a Polarized Signal to the Determination of Wavenormal Directions in Space (GA643).

Part 2. September 1 p.m., Room: Kane 120, Chairman: A. W. Green, Jr.

K. Kodera, R. Gendrin, C. de Villedary: Application of the Modified Moving Window Method to the Study of Time-Varying Signals with a Small bt Value (GA644).

R. Thompson, R. M. Clark: Cross-Validation Smoothing of Serial Magnetic Data Distributed on a Sphere (GA645).

P. F. Fougere: Maximum Entropy Power Spectral Analysis (Invited paper, GA646).

J. S. Reid: The Application of the Maximum Entropy Method to the Estimation of Relationshlps between Time Series (GA647).

P. F. Fougere: Dynamical Maximum Entropy Power Spectra of AFGL Magnetometer Data (GA648).

N. B Trivedi, I. J. Kantor, J. M. da Costa: Annual and Semi-Annual Variation in the H-Field at Vassouras (GA649).

G. D. Nastrom: The Components of the Annual Line in Geomagnetic Field Elements (GA650).

M. Sugiura: Quasi-Biennial Oscillations in the Geomagnetic Field and in Solar Activity (GA651).

The main themes of this session were the theory and application of signal processing to geomagnetic data. Three tutorial papers were presented which served to introduce the principal topic areas.

The first tutorial paper by *Green* reviewed analog and digital filtering operations in both the time and frequency domains. Topics discussed in this paper included: transfer functions, the convolution integral, Fourier transforms, auto correlation and cross correlation functions, power spectral density computation by both direct and Weiner Autocorrelation Theorem methods, and the Shannon-Kolmogorov Sampling Theorem. Special attention was given to such practical considerations as sampling, "aliasing", assumptions of periodicity, quasiperiodicity, aperiodicity, or randomness as applied to specific classes of geomagnetic temporal variations. Examples of amplitude spectra, power spectra, and convolution filtering of various geomagnetic events were presented.

The second tutorial paper by *Lacoume* discussed different approaches to obtaining power spectral density estimates of truncated time series in the presence of noise. In particular he compared the use of discrete Fourier Transforms, the maximum entropy method, and the Pisarenko method under various conditions.

The third tutorial paper by *Fougere* was a comprehensive introduction to the computation of power spectral densities by the maximum entropy method. He discussed the use of a "prediction error filter" to extend a finite data set in both positive and negative time directions in such a way that the entropy, as defined in classical statistical physics, is maximized. By significantly extending the data in the time domain, narrower "line-like" representations in the frequency domain are possible in accordance with the classical "Uncertainity Principle".

A number of authors discussed applications of linear filters and conventional (Fourier-Weiner) power spectral analyses to geomagnetic data. *Owens* considered the effects on computed power spectra of time domain filter operations such as "detrending", the subtraction of moving averages or fitted polynomials, etc. *Thompson and Clark*

presented their results in the smoothing of time series representing paleomagnetic field directions. Their technique, called "cross-validation smoothing" is used to develop a statistically significant master curve for paleomagnetic dating. *Trivedi, Kantor and da Costa* presented power spectra of the *H*-field at Vassouras which showed both annual and semi-annual components. *Sugiura* presented the results of his analysis of high-pass filtered *Dst* and sunspot data which show correlated quasi-biennial variations. *Nastrom* used spectral analysis to make a study of the geographic and local time dependence of the annual variation. The high resolving power of the maximum entropy method of power spectral analysis was used by *Fougere* to compute dynamic power spectra of critical periods during the development of a magnetic storm. *Reid* showed relationships between linear regression coefficients and prediction error coefficients and used these relations to establish confidence limits on the individual maximum entropy power spectral peaks. *Surkan et al.* demonstrated a technique for the coding and compression of magnetometer data using discrete cosine transforms. *Glangeaud et al.* used a diagonalization method on the cross power spectral density matrix to discriminate discrete Pc1 emissions having joint frequencies at three different stations. *Gendrin, de Villedary, Kodera, Cornilleau-Wehlin, and Loisier* presented a suite of four papers dealing with methods such as complex representation and a "modified moving window" to analyze structured ULF and VLF emissions. These emissions are characterized by multiple frequency components which vary in time, and have a small time-band width product. The methods are successfully used to determine polarization patterns, wave normal directions, and time varying frequency spectra.

LSR V LATEST SIGNIFICANT RESULTS SESSION OF DIVISION V (Convener: P. H. Serson)

Only one paper was submitted, so that this session was held immediately preceding the SV2 session as follows.

August 31 a.m., Room: Kane 120, Chairman: L. R. Alldredge

J. H. Allen, D. A. Dunham: Classification of Relative Magnitudes of Major Magnetic Storms, Their Frequency and Distribution Patterns from 1932–1975 (GA207).

SA INTERIM RESULTS OF ANTARCTIC IMS (Convener: T. Nagata)

The following 14 papers were presented to the two sessions. Highlights of the sessions were the coordinated measurements of auroral substorms by ground-based networks, sounding rockets and satellites. Particularly, the VLF auroral hiss phenomena have been

clarified in fair detail. The proceedings of these sessions will be published in an appropiate form in accordance with the request of the majority of speakers.

August 23 a.m. and p.m., Room: Kane 210, Chairman: T. Nagata

J. S. Reid: Australian Upper Atmosphere Research in Antarctica (Invited paper, GA655).

T. Nagata, T. Hirasawa, M. Ayukawa, H. Fukunishi: Multipoint Ground Observations around Syowa Station, Antarctica by Means of Manned and Unmanned Observations (GA656).

J. R. Dudeney: United Kingdom Antarctic Research Contributions to the IMS (Invited paper, GA657).

A. R. W. Hughes, B. J. Nugent: Satellite and Ground Observations of VLF Emissions Made at SANAE (GA658).

T. Nagata, H. Fukunishi, T. Yoshino: Satellite Telemetry Reception at Syowa Station, Antarctica (GA659).

N. G. Kleimenova, Yu. V. Golikov: The First Results of VLF-Observations at the Auroral Antarctic Molodejnaia Station (GA660).

H. Fukunishi, Y. Yoshino, M. Makita, I. Kimura: Simultaneous Observations of VLF Emissions on a Satellite and a Sounding Rocket and on the Ground (GA661).

