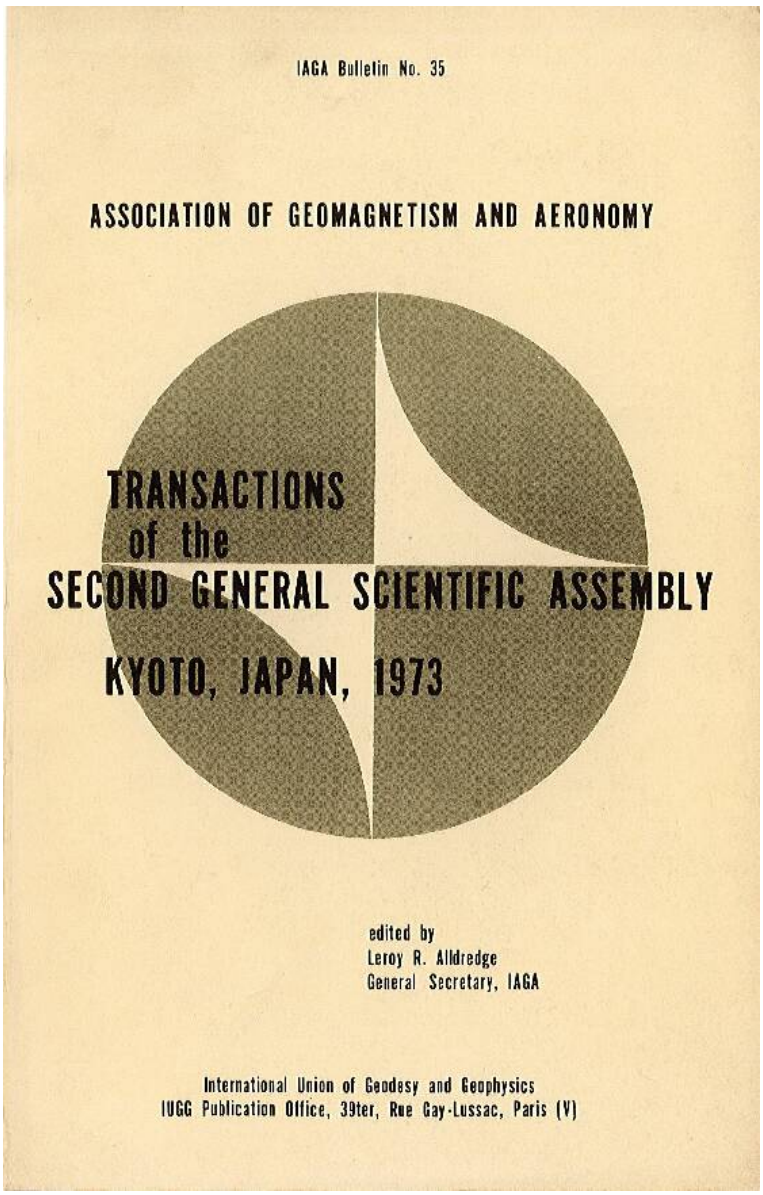
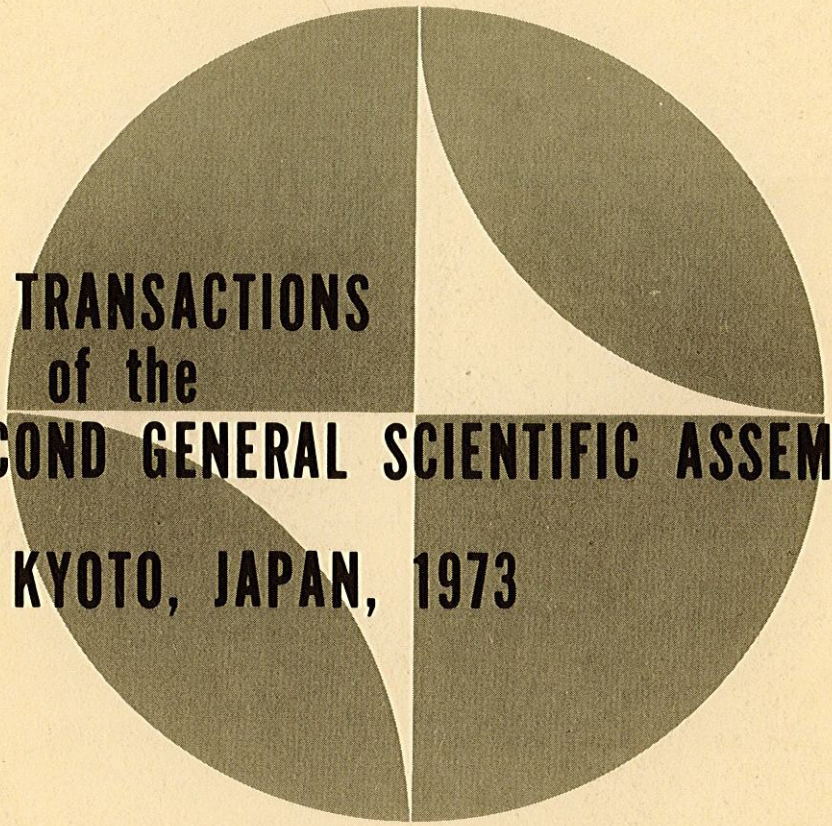


How to cite:

IAGA (1973). ***IAGA Bulletin No. 35, Transactions of the Second General Scientific Assembly, Kyoto, Japan, 1973.*** **IUGG Publications Office. https://doi.org/10.25577/0cwm-0d55**

IAGA Bulletin No. 35

ASSOCIATION OF GEOMAGNETISM AND AERONOMY



TRANSACTIONS of the SECOND GENERAL SCIENTIFIC ASSEMBLY KYOTO, JAPAN, 1973

edited by
Leroy R. Alldredge
General Secretary, IAGA

International Union of Geodesy and Geophysics
IUGG Publication Office, 39ter, Rue Gay-Lussac, Paris (V)

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Transactions Of The

Second General Scientific Assembly, IAGA

Leroy Alldredge, Editor

Introduction

The International Association of Geomagnetism and Aeronomy (IAGA) held its Second General Scientific Assembly in Kyoto, Japan, on 9-21 September 1973, as the guests of the Science Council of Japan.

In total, 613 scientists from 38 countries registered for the assembly. There were 766 papers presented.

Although the assembly was advertized as a scientific one, it was decided that the matter of reorganizing IAGA was of the utmost importance and could not wait another two years. For this reason, as can be seen several places in these transactions, the subject or reorganization was given considerable attention during the assembly.

Acknowledgments

The local Organizing Committee were

Honorary Chairman:	T. Nagata
Chairman:	T. Rikitake
Secretaries:	N. Fukushima
	T. Obayashi
	H. Maeda
Associate Secretary:	T. Yukutake

All sessions were held in the beautiful Kyoto International Conference Hall.

Sincere appreciation is given to Chairmen T. Nagata and T. Rikitake and their committee who made the visit to Japan a truly memorable occasion. IAGA is also grateful for the secretarial services and facilities provided by the local committee. N. Fukushima was particularly helpful to the IAGA Secretariat during the assembly in his dual position of secretary of the Local Organizing Committee and as Adjoint Secretary of IAGA.

The many conveners of Special Symposia and the Commission Chairmen, Cochairmen, and Reporters who helped with the planning of the program deserve special commendation

It is a pleasure to especially recognize the good work done by the Finance Committee of the Local Organizing Committee under the direction of Chairmen T. Nagata. This committee raised a substantial contribution to hold a well-organized assembly in Kyoto. It is also worth noting the effort to invite the delegates from the IUGG member countries in the Western Pacific area.

Opening Plenary Session

The opening IAGA plenary session was called to order at 1300h on Monday, 10 September, in the Main Hall at the Kyoto International Conference Hall. Dr. T. Rikitake, chairman of the local organizing committee, introduced the speakers and acted as master of ceremonies.

Welcoming Addresses

T. Nagata, Honorary Chairman of the Organizing Committee and Past President of IAGA.

Madam President, Honorable Guests, Ladies and Gentlemen:

On behalf of the Japanese Organizing Committee for the Second General Scientific Assembly of the International Association of Geomagnetism and Aeronomy, I have the honor to extend our cordial welcome to all of you, especially to those who have come a long way from various countries abroad, to this old town, Kyoto in Japan.

When the Executive Committee of IAGA met in Leningrad in 1970 to discuss where and when the Second General Scientific Assembly of IAGA should be held, the majority of the executive members expressed their preference of Japan. So, I said, "OK, The Japanese National Committee will seriously consider your kind invitation on this matter." Then I asked, "If the Science Council of Japan could accept your invitation to be the host of the next general scientific assembly, we may have a choice of the town for your convention, either Tokyo or Kyoto. Which do you prefer?" The unanimous reply to my question was "No doubt to be Kyoto". So, now, here we are in Kyoto!

I would like to remind you at this opportunity that, just 12 years ago, September 1961, we had the honor to be the host in this same town for the International Conference on Cosmic Rays and the Earth Storm. I am sure that tremendous progresses have been achieved since that time in our scientific territory which covers geomagnetism and aeronomy, including the cosmic rays and the earth's storms; however, I do not feel any necessity to emphasize a scientific significance of this assembly. I would rather like to suggest that you enjoy your Kyoto life whenever possible in this old and relatively quiet Japanese town. In one of Japanese proverbs to young people, it is said that "to be a good boy, study hard and then play in the best way". I believe that Kyoto is a very nice place for both studies and play. Further, I believe that this is the very reason why the IAGA Executive Committee strongly recommended Kyoto for the conference place. So, my last words would be "good luck for both your science and pleasure in Kyoto".

Editor's Note:

It should be noted that at the beginning of the session and at the end lovely Koto music of Japan was played by Japanese ladies dressed in the traditional kimono.

The official opening plenary session ended about 1430h, but at 1800h, after two hours of scientific sessions, a delightful welcoming reception was staged in and on the grounds of the Conference Hall. A great variety of delicious Japanese food was available. The finale consisted of a very spectacular fireworks display that will long be remembered by the participants.

Y. Ochi, President of the Science Council of Japan

Distinguished Guests, Ladies and Gentlemen:

It is a great pleasure and honor for me to greet you all on behalf of the Science Council of Japan, on the occasion of the opening of the Second General Scientific Assembly of the International Association of Geomagnetism and Aeronomy. First of all, I wish to extend my heartiest welcome, in the name of scientists in Japan, to the Vice President and General Secretary of the International Union of Geodesy and Geophysics, to the President and members of the Executive Committee of the International Association of Geomagnetism and Aeronomy, and to the fellow scientists who have assembled here from all over the world to attend this conference.

I am fully convinced that this conference with about 600 scientists assembled here from different parts of the world to discuss various subjects in the field of geomagnetism and aeronomy will contribute a great deal to the development of this specific field of science, as well as to the progress of science in general, and the welfare of mankind.

The Science Council of Japan is the organization representing, internally and internationally, the Japanese scientists in all fields of sciences. In this capacity, it is affiliated with the International Council of Scientific Unions and other international organizations, and maintains liaison with these scientific bodies. The Council also organizes or sponsors, in cooperation with the international organizations, a number of international scientific meetings in various fields of sciences, and sends the Japanese scientists to the similar international gatherings held abroad, with a view to promoting international scientific exchange.

Needless to say, an international conference is not only an appropriate means of exchanging scientific knowledge and information, but also a good opportunity for participants from different countries to get acquainted with each other and deepen mutual understandings and friendships regardless of differences in the customs and languages.

Many of you who have come to Japan from abroad, particularly those who have come for the first time, may be interested not only in the subjects of geomagnetism and aeronomy, but also in Japanese culture and nature. It is my sincere hope that you will enjoy your stay in our country and become familiar with our people, our life, and our tradition.

Before concluding my address, I wish to express my heartiest gratitude to the various organizations and individuals within and outside Japan for their generous support in organizing this important conference.

I wish you all success in your work.

M. Funahashi, Mayor of Kyoto

Madam President, members of the International Association of Geomagnetism and Aeronomy and distinguished guests.

It is a great pleasure for me, along with the 1,4000,000 citizens of Kyoto, to welcome the Second General Scientific Assembly of IAGA with its worldwide participation from 38 countries to Kyoto.

In modern society, the work of scientists in various fields, including the activity of your Association, is making substantial contributions to the welfare of mankind. At the same time, culture and art are also contributing, so that the remarkable progress in science and the development of culture and art are complementary with each other, like both wheels of a carriage.

From this viewpoint, it is very delightful to hold this Assembly of the highest level in the city of Kyoto. Kyoto had been the capital of Japan for more than a thousand years, and I hope you will see a number of our important monuments and traditional festivals.

Although you will have a busy schedule every day for your important research and discussions, I really hope that you can still find time to visit some famous places and cultural monuments, and I hope you go back home with a pleasant memory of your stay in Kyoto.

Finally, I wish to express my heartfelt thanks to the Science Council of Japan and the related organizations for their enthusiastic efforts to prepare and manage this significant Assembly in Kyoto.

Message From IUGG President, H. Charnock

(Read by A. A. Ashour, IUGG Vice President)

I was very glad to have been invited to send a message to the participants of the Second General Assembly of the International Association of Geomagnetism and Aeronomy meeting in the beautiful and historic city of Kyoto.

Perhaps I can start on a personal note, by greeting your President, Dr. Troitskaya. Her many friends, colleagues and admirers trust she is now fully recovered from the injuries of her car accident last year. They send their best wishes for her work in guiding the Assembly where significant scientifc problems and far-reaching organizational arrangements are to be discussed.

IAGA scientists interact strongly with colleagues involved in other Unions (like IAU and URSI), in scientific and special committees (like the International Astronomical Union (IAU) and Union Radio Scientifique Internationale (URSI), in scientific and special committees (like Committee on Space Research (COSPAR), Scientific Committee on Oceanic Research (SCOR) and now Special Committee on Solar-Terrestrial Physics (SCOSTEP)) as well as with the other Associations of our own Union of Geodesy and Geophysics.

Such interactions between scientists must benefit our understanding of the

complicated processes of magnetospheric physics; they are a welcome sign that the subject is developing and expanding in scope. The problem is to encourage them without creating unnecessarily complicated and frictional administrative machinery.

In this connection I am glad to express appreciation, on behalf of the Union, for the preparatory work done by your Vice President Roederer. He has been assiduous in consulting individual scientists and I have every confidence that their views will be fully considered. The recommendations from your Assembly will certainly be seriously and sympathetically discussed by the Union's Bureau and Executive Committee.

Professor Ashour, to whom I am grateful for reading this message, is representing the IUGG Bureau.

I hope you have exciting scientific discussions and constructive organizational meetings. All good wishes for a successful Assembly.

Opening Remarks,

V. A. Troitskaya, President of IAGA

Ladies and Gentlemen:

On behalf of IAGA I would like to express our most cordial thanks for all the warm welcoming words we have just heard. Japanese courtesy traditions are known throughout the world, and it is a real pleasure to have the Second Scientific Assembly in this extraordinary country, which moreover is a real home of geomagnetism and aeronomy, both as regards history and its actual continuous contribution in these fields of research.

Everyone knows the name of the late Professor Tanakadate, who initiated extensive studies of geomagnetism in Japan; of Professor Nagaoka, a pioneer in propagation and ionospheric studies in this country, and the name of Professor Hasegawa, who works in the analysis of the variations of the magnetic field. The past president of IAGA, Professor Nagata is known both to the specialists in internal and external geomagnetism, because of his fundamental contributions in a broad range of directions of research, including his last work on lunar samples. This enumeration could be continued, but I do not doubt that people present here are well acquainted with the role of Japanese scientists in the progress of geomagnetism and aeronomy.

In spite of the fact that Japan is a "middle and low latitude country," its success in investigations of geophysical phenomena in polar regions have won universal appreciation. One can hardly mention a direction of research in the frame of the IAGA to which this country has not contributed with imagination, skill, and high scientific standing. Everyone knows the scientific geophysical journals, published in Japan, which are widely used by the scientific community We have also to thank the Japanese institutions for their regular work in maintenance of the World Data Centers on geomagnetism, ionosphere, cosmic rays, and special centers regularly publishing processed information on

geophysical situation, etc. Therefore, there is no doubt that having our Assembly in this country we can expect every possible help for the success of our enterprise.

I wish to thank Professor Rikitake, chairman of the local organizing committee, as well as all the other distinguished members and, especially, Professor Fukushima for taking on the difficult task of preparation of this General Assembly and providing our meetings with such splendid facilities. On behalf of IAGA I would like to express our sincere gratitude to the President of the Science Council of Japan, Professor Y. Ochi, and to the Mayor of Kyoto, Dr. M. Funahashi, for their generous and constant help during the preiod of preparation for this Assembly. I also take this public opportunity to thank all who have actively participated in the efforts of the last two years to elaborate general opinion about the future of the IAGA task, structure, and manner of functioning.

General Report

L. R. Alldredge, General Secretary of IAGA

Ladies and Gentlemen:

It is indeed a pleasure to be here in Kyoto. The local organizing committee has done a great job in preparing for this Assembly.

Official notifications have been received that the following official representatives of other organizations are expected to attend this Assembly:

A. A. Ashour - IUGG
F. L. Scarf - URSI
V. V. Migulin - URSI
E. A. Lauter - COSPAR
J. London - IAMAP
A. D. Belmont - IAMAP

The Executive Committee has appointed a Resolutions Committee:

A. J. Dessler - USA (chairman)
N. Fukushima - Japan
P. N. Mayaud - France
O. M. Raspopov - USSR
S. R. C. Malin - U. K.

As in past Assemblies, Commission Chairmen, Working Group Reporters, and Symposium Conveners should report highlights of scientific sessions and business meetings to the Secretary before leaving Kyoto if possible so the transactions can be prepared without delay.

One big problem facing IAGA is that of reorganization. Today or tomorrow you will receive in your mail boxes the latest reorganization proposal worked out last Saturday by the Executive Committee. Please discuss this in working-group and commission meetings this week. The latest proposal represents an

effort started two years ago headed by Vice President J.G. Roederer.

As has been true since 1963, IAGA News continues to report administrative things of interest to members which miminizes the need for a lengthy secretary report. Since our last Assembly in Moscow in 1971, IAGA News No. 10 appeared in August 1971 and IAGA News No. 11 was distributed in November 1972.

This Assembly is a huge affair. All papers that were submitted were reviewed by the proper authorities prior to acceptance. Two hundred and thirty-four scientic papers will be presented during 34 Commission sessions, and 532 papers. will be presented at 60 Special Symposia and Workshop sessions. This makes a total of 766 papers.

I would like to personally thank Dr. Naoshi Fukushima who was appointed as adjoint secretary at the Moscow Assembly and is one of the secretaries of the Kyoto Local Organiziang Committee for his help in arranging the program for this Assembly. Dr. Fukushima spent several days in Boulder, Colorado, helping me put the finishing touches on the program. He carefully proofread the entire program and caught many errors prior to printing. (We do have a very late dead-line on papers which does not give sufficient time for proper editing.) I apologize for errors which may remain in the printed program.

As of 15 August, Dr. Fukushima reported that 500 scientists from 34 countries had already sent in registration forms. Approximately a half of these are from the host country, Japan.

The IAGA finances are always a problem because of our very small allocation from IUGG. The statutes require a full accounting only at the General Assemblies, but we are still solvent. Dr. T. Nagata, our past president, as head of the Finance Committee of the Local Organizing Committee was successful in raising enough money to pay the living expenses of the Executive Commission members while they are in Kyoto. This one item will save IAGA approximately $4,500.00, which is more than a third of the annual IUGG allocation to IAGA. The Local Committee was also able to pay the expenses to the Assembly of a representative from each of seven Far East countries which adhere to the IUGG.

Unfortunately, several of our IAGA leaders have indicated they cannot be here with us in Kyoto. Because of a change in the line of research he is pursuing, J.A. Jacobs, chairman of Commission IV, has resigned and cochairman Dr. M. Sugiura, will head Commission IV during this Assembly. Dr. A.P. DeVuyst, chairman of Commission I, cannot attend for reasons of health and Dr. P.H. Serson, the cochairman, will head up Commission I at this Assembly. In addition, several others have sent word indicating they had planned to attend but could not find financial support to make the trip.

As you know the next IUGG General Assembly will be held in Grenoble, France, during the summer of 1975. Interdisciplinary topics for symposia will be welcome until Friday.

It may be of interest to this group to learn that President Troitskaya has

received an invitation from the President of the U. S. National Academy of Sciences to hold the IAGA Third General Scientific Assembly in the United States during the summer of 1977 in conjunction with IAMAP.

During this Assembly the secretariat stands ready to help each of you get official business cared for efficiently. Ms. Christina M. Whitmarsh, who heads the clerical and services staff, can be found in Room K1 most of the time. IAGA is grateful to the Japanese Local Arrangements Committee for providing additional secretarial help, duplicating equipment, etc., which is so necessary to the smooth operation of a great Assembly such as this.

Presidential Address

V. A. Troitskaya, President of IAGA

Ladies and Gentlemen:

The Scientific IAGA Assembly, which begins today, is a real forum gathering scientists of many countries with different national cultures and different conceptions on the basic problems of our existence, but we are all united in our efforts to widen the horizons of science.

The results of scientific investigations, which increase the understanding of Nature, are slowly but constantly absorbed by all humanity and applied in everyday life.

Geophysics, perhaps more than all other sciences, is very close to many actual general problems. Moreover, geophysical investigations are not possible without close and now traditional cooperation, which can efficiently contribute to the efforts of peaceful solution of problems which confront humanity.

Therefore, I sincerely hope, that the discussions we shall have here during the next few days, in this beautiful country of the "Rising Sun", will not only help in the understanding of the scientific problems, but will also clarify the potential possibilities of our science for solving of the so-called relevant problems.

Assemblies like this one provide possibilities for the quickest exchange of information of new experimental facts, directions of theoretical research, and intuitive development of opinions, which are really important and significant. It is well known that the formulation of correct questions is no less difficult and no less important than the answers to them. We hope that at least some of these questions will be asked at this Assembly.

It is necessary to stress that many questions arise due to the fact that the last decades have shown that previously independent directions of research have common interests (for instance, geophysics, radiophysics, astronomy, physics). Most of the problems we have to solve are of interdisciplinary nature. The borders between these disciplines become diffused and the problems themselves appear more and more manifold. Science benefits from this attack from different sides, but the methods and organization of the approach to the

solution of such problems contain definite difficulties both as regards the establishment of common language and of the realization of complex cooperative investigations.

This situation, which corresponds strictly speaking to some kind of transient period, requires elaboration of new forms of organization and establishment of close ties between different directions of research. In this transient period the duty of the IAGA is to take an active position completely excluding the policy of "laisser faire". The vitality of the Association must be constantly preserved and strengthened. Thinking of the future, we have to realize that the Association, which has won international recognition in the past, has the responsibility to find energetic ways to serve the scientific community in this difficult period. This requires understanding of new forms of partnership between previously indepedent fields of research, and development of the feeling of collective responsibility. Consequently, we are drawn to the necessity of elaborating new forms of organization of our work which will differ from those which were established in the past in a considerably more quiet epoch. Therefore, our place and role in the family of international scientific bodies will greatly depend on our ability to find the most rational form of organization of our work. We have to acknowledge openly that in the field of research, traditionally conducted in the frame of IAGA, we witness definite competition which undoubtedly has its positive sides. The ties with other international bodies are profitable for the IAGA because the circle of scientists dealing with the same problems is widened.

The necessity of coordination of the IAGA efforts and actions with other international bodies leads us inevitably to internal reorganization of the Association which will require the attention and time of all IAGA active members. We have to strengthen the ties inside the Association itself between its Commissions, then enhance the cooperation of the IAGA with other Associations of our Union and find new constructive and acceptable forms of interaction with other international Unions and Committees.

Among other problems we have to look into, we must take into account the new requirements which during recent years were set before the scientists in many countries. I have in mind the relevant problems, or problem, of immediate practical value. In spite of the fact that fundamental investigations remain in the major concern of the IAGA, it is indeed the responsibility of scientists to distinguish and predict which results, in our fields of research, have or will have practical value. Only by assuming this responsibility can we prevent the appearance of speculative directions of research which easily arise in fashionable relevant problems. Therefore, in the future a conscientious effort is necessary in giving time and place during our meetings for discussions of these problems.

At the same time further development of geophysics requires diligent continutation of fundamental investigations because they actually form the base

of development of culture and civilization. Indeed the degree of encouragement of these investigations characterizes our disposition to look ahead and support the development of new trends in science. As an example, I can mention that the support of fundamental near earth space investigations has opened a new era of studies of other planets in which the knowledge of the planet Earth is used in the vast spaces of the Universe. Moreover, we witness how during the last few years the recently completely absorbing solar-terrestrial relationships have extended into solar-planetary relationships.

On the other hand these investigations have shown that the planet Earth is the only refuge for humanity, for life in its broad meaning, and, that therefore, with the greatest care we have to treat our environment. The role of geophysics in its investigation and protection cannot be overestimated.

It becomes evident that the state of our immediate environment is connected with the state of the outer space and that is the region intensively investigated by IAGA. Speaking about the environment, we have to make it clear that it encompasses not only the lower but also the upper atmosphere, the magnetosphere, its particle population and the geomagnetic field with all its variations in a wide frequency range. In taking care of the purity of the environment the time has come to insist on establishing electromagnetic "reservations" where we shall be able to observe without perturbations the variety of magnetic field variations and details of aurora and airglow emissions which in the nearest future would be otherwise lost and drowned in the noise and the light of civilization, and in this way the most valuable information constantly arriving on the Earth from outer space will be lost.

In connection with the outlined situation, what is the basis and what are the possibilities of strengthening the ties between the IAGA Commissions, other Associations of the IUGG, as well as different international bodies, which in their investigations have closely approached the problems traditionally studied by IAGA.

Analyzing the trends of development of geomagnetism and aeronomy, we have to state that beginning from the middle of this century we witness their striking intensification. This was caused first by the significant progress in the measurements technique on the Earth's surface, in the atmosphere and on moving objects (ships, aircrafts, balloons, and, finally, rockets and satellites); second due to the advent of the space era; third due to the wide use of computers for processing of data, and fourth due to the successful development of cooperation realized in the frames of a number of international projects. This program was on the one hand a natural foundation for bringing together aeronomy, space physics, geomagnetism and solar-terrestrial physics. Moreover these investigations brought close together geophysics and plasma physics. Indeed with the beginning of the space era it was soon realized that the magnetosphere can be considered as a gigantic laboratory in which we can study plasma behaviour in conditions never produced on the Earth's surface. We can observe here the

development of processes in practically unlimited time and space scales, and moreover we can observe details for plasma which is simultaneously dense and collisionless. The outer space therefore presents the possibility of study by fundamental laws of magnetohydrodynamics, collisionless shocks and the nonlinear processes developing in the course of wave-particle interactions. Some of the instabilities which can play an important role determining the big scale processes in the magnetosphere never develop in the laboratory plasma. They can be however revealed experimentally, for instance in the evolution of the series of pearl-type pulsations in some of the VLF emissions. Therefore investigations having initially geophysical aims can widen the borders of our knowledge on the fundamental processes which traditionally are studied in the physics of plasma.

Moreover the efforts of geophysicists in realizing controlled experiments in the magnetosphere (artificially injected cold and hot plasma, generation of waves, barium clouds release, etc.) and the comparison of the predicted and expected phenomena with the observations bring together and strengthen the ties of geophysics and physics. On the other hand, the appearance of detailed and precise information on the distribution of the geomagnetic field in space and time and the quick development of paleomagnetism, which neatly widens the interval of time of direct measurements and which lead to the discovery of the reversals of the geomagnetic field, formed a new basis for uniting the efforts of IAGA in the investigations of the Earth's interior with the work of other Associations of our Union. It is interesting to note that the modern hypotheses on the spreading of the ocean floor leading to the consideration of the possible drift of continents on a new level and presenting interest for all IUGG was to a significant degree a consequence of geomagnetic investigations.

In using the geomagntic field for the interrogations of the Earth's interior we have to stress that it has some specific properties which distinquish it from all other physical fields. First of all, we have the possibility of dividing the field measured on the Earth's surface into three parts having completely different sources. Second, typical for the geomagnetic field is the existence of variations in time in an extremely wide range - from fractions of a second up to millions of years. Moreover, each source has its own spectral range. These essential properties allow one to use the geomagnetic field as a unique tool for the investigation of the Earth's interior and the processes developing in its depths.

If we consider only the space structure of the field produced by the interior sources, then the possibilities of magnetic and gravitational fields are equal. However, the possibility of utilizing in addition the periods, phases, and space distribution of the amplitudes of magnetic field variations from outer and inner sources allows one to draw conclusions on the dynamics of the inner source, conductivity distribution, etc.

The geomagnetic field provides information on the deepest structural elements of the Earth which cannot be discovered by seismic methods. For instance, during recent years much attention was given to the shapes of the core to the boundary between the upper mantle and the core and to the core-mantle coupling. The estimations of this coupling which reveals itself in the westward drift of the geomagnetic field and in the changes of the velocity of the Earth's rotation have shown that it is necessary to suggest an inhomogeneous structure of the boundary core-upper mantle. The conception of hot spots or bumps 1-2 km high was introduced to explain the above mentioned phenomena. This conception was elaborated as a result of analysis of the geomagnetic field and its correlation with the gravitational field.

If we look in the direction of the common lines of research of aeronomy and geomagnetism it is necessary to mention the results obtained recently on rockets and satellites showing definite changes in the composition of the neutral atmosphere during geomagnetic disturbances. Moreover, the changes in the ionic composition in the E region of the ionosphere (100-200 km) during geomagnetic disturbances was revealed. It is thought to be connected with changes in concentration of minor constituents of the atmosphere. It is known also that the density of the atmosphere in a great range of heights , even to the stratosphere, increases during geomagnetic disturbances. The state of these investigations reached the stage where there is no doubt that the upper atmosphere reacts to the changes of solar and geomagnetic activity. The quantitative measures of these connections, as well as the physical mechanisms which lie in their origin, remain unclear and need cooperative investigations. These must include detailed studies by direct and surface measurements of the different parameters of the atmosphere in a wide range of heights for instances during special events (solar flares and eclipses, geomagnetic disturbances, PCA, etc.)

Together with the Association of Meteorology and Atmospheric Physics we have to find the answer to the question on the possible influence of solar and magnetic activity on weather and climate. Just recently new results were obtained on the contribution of solar corpuscular radiation on the scheme of the big scale atmospheric circulation. Up until now there does not exist a consistent and satisfactory explanation of these ties. This problem is a hot point and it needs for its solution efforts and cooperation of different specialities, and first of all close contacts between IAGA and IAMAP. We can add to this problem the necessity to elucidate the reason of the development of troughs of low pressure after geomagnetic storms, the laws of interrelation of solar wind sector structure with the character of circulation in the stratosphere and finally the origin of stratospheric heating after solar flares.

In recent years, we also witnessed the development of an entirely new specific direction of research: biomagnetism, which by definition lies on the boundary between quite independent sciences. I think that time has come to elaborate the position of IAGA on this matter. With changing success the

investigations in this direction develop both in the form of direct experiments, in which electromagnetic fields are simulated and their action on biological objects are studied, and in improvement of statistical methods of comparison of the characteristics of geophysical situation with the medical data on cardiac-vascular diseases. Recently some results were obtained which show that the most bioeffective are probably pulsations of the magnetic field in the range of fractions of a Hz up to approximately 10 Hz.

Observatories sponsed by IAGA produce data useful in a variety of related subjects. As an example of these, consider uses made of the permanent observations of space and time variations, of the geomagnetic field, made at the observatories. We see that they are used both for obtaining magnetic charts which are necessary for prospecting, navigation and investigation of the Earth's interior, and for tracing of processes determining the state and the behaviour of the magnetosphere. Nowadays it is difficult to imagine a field of geophyiscal and space research where data, supplied by observatories in the form of magnetograms or indices of magnetic activity, are not used. Moreover this information has a still growing application in other disciplines such as meteorology, seismology, and even biology.

All the examples given show that the results of investigations regularly obtained in our field of research are needed and are used in the solution of the ever increasing number of problems. It is necessary also to stress that simultaneously with the still growing number of interdisciplinary ties we observe significant differentiation of each discipline and the appearance of new and vital directions of research which never before came to the attention of IAGA and has not been developed in the frames of other international bodies. This process similar to every new born tendency meets resistance, but if we do not make too many mistakes and successfully proceed in our evolution and development we shall find the peaceful way.

New effective forms of cooperation which will lead to success must be found even though they may lead to difficulties. In his recent letter concerning the years of International Magnetospheric Study (IMS), Professor J. Couloumb, president of International Council of Scientific Unions (ICSU), wrote that this project will require much greater degree of cooperation than any other previous international projects and first of all a new level of coordination between satellite and ground based measurements. We have to be ready for this cooperation acting with responsibility as regards our international reorganization and in establishing the necessary ties with other international bodies. IAGA has a sincere wish to find proper ways to do it and where there is a will there is a way.

Minutes of Executive Committee Meeting

(Kyoto, Japan, 8-21 September 1973)

Sessions of the Executive Committee meeting were held intermittently from 0900h on 8 September to 1800h on 21 September 1973. Sessions were held almost every day and many of the sessions were very long. Much of the time spent was related to reorganization. The topic received intermittent interplay between the Assembly Delegates and the Executive Committee throughout the period.

The results of all the sessions are run together as if it was one meeting, except where the narrative makes a distinction.

All members were present in Kyoto for most of the sessions except O. Schneider who sent a letter of regret explaining that he could not attend for personal reasons. Dr. J. W. Dungey did not arrive until Monday, September 10, 1973.

President Troitskaya made note of the fact that official representatives were expected at the Kyoto Assembly from other organizations as follows:

A.A. Ashour representing IUGG
J. London and A.D. Belmont representing IAMAP
F.L. Scarf and V.V. Migulin representing URSI
E.A. Lauter representing COSPAR

(Subsequent to this the above did arrive and participate in the assembly, except for Drs. Belmont and Migulin.)

The minutes of the last Executive Committee meeting held in Madrid, Spain, on 8, 9, 10 May 1972, were approved as they appeared on pages 23-34 of the IAGA News No. 11.

Finances

Finances of the Association were discussed at some length. IAGA is solvent only because many things that should be done have not been started because of our very limited income. All members of the committee feel very strongly that IAGA does not get its share of the IUGG income when the importance and size of IAGA in comparison to the other Associations are considered. The following was decided: (1) G.D. Garland, secretary general of IUGG, and Dr. A.A. Ashour, vice president of IUGG, should be invited to the Executive Committee meeting to hear of our financial needs; (2) An Ad Hoc Committee consisting of the president, two vice presidents, general secretary and T. Nagata should draft a letter or resolution to the IUGG explaining our financial needs; and (3) President Troitskaya should bring up the financial problem at the forthcoming IUGG Executive Committee meeting in London on 3 and 4 October 1973.

T. Nagata, who was very successful in raising money to support the Kyoto Assembly, indicated some funds may remain after the Assembly which might be used to help defray publication costs related to the Assembly.

It was agreed that IAGA should pay the deficit expected by D. van Sabben for the International Service of Geomagnetic Indices (IGSI) which might be as much as $1,700 for 1973. IAGA will also pay for half the cost of the publication of the Bulletin No. 33, containing the 100 years historical series of daily magnetic indices and sudden commencement of magnetic storms being published by ISGI. IUGG has promised to pay the other half.

1975 Grenoble Assembly

Preparation for the IUGG General Assembly, 25 August - 6 September 1975, in Grenoble, France, was discussed. IAGA must nominate interdisciplinary symposia at the IUGG Executive Committee meeting to be held in London on 3-4 October 1973. It was agreed that the Executive Committee would entertain suggestions from Commissions during the first week of the Kyoto Assembly. An ad hoc committee consisting of G.M. Weill, chairman, J.G. Roederer, T. Rikitake and L.R. Alldredge was assigned to consider these suggestions during the second week of the assembly and to recommend a tentative program for the Grenoble Assembly. It was agreed that a small committee should be appointed to help with all aspects of the Grenoble Assembly following the Kyoto Assembly. (Subsequent to this meeting, President Troitskaya appointed the following Program Committee for this purpose: G.M. Weill, chairman, J.G. Roederer and L.R. Alldredge.)

Dr. Weill pointed out that IAG has requested that they be permitted to hold their own Association General Scientific Assembly one week prior to the IUGG General Assembly in Grenoble. The possibility of IAGA requesting such a time for perhaps a joint URSI Symposium was discussed but dropped.

Dr. Weill indicated that space available at Grenoble will permit more than just the interdisciplinary symposium allowed by the new IUGG Assembly rules. The local organizing committee feels it needs guidance on what should be planned for Grenoble. At this point in time, it was agreed we should give highest priority to the interdisciplinary symposia, but should plan additional association scientific sessions under fairly tight control of a program committee.

Dr. Roederer prepared a list of proposed symposia for Grenoble which had come in from Executive Committee members, Commissions, and Working Group business meetings and from individual delegates. It was decided to distribute this list to all delegates with a request that delegates indicate their priority of the various symposia.