R. A. Helliwell, D. L. Carpenter: Mangetospheric VLF Probing Experiments at Siple Station, Antarctica, and Roberval, Canada (Invited paper, GA662).

M. W. J. Scourfield, D. D. Duthie: Aurorae and Closed Field Lines (GA663).

S. M. Mansurov: Dependence of the Day-Side High Latitude Electrojet Position on the Interplanetary Field Sector Polarity (GA664).

T. Iijima, R. Fujii, T. A. Potemra: Field-Aligned Currents in the Southern Dayside Cusp Observed by TRIAD (GA665).

V. A. Troitskaya, O. V. Bolshakova: Diurnal and Solar Cycle Variations on Latitude of the Location of the Dayside Cusp (GA666).

T. Nagata, H. Fukunishi, I. Kimura, T. Tohmatsu: Sounding Rocket Campaign at Syowa Station, Antarctica (GA667).

H. Kubo, T. Itoh, S. Murata, S. Kokubun, T. Hirasawa: Rocket Observations of Electron Precipitation into the Antarctic Auroral Zone (GA668).

SH GEOMAGNETIC AND AERONOMIC STUDIES OF HISTORICAL IMPORTANCE (Convener: E. J. Chernosky)

August 27 p.m., Room: Kane 110, Chairman: E. J. Chernosky

U. Schmucker: The 200th Anniversary for Carl Friedrich Gauss in Germany (Invited talk).

W. T. Sullivan, III: Karl Jansky's Discovery of Extraterrestrial Radio Emission (GA653).

W. Schröder: Otto Jesse—A Pioneer of the Exploration of the High Atmosphere (GA654).

The handicap of a Saturday afternoon session for the History Commission meeting was successfully offset by the wide interest in the presentations made. The 200th anniversary of the birth of Carl Friedrich Gauss was effectively given and illustrated by *Schmucker*. Little known facts about this important scientist in our and other fields were presented as well as memorabilia from the German observance of this Bicentennial.

The presentation by *Sullivan III* on Karl Jansky's discovery of extraterrestrial radio emission likewise attracted a number of concerned listeners. The difficulties Jansky had in adequately researching scientific findings where only restricted applied objectives were themselves supported in a limited way were noted. In the absence of *Schröder, Wienert* kindly presented for him a brief summary of the historical research of Otto Jesse — a pioneer in the exploration of the high atmosphere as reported by Schröder.

SEI RELATIONS BETWEEN EXTERNAL AND INTERNAL MAGNETIC VARIATIONS (Convener: A. A. Ashour; Co-convener: D. J. Stone)

A well attended meeting was held. From the 13 scheduled papers one was withdrawn and three not given due to the absence of authors.

The nine papers which were delivered, all contributed papers, dealt with relations between the source and internal fields and their separation in connection with *Sq*, the equatorial and polar electrojets, conductivity anomalies and models.

August 29 a.m., Room: Kane 110, Chairman: A. A. Ashour

S. Sampath, T. S. G, Sastry: Depth of Conducting Layer in the Indian Ocean Region around Thumba, Derived from In-Situ Investigations of Equatorial Electrojet (GA670).

F. Küppers, O. Schomburg: The Regional Field of Geomagnetic Bays in Middle and Northern Europe (GA671).

V. R. S. Hutton, J. M. Sik, G. Dawes: A Geomagnetic Array Study in N. Scotland (GA672).

M. Mareshal: Simulating the Earth-Induced Components of Substorm Fields Recorded at the Earth's Surface (GA674).

B. J. Srivastava: Electromagnetic Induction Anomalies in Relation to theiContinental Margins of India (GA675).

S. Matsushita: The Role of the Interplanetary Magnetic Field in the Determination of the External Fields (GA677).

E. M. Didwall, R. A. Langel: Internal and External Magnetic Field Variations as Determined from Satellite Magnetic Storm Data (GA678).

A. Suzuki, H. Maeda: UT and Day-to-Day Changes in External and Internal Current Systems (GA679).

D. E. Winch: Electrical Conductivity Models and the Transient Geomagnetic Variations (GA680).

OTHER MEETINGS DURING THE SEATTLE ASSEMBLY

In addition to the meetings of the IAGA Working Groups, Divisions and the IAMAP Commissions, the following meetings were held during the Seattle Assembly.

Open Meeting for "Middle Atmosphere Program"
August 30, 14–18h Room: Kane 130

IAGA/URSI Working Group on Passive Electromagnetic Probing of the Magnetosphere
August 30, 19–21h Room: Smith 109

IAGA/URSI Working Group on Wave Instabilities in Space Plasma
September 1, 19–21h Room: Smith 105

IAGA/URSI Meeting on Needs for Ionosondes after IMS
September 1, 19–21h Room: Smith 107

URSI Ionosphere Network Advisory Group
August 30, 19–21h Room: Smith 111

IUGS/IAGA Subcommittee on Magnetic Stratigraphy
September 2, 9–12h and 14–17h Room: Smith 107

SCAR Working Group VIII
August 31, 9–12h and 14–17h Room: Smith 113

Meeting for ISIS (International Satellites for Ionospheric Studies)
August 23, 9–12h and 14–17h; August 24, 14–17h; August 26, 9–12h
Room: Smith 111

Open Meeting on "Observational Plans for Total Solar Eclipse, 26 February 1979, in North America"
September 1, 19–21h Room: Smith 102

IAMAP RESOLUTIONS
OF THE SEATTLE ASSEMBLY

1. On the World Network of Dobson Spectrophotometers

The International Ozone Commission *noting with appreciation*

(1) the strong support given by WMO to the modernization and recalibration of several instruments (notably No. 50 (Reykjavik) and Nos. 8, 14, and 56 (Norway)), and the work done on these instruments by the National Oceanic and Atmospheric Administration of the USA under the direction of Mr. W. Komhyr,

(2) the organization by WMO of an intercomparison at Boulder, Colorado, in August 1977, during which almost all those instruments designated as secondary reference instruments by the Commission at Dresden in 1976 were overhauled and compared with the primary reference instrument (No. 83, USA),

(3) the work of Mr. W. Komhyr in covering and conducting the intercomparison and the excellent facilities made available by NOAA, and

(4) the work of the National Aeronautics and Space Administration of the USA in processing the data from the Backscattered Ultra-Violet (BUV) Experiment on Nimbus 4 and other satellites,

recommends

(1) that the users of secondary reference instruments now take urgent action to ensure the highest possible performance of the instruments in their area and to arrange the necessary intercomparisons in cooperation with WMO and the Commission,

(2) that the results of intercomparison of individual stations with the BUV experiment should be sent when available to the countries concerned through WMO, together with a summary of the statistical results for all Dobson stations for comparison.