The results of this poll was considered along with interviews with the proposed new division leaders in the new IAGA organization, by the above named ad hoc committee. Their results were further modified by the Executive Committee culminating in a list of symposia or division special sessions for the Grenoble Assembly as shown in Appendix A. It was admitted that this list was far from complete regarding the IMS, as can be seen from the footnote at the end of Appendix A. Dr. Roederer pointed out that the Steering Committee of the IMS had requested that a Symposium and Workshop on the IMS consisting of many sessions be held during the Grenoble Assembly.

It was agreed that the President and Secretary should present those interdisciplinary symposia under Part A (Appendix A) at the IUGG Executive Committee meeting to be held in London during the first week in October.

Drs. F.L. Scarf and J.W. King indicated the next URSI meeting will be held in Peru in 1975 one week after the Grenoble Assembly. This will make it difficult

for URSI to join with IAGA on the proposed IMS symposium. In Peru, Dr. Scarf hopes for a small URSI program for URSI Commission IV so they may in some way be able to join with IAGA in an IMS symposium at Grenoble.

Dr. Nagata pointed out that strong support of the IAGA Executive Committee would be needed so Division symposia will be allowed by IUGG in Grenoble. A strong point here is that IAGA relates to Unions other than IUGG in a stronger way than it does to other Associations in IUGG.

By acclamation Dr. A.J. Dessler was asked to head the Resolutions Committee for the Grenoble Assembly. He agreed.

Other Future Meetings

It was agreed that IAGA should send President V.A. Troitskaya to the Solar Terrestrial Physics (STP) Symposium at São Paulo, Brazil, 17-22 June 1974, as an official representative of IAGA.

Note was made of the invitation by the U.S. National Academy of Sciences for IAGA to hold its Third General Scientific Assembly in the United States, in conjunction with IAMAP, in the summer of 1977. It was agreed that this invitation would be made known at the first plenary session, but a decision would be held up until the end of the Assembly to see if other invitations are received. At the end of the Assembly it was agreed to accept the U.S. National Academy of Sciences invitation with thanks.

The committee agreed to cosponsor, at no cost to IAGA, another Workshop on Electromagnetic Induction, to be held at Carleton University, Ottawa, Canada, during 22-28 August 1974. It was recommended that IAGA try to help them get money from IUGG.

It was noted that IAGA has been invited by the American Geophysical Union to cosponsor an International STP meeting in Boulder, Colorado, USA, in the summer of 1976. It was also noted that IAGA has been invited by the Royal Society of New Zealand to cosponsor an International Symposium on the Magnetosphere in February or August of 1976. It was agreed that IAGA could not sponsor both of these meetings. After considerable discussion it was agreed that IAGA would accept the first invitation, but not the second. The Secretary was instructed to write a letter explaining why the invitation was declined, and to express the thought that the symposium might better be called a regional symposium with the results being summarized at the Boulder STP meeting the same year.

Reorganization

At the first session of the Executive Committee meeting, held on 8 September, much time was directed to the problem of reorganizing IAGA. Dr. Roederer explained activities of the past year and a half in this area. Dr. Roederer, through the Secretary, had sent out several questionnaires and had carefully analyzed the returns which have resulted in an organization proposal which was detailed in a memborandum sent out to interested people dated 30 July 1973. During the first session these proposals were further refined with the result given in Appendix B. It was agreed that copies of the results contained in Appendix B would be distributed to those present at Kyoto with instructions that working groups and commissions should fully consider this reorganization proposal during the first week and turn in written comments by the end of the week. These comments should include proposed terms of reference for the new Divisions with proposals on how the Divisions should be divided into working groups to be able to function effectively. It was decided that the resulting proposals would be discussed at the open meeting on reorganization scheduled for Friday, 14 September. On that occasion, Union representatives as well as National Delegates would have an opportunity to make statements on the subject of IAGA reorganization. The Executive Committee would then consider all of this input and make final decisions hopefully to be announced at the final plenary session.

It was agreed that the organizing of inter-Association and inter-Union working groups would be worked out during the interim period between the Kyoto and Grenoble Assemblies. On Monday, 10 September, with the Commission Chairmen present, the reorganization problem was discussed further. Dr. Roederer reiterated the history of this effort. Each Commission Chairman made comments. Two expressed reluctance to reorganizing, but most Chairmen expressed a desire to go through with the reorganization.

The question of whether to try to effect the change in Kyoto or Grenoble was left pending until after the open meeting on reorganization scheduled for Friday, 14 September. The Commission Chairmen were urged to discuss how the old topics could be accommodated into the new proposed organization in their business meetings.

On Wednesday, 12 September, official representatives, or officers, of other organizations, namely: E.R. Dyer (IUCSTP), E.A. Lauter (COSPAR), J. London (IAMAP), A.A. Ashour (IUGG) and G.D. Garland (IUGG) met with the Executive Committee. The background of the proposal to reorganize IAGA was explained by Dr. Roederer. It was explained that the time scale for implementing the plan was still indefinite but it was felt it should be done either at the end of the

Kyoto Assembly or very soon thereafter so that the new organization could be in charge of the Assembly in Grenoble, France.

Dr. London indicated that the IAGA concern about reorganization has caused IAMAP to consider reorganization of its own. IAMAP welcomes a joint working group with IAGA on Stratospheric and Mesospheric Processes in Planetary Atmospheres. Details can be worked out in the near future.

Dr. Dyer felt that the proposed joint IAGA-IAMAP working group on Stratospheric and Mesospheric Processes in Planetary Atmospheres would be a good home for part of the Structure and Engergetics of the Stratosphere and Mesosphere (SESAME) program. If Unions can take over all STP problems IUCSTP (SCOSTEP) would not be needed in the future.

Dr. Lauter said that it may have appeared earlier that COSPAR had rejected all of IAGA's plans, but this is not the case. COSPAR does not object to the new organization. The Executive Council of COSPAR appreciates the general description behind IAGA's plans which makes the new proposed organization more understandable. COSPAR will be glad to cooperate with IAGA. It would be very good if the ideas in President Troitskaya's Kyoto Presidential Address were attached to the reorganization outline as a preface. The IAGA new Division II and URSI Commission III should be in close contact. COSPAR would like to strengthen its ties with IAGA in the same way in which it has improved relations with URSI. COSPAR would welcome representatives from the new Divisions II and III on COSPAR working groups. The reorganization should spell out the relationship between the new IAGA Divisions and such bodies as SCOSTEP and COSPAR. We should not create too many new interorganization working groups. In many cases, IAGA can join COSPAR working groups instead of creating new ones. IAGA should not start nominating separately those to lead interorganization working groups, but rather they should be carefully considered jointly with the other organizations involved over a period of time.

Dr. Dungey pointed out that where a working group exists on a topic IAGA should ask for membership on that rather than start a new one.

On Friday, 14 September, J.W. King and F.L. Scarf attended the Executive Committee meeting. They had both seen the latest reorganization proposal. both stated that in general they thought the proposal was good, and that additional IAGA-URSI joint working groups whould be welcome. Dr. Scarf felt that if joint working groups were to be set up which would not duplicate what already exists in Unions, they should deal with specific, narrow topics not now adequately covered in the Unions (or Associati-ns). Dr. King commented that URSI has working groups that relate directly to the first three proposed joint working groups (see Appendix B). URSI Commission III also has a very strong interest in the proposed work on Structure, Composition and Photochemistry of Ionized

and Neutral Constituents, Including Excited Species, of the proposed IAGA Division II.

Later, on 17 September, a further discussion on inter-Union working groups was held with the following guests present: Dr. J. London (IAMAP), Dr. F. Scarf (URSI) and Drs. M. Sugiura, C.-G. Fälthammar, L.P. Block, B. Hultqvist, T.R. Kaiser and J.D. Williams, representing Commissions in IAGA.

Dr. Scarf explained that URSI is not a Geophysical Union yet it has an extensive interest in the area which is not likely to decline much, if any, in years ahead. He suggested that since the earlier attempts to merge IAGA and URSI had failed it would be better to start over again with a few inter-Union working groups on very narrow subjects such as: (1) The auroral oval and its extension into space, and (2) Physics of the plasmapause . If they are kept narrow they won't detract from the work of the Unions. URSI has already approved these two.

Dr. Roederer explained that the two titles above had been expanded as a result of his reorganization circulars, but IAGA would be glad to simplify them again.

Dr. Hultqvist pointed out that perhaps IAGA should establish a general procedure offering cooperation with URSI for every working group IAGA planned to set up. This idea was thought by others to be equivalent to almost an amalgamation of the two which failed recently. Most people present felt that IAGA should start with a few joint working groups covering very narrow topics.

Dr. Scarf indicated he would like to get IAGA-URSI relation to be like the URSI-IAU relation, that is a complementary one.

Dr. Hultqvist remained dubious as to the real goal of the inter-Union working groups, feeling that the proposed titles were a bit arbitrary. Dr. Williams didn't feel that the Unions played a very important part in space experimental work. Dr. Kaiser felt that they provided a useful means of communication especially for small countries and for gound-based work.

Dr. London pointed out that the problem of joint working groups between IAGA and IAMAP is quite different than the URSI problem. Here we are dealing with a common interface between two Associations in one Union. An earlier attempt at such a joint working group failed but now the working scientists from both Associations are interested in the stratospheric and mesospheric problems. Dr. London pointed out that IAMAP did not feel strongly the need for permanent joint working groups since the area is covered in the IAMAP structure, but IAMAP would work with joint working groups as proposed by IAGA. The IAMAP Commission on the Upper Atmosphere elects its own leadership and makes its own external arrangements.

Proposals made by IAGA could probably be acted on next January in Australia.

On Saturday, 15 September, the Executive Committee met at noon to further discuss reorganization.

Dr. Shepherd, representing Commission VI, made a statement regarding the new proposed reorganization to the effect that auroral physicists will be split between Divisions II and III. Commission VI agrees with Dr. Block's description of auroral topics that should be in Division II but in Division III there is a greater problem because auroral physicists have not properly interacted with magnetospheric physicists in the past. There needs to be a visible place in Division III so this will happen. He suggested a working group in Division III on "Auroral-Magnetospheric Relations" which would get many aeronomy people to interact.

A rather lengthy discussion took place regarding methods of further refining the proposed organization and of selecting new leaders during which the following points were made.

Dr. Dessler suggested that a more detailed outline should be started explaining the structures of the new Divisions and that names should be submitted at a meeting of those interested in each Division so that leaders could be selected.

Dr. Troitskaya warned that they should not develop this new structure too fast; that it should be considered very carefully.

Dr. Turajlic stated that the proposed Divisions are not clearly defined. He suggested that an ad hoc group should be appointed to work on Division definition and to suggest names of leaders for Divisions. In particular, Division V is not clearly defined. Further opportunity to comment on this should be given by another mail questionnaire.

Dr. Dessler stated that the Divisions must be established and leaders be appointed before the Grenoble Assembly.

Dr. Roederer expressed fear of losing momentum on the reorganization problem because many people are not here. For example: Solar Wind people are not represented here as fully as other disciplines. It would be unwise to appoint permanent Division and Working Group leaders now, but perhaps it would be proper to appoint temporary leaders with instructions as to what they should do.

Dr. Dungey suggested that the Executive Committee make a list of possible Division leaders. This was done.

It was further decided that on Monday, 17 September, a new description of the proposed Divisions would be circulated to all delegates with the list of possible leaders and the delegates would be requested to express their preference in an opinion poll. On 19 September, the Executive Committee, considering the preference poll discussed above and the need to have a suitable international representation in the Division leadership, selected Division leaders for the

new Divisions. After agreeing to serve, these new Division Leaders were consulted in determining three cochairmen for each Division. The three co-chairmen were decided upon to give a better representation of both countries and subjects. This work resulted in the following selections:

DIVISION I	J.C. Cain (USA) Chairman	
	K.N. Creer (U.K.)(tentative) W.D. Parkinson (Australia) T. Yukatake (Japan)	Cochairmen
DIVISION II	B.R. Tinsley (USA) Chairman	
	M. Ackerman (Belgium H. Rishbeth (U.K.) A. Vallance-Jones (Canada)	Cochairmen
DIVISION III	C.-G. Fälthammar (Sweden) Chairman	
	R. Gendrin (France) T. Obayashi (Japan) D.J. Williams (USA)	Cochairmen
DIVISION IV	I. Geiss (Switzerland) (Tentative)	
	(This work was not completed at Kyoto)	
DIVISION V	P.H. Serson (Canada) Chairman	
	P.N. Mayaud (France) R. Pastiels (Belgium) M. Suigura (USA)	Cochairmen

It was agreed that a meeting would be conducted for each Division during the evening of 19 September at which time a member of the Executive Committee would introduce the new leadership and then turn the meeting over to them to discuss problems internal to the Division. A separate meeting for Division V, since it relates to all Divisions, would be held later along with further discussion of inter-Division and inter-Union working groups.

A list of duties for Division leaders was drafted by the Exectuve Committee and distributed to Division leaders (see Appendix C).

It was agreed that the Executive Committee approval would be needed before any working groups were established. Working groups should have a limited membership.

It was further agreed that the old Commission structure would end 1 January 1974, at which time the new Division structure would take effect. In the interim, the internal Division structure should be completed.

On 21 September just prior to the final plenary session, the Executive Committee met to consider the suggestions made in reports of the meetings of the new Divisions regarding their Division names, substructrues and operating procedures. These suggestions were approved and adopted as shown in Appendix D.

It was agreed that if a Division wanted to appoint reporters and working group leaders they could do so without specific Executive Committee approval, but they should do so with proper regard for good geographical distribution.

The Executive Committee did, of course, retain the right to name IAGA representatives to bodies involving outside organizations.

Dr. Dessler stated that Division IV had decided that verbal presentation of papers will be permitted only by the authors themselves at future Division meetings. He suggested that IAGA as a whole should make a rule -- no action was taken.

Regarding organization, it was decided to continue the work of the old Commission IX on History as a new "Inter-divisional Commission on History" with E.J. Chernosky as chairman. It was agreed to have an Interdivisional working group on "Relations between External and Internal Magnetic Variations" with A.A. Ashour as the chairman (later confirmed). Dr. C.A. Onwumechili was approved as cochairman (not confirmed). This working group should work problems through the Division which is most closely related to the problem at hand. It was agreed to continue the present Antarctic Committee work under an Interdivisional Commission with T. Nagata as chairman.

To perserve uniformity of nomenclature throughout IAGA structure it was agreed that the terms "chairman and "cochairman" would be used for leaders of all orgainzational operating units such as Divisions, Commissions, Working Groups, etc., and the term reporter would be reserved for those chosen to report on a given area, but with no organizational elements attached.

No firm conclusion was drawn regarding the length of the term of office for appointed officials within the structure of IAGA except to say that their performance should definitely be reviewed every two or four years and reappointment would not be made unless some good work had been demonstrated.

It was agreed that Dr. Dessler would write to Dr. Geiss regarding the leadership for Division IV.

It was agreed that the President write formal letters of appointment to all Division chairmen and cochairmen inviting them to serve. A favorable reaction in writing would be required before they are formally appointed. They should be encouraged to send similar letters to reporters and chairmen and cochairmen of working groups in their Divisions with copies of the response being transmitted to the President and General Secretary.

It was agreed, upon the suggestion of Dr. Roederer, that the Interdivisional Commission on History be asked to investigate, during the next two years, the history of the usage of the terms "magnetosphere", "ionosphere", and "aeronomy". It was agreed that this Commission should find proper ways of interacting with the International Union on the History of Science.

Miscellaneous Items

Note was taken that Dr. H. Kautzleben, because of his change in interest, has resigned as a representative of IAGA on the Inter-Association Committee on Mathematical Geophysics. It was agreed that IAGA's single representative, Dr.

J. Cain would be adequate representation for the present time.

The Secretary was asked to encourage all conveners to seek ways of publishing the results of their Kyoto symposia and was authorized to pay a few hundred dollars to have copies of each of these publications sent to Paris for sale.

Twenty-one scientific resolutions and one resolution of thanks were considered. The Resolutions Committee review was discussed and the resolutions approved in principle. Dr. Roederer strongly recommended that in the future, recommendations be specific as possible, and that "general goodwill statements" be avoided. A few needing corrections were noted. It was decided that corrected copies would be distributed in the mail boxes of delegates before the final plenary session to eliminate the need of reading them at the final session.

Regarding the proposed change in the SCOSTEP constitution, it was agreed that IUGG should ask for two votes in contrast to one for URSI so that the atmospheric sciences (IAMAP) could be adequately represented. This decision was immediately transmitted to President Charnock so he would have it before the next ICSU meeting.

A clear decision was not made regarding the location of the next Executive Committee meeting. The following three places were suggested: Moscow, USSR; Grocka, Yugoslavia; Rio de Janeiro, Brazil (in connection with COSPAR). Most members felt August or September 1974 would be the best timing. The President will decide the place in a few months.

Appendix A. Proposed Symposia For Grenoble Assembly - 1975

The following symposia were tentatively approved at the Kyoto Assembly. The list must be considered tentative because approval must first be received from the IUGG Executive Committee in Oct. 1973 and where applicable by other Unions. The number of sessions shown are only estimates.

A. Proposed Interdisciplinary Symposia

1. Analysis of the main field - Physical and Observational Aspects of Recent Secular Change (with IASPEI, IAVCEI and IAG) (Proposed conveners: T. Yukutake, J.C. Cain, B.R. Leaton)
   (Theory of short periods; length of day; tectonic associations; observation of morphology; IGRF as a survey base; time spectra; solar cycle effect)

2. Methods of Analyzing, Processing and Interpretation of Geophysical Data Including Inversion Methods (with all other Associations). (3 sessions)

3. The Identification of Ancient Plate Margins (with IASPEI and IAVCEI) Proposed convener: J.C. Briden) (2 sessions)

4. Magnetic Properties of Submarine Basalts and Their Relation to Magnetic Anomalies at Sea (with IASPEI and IAPSO). (Proposed conveners: S.E. Haggerty and J.W. Ade-Hall.) (3 sessions)

5. Geophysical Forerunner Phenomena for Earthquakes (with IASPEI and IAG) (3 sessions)

6. Transport Phenomena and Structure in the Thermosphere and Exosphere (particularly including effects in tropical regions). (with URSI and COSPAR) (Proposed conveners: A.F. Nagy and H. Rishbeth) (3 sessions)

7. Stratospheric and Mesospheric Relations (with IAMAP). (Proposed conveners: M. Gadsden and P. Crutzen) (4 sessions)

8. Optical Sensing and Probing of the Atmosphere, Including Noctilucent Clouds, Lidar Measurements, Aerosols, Atmospheric Scattering of Artifical Light (with IAU, IAMAP: Consultation to take place with the IAU). (4 sessions)

9. Interaction Effects in Tidal Phenomena (with IAPSO and IAMAP). (An interdisciplinary approach to discuss the multiple sources that contribute to observed geophysical tidal phenomena). (2 sessions)

10* High-Latitude Phenomena (including Birkeland currents. (with SCAR and IAGA Interdivisional Commission on Antarctic Research) (2 sessions)

11* Physics of the Plasmapause. (with URSI and COSPAR) (Proposed convener: T. R. Kaiser)

12. The Interplanetary Medium between 0.3 to 5 AU and beyond. (with IAU) (Proposed convener: P. Hedgecock) (3 sessions)

* Detailed plans of these three symposia will be established in connection with the development of the IMS. Additional symposia - workshops (as many sessions as needed) on the IMS "Implementation" with URSI, COSPAR and SCOSTEP will also be held.

13* Global Effects of the Interplanetary Medium-Magnetosphere-Lower Atmosphere Interaction (with IAMAP, IAU and COSPAR). (Proposed conveners: W.H. Campbell, E.R. Mustel and J. Wilcox) (3 sessions)

14. Analysis Techniques for Non-Stationary Signals (with URSI). (3 sessions)

15. Subduction Zones, Mid-Ocean Ridges and Geodynamics (with IASPEI, IAVCEI, IGC) (3 sessions)

16. History of Geosciences (with all other Associations) (2 sessions)

17. Evolution of Atmospheres of the Terrestrial Planets (with IASPEI, IAVCEI) (Program Committee would comprise D.M. Hunten, M.Ya Marov and S.J. Bauer) (under the auspices of the IUGG Committee on Geochemistry) (4 sessions)

B. Proposed Topics for Scientific Sessions of the Divisions of IAGA. (Some propsals for session conveners are indicated.)

DIVISION I

I-1 Dynamo Theories of the Geomagnetic Field (Proposed convener: D.E. Winch) (2 sessions)

I-2 Fluctuations of the Field during Times of Constant Polarity (Proposed convener: K.M. Creer) (2 sessions)

I-3 Rock Magnetic Problems in Paleointensity Methods and the Strength of the Ancient Field of the Earth and the Moon (Proposed convener: C.M. Carmichael) (2 sessions)

I-4 Fine Structure of Geomagnetic Reversal History (Proposed convener: N. Kawai) (2 sessions)

I-5 Secular Variations for the New IGRF (Proposed convener: A.J. Zmuda) (2 sessions)

DIVISION II

II-1 Dynamical Processes in Aurora and Airglow (Effects of the neutral atmosphere on airglow and ionospheric processes, and effects of the energy input into the auroral zone on neutral atmosphere dynamics)(Proposed conveners: A.F. Nagy and H. Rishbeth) (3 sessions)

II-2 Auroral-Magnetosphere Relationships (Global features of instantaneous patterns of auroral precipitation and their relation to observable characteristics of the magnetosphere)(Joint interest with Division III) (3 sessions)

DIVISION V

V-1 New Techniques of Magnetic and Electric Measurements in Geophysical Phenomena (2 sessions)

V-2 Airglow and Aurora Calibration (1 session)

Note: Conveners are requested to work with relevant Division Chairmen with the view of reducing redundancy and overlap between symposia.

Appendix B. Reorganization Proposal As Reworked By The Executive Committee On 8 September 1973

DIVISION I

Internal Magnetic Fields

- Analysis and representation of worldwide aspects of the geomagnetic field
- Secular variation
- Origin and dynamo processes
- Magnetic fields of the moon and planets
- Paleomagnetism
- Rock magnetism and archeomagnetism
- Magnetic anomalies
- Electric conductivity of the earth and moon
- Induction and tidal phenomena

DIVISION II

Chemospheric and Ionospheric Aeronomy

(Thermospheres, Exospheres and Ionospheres)

- Solar emissions
- Structure and composition
- Photochemistry of ionized and neutral constituents, including excited species
- Atmospheric quantal emissions, including aurora and airglow
- Waves
- Structure and composition of planetary atmosphere
- Laboratory experiments

DIVISION III

Magnetosphere Plasmas, Fields and Waves

- Average quiet-time magnetospheric configuration (fields, particles, currents and waves)
- Field models
- Cosmic ray access and propagation
- Basic morphology of magnetospheric perturbations
- Hydromagnetic perturbations and wave-particle interactions
- Radiation belt dynamics
- Laboratory experiments

DIVISION IV

Solar Wind and Interplanetary Magnetic Field

- Magnetic and thermodynamic structure of the solar corona

Large-scale structure of the solar wind (shock waves, quasistationary sectors and streams)

Small-scale structure of the solar wind (discontinuities, waves and plasma processes)

Interaction of the solar wind with solar system bodies (earth, moon, planets and comets)

DIVISION V

Observatories, Instruments and Logistics

Instrumentation (ground, aircraft, balloon, rocket)

Standards of calibration

Observatories and surveys

Geophysical indices

Data supply, processing and dissemination

Geophysical alerts and forecasts

Interdivisional Commission on History

JOINT WORKING GROUPS
(Limited Lifetime)

High-latitude Magnetosphere-Ionosphere Interaction (IAGA-URSI)

Polar cap particles, precipitations, currents, and ionospheric heating

Polar wind

Polar cusps

Field-aligned currents

Structure, flow and instabilities of the plasmasheet substorms

Particle acceleration and precipitation mechanisms

(Drs. B. Hultqvist and Ch. Russell have been appointed organizers by IAGA Commission V and URSI Commission IV)

Physics of the Plasmapause (IAGA-URSI)

Morphology

Large-scale perturbations

Instabilities

Recovery of the plasmasphere

Ring current effects, mid-latitude precipitations, SAR arcs

(Drs. D.J. Williams and T. Kaiser have been appointed organizers by IAGA Commission V and URSI Commission IV)

Stratospheric and Mesospheric Processes in Planetary Atmospheres (IAGA-IAMAP)

Structure and composition

Transport processes

Photochemical, photoionization and photoelectron effects

Chemical reactions

Artifical constituents

Mesosphere-thermosphere boundary

Tides and related phenomena

Meteors and aerosols

The following joint Working Groups have been suggested, but no action has yet been taken:

Standard Atmosphere and Ionosphere (IAGA-URSI, IAMAP?)

Environmental Effects on Earth (IAGA-?)

Controlled Geophysical Experiments (IAGA-?)

Regional Programs (IAGA-?)

Appendix C. Tasks And Duties Of Division Chairmen With The Assistance Of Cochairmen

1. Temporary activities (1973-1975)

(a) To activate the structure of the Association as adopted in Kyoto, so that it be fully operational in January 1974, in time for efficient preparation of the 1975 meeting.

(b) To make proposals and provide expert advice to the Executive Committe on the titles, scope and staff of the Divisional Working Groups as listed at the Kyoto Assembly.

(c) Suggest the establishment of such additional Inter-Divisional, Inter-Union or Inter-Association working groups as may appear necessary.

2. Permanent Activities

(a) At all times serve as focal scientists for reporters and members of the Division, with a view to discuss and disseminate scientific information and generally see that such activities as may have been agreed upon within the Division are carried out actively and efficiently.

To keep abreast of the development of knowledge and activities within the field of interest of the Division.

To propose to the Executive Committee the establishment or discontinuation of internal and Inter-Divisional, Inter-Association or Inter-Union working groups or activities as this development may command.

To provide expert advice to the Association executive committee, to member countries or external bodies as may be requested by the Association.

To promote wide endorsement on National and International scales of scientific programs, activities, or resolutions adopted and endorsed by the Association.

(b) Prepare, conduct, and report Association meetings and symposia.

To prepare and present at the IUGG or IAGA assemblies such broad reviews as may be requested by the President of IAGA within the field of the Division.

To appraise the needs, within the field, for International cooperation in the near future.

To advise the General Secretary on types and particulars of meetings to be planned in advance of Assemblies for the efficient dispatch of Divisional activities.

To organize Business Meetings and Scientific Sessions of the Division at the Assemblies.

To serve as focal point for Working Group Chairmen at Assemblies, and see that Working Group activities properly take place (when, for instance, some Chairmen or members are unable to attend).

To provide the General Secretary of the Association as specified at each Assembly with such information, resolutions and reports as may be requested.

Appendix D. New IAGA Structure

DIVISION I Internal Magnetic Fields

Leadership

Chairman: J.C. Cain (USA) (confirmed)

*Cochairmen: K.M. Creer (U.K.)(to be contacted)
W.D. Parkinson (Australia)(confirmed)
T. Yukutake (Japan)(confirmed)

Working Groups

1. Analysis of the main field and secular variations.
2. Theory of the main field and secular variations.
3. Electromagnetic induction and electrical conductivity of the earth and the moon.
4. Magnetic anomalies.
5. Paleo- and archeo- magnetism.
6. Rock magnetism.

DIVISION II Aeronomic Phenomena

Leadership

Chairman: B.A. Tinsley (USA)(confirmed)

*Chairmen: M. Ackerman (Belgium)(to be contacted)
H. Rishbeth (U.K.)(to be contacted)
A. Vallance-Jones (Canada)(confirmed)

Topics

1. Structure, composition and dynamical processes of neutral and ionized constituents.
2. Solar fluxes, and photochemistry of ionized and neutral constituents, including excited species.
3. Atmospheric quantal emissions, including auroral processes and airglow.
4. Ionospheric irregularities, including small-scale auroral structures.
5. Ionosphere-magnetosphere interactions, including large-scale auroral

structures.

6. Upper atmosphere-lower atmosphere interactions
7. Aeronomy of other planetary atmospheres.
8. Laboratory experiments of aeronomical interest.

Reporters

The names of persons who would be suitable as reporters for each of the topics listed in the scope of the Division were discussed at the first Division meeting. From the names proposed the Executive Committee, guided by Chairman and Cochairmen, will make the final selection to ensure good geographical representation.

DIVISION III Magnetospheric Phenomena

Leadership

Chairman: C.-G. Fälthammar (Sweden)(Confirmed)
*Cochairmen: R. Gendrin (France)(confirmed)
T. Obayashi (Japan)(confirmed)
D.J. Williams (USA)(confirmed)

Topics

Each of the subdivisions should be covered by two reporters.

1. Magnetic fields, electric fields and current systems, including relevant ground observations.
2. Magnetosheath, magnetospheric boundary and plasma penetration.
3. Distribution and properties of magnetospheric plasmas.
4. Energetic particle population including cosmic ray entry.
5. Magnetic oscillations, waves and wave-particle interactions.
6. Magnetic storms and substorms, including aurora-magnetosphere relations.
7. Magnetosphere-ionosphere interactions.
8. Magnetospheres of other planets.
9. Laboratory experiments of magnetospheric interest.

Reporters

It was agreed that the reporters would be required to (1) act as links with active researchers in their field of responsibility in an attempt to find areas in which Division III may be of service to the scientific community and (2) prepare, and present at IAGA meetings, progress reports highlighting the scientific developments in their fields of responsibility since the last IAGA meeting.

Working Groups

Working groups should be established as the need arises and should have well-defined tasks, which should be completed in a prescribed interval of time. It was decided not to institute any working groups at the present time. Members could submit, at any time, suggestions to the Division leadership regarding the establishment of working groups.

Membership

It was decided to recommend to the Executive Committee that the membership-at-large should be open to all active scientists interested in the areas of

research covered by Division III and desiring to become members. On the basis of appropriate mailing lists, announcements would be distributed describing the new organizational structure of IAGA and inviting membership in Division III. Additional suggestions for potential members should be solicited from the national adhering bodies and individual scientists. Response to the questionnaire, or independent written requests to the Chairman, would be required to obtain membership. The Chairman should prepare regularly an up-to-date membership list and forward a copy to the IAGA General Secretary.

DIVISION IV Solar Wind and Interplanetary Magnetic Field

It was decided that the leadership would be established from the list of candidates adopted during the Kyoto Assembly by the Executive Committee in consultation with specialists in the field.

Topics

1. Structure of the solar wind and the interplanetary field.
2. Interplanetary plasma physics.
3. Interaction of the solar wind with unmagnetized bodies.

Reporters

Names have been proposed for reporters for these topics, and will be made public upon confirmation. It was decided that any working groups that might be set up would automatically expire at the end of the next Assembly, unless they are specifically renewed by action of the Division.

DIVISION V Observatories, Instruments, Indices and Data

Leadership

Chairman: P.H. Serson (Canada)(confirmed)
*Cochairmen: P.N. Mayaud (France)(confirmed)
R. Pastiels (Belgium)(confirmed)
M. Sugiura (USA)(confirmed)

Working Groups

1. Magnetic observatories.
2. Meteor-radar observatories.
3. Geomagnetic instruments and standards.
4. Optical calibration standards.
5. Magnetic surveys and charts.
6. Geophysical indices.
7. Collection and dissemination of data

Reporters Only

8. Geophysical alerts and forecasts.

Ad Hoc Working Groups

9. Ad hoc advisory group on coordination of IMS ground-based, balloon and rocket experiments
10. International geomagnetic survey by satellite

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* All Cochairmen are listed in alphabetical order.

11. Two IAGA members of a joint working group with Commission 22 of IAU.
"Ad hoc committee on radar observations of meteor flux, radiants and anomalies at the base of the thermosphere"
This joint committee would report to IAGA through Division V.

INTERDIVISIONAL WORKING GROUP Relations between External and Internal Magnetic Variations

Leadership

Chairman: A.A. Ashour (Egypt)(confirmed)
Cochairman: C.A. Onwumechili (Nigeria)(to be contacted)

INTERDIVISIONAL COMMISSION History

Leadership

Chairman: E.J. Chernosky (USA)(confirmed)

Working Groups:

1. American Area
2. Pacific-Asian area
3. European-African area
4. Development of research

INTERDIVISIONAL COMMISSION Antarctic Research

Leadership

Chairman: T. Nagata (Japan)(confirmed)

INTER-UNION AND INTER-ASSOCIATION WORKING GROUPS

1. The auroral oval and its extension into space (with URSI)
2. Physics of the plasmapause (with URSI)
3. Stratospheric and Mesospheric processes (with IAMAP)

Details of all working groups will be worked out between the relevant Division leaders, the Executive Committee and the members in the other bodies.

The details of functions, rules, terms of office, etc., of Division Leaders, Reporters and Working Group leaders will be worked out by the Executive Committee with the Division leaders during the coming months. The new structure will officially be put into operation on 1 January 1974, at which time the old Commissions and Working Groups will be dissolved.

Association General Meeting On Reorganization

Since the topic of reorganization has been a high priority item in IAGA for the past two years, a general meeting on reorganization was scheduled during the Kyoto Assembly in the afternoon of Friday, 14 September. No conflicting sessions were allowed on the program.

In preparation for this general meeting on reorganization, the Executive Committee, meeting on 8 September, reworked the proposed IAGA reorganization scheme distributed to IAGA members by Dr. Juan G. Roederer in a letter dated 10 July 1973 (see Appendix B of minutes of the Executive Committee in this bulletin).

Copies of this revised proposal were distributed to all delegates in Kyoto with instructions that the proposal should be discussed in all Commission and Working Group meetings and that all proposals would be discussed at the general meeting on reorganization scheduled for 14 September. Approximately 130 scientists attended the reorganization meeting.

President Troitskaya explained that Dr. Roederer had spent much time on this topic during the past two years. She thanked him for his extensive efforts and asked him to chair the remainder of the meeting.

Dr. Roederer gave a short description of the reasons for the reorganization and a historical review of the past two years activities on this topic. His remarks are given in detail.

Report By Juan G. Roederer

As a result of the IGY and ensuing "space age", the scientific field of IAGA has undergone a profound transformation. A whole new dimension of concern to geophysicists was uncovered as a result of the satellite exploration program, and a conglomerate of disciplines has emerged unified into what is now known as solar-terrestrial physics. The earth's magnetic field and atmospheric plasma were found to extend into what we now call the magnetosphere. The solar corona on the other hand, expands outward in the form of the solar wind, carrying embedded in it the solar magnetic field with imprints of solar surface perturbations stretched for out into outer-planetary space. The solar wind and the magnetosphere meet at the magnetopause, the cusps and the tails boundary layer. Energy and particles of the solar wind are continuously being fed into the magnetosphere, and dissipated continuously as well as sporadically thoughout its base, the ionosphere.

In recent years we have reached a point of sufficient understanding of this complicated solar wind magnetosphere system so that we can now clearly identify the problems and propose strategies for their solution. The solar-terrestrial complex exhibits multiple surface and low-latitude manifestations whose correlation with space phenomena is now sufficiently understood so that STP has become experimentally accessible to all countries, regardless of their satellite-launching capabilities. It is one of the primordial duties of an

international organization like IAGA to inform smaller, developing countries of all the possibilities of research open to them and to assist in drawing up plans that will allow their scientists to participate in STP activities.

With the emergence of solar-terrestrial physics, the whole perspective of research in geomagnetism and aeronomy has changed, coverging more and more toward a multidisiciplinary approach; geomagnetic, auroral and aeronomic measurements, radio probing, and in situ satellite and rocket observations must all be conducted in a coordinated, simultaneous way to provide the required information on the multiple interconnected processes, on the strong feedback systems that rule our outer environment. At the same time, we have witnessed how enormously lunar and planetary studies have flourished in the last few years thanks to the active participation of geophysicists.

This development has deeply affected several ICSU bodies, and has created serious overlap of interest amoung different Associations, Commissions and Working Groups of IUGG, URSI, IAU and IUPAP. A solution to this problem was attempted originally by these organizations, through the establishment of COSPAR and, later, of IUCSTP. It became clear, however, that in the end the overlap was only aggravated, particularly when it came to the conduct of international meetings, to the point of bewildering and appearing sometimes ridiculous to the working scientists. COSPAR, of course, was quite successful in providing a channel for information exchange on satellite work, particularly in the early phase of space exploration. IUCSTP is instrumental in providing a forum and home for special interdisciplinary STP projects. But still, up to this very day, seriously conflicting overlaps remain between several of the Unions.

An initially promising attempt to fuse part of URSI with IAGA was overwhelmingly defeated by the Council of National Delegates to the 1972 URSI Assembly in Warsaw, an extremely regrettable step. But most of those delegates were telecommunications specialists and not-so-specialists with little expertise in STP. Such an IAGA-URSI marriage would have provided a quite natural, unified and stable home for STP within ICSU.

So the problem still remains: STP needs a stable, unified home within ICSU. IAGA is the natural place, for scientific and historical reasons. Provided, of course, we offer the right furniture and interior decoration! Drs. Sugiura and Lanzerotti have recently made a survey of opinions, that included a question on which of the ICSU bodies was considered to be the appropriate one to deal with STP matters. IAGA "won" with an overwhelming majority! As a matter of fact, the number of STP papers presented at IAGA meetings has been increasing steadily over the past decade. Here in Kyoto, for instance, we have 203 papers on solid earth geomagnetism plus 17 papers on observatories, 230 papers on aeronomy and 305 papers on the magnetosphere and solar wind. I should point out that this time we have had no symposia on the solar wind. This number of STP papers has not forced its way into IAGA: their authors have been attracted to IAGA and their presentation represents a quite natural expansion of IAGA's original scope in the light of the developments mentioned earlier.