2. On Measurement of the Vertical Distribution of Ozone

The International Ozone Commission *noting*

(1) the importance of balloonsonde measurements in the WMO Global Ozone Research and Monitoring Project,

(2) with appreciation the plans made by WMO and the Meteorological Service of the Federal Republic of Germany for an intercomparison of electrochemical balloonsondes at Hohenpeiszenberg in April 1978,

(3) the value of rocketsondes in measuring the upper part of the distribution

recommends

(1) that the list of required ozonesonde stations in the WMO Global Ozone Research and Monitoring Project be expanded and that new attempts be urgently made to implement this network for at least a three-year period.

(2) that an intercomparison between rocketsondes of different types and one balloonsonde be arranged as soon as possible,

(3) that further intercomparison be made between sondes and the BUV experiments.

3. On Instruments Measuring Ozone near the Ground

The International Ozone Commission *noting* that measurement of ozone near the ground has become an important requirement in assessing the tropospheric ozone budget

recommends

that the intercomparison of surface ozone measuring instruments which is presently under consideration by WMO be conducted as soon as possible and be continued for a period of at least six (6) months.

4. Rocketsondes

The International Commission on the Meteorology of the Upper Atmosphere *noting* the need for meteorological rockets to calibrate satellite observations, and their capability to provide detailed vertical profiles of wind pressure and temperature, and

considering the increased need for such data during the planned MAP, and

learning of current plans to discontinue such rocket stations,

earnestly recommends that highest priority be given to continuing those stations which sample different latitude belts, especially near the equator and in highest latitudes, and that if some stations must be closed that they be among the multiple stations in the 30°N lat-band. Special importance is attached to Poker Flat, Alaska; Churchill and Primrose Lake, Canada; and Thule, Greenland for their ability to detect and measure sudden warmings and in providing anchors for the planetary waves on upper stratosphere charts.

5. Long-Range Localization of Lightning Activity

The International Commission on Atmospheric Electricy *notes*

that the global distribution of thunderstorm activity with time, season, and location is a parameter of increasing importance. The climatological applicability of such information is obvious, and interest in thunderstorms is indicated by the research efforts reported at this meeting. Additionally, the growing interest in solar effects on terrestrial meteorology creates a requirement for storm distribution data to provide suitable assessment of any such interactions. Similarly, NO_x compounds produced by lightning must be quantified as an input to ozone layer modeling; and tropospheric electrical studies require a thunderstorm activity index to serve as a background from which deviations may be observed.

A continuous global scale measurement of thunderstorm activity might be accomplished in a number of ways. Netted direction finder arrays, an interconnected grid of time of arrival receivers, a system of VLF single station dispersion analysers, a small number of EF receivers, a multitide of local short-range lightning flash counters, and satellite borne instruments both optical and electromagnetic have been employed toward this end in the past. Of these, only the VLF dispersion technique is both economically and scientifically feasible at this time. It has been estimated that nine or ten such sets of equipment could provide almost total global coverage at all times without any requirement for real time networking and/or analysis.

It is *recommended,* therefore,

that the construction and deployment of such apparatus be strongly encouraged. It is *further recommended* that all stations be operated for a minimum common time of several years in order to provide a data base adequate for the purposes enumerated above. Instrument locations should be selected so that all tropical and mid-latitude areas of the earth

are sensed with coverage toward polar regions desirable but secondary. Institutions and individuals to operate the equipment should be chosen among those whose interest and competence will assure operational success.

6. Continuation of a Key Station

The International Commission on Atmospheric Electricity *noting*

the need to cooperate in field investigations of thunderstorms and fair weather electric measurements has learned of current plans to discontinue the research station at Weissenau, Federal Republic of Germany.

Noting

that this station is the only research effort in the Federal Republic of Germany devoted entirely to atmospheric electricity and *noting* that their effort comprises a significant contribution to the determination of the global distribution of ionospheric potentials as well as an important contribution to the international thunderstorm program

recommends

that high priority be given to continue operation of the Weissenau research group in the interest of long term, internationally cooperative research commitments.

7. Need for Climatic Data from the South Polar Region

The International Commission on Polar Meteorology, *noting*

the increasing scientific and practical importance given to the accurate description of climatic characteristics, to the monitoring of change in climate, and the increasing emphasis given by many nations to the need for understanding of climatic processes, and *recognizing*

that full and complete information about climatic elements accessible to scientists of all nations is essential to effective and economical description of climate and research on climatic processes or variations, and *recognizing further*

that World Data Centers have been established for the reception, archiving and ready dissemination of climatic data, but *being aware*

that there are serious gaps in the past and current climatic data concerning the south polar regions in the information available from the World Data Centers and that these gaps inhibit scientific research and the formulation of responsible decisions affecting the solar polar regions, the ICPM *urges*

that all countries make vigorous efforts to provide the World Data Centers with all climatic and other meteorological/hydrometeorological data concerning the south polar regions, which they have obtained in the past and are presently obtaining; and that they continue to provide promptly to the World Data Centers all climatic data obtained from future programs.

8. MAP

IAMAP endorses the continued planning of the Middle Atmosphere Program (MAP) by the Interim Steering Committee being established in SCOSTEP. IAMAP recommends to IUGG to support conversion of SCOSTEP into a scientific Committee of ICSU for Solar Terrestrial Programs in order to provide long-term planning and administrative support to such international, multi-Union programs as MAP.

9. Administrative Resolution

IAMAP warmly welcomes, within the spirit of the ICSU principle of the universality

of science, the full participation of our scientific colleagues of the People's Republic of China in the IUGG and its Associations, and expresses the hope that within the same ICSU principle of universality steps will continue to be investigated to assure the future full participation in IUGG and its Associations by our scientific colleagues located in Taiwan. IAMAP urges the IUGG to take all steps possible to invite scientists located in Taiwan to the next IUGG General Assembly, Canberra, December 1979.