The other day, somebody told the Executive Committee that an organization that is reorganizing itself, is showing signs that it is dying. Not only must we reorganize to keep alive - we must achieve a structure that has the necessary flexibility to respond to current needs with a time constant similar to the time scale of current developments! Moreover, as our President so eloquently stated in her address, it is us in IAGA who must take the lead in promoting serious studies of possible correlation between weather system and magnetospheric electric field and particle precipitation mechanisms. It is us in IAGA who must vigorously promote serious research in the possible influence of low frequency micropulsation fields on biological specimens. It is us in IAGA who must take a lead in promoting more intensive research in geomagnetic induction effects on power and signal transmission lines.

Why reorganize IAGA? Can't the emergence of STP and other even newer topics be satisfactorily accommodated in the present structure? Is not the present structure, conceived in 1963, already a result of the emergence of STP? I have no time to dwell at length on all the various arguments that have been given in support of the need for reorganization. Let me just point out some of the inconsistencies or inadequencies of the present structure. For instance, we have a Commission that encompases a wide range of upper atmosphere phenomena. At the same level we have another Commission that deals with just one phenomenon, airglow. We have a Commission on magnetic variations what encompasses a wide range of phenomena determined by currents flowing in the base of the magnetosphere and further out. At the same level we have another Commission that deals with just one type of variations, those caused by tidal effects in the atmosphere. Next, we have one Commission on solar-magnetospheric relations that, if it were to follow its terms of reference literally, would cover everything that happens between the solar wind and the ionosphere. At the same level we have another Commission that deals with just one manifestation of magentospheric instability, the aurora. We have a Commission on magnetic observatories and instruments - yet all other types of observatories and instrumentation had to be dealt with sometimes cramped into one of the pertinent Commissions. Please don't misinterpret me: I am not saying here that I consider magnetic observatories, the aurora and lunar variations as of secondary importance. What I am trying to point out here is the need to equalize the scope of each one of IAGA's permanent subdivisions.

On the other hand, consider the conflicting overlaps in the present structure. The best example is given by the difficulty we had recently to accommodate in this Assembly symposia and commission sessions without serious conflicts. Commissions IV, V and VI are probably the most exposed victims of such an overlap.

What should be considered today as perhaps the most serious deficiency of our present structure is its inadequacy to be able to cope with, to deal effectively with, what our President has termed in her presidential address the diffusion of boundaries between the phenomena governing the aeronomic and geomagnetic complex, and to be able to do so with the expediency with which problems develop and get attacked in today's research.

All this requires that the stable frame, the backbone of a new structure must be defined according to physical processes, bundled together with global "spheres", rather than defined by the techniques or by individual morphological manifestations.

This has been the main area in our reorganization effort.

Let me finally briefly review the history of our reorganization effort. It was clear from the beginning that any new structure should emerge as the result of recommendations by the working scientists, based on his current needs. It was also clear that the new structure would have to attract the participation - I now mean administrative participation - of the new generation of scientists, or IAGA would be doomed to an exponential decay in time. I was asked by the previous Executive Committee to act as a coordinator in this back-and-forth consultation with the membership. This task was difficult and at the same time interesting and frustrating: (1) because of the originally wide range of opinions of those who responded, (2) because of the indifference of many, (3) because of some nasty and unpleasant remarks of a few, and (4) because of the many hours and hundreds of dollars of secretarial expenses. The work proceded in several steps: An original memorandum with a questionnaire was sent out in February 1972, a second memorandum reporting on the results, in April 1972, a report of the Secretary was sent out in June 1972, a report on the results and proposed matrix structure sent out in February 1973, a "best fit proposal" sent out in July 1973, and the last short document distributed to your mailboxes here in Kyoto. The matrix structure scared the hell out of a lot of people in IAGA and in other Unions and COSPAR, but it simply was the result of the fact that it seemed impossible to accommodate into one observation all the proposals made. The funny thing is that after having reverted to a one-dimensional picture in our last version, interdivisional working groups are popping up again, simply because a one-dimensional structure is an oversimplification.

Let me make one thing perfectly clear. I have heard frequently these reorganization proposals referred to as the "Roederer proposals". Everything I repeat, everything that had been written down in those memoranda had been suggested by somebody else who wasn't me -- somebody among a total of about 250 detailed, sometimes many pages long, replies. My job has been limited to (1) gathering opinions, (2) trying to pin down a consensus, if any, and (3) to relay back a synthesized picture.

A new structure is worthless if it is nothing but a piece of paper. The most beautiful scheme won't work if it is not staffed with the right people who know precisely what is expected from them and who have committed themselves explicitly to devote enough of their time to the organization.

What is IAGA? Why is there an IAGA? Why is there an ICSU? What are we really supposed to do? The good times are over for many of us, those times in which our governments eagerly supported our work if it came wrapped in the mystic halo of an international recommendation. Those days are gone, and if they are not gone yet in your country, I predict they soon will be. It is a

matter of fact that many governments, for instance mine, are taking a very hard look at benefits that an affiliation to a given scientific union brings to its communities of scientists. Cost-effectiveness may be abhorred by many of you, but it's here to stay, and no political system seems to be able to escape from it. We would be fools in IAGA if we ignored these developments. There are other rather recent developments that cannot be ignored in our attempt to define the objectives of IAGA. A proliferation of bi- or multi- lateral scientific agreements between countries, mainly the advanced countries, leads to an ever decreasing demand of Union or Association intervention. Data, people, information are exchanged and observations made, on almost a self-sufficient basis. This even applies to individual scientists who, compelled by the complexity and/or high cost of their research, team up, often across national boundaries, in total independence of any international scientific organization.

To meet all these adverse circumstances successfully, we need hard workers in IAGA positions from top to bottom. People willing to give a significant portion of their time to IAGA. A figurehead, however famous, will be worthless to IAGA as long as he remains just a figurehead.

Now to the last part. A superb structure, staffed with top people, operating toward crystal clear objectives still is a worthless dream as long as there is no budget to support its activities. Here is another very sore point. IAGA is one of the financially poorest organizations in the frame of ICSU, taking into account its size and scope. Of course this is related to the fact that it is just one out of seven Associations of our parent Union. Believe it or not, but out of a budget of about $382,000 dollars of IUGG for the Associations in the period 1967-1970, IAGA has received $40,000 - that is $15,000 less than one-seventh of the IUGG allocation for its Associations. IAGA is at least as big as the Association of Geodesy, and probably bigger than the sum of all Associations! This situation is outrageous and must change drastically. Of course it will require a concerted and forceful campaign on part of IAGA and its adherent bodies in each member country.

Results Of A Questionnaire Concerning The Problem Of International Meetings On Solar-Terrestrial Physics

The chairman asked Dr. L.J. Lanzerotti to present the results of a survey he and Dr. M. Sugiura had conducted regarding the value of various international organizations in the Solar-Terrestrial Physics effort and the number of meetings that should be held. Excerpts of this survey are given below:

> "This preliminary report gives a summary of the responses to a questionnaire concerning the problem of international meetings on solar-terrestrial physics. ------. The questionaire, was distributed to approximately 180 U.S. and 140 non-U.S. scientists who are actively working in many different areas of solar-terrestrial research, regardless of their affiliation with international organizations. Of these recipients of the questionnaire, 88 U.S. and 51 non-U.S. scientists responded within a prescribed, relatively short, period of time. We believe that these scientists represent various areas of solar-terrestrial physics reasonably well, and in a crude way, proportionately to the number of scientists working in each area. The mailing list used was drawn from sources independent of international organizations. The present report was prepared to make the results of the questionnaire available to the participants of the IAGA Kyoto Assembly. Our interpretations of the results and suggestions for the future will be published at a later date".

A copy of the questionnaire is given below:

Questionnaire

1. Two most recent international meetings you attended:

   (1) The last

   (2) The second last

2. How often do you think there should be such meetings?

3. What international organization do you think most represents STP interests?

4. How often do you think there should be a special meeting devoted to STP?

Every year	☐
Every other year	☐
Every three years	☐

5. Should the meeting referenced in Question 4 be held in close connection with a regular international (IAGA, IAU, URSI, COSPAR) meeting, i.e. at the same place immediately before or after?

Yes ☐ No ☐

Why?

6. Comments:

Name*

*We would like to have your name, but we will keep your name confidential.

Tabular results on questions 2, 3, 4 and 5 are given below:

Question 2. How often do you think there should be such meetings as listed under Question 1?

Interval (years)	All respondents (%)	U.S. (%)	Non-U.S. (%)
1/2	2	2	5
1	42	47	32
2	43	39	49
3	9	9	7
>3	4	3	7
	100	100	100

Question 3. What international organization do you think most represents STP interests?

Organization	All respondents (%)	U.S. (%)	Non-U.S. (%)
IAGA	47	47	48
COSPAR	13	15	10
IUCSTP	12	8	20
URSI	2	2	2
None	7	8	4
Not sure	6	10	-
No opinion	13	10	16
	100	100	100

Question 4. How often do you think there should be a special meeting devoted to STP?

Frequency	All respondents (%)	U.S. (%)	Non-U.S. (%)
Twice a year	1	0	2
Every year	18	18	18
Every other year	63	60	70
Every three years	17	22	8
None	1	0	2
	100	100	100

Question 5. Should the meeting referred to in Question 4 be held in close connection with a regular international (IAGA, IAU, URSI, COSPAR) meeting, i.e. at the same place immediately before or after?

Answer	All respondents (%)	U.S. (%)	Non-U.S. (%)
Yes	68	72	61
No	21	17	29
No opinion	11	11	10
	100	100	100

Editor's Note: The report also contained many pages of representative remarks from the respondents on questions 3, 5 and 7. In the interest of conserving space these will not be copied here. Copies of the report can probably be obtained from the authors.

Open Discussion, Proposed "Paper Structure"

Dr. Roederer next had the meeting consider the reorganization proposal identified in paragraph two, Division by Division, first asking for prepared statements by Commission Chairmen and others and then opening the meeting up for a general discussion. There were no major objections voiced to the general idea or reorganizing along the general lines proposed. The highlights of the discussion are given below for each proposed Division.

Division I - Internal Magnetic Fields

B.R. Leaton speaking for Commission II stated that Commission II was concerned that a stable place be found for "Daily Variations". It was felt that this topic should be placed in Division I. The Commission was unanimous in thinking that the present organizational structure should be retained until the Grenoble Assembly in 1975. The name should be shortened to "Magnetic Fields". Commission II would like to play an active part in formulating the fine structure of Division I.

T. Rikitake speaking for Commission III indicated there may be a need for some permanent interdivisional working groups.

D.E. Winch noted with concern that there is no obvious place for transient daily magnetic variations Sq, L., SD and the disturbance storm time variation Dst in the proposed structure. He gave some background arguments regarding sources and the fact that all these manifestations are variations in the magnetic field and concluded that they should all be placed in Division I, provided that "internal" be omitted from the name of the Division.

S.R.C. Malin for the Lunar Committee put forth arguments very much like those brought up by Dr. Winch. The above arguments provoked a lively discussion by P.N. Mayaud, E. Selzer, B.R. Leaton, M. Sugiura, J.G. Roederer, J.C. Cain and T. Nagata which brought out the points that if "internal" is dropped from the name, Division I would lack a focal point and that the magnetic field variations should be in Division III where it will get more attention by the magnetospheric people. Some felt the subject should be accommodated in an interdivisional working group. At this point two polls were taken yielding the following results: The word "Internal" should remain in the title and the magnetic field variations should be accommodated in an interdivisional working group.

Editor's Note: This idea was later formalized by creating an Interdivisional Working Group on "Relations between External and Internal Magnetic Variations".

Division II - Chemospheric And Ionospheric Aeronomy

L. Block reporting for Commission VIII gave a rather comprehensive formal statement which included important general comments extending beyond matters relating strictly to Division II. His ideas related to Division II are summarized below.

The Division title should be reduced to the single word "Aeronomy". The Division should cover the following topics:

- Structure, composition and dynamical processes of neutral and ionized constitutents.
- Solar fluxes and photochemistry of ionized and neutral constituents, including excited species.
- Atmospheric quantal emissions, including auroral processes and airglow.
- Ionospheric irregularities including small-scale auroral structure.
- Ionosphere - Magnetosphere interactions.
- Upper Atmosphere - Lower Magnetosphere interactions.
- Aeronomy of other planetary atmospheres.
- Laboratory experiments of aeronomical interest.

One or two reporters should be appointed for each of these topics with the responsibility to report on the progress in their field at meetings and to participate when appropriate in the organization of scientific sessions and symposia.

Should the need arise for a working group on any of these topics, or on some other topic within the scientific field covered by the division, the appropriate reporter, or the division chairman, may nominate members to the working group.

Commission VIII urges that in Division II a very strong working group be set up to deal with energetics, dynamics, and structure of the thermosphere and exosphere, and it should work with other relevant organizations through SCOSTEP.

G.G. Shepherd reporting for Commission VI supported the basic proposed divisional structure. While recognizing that all divisions are arbitrary to a certain extent, the fundamental simplicity of the new structure offers considerable advantages in coordinating the scientific affairs of the Association. We are also in sympathy with the desire to base the divisions on a firmer physical basis, now that these bases are better understood.

Nevertheless, the members of the Commission fear that in achieving this objective, the proposal gives the impression of suppressing the very phenomna which we seek to study. In short, we think that in the new structure, the aurora should be clearly visible (or perhaps I should say visual). Theories and divisions may come and go, but the aurora will always be there. Its distinctive and unambiguous character has served as a unifying force in our work in the past, and can continue to be a focal point for many of us who

wish to retain some common identity.

This objective can be adequately met by the appropriate working group structure, and the following would meet the needs of the auroral community in Division II:

- a working group on auroral processes.
- a working group on auroral structure.

(In Division II we also suggest that "structure and composition" should become "structure, composition and dynamics".)

As rationale for the above working groups, Dr. Shepherd gave the following:

1. Auroral processes - The subject of energetic particle interaction with the atmosphere, in which the energy degradation of the primary particle is followed down through ions, electrons, neutrals and quantal emissions to thermal energy is a very large topic, and deserves to be treated as a distinct topic.

2. Auroral structures - Auroral processes are considered to be microscopic ones. The study of medium scale phenomena, larger than single particle, but small enough that the larger characteristic of the magnetosphere do not dominate, are very important in auroral physics, and needs to be treated separately.

G.G. Shepherd also made proposals regarding the structure of Divisions III and V which are given later. He concluded by stating that Commission VI had hoped that some of these working groups will overlap with others proposed, and some adjustments will be required. That is the purpose of reorganization but Commission VI feels very strongly that the aspects of auroral studies described should be clearly identifiable in the new IAGA.

S.J. Bauer suggested that the role of planetary atmospheres should not be left to the astronomers even though they think it should be reserved for them. The topic of planetary atmospheres must definitely be in IAGA.

H.B. Liemohn indicated that definition of "aeronomy" has changed. It now seems to mean "upper atmosphere chemistry".

L. Block said that in Commission VIII it was agreed that "aeronomy" meant "physics and chemistry of the upper atmosphere".

J. London said "aeronomy" had been rejected by the meterologists because its meaning is obscure.

Division III - Magnetosphere Plasmas, Fields And Waves

M. Sugiura speaking for Commissions IV and V, that had met jointly in considering reorganization, indicated that they had discussed topics that should be covered in Division III. They are in favor of naming two reporters for each topic.

C.-G. Fälthammer suggested the title be shortened to "Magnetospheric Phenomena". He named nine possible topics for the division. He indicated

that reporters should be appointed for each topic. He felt that the division should be free to set up working groups.

M. Gadsden and G.G. Shepherd proposed a working group on auroral magnetospheric relationships, offering the next paragraph as the rationale.

The determination of the global pattern of the aurora requires an experimented and a coordinated effect that unites many people. The objective of this work will be, in the next few years, to identify the correspondence of this aurora and its features to the observables in the magnetosphere. Auroral physicists look forward to working with magnetospheric scientists in this task.

L. Block recommended that the equatorial electrojet be specifically involved in the topics listed under Division III.

B. Hultqvist pointed out that there is a problem of overlap and duplication with what is listed as a topic under Division III and the subject proposed as a joint working group with URSI on "High-latitude Magnetosphere - Ionosphere Interaction". He suggested that perhaps the joint working group with other Unions should be more interdisciplinary in nature and the Division working groups be more specific.

C.-G. Fälthammer said there was no overlap yet and this could be minimized by using only reporters for most topics within Division III. We must be very careful of the working groups we activate.

B. Tinsley and J.C. Armstrong pointed out it would be necessary to determine what working groups would be established inside IAGA before the question of inter-Union joint working groups is considered, since we would not want to create overlapping working groups.

C.-G. Fälthammer expressed the feeling that the following working groups might be established.

1. Magnetic and electric field models
2. Magnetospheric boundaries
3. Hydromagnetic oscillations
4. Laboratory experiments

Division IV - Solar Wind And Interplanetary Magnetic Field

J.G. Roederer stated that until now this topic had been encompassed in one working group in Commission V, but since IAU is not covering this field adequately IAGA proposes to expand to do the job.

M. Dryer spoke in favor of adopting this new division. He indicated that there has not really been a home anywhere for the solar wind scientists.

J.C. Armstrong asked whether the area of interest might be widened to include cosmic ray propagation and modulation. J.G. Roederer answered that IUPAP had recently promised to cover this topic so IAGA should not try to include it.

M. Dryer expressed the feeling that when studying the solar wind he would envision including solar cosmic rays and low energy intergalactic cosmic rays.

Division V - Observatories, Instruments, And Logistics

R.B. Leaton suggested that because of the way the data is used, Observatories and Surveys should be separated and not be shown on the same subheading.

P.H. Serson indicated that all activities of Commission I fall within the proposed Division V. For this Division, Commission I prefers the title "Observatories, Instruments and Data". Division V would be concerned with the operation of a network of permanent observatories and continuing programs of surveys, and therefore requires a permanent structure rather than a succession of ad hoc working groups. Commission I strongly recommended that Division V include the following permanent working groups:

1. Geomagnetic instruments and standards
2. Magnetic observatories
3. Magnetic surveys and charts
4. Processing and dissemination of geomagnetic data.