10. Joint Resolutions of Thanks (The text is the same as shown on p. 52)

OPEN MEETING ON THE MIDDLE ATMOSPHERE PROGRAM (MAP)

The open meeting on MAP was arranged on 30 August 1977 for all interested persons attending the IAGA-IAMAP Joint Assembly in Seattle (21 August–3 September 1977). Professor S. A. Bowhill (Chairman of SCOSTEP Steering Committee for Atmospheric Physics Programs), Dr. John B. Gregory (Convener of the SCOSTEP inter-Union Planning Group for MAP), and Dr. E. R. Dyer (Secretary of SCOSTEP) organized the meeting. Prof. Bowhill presided at the meeting, which was attended by about 120 persons.

MAP was described as a proposed internationally coordinated program to study the structure, chemistry, energetics, and dynamics of the stratosphere and mesosphere regarded as a unitary global physical system (here called the Middle Atmosphere), combining theoretical modelling with observations made with all available techniques (ground-based, balloons, aircraft, rockets, spacecraft) and concentrating on the first half of the 1980's.

1. SCOSTEP

Professor K. D. Cole, newly elected President of the ICSU Special Committee on Solar-Terrestrial Physics (SCOSTEP) briefly reviewed what SCOSTEP is, what its objectives and methods of working are, etc. SCOSTEP's chief responsibilities include the promotion, organization, and coordination of international programs, the scientific objectives of which cut across the interests of more than one of the International Scientific Unions (usually three or four) and the carrying out of which involves research efforts in a large number of countries. To achieve these goals, SCOSTEP's Bureau (executive committee) includes the representatives of IAU, IUGG/IAGA, IUGG/IAMAP, IUPAP, URSI, and COSPAR. SCOSTEP also has 15 scientific discipline members, each an expert in some field of solar-terrestrial physics (STP), members representing the World Data Centres and other organizations, etc. It relies on national committees and correspondents in nearly 50 countries for detailed advice on the implementation of its programs, financial support, and contact with the STP community in each country. SCOSTEP creates ad hoc working or study groups to plan its programs. When plans have reached a sufficiently advanced stage of development, they are circulated to the international scientific bodies concerned and to national STP contacts for review, comment, expressions of support, etc. When a program is ready to be converted from a plan on paper to a working reality, the study group is replaced by an operationally oriented steering committee to work out the practical details. MAP has now reached this stage. (See *STP Notes* for further information on SCOSTEP's goals and operations.)

2. History of MAP

Dr. John B. Gregory described the development of MAP, beginning with the seed of an idea dating back to 1971–72, when an ad hoc group under Professor Dr. E. A. Lauter drafted the first outline at a working meeting of SCOSTEP. The first planning document is reprinted in *STP Notes 12*, pp. 38–42; in this early version the proposed

program was called SESAME (for Structure and Energetics of the Stratosphere and Mesosphere). With the resignation of Lauter from SCOSTEP in 1974, Gregory assumed responsibility for further development of the plan and led what later became known as the MAP Planning Group, operating under SCOSTEP auspices. The program's designation was changed from SESAME to MAP in 1975 because, in the meanwhile, another atmospheric program with the designation SESAME had begun, and the risk of confusion was too great. A nucleus of the MAP Planning Group met at the COSPAR Meeting in Varna, Bulgaria, in June 1975, and drafted a succinct restatement of MAP's goals. During the following weeks this restatement was revised in direct consultation with COSPAR and by correspondence with the approximately 20 members of the MAP Planning Group representing the other interested bodies. By September 1975 the revised MAP statement had been endorsed with varying degrees of formality by SCOSTEP, COSPAR, URSI, IAGA, IAMAP, and IUGG.

In June 1976, a MAP Planning Conference was convened at the University of Illinois under SCOSTEP sponsorship, with the cooperation of URSI, IAMAP, IAGA, and others. It was attended by more than a hundred experts, some representing the above-named bodies and WMO. The Conference also benefitted from about 300 responses (26 countries) to a questionnaire mailed to interested members of the world scientific community. Gregory cited some statistics from the questionnaire. The output of the June 1976 MAP Planning Conference was the *MAP Planning Document* which deals with theoretical problems and modelling, types of program by technique, specific proposals to deal with chemistry and structure, radiation, motions on all scales, etc., and applications to practical problems.

3. MAP Planning Conference

Prof. Bowhill described in detail the organization of the June 1976 MAP Planning Conference, of which he was Chairman; Dr. C. F. Sechrist was responsible for local organization. The participants had before them position papers prepared in advance on different aspects of the middle atmosphere. After an opening plenary session to set the stage, six working groups were formed (corresponding to the six main chapters of the report), three of which met the second day and three the third. At a closing plenary on the fourth day the six reports were presented, discussed, and approved subject to details being worked out by mail before publication as the *MAP Planning Document*. Bowhill noted that the Document should still be considered preliminary, and invited all interested persons to suggest changes, additions, etc., that might improve it.

4. Status Report on MAP Organization

As Secretary of SCOSTEP, Dr. Dyer reported on the organizational plans proposed by SCOSTEP, now almost complete. In June–July 1976, SCOSTEP proposed the creation of an interim inter-Union Steering Committee for MAP to operate under SCOSTEP auspices, with responsibilities not only for looking after and updating the scientific goals as necessary, but also for developing contacts with the government agencies and major research institutions that would be carrying out the actual work. The Steering Committee would use existing mechanisms or establish new ones, if necessary, for coordination of observing schedules, data collection and exchange, and other practical matters. At the time of the meeting, the following organizations had been asked for expressions of

interest in cooperating in MAP and, if they were interested, to appoint one or two members to the proposed interim Steering Committee: COSPAR, IAGA/IUGG, IAMAP/IUGG, URSI, IAU, IUPAP, and WMO (for liaison purposes). SCOSTEP had appointed Prof. Bowhill as Chairman and Dr. Gregory as member, COSPAR had appointed three members, and WMO a liaison member (Dr. R. Bojkov); IAGA and IAMAP had the matter under favorable consideration; and URSI and IAU had expressed interest.

The MAP Steering Committee is designated "interim" because SCOSTEP, which is tentatively scheduled to be dissolved at the end of 1980, cannot formally assume responsibility after that date. If, however, most of the Unions and National Adherents that are members of SCOSTEP agree that SCOSTEP should continue to be responsible for MAP and other organized international interdisciplinary programs after 1980, the International Council of Scientific Unions would extend SCOSTEP long enough to take care of them.

5. WMO Interest

Dr. R. Bojkov, Chief of Atmospheric Sciences Division of the WMO Secretariat, noted that WMO will continue to follow MAP with great interest, and through its Commission on Atmospheric Science (CAS) will undertake a careful review of what is already happening. WMO is already involved in some activities related to the goals of MAP (for instance, the Ozone Network) and is interested in complementing MAP in similar ways. Dr. G. W. Boville is the CAS rapporteur for MAP.

6. Remarks on the MAP Planning Document

Dr. L. Thomas, Chairman of the MAP Planning Conference Working Group on Composition and Structure (Chapter 5 of the planning document), Dr. J. C. Gille, Chairman of the Working Group on Radiation (Chapter 7), and Dr. M. A. Geller, member of the Working Group on Motions (Chapter 6), respectively reviewed those chapters, highlighted principal recommendations and suggested ways in which their content might be improved.

7. Miscellaneous Topics

Dr. Warren Berning presented some early planning for rocket observations of the reaction of the middle atmosphere to the solar eclipse of February 1979 (path from the Pacific through the northwestern USA and Canada to Hudson Bay, with the eclipsed sun low in the sky). The emphasis will be on ion chemistry (especially negative ions) and related questions. Berning was looking for coordination with rocket launches planned in Montana and Western Ontario.

Several speakers noted a need for cooperation and coordination in studies of noctilucent clouds, stratospheric-mesospheric interactions, drift measurements, the meteor zone, infrasound waves, and atmospheric electricity, none of which is adequately covered in the Planning Document.

8. Informal National Reports

A number of impromptu and hence highly informal reports on MAP-related work in progress or planned in several countries were made by unofficial spokesmen for those countries or their major institutions. Since these programs will be reported in detail in due course, the informal reports will be only listed here in the order in which they were given. These were:

USSR: Dr. A. D. Danilov
USA: Drs. Feynman, Telarsky, Ferguson, and others
Japan: Dr. T. Tohmatsu
Germany, F. R.: Dr. U. von Zahn
UK: Dr. L. Thomas
France: Dr. G. M. Weill
New Zealand: Dr. W. J. Raitt
Canada: Dr. J. B. Gregory

(E. R. Dyer, Jr.)

PARTICIPANTS OF THE IAGA ASSEMBLY

The country names in the parentheses in the following list are those where the participants' affiliated organizations at the time of the IAGA Assembly are located, regardless of the nationalities of the participants.

Ackerman, M. (Belgium)
Afanasjeva, L. T. (U.S.S.R.)
Aitken, M. (U.K.)
Ajakaiye, D. E. (Nigeria)
Akasofu, S.-I. (U.S.A.)
Alldredge, L. R. (U.S.A.)
Allen, J. H. (U.S.A.)
Amerigian, C. (U.S.A.)
Anderson, D. (U.S.A.)
Anderson, H. R. (U.S.A.)
Anger, C. D. (Canada)
Armstrong, R. J. (Norway)
Arnold, F. (FR Germany)
Arnoldy, R. (U.S.A.)
Arthur, C. W. (U.S.A.)
Ashour, A. A. (Egypt)
Ashour-Abdalla, M. (U.S.A.)
Atkinson, G. (Canada)
Awe, O. (Nigeria)

Babcock, Jr., R. R. (U.S.A.)
Baker, K. D. (U.S.A.)
Banerjee, S. K. (U.S.A.)
Banks, P. M. (U.S.A.)
Barfield, J. N. (U.S.A.)
Barker, F. S. (U.S.A.)
Barlier, F. (France)
Barraclough, D. R. (U.K.)
Barth, C. A. (U.S.A.)
Bates, D. R. (U.K.)
Bates, H. F. (U.S.A.)
Bates, J. R. (Ireland)
Battaner, E. (Spain)
Bauer, P. (France)
Bauer, S. J. (U.S.A.)
Baumjohann, W. (FR. Germany)
Beck, Jr., M. (U.S.A.)
Behannon, K. W. (U.S.A.)
Benesch, W. (U.S.A.)
Bering, E. A. (U.S.A.)
Berkey, F. T. (Canada)
Bernhardt, P. A. (U.S.A.)
Bertaux, J. L. (France)
Bertin, F. (France)
Beske-Diehl, S. (U.S.A.)
Bhargava, B. N. (India)
Bina, M. M. (Iran)
Björn, L. (Sweden)
Blanc, M. (France)
Bleil, U. (FR. Germany)
Block, L. P. (Sweden)
Boerner, W.-M. (Canada)
Bonhommet, N. (France)
Booker, J. R. (U.S.A.)
Boström, R. (Sweden)
Bowhill, S. A. (U.S.A.)
Brace, L. H. (U.S.A.)
Brasseur, G. (Belgium)
Brekke, A. (Norway)
Brewitt-Taylor, C. R. (U.K.)
Brock, A. (Lesotho)
Broussard, R. M. (U.S.A.)
Bucha, V. (Czechoslovakia)
Burch, J. L. (U.S.A.)
Burlaga, L. F. (U.S.A.)
Busse, F. (U.S.A.)
Butler, D. M. (U.S.A.)

Caan, M. (U.S.A.)
Cahill, Jr., L. J. (U.S.A.)

Cain, J. C. (U.S.A.)
Calderon, C. (Peru)
Campbell, M. (U.S.A.)
Campbell, W. H. (U.S.A.)
Cande, S. C. (U.S.A.)
Candidi, M. (U.S.A.)
Cardus, J. O. (Spain)
Carlson, C. (U.S.A.)
Carlson, H. (U.S.A.)
Carlson, R. W. (U.S.A.)
Carmichael, C. M. (Canada)
Carmichael, R. S. (U.S.A.)
Carovillano, R. L. (U.S.A.)
Cartwright, D. C. (U.S.A.)
Castleman, Jr., A. W. (U.S.A.)
Chan, G-H. (Canada)
Chernosky, E. J. (U.S.A.)
Chiu, Y. T. (U.S.A.)
Christensen, A. B. (U.S.A.)
Christon, S. P. (U.S.A.)
Cisowski, S. M. (U.S.A.)
Cladis, J. B. (U.S.A.)
Clark, K. C. (U.S.A.)
Clark, R. R. (U.S.A.)
Clauer, C. R. (U.S.A.)
Cochrane, N. A. (Canada)
Coffey, H. (U.S.A.)
Cole, K. D. (Australia)
Coles, W. A. (U.S.A.)
Conkright, R. (U.S.A.)
Cox, A. (U.S.A.)
Cox, C. S. (U.S.A.)
Creer, K. M. (U.K.)
Crooker, N. U. (U.S.A.)
Crutzen, P. J. (U.S.A.)