J. London stated that hardware recommendations have a better chance of success if the hardware is versatile. Meterology rockets and satellites for probes are used, and the instruments must be carefully standardized and calibrated. IAGA scientists, of course, do the same. It would be useful if and when they do this they would cooperate with related scientists in standardizing and calibrating instruments.

T. Rikitake stated that the scientists in the observatories are thinking of having intergovernmental coordination and IAGA is providing that need. To do this better, we need a standing group to coordinate magnetic observatories and surveys.

M. Sugiura speaking for Commissions IV and V stated that the topic of geophysical indices won't prosper in Division V unless other working scientists are included. IAGA should appoint a coordinator for data coordination in data centers and information centers.

J.G. Roederer expressed the thought that the Geomagnetic Meridian Project and the Conjugate Point Experiments should be included in Division V.

R. Gendrin was in favor of having some focal point in Division V for Antarctic research scientists.

J.V. Lincoln spoke from the viewpoint of World Data Center A for Solar-Terrestrial Physics, particularly concerning working group structure for Division V. The selected leaders should be involved in at least one of the four other divisions. In fact for each of the suggested subdivisions, and especially for data supply, processing and dissemination to work there should probably be representatives from each of the other divisions forming a steering committee under the leadership of the chairman and co-chairman appointed by the Executive Committee. This steering committee could establish sub-groups or correspondent members as necessary. Also ex-officio members from appropriate international bodies should be appointed. For example, MONSEE representation for data supply, processing and dissemination and IUWDS representation for geophysical alerts and forecasts. Under geophsycical indices - solar, interplanetary, micropulsations,

etc., should be represented as well as geomagnetic indices.

Perhaps Division V might be called "Observatories, Instruments and Data

Interdivisional Commission On History

E.J. Chernosky was satisfied with the proposed establishment of this interdivisional commission and suggested that four working groups be established as follows:

1. American Area
2. Pacific-Asian Area
3. European-African Area
4. Development of Research

Interdivisional Commission On Antarctic Research

Although this title did not appear in Appendix B (p. 26), it is included here for completeness.

Dr. T. Nagata, representing the Committee on Antarctic Research, indicated that the committee work overlaps the work of the proposed Divisions II, III, IV and V, and should be allowed to survive at least until after the Grenoble Assembly in 1975.

Joint Working Groups

L. Block speaking for Commission VIII recommended that the suggested Joint Working Group "Environmental Effects on Earth" be deleted, but that IAGA should recognize that it has a general responsiblity to examine the processes within its scientific field which may alter the environment.

Commission VIII also recommended that the suggested Joint Working Group "Standard Atmosphere and Ionosphere" be deleted.

Remarks By National Delegates

B. R. Leaton, United Kingdom delegate:

Opinions of the United Kingdom scientists present range from unqualified acceptance of the new structure to its outright rejection. They are divided roughly:

For Divisional structure, with or without modifications	75%
For Existing structure with less radical changes	15%
Undecided	10%

More than two-thirds think that implementation of any major re-structure before Grenoble, 1975, would create more and serious practical difficulties than any similar action now or in the intervening period.

Other opinions expressed, but on which there is no composite view

(1) Consultation on the details of any new major structure which may be agreed should be as wide as is practicable.

(2) The adoption and announcement of the scope of some of the proposed new divisions, notably Division II, III and IV are sure to start again reaction from other organizations.

(3) Adoption of the "new" structure could be harmful to IAGA if the vote is split down the middle

W.W. Mundt, German Democratic Republic delegate:

Germany (Democratic Republic) will support the general reorganizational proposal as given by President V.A. Troitskaya.

F.S. Johnson, United States delegate;

The United States of America has not adopted a formal position, but the general feeling certainly supports the reorganization plans.

T. Nagata, Japan delegate;

As chairman of the Japanese National Committee of the IUGG, I can say the proposal to reorganize has general support.

E. Oni, Nigeria delegate;

The National Committee of Nigeria has no objection to the new proposed structure, but it should be borne in mind that very few scientists in Nigeria work in a single field so Nigeria favors more Inter-Association and Inter-Union groups.

Open Discussion On How To Make "Paper Structure" Work

W.H. Campbell opened this part of the meeting with a plea for more democracy in the running of IAGA which is included here in its entirety:

> At the risk of unpopularity, I would like to speak of some issues that need exposure. These are issues that have been talked about at times at the back of the meeting halls, in the assembly corridors, and in the privacy of our offices and laboratories at home.
>
> At the introduction of this subject, let me indicate very clearly that the concern is only issues, not personalities. There is no intention to offend anyone here; there is not an individual or group here I dislike; any offense would surely errode the purpose of raising the subject here, at this time.
>
> I would like to speak to the problem of implementation of our reorganization; the question of how we may be effective as an organization.
>
> The membership assembled here in Kyoto consists of highly intelligent, particularly capable scientists who, as researchers, have been schooled in independent thinking. Because of this fact, it is reasonable to assume that any set of them may produce an acceptable regrouping of the subject matter such as the new five divisions proposed today to replace our old commission structure.
>
> What seems more important to me is the restructuring of our process of decision making. It is this feature, not new subgroup titles, that will strengthen or weaken our future IAGA. As Dr. Shepherd just stated,

we don't really reorganize the physics of our environment. Rather we rearranoe the transactionsbetween our members. What we have done thus far are largely cosmetic changes. What I mean is that although a man"s new clothes may be changed with the fashion of the times and his expanded waistline - clothes that are certainly important to many aspects of his happiness in daily life - rather, what truly matters for his continued existance is the internal functioning of his organs. If we are to be genuinely effective in IAGA as an organization - to be something more than a convention center - we must consider having a constitution prescribing the rights and procedures in such a way that the power of major decisions rests upon the full membership.

Some of us who have been with the organization long enough to see its inner workings, at times have been dismayed by some of the methods of chairman selection, the creating and dumping of approved symposia topics, the ignoring of parlimentary procedures, etc. What small democratic group actions we have experienced, such as those at this meeting, here, this afternoon, have apparently occurred as a result of leadership's temporary grant rather than membership's right. There is a great difference in these two aspects.

Let me not imply that these past authoritarian actions have been done with malice or destructive purpose. Rather, in the vacuum of no democratic or representative procedure, awkard and unfortunate actions have occurred.

There are numerous group psychological studies to show that the most effective organizations are those in which there is full participation of the membership in decision making, goal setting, and leadership selection (C.F. Lewin et al., 1939; McGregor, 1960; Berne, 1965). What would be most effective for IAGA would be a structure in which each Division has the power to decide upon its own procedures for selection of Chairman and Co-chairman; through its own democratic process select what are to be the working groups, fully define by itself what symposia and reports to sponsor, etc. The Executive Committee of IAGA should be the representatives, agents and servants of the membership. The Executive Committee should not have the power to control the organization to the extent it now has.

I was informed this morning that rules require the present methods of selection of Officers, Commission Chairmen etc; that it is not possible to change many of these. Some have told me that we must accept such procedures; it is not smart to try to upset the present "political" order. This is simply not true. We here, today, are the vital part of the organization; we decide what is acceptable to us.

I am reminded of the English king who argued that Parliament could have no power because God had conferred upon him a "divine right" to rule. History records his inglorious demise.

If we indeed have IUGG or other requirements to remain within certain procedures we could continue to use, for example, an appointed leadership only restrict it to individuals identified by the advise and consent of the full commission membership. Other more representative methods than those presently in effect, could be instituted easily if we desire to change. There are no means, now in existence, by which the present membership may, of itself, remove and replace an ineffective leader. If we are to be a truly healthy organization IAGA's future must contain a restructuring of its procedures.

The present situation and attitudes of some I have encountered reminds me of the old parable of the sandles. A stranger visiting an aboriginal society found the natives all with bruised and torn feet resulting from their hard life on an island of lava rock and shores of coral. Upon questioning, the natives reported that they knew all about sandles, the benefits of foot protection, and sandle wearing. In fact, the sandle maker, in poverty, was still a very respected member of the society. Nevertheless, the uniform answer to the visitor's question "Well, why don't you wear them" came back to him again and again. "Well, that's just the way our society is, no one wears them." ... Here in IAGA we can fall into that destructive way of thinking -- an acceptance of the way things have existed, although we fully know of better procedures.

The time for true reorganization is now. Now we can best institute procedural changes at the same moment that the topical changes are underway. Now, with the present existing procedures, the Executive Committee can by its order start a new IAGA constitution. I plea to those presently in office to show their magnanimous nature by giving this internal health to our organization.

Thank you for this opportunity to speak.

References

E. Berne, "Structure and Dynamics of Organizations and Groups", Grove Press New York, c. 1963.

D. McGregor, "The Human Side of Enterprise", McGraw Hill Pub. Co., 1960

K. Levin, R. Lippitt and R.K. White, "Patterns of Aggressive Behavior in Experimentally Created Social Climates", J. Social Psychology, 10, 271-299, 1939.

G.D. Garland commented that there was nothing in the IUGG constitution which told IAGA how to conduct the details of its business.

J.W. Dungy expressed some sympathy for Dr. Campbell's opinion explaining that in URSI, Commission Chairmen are semi-elected.

L. Block stated that at the beginning of this Assembly some working group reporters did not even know they had an IAGA position. He suggested each reporter should be given a list of duties and agree to do them before they are

appointed.

He also stated for Commission VIII that many members of IAGA are interested in IAU, URSI, IAMAP, COSPAR and SCOSTEP meetings. However, most of us lack both time and funds for several meetings a year. We strongly recommend that IAGA take action to coordinate topics and dates of future meetings with those of the above mentioned organizations. IAGA should invite related ICSU bodies to arrange the interunion meeting on Solar Terrestrial Physics in 1977 to be held adjacent to or during the 1977 IAGA scientific assembly.

M. Petit, from France, recommended that the new structure should be postponed until after the Grenoble Assembly in 1975 because the IAGA organization is responsible for the scientific program of that Assembly. He suggested that the Executive Committee nominate five persons, one for each Division, to form a Committee to draft rules for implementing the new structure.

J.G. Roederer expressed the thought that at least two persons should be nominated per Division not just one. He also felt that a plan of implementation should be adopted quickly -- within a year -- so the whole thing could be put into effect and function in preparing for the Grenoble Assembly.

B.A. Tinsley stated that a new structure should be defined at an assembly such as this one -- not by a committee between assemblies.

H.M. Sullivan expressed appreciation of the work that had gone into the present reorganization effort, but felt that with all the discussion that has taken place a new outline should be prepared to show where the plans now stand.

J.G. Roederer volunteered to redo the proposed reorganization plan in light of comments and decisions that have surfaced since the last plan was prepared.

E.A. Lauter pointed out that nominations for leaders of IAGA-URSI Joint Working Groups will be needed even if the IAGA reorganization is not completed now.

H. Trefell commented that he felt the present proposed IAGA structure was very fine but what is needed is a procedure for instigating the new structure and terminating the old structure. He emphasized that working groups should be designed to work. Perhaps in the past certain working groups were not necessary. IAGA needs reporters to report on science. It will be very difficult to find good reporters. When working groups are established they should be given very specific tasks. Working Groups should have limited memberships. He was skeptical about the success of IAGA-URSI Joint Working Groups.

C.-G. Fälthammer expressed hope that Trefell's definition of what reporters should do will hold true. In putting the new organization into operation, IAGA should determine general frame of reference for the Divisions and then let the scientists in the divisions decide what the internal division organization should be.

L. Block fully supported Trefell's view. IAGA should not set up needless working groups. Some proposed working groups should be deleted if they won't work. As examples of proposed working groups that probably won't work he cited the "Standard Atmosphere and Ionosphere" and "Environmental Effects on Earth".

N. Davis made a motion that "IAGA take action here and now to adopt the new IAGA structure as modified during this meeting". The motion was passed.

W.H. Campbell made a motion that "The Executive Committee be advised as to how to proceed in a more Democratic fashion". The motion was passed, and Dr. Campbell was asked by the Chairman to explore how this could be done.

Editor's Note: Following the meeting Vice President J.G. Roederer did rework the reorganization proposal to reflect decisions and discussions of this meeting. This he did over the weekend so that early in the week of 17 September a paper "Present Status of Proposed IAGA Structure" was distributed to each participant along with a list of possible leaders for the proposed divisions. Delegates were encouraged to express their preference (an opinion poll) for division leadership by listing in order of priority the names of three people they would like to see as leaders of the divisions. In marking their poll, delegates were intived to use the names listed (by the Executive Committee) or to write in other names.

The Executive Committee, considering these polls along with the need to have a suitable international representation in the division leadership, selected division leaders for the new divisions. These new division leaders agreed to serve after which they were consulted in determining three co-chairmen for each division. These new division leaders conducted meetings of their divisions during the evening of 19 September. (Division V met again on 20 September.) The final new IAGA structure is given as Appendix D in the minutes of the Executive Committee.

Reports Of IAGA Organizational Units

Commission I

Observatories And Instruments

P. H. SERSON - COCHAIRMAN

The review and business meeting of Commission I was held on 12 September 1973. The Commission expressed its deep regret that Chairman De Vuyst was unable to be present. Prof. De Vuyst had been very active in preparing the program of the Commission and the symposium "Modern Magnetic Observatory Techques", but had to cancel his travel plans shortly before the Assembly, on the advice of his physician.

Review Of Activities Of The Geomagnetic Network (Chairman A.P. De Vuyst)

This review had been circulated before the Assembly. It was not read at the Assembly; attention was merely directed to it, and various parts were discussed.

Geophysical research studies on a global basis are increasing in number. For the user of geomagnetic data there are obvious advantages when he can work with records or data in homogeneous format. This is especially true where he is using machines for conversion of analog to digital output. Also, the widespread availability of high-speed electronic computers has made it desirable to have observatory output in machine-readable form. Several IAGA resolutions of recent assemblies have been adopted with a view to modifying observatory output along these lines.

Particularly because of the forthcoming International Magnetospheric Study (IMS), it seems appropriate at this time to call attention to certain goals for the magnetic observatory network and to offer certain comments and recommendations:

ESTABLISHMENT OF NEW OBSERVATORIES

The need for additional stations in certain ocean areas with few or no stations is well known. Several IAGA resolutions have been directed to this need. Individual countries with control in these areas are requested to take appropriate initiative.

STANDARDIZATION OF ABSOLUTE INSTRUMENTS

In 1969 this Commission determined through a questionnaire that 67% of the observatories and proton magnetometers for determining the total intensity (a very few had added coils for determining the components). Furthermore, it was indicated that within five years an additional group will have acquired proton magnetometers, bringing the total to 90%. Thus, it would appear that the goal has been substantially realized as regards the (scalar) total intensity. The problem is diminished, but still remains troublesome with respect to the horizontal and vertical components.

In the past years a set of QHM's has been periodically circulated by IAGA for comparison of observatory standards with the International Magnetic Standards in horizontal intensity. Those observatories which do not yet have proton

magnetometers and which wish to have their H standards compared, and those which do have proton magnetometers and which have found substantial disagreement between directly observed total intensity and magnetograph total intensity, are urged to write to the Meteorological Institute, 2920 Charlottenlund, Denmark requesting that their station be included in a future circuit.

HOMOGENEITY OF OUTPUT

Observatory equipment is diverse, and it does not seem feasible to achieve complete uniformity. Indeed, it is doubtful that agreement could be reached at this time on standard equipment to be recommended. However, much can be done toward achieving a standard output.

Where normal magnetograms do not have the following features, it is requested that consideration be given to making a change at the earliest convenient opportunity:

Universal time (or GMT). Universal time should be shown on magnetograms. Regional time zone may be shown in addition to UT, if desired.

Recording speed of 20 mm/hour. A count of the systems shows that 64% of the present normal magnetographs use a recording speed of 20mm/hour. Most of the others use 15mm/hour; a very few have odd speeds varying from 10 to 30mm/hour. The cost of a new recorder is not great. Perhaps your own instrument shop can build one.

Time indicators. There are several types in use--lines, gaps, dots, and ticks. We have not made a count of the number of observatories which use each type. Although the line may introduce parallax, it seems preferable for input to automatic optical scanning equipment. The second choice would be the gap.

Mean hourly values. Most observatories determine mean hourly values, centered on the half hour. Many observatories do not publish their hourly values, but it is thought that there are only about five observatories that are scaling hourly point values.

Miscellaneous. There are many other possible improvements that would assist the user--for example, better temperature control (avoiding the need for use of temperature coefficients in the computations), better placement of traces on the magnetograms (avoiding excessive entangling), commencing the magnetograms at the same time each day, etc. Some of the problems encountered in digitizing magnetograms were mentioned in the paper, "Transformation of analog records to digital forms," by K.L. Svendsen, presented at Madrid in 1969.

MACHINE-READABLE RESULTS

IAGA resolutions have urged that efforts be made to produce digital results in machine-readable form and to make them generally available through the Word Data Centers. Much progress has been made. Many observatories are key-punching their hourly values and making them available on punched cards, punched paper tape, or magnetic tape. Where this is not already being done, it is urged that

it be done. Formats for machine-readable data are shown in IAGA News No. 8, pages 22-26.

Hourly values are very useful; more frequent samplings of the magnetic field are even more useful. In view of the vast amount of data laready available as 2.5-minute values, IAGA has recommended this as a standard sampling rate for achieving purposes, although this does not preclude recording at a more rapid rate.

It is of interest to note that all of the above requirements would be satisfied by operation of a three-component, digital, proton magnetometer (or another type with suitable standarization). Unfortunately, this equipment is expensive. Also, keeping the equipment in good working order requires qualified personnel and, generally, a supply of spare parts. An alternative is to acquire equipment for mechanical transformation of analog recordings (magnetograms) to digital form. Some of the presently available equipment is relatively simple and inexpensive. There are several present advantages to this second approach, the most important ones being: (a) the format of the output can be independent of the recording equipment, and (b) because many institutions can acquire such equipment, homogeneity of output is a feasible goal.

CONCLUSION

It is hoped that some improvements can be effected prior to IMS, but it is important that there be no loss in present efficiency. It would be unfortunate if use of new techniques, or acquisitions of new equipment interrupted the present flow of data for any significant interval of time.

Observatories in a position to acquire new equipment are urged to consider the above remarks. If your resources are too limited to consider direct digital recording, it is suggested that you investigate acquisition of equipment to expedite conversion of analog records to machine-readable, digital form.

As regards the recording of pulsations and other special phenomena, different types of equipment are required, depending upon the particular research topic under study, therefore, it seems impractical to suggest the same special instrumentation for all stations.

And, most important, magnetograms on film, tabular data, and machine-readable data should be sent to the World Data Centers as rapidly as possible following the recording period. If special problems are encountered as regards film or postal service, inform the Center. They may be able to assist you.