Daily, W. D. (U.S.A.)
Damaske, D. (FR. Germany)
Danilov, A. D. (U.S.S.R.)
Davis, Jr, L. (U.S.A.)
Davis, T. N. (U.S.A.)
Dawson, E. (Canada)
Dawson, T. W. (Canada)
Day, R. (U.S.A.)
De Godoy, R. C. (Brasil)
de la Beaujardiere, O. (U.S.A.)
Degen, V. (U.S.A.)
Dengler, L. (U.S.A.)
Dessler, A. J. (U.S.A.)
Deutsch, E. R. (Canada)
Devane, J. F. (U.S.A.)
Dickinson, R. E. (U.S.A.)
Didwall, E. M. (U.S.A.)
Diehl, J. F. (U.S.A.)
Dobrowolny, M. (Italy)
Dolezalek, H. (U.S.A.)
Dosso, H. W. (Canada)
Doupnik, J. R. (U.S.A.)
Duba, A. (U.S.A.)
Dubois, R. L. (U.S.A.)
Dudeney, J. R. (U.K.)
Duewer, W. H. (U.S.A.)
Dunlop, D. J. (Canada)
Dusenbery, P. B. (U.S.A.)
Dyer, Jr., E. R. (U.S.A.)
Dyson, P. L. (Australia)

Eleman, F. (Sweden)
Emery, B. A. (France)
Engebretson, D. C. (U.S.A.)
Essex, E. A. (Australia)
Evans, D. S. (U.S.A.)
Evans, J. V. (U.S.A.)
Evans, T. (Canada)
Eymard, L. (France)

Fabiano, E. B. (U.S.A.)
Fälthammar, C-G. (Sweden)
Fejer, B. (U.S.A.)
Feldman, W. C. (U.S.A.)
Fennell, J. F. (U.S.A.)
Ferguson, E. E. (U.S.A.)
Feynman, J. (U.S.A.)
Filloux, J. H. (U.S.A.)
Fischer, G. (Switzerland)
Fogle, B. (U.S.A.)
Fontheim, E. G. (U.S.A.)
Foster, J. C. (U.S.A.)
Fougere, P. F. (U.S.A.)
Fraser, B. J. (Australia)
Freeman, J. W. (U.S.A.)
Fremouw, E. (U.S.A.)

Friis-Christensen, E. (Denmark)
Frischknecht, F. (U.S.A.)
Fritz, T. A. (U.S.A.)
Frohlich, R. K. (U.S.A.)
Fukunishi, H. (Japan)
Fukushima, N. (Japan)
Fuller, M. (U.S.A.)

Gadsden, M. (U.K.)
Galperin, Yu. I. (U.S.S.R.)
Garrett, H. B. (U.S.A.)
Gendrin, R. (France)
Gerard, J. C. (Belgium)
Ghielmetti, A. (U.S.A.)
Gilliland, J. M. (Canada)
Glasgow, L. (U.S.A.)
Glass, M. (France)
Goldberg, R. A. (U.S.A.)
Gombosi, T. I. (Hungary)
Gonzales, C. (U.S.A.)
Goree, W. S. (U.S.A.)
Gosling, J. T. (U.S.A.)
Gramling, F. (U.S.A.)
Green, A. (U.S.A.)
Green, J. L. (U.S.A.)
Green, V. R. (Canada)
Green, Jr., A. W. (U.S.A.)
Greenstadt, E. W. (U.S.A.)
Greenwald, R. A. (FR. Germany)
Gringauz, K. I. (U.S.S.R.)
Grobecker, A. (U.S.A.)
Gromme, S. (U.S.A.)
Grossi, M. D. (U.S.A.)
Gruenwaldt, H. (FR. Germany)
Gubbins, D. (U.K.)
Guntur, P. (Canada)
Gurnett, D. A. (U.S.A.)

Haerendel, G. (FR. Germany)
Haeusler, B. (FR. Germany)
Hahn, A. G. (FR. Germany)
Hahn, J. (U.S.A.)
Hailwood, E. A. (U.K.)
Hale, L. C. (U.S.A.)
Halgedahl, S. (U.S.A.)
Halls, H. C. (Canada)
Hampson, J. (Canada)
Hanson, W. B. (U.S.A.)
Harel, M. (U.S.A.)
Harmon, J. K. (U.S.A.)
Harper, R. M. (U.S.A.)
Hayashi, K. (Canada)
Heacock, R. R. (U.S.A.)
Heaps, M. G. (U.S.A.)
Heckman, G. R. (U.S.A.)
Hedgecock, P. (U.K.)
Hedin, A. E. (U.S.A.)
Heelis, R. A. (U.S.A.)
Heikkila, W. J. (U.S.A.)
Heinz, O. (U.S.A.)
Heirtzler, J. R. (U.S.A.)
Helliwell, R. A. (U.S.A.)
Helsley, C. E. (U.S.A.)
Hernandez, G. (U.S.A.)
Hibberd, F. (Australia)
Hillhouse, J. W. (U.S.A.)
Hinteregger, H. E. (U.S.A.)
Hinton, G. F. (U.S.A.)
Hobbs, B. A. (U.K.)
Hoegy, W. R. (U.S.A.)
Hoffman, J. H. (U.S.A.)
Hoffman, K. (U.S.A.)
Holzworth, R. (U.S.A.)
Hones, Jr, E. W. (U.S.A.)
Hood, P. (Canada)
Horita, R. E. (Canada)
Hruska, A. (Canada)
Hudson, M. K. (U.S.A.)
Hudson, R. (U.S.A.)
Hughes, A. (South Africa)
Hughes, W. J. (U.K.)
Hultqvist, B. (Sweden)
Hung, R. J. (U.S.A.)
Hunten, D. M. (U.S.A.)
Hutton, V. R. S. (U.K.)

Iijima, T. (Japan)
Imhof, W. L. (U.S.A.)
Intriligator, D. S. (U.S.A.)
Irving, E. (Canada)
Işikara, A. M. (Turkey)
Itoh, T. (Japan)

Iufer, E. J. (U.S.A.)
Iversen, I. B. (Denmark)

Jamsonov, V. (U.S.S.R.)
Jean, G. (U.S.A.)
Johnson, B. D. (Australia)
Johnson, F. S. (U.S.A.)
Johnson, R. G. (U.S.A.)
Johnston, M. J. S. (U.S.A.)
Johnstone, A. D. (U.K.)
Jones, D. (Netherlands)
Jones, M. (U.S.A.)
Jones, T. (U.K.)
Jørgensen, T. S. (Denmark)
Jozef, H. (Belgium)

Kaiser, M. L. (U.S.A.)
Kamei, T. (U.S.A.)
Kamide, Y. (U.S.A.)
Kamiyama, H. (Japan)
Kane, R. P. (India)
Kataja, E. I. (Finland)
Kato, S. (Japan)
Kato, Y. (Japan)
Kaufman, F. (U.S.A.)
Kawasaki, K. (Canada)
Kazimirovsky, E. (U.S.S.R.)
Keating, B. H. (U.S.A.)
Keesee, R. G. (U.S.A.)
Keller, H. U. (FR. Germany)
Kellogg, P. J. (U.S.A.)
Kelly, J. (U.S.A.)
Kelly, M. C. (U.S.A.)
Kent, D. V. (U.S.A.)
Khantadze, A. G. (U.S.S.R.)
Khocholava, G. M. (U.S.S.R.)
Kim, J. S. (U.S.A.)
King, J. W. (U. K.)
Kintner, P. M. (U.S.A.)
Kitamura, T-I. (Japan)
Kivelson, M. G. (U.S.A.)
Kleimenova, N. G. (U.S.S.R.)
Klumpar, D. (U.S.A.)
Knudsen, W. C. (U.S.A.)
Köhnlein, W. (FR. Germany)
Kolawole, L. B. (Sweden)
Kosik, J. C. (France)
Krankowsky, D. (FR. Germany)
Krishna, V. S. (U.S.A.)
Kroehl, H. W. (U.S.A.)
Kroemer, G. (Austria)
Krutikhovskaya, Z. A. (U.S.S.R.)
Kubo, H. (Japan)
Kuhn, W. (U.S.A.)
Kumar, S. (U.S.A.)
Küppers, F. (FR. Germany)
Kuwahara, R. (Canada)

Laird, M. (U.K.)
Lämmerzahl, P. (FR. Germany)
Langel, R. A. (U.S.A.)
Lanzerotti, L. J. (U.S.A.)
Larsen, J. C. (U.S.A.)
Larsen, S. (Denmark)
Lassen, K. (Denmark)
Lauridsen, E. K. (Denmark)
Law, L. K. (Canada)
Lazarus, A. J. (U.S.A.)
Leaton, B. R. (U.K.)
LeMaire, J. (Belgium)
Lennartsson, W. (Sweden)
Leverenz, H. (U.S.A.)
Levine, J. S. (U.S.A.)
Levine, R. H. (U.S.A.)
Likhite, S. D. (India)
Lin, C. S. (U.S.A.)
Lincoln, J. V. (U.S.A.)
Lowe, R. P. (Canada)
Lowes, F. J. (U.K.)
Lowrie, W. (Switzerland)
Lucien, B. (Belgium)
Lucien, D. (France)
Luhmann, J. (U.S.A.)
Lund, S. P. (U.S.A.)
Lundin, R. (Sweden)
Lyatskaya, A. M. (U.S.S.R.)
Lyons, L. R. (U.S.A.)

MacDougall, J. W. (Canada)
Maeda, H. (Japan)
Maggs, J. E. (U.S.A.)
Maher, L. J. (U.S.A.)

Maltseva, N. F. (U.S.S.R.)
Mambo, M. (Japan)
Mange, P. (U.S.A.)
Manka, R. H. (U.S.A.)
Mantas, G. (U.S.A.)
Maple, E. (U.S.A.)
Mareschal, M. (Canada)
Mariani, F. (Italy)
Marov, M. Ya. (U.S.S.R.)
Matsushita, S. (U.S.A.)
Mayaud, P. N. (France)
Mayhew, M. A. (U.S.A.)
Mayr, H. G. (U.S.A.)
McAfee, J. R. (U.S.A.)
McClure, J. P. (U.S.A.)
McCormac, B. (U.S.A.)
McDiarmid, D. R. (Canada)
McElhinny, M. W. (Australia)
McEntire, R. W. (U.S.A.)
McPherron, R. L. (U.S.A.)
Meek, C. E. (Canada)
Megie, G. (France)
Megill, L. R. (U.S.A.)
Mehta, N. C. (U.S.A.)
Merrill, R. T. (U.S.A.)
Meyers, H. (U.S.A.)
Miles, T. J. (Canada)
Mitchell, J. D. (U.S.A.)
Mitra, A. P. (India)
Mizera, P. F. (U.S.A.)
Moe, K. (U.S.A.)
Montierth, K. (U.S.A.)
Moraal, H. (South Africa)
Moravcsik, M. J. (U.S.A.)
Morgan, G. E. (U.K.)
Morgan, M. G. (U.S.A.)
Morse, F. A. (U.S.A.)
Moskowitz, B. (U.S.A.)
Mullaney, H. (U.S.A.)
Muller, C. (U.S.A.)
Mundt, W. (DR Germany)
Murphree, J. S. (Canada)
Murphy, J. (U.S.A.)
Murthy, G. S. (Canada)
Murty, C. R. K. (India)
Mustel, E. R. (U.S.S.R.)

Nadubovich, Y. A. (U.S.S.R.)
Nagata, T. (Japan)
Nagy, A. (U.S.A.)
Najita, K. (U.S.A.)
Nakano, G. H. (U.S.A.)
Nerney, S. (U.S.A.)
Ness, N. F. (U.S.A.)
Neubauer, F. M. (FR. Germany)
Neugebauer, M. (U.S.A.)
Nevanlinna, H. (Finland)
Niblett, E. R. (Canada)
Nicolet, M. (Belgium)
Nielsen, E. (FR. Germany)
Nielsen, H. C. S. (U.S.A.)
Nienaber, W. (Canada)
Niestroj, B. (FR. Germany)
Niitsuma, N. (Japan)
Niles, F. E. (U.S.A.)
Nisbet, J. S. (U.S.A.)
Nishida, A. (Japan)
Nordemann, D. (France)
Novikov, A. M. (U.S.S.R.)