Results Of Magnetic Observatory Questionnaire

At the end of 1972 a questionnaire was sent by Dr. De Vuyst to all organizations operating magnetic observatories to gather information on (a) the use of proton magnetometers, (b) data in machine-readable form, and (c) sensors and recording speed for rapid variations. Replies representing a total of 113 observatories gave the following conclusions:

- Base-lines are in general checked or measured with proton magnetometers and related equipment.
- There is a trend toward storage of hourly values and year-books on magnetic tape.

- The adoption of automatic or semi-automatic means of analog-to-digital conversion is proceeding rather slowly; direct digital recording is progressing more rapidly.
- Almost all recording of rapid variations is by suspended magnets or induction coils.
- A great variety of recording speeds are used for rapid variations.

Preparations For The IMS

It was decided that K.L. Svendsen would prepare and mail to all magnetic observatories a circular letter based on Dr. De Vuyst's memorandum on improvements which could be made in the geomagnetic observatory network before the beginning of the International Magnetospheric Study (IMS). The letter would draw attention to the fact that it should be possible for almost every observatory possessing a proton magnetometer to construct a proton vector magnetometer, and that instructions and examples of observations are given in "Notes on geomagnetic observatory and survey practice" by K.A. Wienert.

Resolutions And Recommendations

Commission I approved the following resolutions subsequently adopted by IAGA: (See Resolutions in this publication)

Resolution 3- SI Units

Resolution 6- Data from temporary magnetic observatories

Resolution 8- AE-indices

Resolution 13- IMS ground magnetic stations

Resolution 19- Uniform magnetograph speed of 20mm/hour

In addition, Commission I adopted the following recommendations:

RECOMMENDATION 1

Commission I recommends for direct digital recording from magnetometers a sampling interval of one minute. This does not preclude a faster sampling rate when required.

RECOMMENDATION 2

Commission I recommends the following format for magnetic tape storage of one-minute observatory values:

1. Record length is 1464 BCD characters, parity is even, and density is 556 or 880 bpi. There is one logical record to a block.
2. There is an end-of-file mark after the last block. If incomplete, the last block is padded with nines.
3. Each block contains data for one hour in the following format: (Lat, Long, Year, month, day, hour)$(X,Y,Z,F)_1$, $(X,Y,Z,F)_2$ ... $(X,Y,Z,F)_{60}$.
4. (LAT), (LONG), (YEAR) (MONTH DAY HOUR) are 6 character fields with leading zeros for LAT, LONG, YEAR.

   LAT is geographic latitude of station in hundredths of a degree. A minus sign (octal 40) precedes the latitutde of southern hemisphere stations.

   LONG is geographic east longitude of station in hundredths of a degree.

   MONTH is month of the year from 01 to 12

   DAY is the 2-digit day of the month

   HOUR is U.T. hour of the day starting from 00.

5. Each data item for X,Y,Z,F has a field of 6 characters including the sign. The sign character is the minus sign (octal 40) for negative values or a blank (octal 20) for positive values.
6. Missing values are padded with 999999. To be compatible with CDC computers the record length may be reduced to 1460 BCD characters by omitting the leading zeros in LAT, LONG, YEAR.

RECOMMENDATION 3

Commission I recommends that digital magnetic observatories publish their results in standard observatory year-books.

Minimum requirements for year-books from magnetic observatories are:

1. A full description of station location with geographical coordinates and elevation, observatory instrumentation, and methods used in data reduction to be given in each year-book.
2. Changes in station location, equipment or operational procedures to be clearly stated.
3. Lists of measured and adopted baselines and scale values.
4. Mean hourly value tables in H(X), D(Y), A. Quiet (Q) and disturbed (D) days to be clearly indicated in the tables.
   Sign convention of both baselines and tabular base values to be clearly specified.
5. Summary tables by month of the year and hour of the day of actual field values for each recorded element for all, quiet and disturbed days.
6. Summary table of annual values.
7. Time to be U.T.

RECOMMENDATION 4

Commission 1, recognizing the need for a better understanding of the longitudinal variation in Sq patterns, endorses IAGA Resolution 10 (Moscow) and recommends that magnetic observatories be established on the mid-oceanic islands of Tristan de Cunha, Ascension, and St. Helena.

Reorganization Of IAGA

Commission I approved the general principle of reorganizing IAGA in five Divisions. For Division V it proposed the title "Observatories, Instruments and Data". Commission I is concerned with continuing programs of surveys and permanent networks of observatories, and therefore strongly recommended that Division V include the following permanent working groups:

1. Geomagnetic instrumentation and standards
2. Magnetic observatories
3. Magnetic surveys and charts
4. Processing and dissemination of data

It was considered that geomagnetic indices belong in Division V, but opinion was divided concerning the proper home for studies of S and L variations.

Working Group I-1, Magnetic Observatories

K. L. Svendsen - Reporter

The working group noted that many operators of magnetic observatories still do not have access to the book "Notes on geomagnetic observatory and survey practice" by K.A. Wienert, published in 1970 by UNESCO, Paris, in English and French. It was recommended that a second notice be placed in IAGA News, and that the Reporter should send to all organizations operating observatories a circular letter drawing attention to this most useful manual, and giving information on how it can be obtained.

The working group pointed out that it should be possible for almost every mangetic observatory possessing a proton magnetometer to construct at small expense a proton vector magnetometer. Instructions and examples of observations are given in Dr. Wienert's manual. Wider adoption of proton vector measurements would greatly improve absolute control in the world network.

Several operators of magnetic observatories have asked whether IAGA could recommend specific types of digital recording magnetometers and automatic or semi-automatic devices for scaling magnetograms. The opinion of the working group was that the development field is too fluid and that the requirements of different observatories are too diverse to permit firm recommendations. The working group will try to find an expert willing to prepare a review paper for the information of potential users of such devices. It was noted that since most observatories derive only hourly values, scaling by hand is quite satisfactory in many cases.

It was noted that individual observatories have solved a number of instrumental and operating problems which are common to many observatories. The Reporter agreed to collect such solutions and prepare a circular letter to all observatories describing them.

The working group drafted resolutions and recommendations on the adoption of a uniform recording speed for standard magnetographs, on the need for additional observatories for AE index and for studies of Sq, and on the sampling rate of digital magnetometers.

Working Group I-2, Geomagnetic And Telluric Instrumentation

P. H. Serson - Acting Reporter (for V.N. Bobrov, Reporter)

The working group draws attention to the publication of an excellent review of recent developments in instruments for ground-based geomagnetic measurements: W.F. Stuart, Earth's field magnetometry, Reports on Progress in Physics, 35, 803-881, 1972. It describes magnetometers using nuclear and atomic resonance, saturable cores, suspended magnets, induction coils and superconducting devices. Methods of making vector measurements with total field sensors are discussed, and the review concludes with a survey of digitally recording automatic observatory systems.

An earlier project of the working group, the preparation of a bibliography of selected papers describing techniques and instruments for measurement of the geomagnetic field covering the last 20 years, was brought to completion with the appearance of two publications: F. Primdahl, Bibliography of fluxgate magnetometers, Pub. Earth Physics Branch, Ottawa, 41, no. 1, 1-14, 1970 and P. H. Serson and F. Primdahl, Bibliography of magnetometers, Pub. Earth Physics Branch, Ottawa, 43, no. 8, 500-506, 1972.

Working Group I-3, Comparison Of Magnetic Standards

K. L. Svendsen - Acting Reporter (for E.K. Lauridsen, Reporter)

K.A. Wienert presented a report for the period 1971-73 prepared by Dr. Lauridsen, pointing out the continuing need for comparisons through exchange of QHM's of observatory standards of horizontal intensity. The calibrations are made by the Danish Meteorological Institute at Rude Skov, and QHM's are available for this purpose without charge. Comparisons with Wien-Kobenzl and Hong Kong were reported and also comparisons with the instruments of the Soviet survey vessel ZARYA on three occasions.

A paper "On the use of the QHM as an observatory standard" by E.K. Lauridsen was distributed. It presents results of a thorough examination of the changes in the constants of some 100 QHM's over periods of 10 years or more. All instruments except one showed a systematic decrease in the main constant, with a mean rate of 10^{-4} per year. Other factors such as changes in humidity, long-term decreases in the temperature coefficient, and non-linear temperature effects are discussed. The importance of periodic standardizations of QHM's is stressed. Copies of this paper will be sent to every magnetic observatory.

Working Group I-4, Processing Techniques For Observational Data

E. I. Loomer - Reporter

Following extensive correspondence and consultation with working group II-6 (Data Interchange, H. Maeda, Reporter), agreement was reached on a format for magnetic tape storage of one-minute values from magnetic observatories. This format was subsequently approved by Commission I as reported above.

Recommendations were also drawn up by working group I-4, and subsequently adopted by Commission I, concerning a one-minute sampling interval for digital magnetometers, the publication of standard observatory year-books by digital magnetic observatories and the minimum requirements for year-books from all magnetic observatories.

Commission II

Representation Of Main Fields

B. R. LEATON - Chairman

The Commission II business meeting of 21 participants was started on 14 September with B.R. Leaton as chairman. It was continued at a later date.

General Discussion

It was pointed out that there were no plans for a continuing low-altitude satellite survey. This provoked a lot of discussion, particularly as such a survey would be essential if satellite data were to make an accurate contribution to the determination of secular change and if there was going to be any hope of confirming the suspected high order global anomalies. A brief account was given by the Chairman of the historical development of the use of SI Units within IAGA with particular reference to the work of Commission II. The subject is treated in more detail in the report on page 146.

As a result of recommendations from the various working groups, seven resolutions were discussed and outlines formulated for their drafting.

Discussion on possible reorganization of IAGA was protracted and consequently could not be completed in one meeting. The meeting was therefore adjourned and continued later. The reorganization was further discussed in the light of fast-moving events and frequent issues of papers from the Executive Committee on the subject.

The draft resolutions for submission to the Resolution Committee were agreed upon with minor modifications.

The question of possible symposia for Grenoble 1975 was discussed at some length. although the final details were to be left to the Chairman and Working Group Reporters, it was agreed that the general label of the symposia would be something like "Physics and applications of the main geomagnetic field and its secular change including the IGRF," it being understood that the principal emphasis would be on the physics of the phenomena. This could involve other associations such as IASPEI, IAVCEI and IAG.

The status of the secular variation center of IZMIRAN at Moscow was discussed in relation to Resolution No. 4, of the Scientific Assembly in Moscow, August 1971. During the discussion it was the general concensus that IZMIRAN was doing well the task of collecting and publishing observations from magnetic observatories and repeat stations. Some concern was expressed at the meaning of part three of the resolution. There was some fear that this statement might inhibit or devalue secular change analyses made elsewhere than at Moscow. The meeting felt that this was clearly not intended and was the result of a lack of proper discussion about the resolution in the final Plenary Session of the Moscow meeting 1971. IAGA would clearly take into account all analyses submitted to it when establishing any model of secular change which was intended to have the official backing of IAGA.

Summary Report For Last Two Years

B. R. Leaton - Chairman

LAND AND AIRBORNE SURVEYS

Purpose-designed large-scale aeromagnetic surveys on a regional basis have been conducted by Canada and Japan. The furtherance of near surface coverage has been greatly enh:nced by the agreement of the United States government to continue "Project Magnet." The new survey will have considerable advantages over previous similar surveys in that greater flight duration enables coverage of great tracts of the southern oceans previously inaccessible.

Land surveys have been made, or the data became available, during the period in the following countries: South Africa, Japan, Australia, United States, Canada, Central America, South America, Bulgaria, Poland, Finland, East Germany, West Germany, Ireland, West Pakistan and Kenya.

OCEAN SHIP-BORNE SURVEYS

Now that the Zarya is no longer fit for ocean-going, there is unfortunately now no purpose-built nonmagnetic ship for large-scale surveys so there are none to report during this period.

There has been a continuation of activity by oceanographic instititutes of their total field intensity surveys (mostly in the Pacific Ocean). These are high density surveys whose primary purpose is to detect small-scale anomalies. The originators of these data, as original researchers, are reluctant to release them when new, usually for several years. In any case, the physical task of extracting samples or selections for world modelling purposes is not trivial. The selection of some 300,000 of these data points has been used in a study to be reported elsewhere on the use of the IGRF. This should be adequate for representative cover but the indications are that there are considerable system errors in the data, and hence a greater proportion may have to be used. Many more of these data are being put into the data set currently available for world modelling.

SATELLITE SURVEYS

During the period, data from Cosmos 49 and OGO 4 have been made more readily available. Data from OGO 6 have a limited availability, and data from this source continued to accrue. Data from Cosmos 321 are not yet freely available except as a model.

ANALYSIS

Except as mentioned below under Secular Change, which naturally has close association and overlaps with the analysis group, the principal concern has been various aspects of the IGRF; considerations of its usefulness, accuracy, whether a low order is adequate or whether even greater precision is required in the various fields of usefulness in the magnetosphere, ionosphere and in the detection of surface anomalies. Some consideration has also been given to where models based on different sets of parameters and with short-term changes, would be of greater use, particularly in magnetospheric studies.

A questionnaire has been circulated on behalf of the working group mostly to preople concerned in crustal anomalies, requesting experience in the use of IGRF in its present form. Although the response has been from a rather small fraction of the total number of users, the information thus obtained is likely to be a significant help in considering the future treatment of the IGRF.

SECULAR CHANGE

There have been a number of research projects of a miscellaneous kind associating current secular change with other geophysical parameters. One example is the use of secular change as an indication of motions in the core or variations in the length of the day. IZMIRAN has continued its good work of collecting current annual values of all elements from the global network of permanent observatories and publishing them. The same institution has been very active also in its research into secular change in historical times. Particularly noteworthy has been their practical application and productive use of an idea which appears to have been first suggested by Bauer for the use of associated coefficients. It is also significant that these results have already been used effectively in the development of theories of the dynamo action of the Earth's core. A smaller but useful effort in these fields has also been made in the U.K.

DATA EXCHANGE

This Working Group has been concerned with the problems likely to be encountered during the IMS and by implication, but to a largely similar extent by Monitoring the Sun-Earth Environment (MONSEE). The Working Group sees its function as helping particularly to coordinate the assembly and distribution of data from the permanent magnetic observatories. There is a distinct need for standardization of analogue records and digital spot values at greater resolution than the 2 1/2 minute scalings where comprehensive standardization already exists.

There are several problems associated with world data centers with the widespread, if not global tendency, for governments and other institutions to question the cost effectiveness of some long based activities of fundamental research. The merits of the continued support of Data Centers are vulnerable candidates for such a scrutiny.

The ICSU Panel on WDCs is committed to preparing a revised "Guide to International Data Exchange through the WDCs." Of particular interest to Commission II will be their recommendations on magnetic surveys, although IAGA resolutions have in the past encouraged surveyors to report their data. The actual mechanism should perhaps be discussed in more detail.

There have been some additions to the World Magnetic Archive both in respect of microfilming and digitizing and perhaps needs some encouragement.

Working Group II-1, Land And Airborne Surveys

P. H. Serson - Reporter

The working groups "Land and Airborne Surveys" and "Ocean Shipboard Surveys" held a joint meeting at Kyoto, 10 September 1973. Reporter P.H. Serson submitted the following report.

Dr. Sucksdorff's paper "Instruction for drawing magnetic charts by hand" has been circulated, revised, and submitted for publication. M. Barsczus' "Bibliographie des mesures magnétiques terrestres en Afrique" is completed and arrangements have been made for its publication.

The preparation of a bibliography of survey data relevant to the World Magnetic Survey (WMS) was recommended. World Data Centers and charting agencies are asked to cooperate in this task to complete the record of the WMS.

A draft of the section of magnetic measurements for the new International Guide to Data Exchange being drawn up by a committee of IUGG was approved, but it was noted that the location of World Data Center C needs definition, as far as the collection of magnetic survey data is concerned. The difficulties of obtaining shipborne survey information and of incorporating it in WDC fiels were discussed. It was concluded that in many cases the most practical solution is to ask for a prompt report to be included in an index of surveys, without waiting for final values in analog or digital form.

Working Group II-3, Low Level Satellite Surveys

J. C. Cain - Reporter

The meeting was attended by the reporter, J.C. Cain (USA, P.T. TAYLOR (USA), D.G. Knapp (USA and B. Theile (FGR) who arrived later. Reports on activities in this area had previously been received from Sh.Sh. Dolginov (USSRO.

The working group recommended the following for symposia topics at the IUGG General Assembly to be held in Grenoble in 1975:

1. Magnetotectonics from satellite and surface magnetic surveys, with IASPEI and IAVCEI. Included would be evidence of lithospheric contrasts between tectonic plates, possible detection of plumes, and general interpretation of magnetic anomalies of wavelengths greater than 100 km arising from crustal sources.
2. Dynamics of Lower Mantle and Core, with IAVCEI, IASPEI and IAG. Included would be the physics of the geomagnetic dynamo, hydromagnetic interactions from the core mantle interface, secular variation both recent and ancient, magnetic - rotation rate and gravitational correlations.
3. Magnetic Reference Fields. This should include main field with corrections for D, Sq, and broad anomalies.
4. Ionospheric Currents with IAMAP. Would include upper atmospheric wind structure, dynamo, solar and lunar variations at low latitude with equatorial electrojet.

5) High Latitude Ionospheric/Magnetosphreic Interactions. Would include field aligned currents, auroral, and polar cap magnetic variations.

On reorganization, the working group recommended that the basic IAGA plan be followed. One dissenter argued that those working in surface magnetic variations, Sq and L, should have a permanent committee under Division I. The majority opinion was that those in external geomagnetism should form the appropriate groups within Divisions II and III according to the probable source of the phenomena.

The working group recommended its immediate dissolution to be replaced by an ad hoc committee whose further existence would be reviewed at the Grenoble IUGG meeting. This ad hoc committee would be under present Commission II and be called "International Project for a Satellite Magnetic Survey." The functions of this group would be as follows:

1. Document the need for a magnetic survey by vector instruments on a low altitude satellite.
2. Prepare a plan as to how such a project could be accomplished.
3. Investigate through the appropriate National Committees whether support could be obtained and implement requests through the appropriate channels to carry out this project.
4. Report to IAGA at the 1975 Grenoble Meeting progress and recommend the continuation or termination of the committee according to its result.

The working group reported the successful functioning of several low altitude spacecraft (OGO-2,46, COSMOS-321, AZUR, TRIAD) and presented results in Symposium S-3 of the Kyoto meeting. Analyses of data from these are expected to continue to produce new results for sometime. However, there are no known plans to continue low altitude magnetic surveys except for the rather nebulous "Space Shuttle" series proposed by the United States for the mid 1980's. The hiatus in further data will be disastrous for those depending on a continual updating of reference fields to a high accuracy in spite of recent improvements in aircraft survey capabilities.