Offermann, D. (FR. Germany)
Ogilvie, K. W. (U.S.A.)
Ogunade, S. (Nigeria)
Oguti, T. (Japan)
Okano, S. (U.S.A.)
Okuzawa, T. (Japan)
Olson, J. (Canada)
Olson, W. P. (U.S.A.)
Oni, E. (Nigeria)
Onwumechili, C. A. (Nigeria)
Opdyke, N. D. (Australia)
Oran, E. (U.S.A.)
Orr, D. (U.K.)
Otaola, J. A. (Mexico)
Oya, H. (Japan)
Özdogan, I. (Turkey)

Palmadesso, P. (U.S.A.)
Palmer, D. (U.S.A.)
Palmer, H. C. (Canada)
Park, C. G. (U.S.A.)
Park, J. H. (U.S.A.)
Parkinson, W. D. (Australia)

Parks, G. K. (U.S.A.)
Paschmann, G. (FR. Germany)
Pastiels, R. (Belgium)
Paulikas, G. (U.S.A.)
Paulishak, W. (U.S.A)
Pearce, G. W. (Canada)
Peddie, N. W. (U.S.A.)
Pedersen, A. (Netherlands)
Pepin, T. J. (U.S.A.)
Perreault, P. D. (U.S.A.)
Pesonen, L. J. (Canada)
Peterson, W. K. (U.S.A.)
Petit, M. (France)
Petitdidier, M. (France)
Pfitzer, K. A. (U.S.A.)
Phillips, R. J. (U.S.A.)
Pilipp, W. G. (FR. Germany)
Pisharoty, P. R. (India)
Plaxine, V. (U.S.S.R.)
Pneuman, G. W. (U.S.A.)
Poppoff, I. G. (U.S.A.)
Potemra, T. A. (U.S.A.)
Prange, R. (France)
Prasad, J. S. (U.S.A.)
Prevot, M. (France)
Prisco, R. A. (U.S.A.)
Pushkov, A. N. (U.S.S.R.)
Pytte, T. (Norway)

Radoski, H. (U.S.A.)
Raitt, W. J. (U.S.A.)
Raja, P. K. S. (Kenya)
Rajaram, R. (India)
Ramakrishna, S. (India)
Rao, K. V. (Canada)
Rastogi, R. G. (India)
Rawer, K. (FR. Germany)
Reagan, J. B. (U.S.A.)
Reber, C. A. (U.S.A.)
Rees, M. H. (U.S.A.)
Regan, R. D. (U.S.A.)
Reid, G. C. (U.S.A.)
Reid, J. S. (Australia)
Reiff, P. H. (U.S.A.)
Revol, J. (U.S.A.)
Rhodes, Jr., E. J. (U.S.A.)
Richards, M. L. (U.K.)
Richmond, A. D. (U.S.A.)
Riesebieter, W. (FR Germany)
Rigotti, P. (U.S.A.)
Rino, C. L. (U.S.A.)
Roberts, P. H. (U.K.)
Roble, R. G. (U.S.A.)
Roeder, J. L. (U.S.A.)
Roederer, J. G. (U.S.A.)
Rogers, J. (U.S.A.)
Romick, G. J. (U.S.A.)
Roper, R.G. (U.S.A.)
Rosenberg, T. J. (U.S.A.)
Ross, D. (Canada)
Rostoker, G. (Canada)
Rothwell, P. (U.K.)
Roy, J. L. (Canada)
Runcorn, S. K. (U.K.)
Rusch, D. W. (U.S.A.)
Russell, C. T. (U.S.A.)
Rycroft, M. J. (U.K.)

Saflekos, N. A. (U.S.A.)
Sagan, C. (U.S.A.)
Sakurai, T. (Japan)
Samsonov, V. P. (U.S.S.R.)
Sanderson, T. R. (Netherlands)
Sastry, T. S. G. (India)
Sato, T. (Japan)
Sauer, H. (U.S.A.)
Sawyer, C. (U.S.A.)
Sayigh, A. A. M. (Saudi Arabia)
Sayre, B. (U.K.)
Scherrer, P .H. (U.S.A.)
Schiff, H. I. (Canada)
Schmeltekopf, A. L. (U.S.A.)
Schmidt, V. A. (U.S.A.)
Schmucker, U. (FR. Germany)
Schonstedt, E. (U.S.A.)
Schulz, M. (U.S.A.)
Schunk, R. W. (U.S.A.)
Schwartz, R. (U.S.A.)
Schwarz, E. J. (Canada)
Schwenn, R. (FR. Germany)
Scourfield, M. W. J. (South Africa)
Sechrist, Jr., C. F. (U.S.A.)

Segawa, J. (Japan)
Selzer, E. (France)
Serson, P. H. (Canada)
Shapiro, M. A. (U.S.A.)
Shapiro, V. A. (U.S.S.R.)
Shapley, A. H. (U.S.A.)
Sharp, R. D. (U.S.A.)
Shawhan, S. D. (U.S.A.)
Sheeley, Jr, N. R. (U.S.A.)
Sheldon, W. R. (U.S.A.)
Shelley, E. G. (U.S.A.)
Shepherd, G. G. (Canada)
Shimazaki, T. (U.S.A.)
Simon, P. (France)
Simon, P. C. (Belgium)
Singer, H. J. (U.S.A.)
Siscoe, G. L. (U.S.A.)
Skinner, N. J. (Kenya)
Smirnov, V. (U.S.S.R.)
Smith, A. (U.K.)
Smith, B. E. (U.S.A.)
Smith, E. J. (U.S.A.)
Smith, E. W. (U.S.A.)
Smith, L. G. (U.S.A.)
Smith, P. H. (U.S.A.)
Smith, R. E. (U.K.)
Solomon, J. (France)
Sonett, C. P. (U.S.A.)
Soraas, F. (Norway)
Southwood, D. J. (U.K.)
Soward, A. M. (U.K.)
Spencer, N. W. (U.S.A.)
Spiro, R. W. (U.S.A.)
Spjeldvik, W. N. (U.S.A.)
Spreiter, J. R. (U.S.A.)
Srivastava, B. J. (India)
Srivastava, S. P. (Canada)
Srnka, L. (U.S.A.)
Stadsnes, J. (Norway)
Stansbery, E. (U.S.A.)
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