The working group noted with alarm that two previous resolutions, one passed at the St. Gall Assembly and the other at the Moscow Assembly, recommending near-earth satellite resurveys of the field have yet to produce any tangible results. The fact that the last useable data terminated in early 1971 will not be felt for a few years, but, since the lead time required is of the order of five years, the present earliest possibility for fresh data would be about 1977 if there were present firm plans. Accordingly, the working group proposed the following resolution:

> The IAGA, recognizing the fact that an accurate global model of the geomagnetic field can only be maintained by periodic resurveys from a low altitude satellite recording the vector components and noting that the last (total field) survey terminated in 1971, recommends the establishment of an "International Project for a Satellite Magnetic Survey" with a committee of specialists to prepare material for its consideration to send to the appropriate National Committees requesting support to carry out this project. [This later became IAGA Resolution No. 17.]

Working Group II-4, Analysis Of Geomagnetic Fields

A. J. Zmuda - Reporter

(These notes were submitted by Commission Chairman B.R. Leaton)

Sixteen people attended with A.J. Zmuda as chairman. The Chairman gave a summary of the paper which he had distributed, "The Geomagnetic Field and its Harmonic Description," laying particular emphasis on the aims, derivation, uses and more recent history of the International Geomagnetic Reference Field (IGRF). He emphasized that the IGRF was far from perfect and certainly needs revision. The user was important and should have a controlling effect on the nature of the revision and how often such revisions should be made. Their wishes should largely determine whether to go to a higher order as several scientific investigators doing ananlyses were advocating.

The rest of the meeting was almost entirely devoted to a long discussion on IGRF covering all of its aspects, e.g. can we do better, should there be an agreed data set, how to incorporate ocean data, the errors that had been shown in the IGRF both in its main field and secular change parts, when should be the next revision and what form should it take? There was some dispute among surface users as to whether the existing IGRF was satisfactory. All users were agreed that a stand-off was not important, but not all agreed that the existing gradients were satisfactory. It was recognized that there is a major advantage in sticking to the existing system as long as possible, at least until the quality or quantity of new data warranted a change.

It was recognized that one of the biggest faults lay in the secular change terms and that data from repeat stations could help to lessen the errors. It was considered unrealistic to attempt to go to second-order time terms. The general concensus which developed from this long discussion was that we should keep the existing IGRF main field terms but attempt to produce better time terms.

There was a brief discussion on the possibility of holding a symposium at Grenoble embracing the general topics of secular change.

A resolution was formulated which later became IAGA Resolution No. 18; see page 147.

Working Group II-5, Recent Secular Change

A. N. Pushkov - Reporter

The Chair was taken by B.R. Leaton, in the absence of A. Pushkov who could not come to Kyoto. The value of repeat stations was emphasized. With their help the Japanese had found short wavelength secular change anomalies of the order of 100 km wide reaching an amplitude of $\pm$ 2 nT/yr. On the other hand, careful analysis of observations in the German Democratic Republic had established beyond reasonable doubt that there was no evidence there of such a phenomenon.

On the global scale, large differences had been reported in the secular change in Z between observatory values and those deduced from POGO.

There was a clear deficiency in repeat stations in two major respects. First, that the considerable repeat station data available had not yet found its way into

Finally, two resolutions which were prepared by Professor Wilson on behalf of Professor Creer, the reporter of WG III-6, were adopted after discussion. These are related to possible IAGA participation in a subcommission of IUGS which deals with magnetic stratigraphy and the exchange of paleomagnetic data.

Dr. Lowes reported on the resolutions which will be submitted by the ad hoc committee on S.I. units (see resolution no. 3).

The meeting was closed at 1200 h.

Working Group III-1, Electrodynamics

F. J. Lowes - Reporter

The majority of the relevant work on the topic of this working group has been on dynamo problem, but there has also been a little work on electromagnetic core-mantle interactions.

There is still considerable doubt whether any of the Bullard-Gellman large scale velocity distributions tried so far is in fact a self-exciting kinematic dynamo, but Gubbins has shown that any difficulty is not due to Braginsky's restriction on longitudinal variation.

The Bullard-Gellman approach has been successfully applied to the macroscopic equations of the small scale, turbulent dynamo, and the conditions under which various idealised systems can produce non-oscillating dipole fields are now better understood. It appears that the addition of meriodional circulation can be quite favourable to dynamo action.

Lerche and Soward have shown how a Lagrangian transformation can simplify the equations, and leads to a simple interpretation of Braginsky's effective variables.

Work is also continuing on the possible contribution of Magneto-Archimedion Coriolis waves to the geomagnetic field and its variations.

The results of the increasing amount of mathematical and numerical work all confirm the likelihood of dynamo action in the Earth's core. However there is an increasing realization that no one effect may be dominant, and that the various simple models being investigated at present are only extremely crude approximations to possible real situations.

There is now increasing work on various, as yet extremely simple, hydromagnetic dynamo systems.

Very useful meetings were the conferences on "The core-mantle interface" held at Melbourne, Florida, USA, in March 1972, and on "Magnetohydrodynamic phenomena in rotating fluids" held at Cambridge, England, in June 1972.

Working Group III-2, Secular Variation

A. V. Cox - Reporter

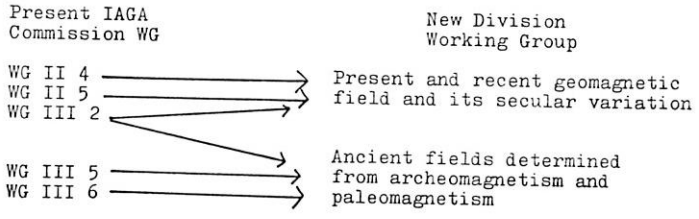
Most of the scientific highlights are covered by the report of S6 "Symposium on Magnetic Polarity Reversals" written by the working group chairman and shown in the report of the closing plenary session.

The business meeting of the working group was held at 1800 h on 11 September. The participants were, in addition to the reporter, F. Lowes, M. Kono,

K. Kobayashi, V. Shapiro, S. Burlatskaya, L. Alldredge and T. Yakutake.

REORGANIZATION OF IAGA

The members of this working group feel that at present there are too many fragmented working groups in Commissions II and III and that the new Division structure of IAGA offers an opportunity to consolidate several working groups. In particular, we would like to suggest to our colleagues the following new working groups.



SYMPOSIA SUBJECTS FOR 1975 IUGG ASSEMBLY IN GRENOBLE, FRANCE

The following topics were suggested as symposia subjects for the Grenoble Assembly:

1. "Fluctuations of the field during times of constant Polarity."

Background: Although this symposium will be of interest mainly to members of IAGA, we wish to propose it because of the large contemporary interest in many countries in the fine structure of the paleomagnetic and archeomagnetic record.

2. "Analysis of the main field and its secular variations."

Working Group III-3, Electromagnetic Induction

D. I. Gough Reporter

GENERAL RE[illegible]

A large increase in observational work has occurred in the last two years. Two-dimensional arrays of three-component magnetometers have now been used in studies of upper mantle and crustal structure in North America, Australia, South and East Africa, and Scotland. Smaller arrays have been used in many countries, notably in the USSR and in the Andes of Peru and Chile. The main deficiency in observations is in the oceans; while three-component sea-floor magnetometers have been developed, their use is still very expensive and hazardous and we are a long way from array studies over oceanic ridges or trenches.

Considerable development can be reported in the interpretation of time-varying magnetic and electric fields in terms of conductivity distribution. Unique inversion is so far limited to restricted one-dimensional cases (layered sphere and half-space). Local anomalies, such as those observed with magnetometer arrays, must still be interpreted by calculating fields due to induction in

models and comparing these with observed fields. The problem of separating and normalizing the anomalous fields still remains formidable in all but a few cases. Where this problem can be solved most workers use numerical methods to model the structures. There has been an advance in the use of analytic methods, however. Analogue modelling work with scaled-down laboratory models has also progressed.

Very recently new work on the physical parameters linked to conductivity in the mantle has indicated that conductivity is strongly dependent not only on temperature but on pressure and on partial melting. Several mechanisms of conduction are probably involved in the high electrical conductivity of partially molten olivine. The iron content and its concentration in the melt fraction are important.

A highly successful Workshop Meeting on Electromagnetic Induction in the Earth was held in the University of Edinburgh, in September 1972. A second such Workshop is to be held in Ottawa, in August 1974. There is certainly a close relation between these meetings and the active state of work in electromagnetic induction.

BUSINESS MEETING

Four members of the working group and twelve interested colleagues attended the business meeting which was held on 11 September 1973.

It was noted that the work of the working group falls within the area to be covered by Division I but it is not explicitly described in the list of topics given in the proposed reorganization draft. In the proposed reorganization draft the working group recommended replacement of the topic "Electric conductivity of the earth and moon, Induction and tidal phenomena" by the topic "Electromagnetic induction and electrical conductivity in the Earth and Moon". The working group supports IAGA as the only international organization covering its field of work.

The working group expressed a desire to participate in interdisciplinary symposia at the 1975 IUGG Assembly in Grenoble, in particular in the following broad areas of study:

1. Symposia on subduction zones, mid-ocean ridges and geodynamics generally.
2. Symposia on methods of inversion of geophysical data generally, including electromagnetic data and associated computational techniques.

The working group noted the great success of the Edinburgh Workshop and recorded its appreciation of the work done by the organizing committee, in particular by the Department of Geophysics of the University of Edinburgh.

The Reporter outlined arrangements already made for a Workshop on Electromagnetic Induction, which will be at Carleton University, Ottawa, Canada, and run 22-28 August 1974. He read a draft First Notice and took note of several suggestions for its improvement. It will be sent to National Committees as well as to members of the organizing committee. The working group gratefully accepted an offer by Dr. V.R.S. Hutton to look into the possibility of organizing group air travel from Europe to Canada for participants.

Dr. Gough read a letter from Dr. Schmucker in which Dr. Schmucker offered to organize an exchange of results of numerical model calculations. The offer was accepted with appreciation. Dr. Gough will ask Dr. Schmucker to circulate a more specific proposal for discussion by mail.

Working Group III-4, Rock Magnetism

C. M. Carmichael - Reporter

GENERAL REPORT

Since the 1971 IUGG meetings there have been many national sessions on Rock Magnetism but the Second IAGA Assembly in Kyoto, 1973 is the first international meeting of the working groups. The scientific papers were divided between a special session and symposium S5 on "Magnetic Anomalies, Rock Magnetism and Petrology". In all, there were 34 papers (six by title) on rock magnetic topics.

Most of the traditional problems are still with us, and some that have not been examined for several years are again being studied. Pressure effects and mechanical shocks before and during application of a field are being studied. These affect the magnetization, and, while the magnitude is not large enought to alter paleomagnetic results seriously, they aid in an understanding of the magnetization process.

Considerable work being done on the very fine single domain particles and those slightly larger, called peudo-single domain, which have some of the properties of the smaller particles. These are too small for direct observation and their properites are studied using synthetic samples and bulk magnetic properties.

Self-reversal mechanisms in both the Magnetite-Ulvospinel and the Hematite-Ilmenite systems are interesting several workers. The potential for self-reversal is definitely present in many mineral assemblages even though most reversed rocks are due to field reversal.

Observation of the minerological changes with temperature and oxygen fugacity inferred from examination of polished sections supported by mircoprobe, x-ray fluoresence studies have provided detailed information on magnetic mineral phase relations. Important advances have been made in this field by S.E. Haggerty and these were presented in an invited paper with an excellent collection of slides of polished sections, which can only be shown at a scientific meeting. The relationship between the magnetization of a rock and large grains which can be studied and small grains which may carry a significant portion of the remanence is still a concern.

BUSINESS MEETING

A meeting of the working group was held on 12 September 1974. Among those attending the meeting, which became a joint meeting with the archeomagnetism working group, were S.K. Banerjee, J.C. Briden, V. Bucha, S.P. Burlatskaya, C.M. Carmichael, E.R. Deutsch, H. Domen, D.J. Dunlop, S.E. Haggerty, K.A. Hoffman, K. Kobayashi, M. Kono, J. Nishida, M. Ozima, J.P. Pozzi, C. Radhakrishnamurty,

S. Sasajima, A. Schult, V.A. Shapiro, M. Shimada, E. Theillier, R.L. Wilson and E.K. Yakubailik.

The proposed reorganization of IAGA in which topics of interest to the two working groups would be included in Division I, on Internal Magnetic Fields, was discussed at length. We understood that at the Secular Variation Working Group meeting it was suggested that the ancient part of secular variation be combined with paleomagnetism and archeomagnetism and possibly rock magnetism. There was general agreement that there would be advantages to combining paleomagnetism, archeomagnetism, and ancient secular variation. Concerning the possibility of including rock magnetism in this enlarged working group there was no general agreement. There were roughly equal numbers who felt the Rock Magnetism Working Group should keep its separate identity as felt it should be included with paleomagnetism. It was agreed that the meeting would recommend that rock magnetism remain a separate working group within the new Division I, and that the question of merging with paleomagnetism could be examined again during the next IAGA assembly at Grenoble in 1975. The reporter for rock magnetism, C.M. Carmichael, had given notice of his intention to resign but in view of the general reorganization and the decision to continue the working group he will continue as reporter until the Grenoble meeting.

In preparation for the Grenoble meeting, symposia topics were discussed. Considering that all the Associations of IUGG would be meeting and that it is anticipated that considerable new ocean floor material should become available through the JOIDES program and the oceanographic studies of many countries it was proposed that a symposium be held on "Magentic Properties of Submarine Basalts and Their Relation to Magnetic Anomalies at Sea," conveners to be S.E. Haggerty and J. Ade-Hall. It is hoped that this will be a joint symposium with IAVCEI and IAPSO.

With the increasing interest in studies of the intensity of the acient field of the earth and that of the moon and meteorites, it is proposed to hold a symposium on "Rock Magnetic Problems in Paleointensity Methods and the Strength of the Ancient Field of the Earth and the Moon," convenor: C.M. Carmichael.

Working Group III-5, Archeomagnetism

V. Bucha (for R.L. Du Bois, Reporter)

GENERAL REPORT

The investigations in the archeomagnetism working group has been on the determination of D, I, F data not only for the period of the past 9,000 years but also for older periods. The results given by Barbetti cover the time interval between 25,000 and 31,000 years. The C^{14} dating method is often used for dating of measured samples. New results have been found also by examining sedimentary rocks covering the time interval of the past 50,000 years. They show that the intensity of the earth's magnetic field changed with a period of about 25,000 years. The relation between elements of the geomagnetic field and

its secular variation with help of the orthogonal projection method was shown. Cycles of about 600 years and 400-200 years were found.

The symposium on "Paleomagnetic Intensity Variations and the C^{14} Balance" which was held has an interdisciplinary character and several specialists working in the field of radiocarbon investigations gave invited papers. In this way joint problems were discussed.

In order to obtain a better and more continuous knowledge of fluctuations of the geomagnetic field the scientists in archeomagnetism will collaborate with others more freely on both archeological samples and young sedimentory rocks. This is the reason it was decided in the working group session to suggest only one working group on paleomagnetism and archeomagnetism in the future organization. The main important problems to be solved in the future in the working group seems to be fluctuations of the earth's magnetic field in the past 100,000 years. The problems dealing with these investigations into the geomagnetic changes are the main topic of the symposium on "Fluctuations of the Field" which was suggested by three working groups to be organized in Grenoble, in 1975.

Working Group III-6, Paleomagnetism

R. L. Wilson (for K. M. Creer, Reporter)

GENERAL REPORT

Paleomagnetism has recently grown in two directions: The study of details of the (predominantly) Cenozoic geomagnetic field itself and the delineation of pre-Cambrian plate movements.

The acquisition and interpretation of data from sea-cores, lake cores, large intrusives and sea-borne geomagnetic traverses has become very sophisticated, and is yielding a wealth of precise information about field inversion processes in particular. With rather uncertain progress, we are also getting an insight into the intensity of the ancient geomagnetic field in normal, reversed and transitional states. Second-order details about the secular variations and about the structure of the geomagnetic source in the core, are also appearing. Various cyclic variations have been found in the field, although it is not clear to what extent they are of global significance. Hopefully, we are gradually heading towards a liaison of palaeomagnetic and magnetohydrodynamic studies. When this is achieved, a realistic source model can be tested against palaeomagnetic evidence.

For more remote times the principal discussions relate to the applicability of the plate tectonic and geocentric dipole models. This is evidently an area for extensive future research, but the current indications are that the dipole model as a long term description of the field geometry is applicable throughout the geological record. Regarding the demarcation of plates, it appears that continuity of palaeomagnetic field variations may prove to be the decisive evidence, as geological evidence, for plate margin location may be ambiguous.

BUSINESS MEETING

Working Group III-6 held a business meeting on Thursday, 13 September at 1800 hours. Those present were M. Barbetti, J.C. Briden, C.M. Carmichael, A.V. Cox, E.R. Deutsch, H. Domen, K. Hirooka, N. Kawai, K. Kobayashi, M. Kono, M. Ojima, C. Radhakrishnamurty, S. Sasajima, A. Schult, E.K. Yakubailik, K. Yaskawa, R.L. Wison (acting reporter in place of K.M. Creer).

The committee considered the attached proposal from Dr. M.W. McElhinny concerning:

- world data centres.
- data compilations and compilers
- suggestions to authors about basic data to be presented in papers, or to be held for request.

It was agreed to recommend that IAGA adopt Dr. McElhinny's draft on "Palaeomagnetism and Archaeomagnetism" prepared for the ICG Committee on World Data Centres and Data Exchange (Solid Earth), subject to a minor amendment entered into section 3.1 (g) which should read "Petrographic description when available". It was also suggested that the recommendations to authors be incorporated into an issue of IAGA News, and submitted by Dr. McElhinny to the Geophysical Journal of the Royal Astronomical Society.

At its Montreal meeting in 1972, IUGS set up a subcommission to deal with magnetic stratigraphy. Since magnetic stratigraphy is also a vital concern of IAGA members, the working group recommended "that IAGA note the existence of the IUGS subcommission on magnetic stratigraphy, and requests the IUGS to make it a joint commission with IAGA". (See IAGA Resolution No. 5). We would also recommend that the following present commission members should become the present IAGA representatives: Prof. K.M. Creer, U.K., Prof. A. Khramov, USSR, Dr. N.D. Opdyke, USA, Dr. M.W. McElhinny, Australia, Dr. C.E. Helsley, USA, Dr. Tr. Einarsson, Iceland and Dr. D.M. Perchevsky, USSR.

The working group noted for information the initiation by the IUGS of an official International Geological Correlation Programme, which has as one project "Quaternary Palaeomagnetism" let by Prof. J. Kukla of Lamont-Doherty Geological Observatory of the University of Columbia. A symposium is planned for Kyoto in September 1974.

The working group read the resolutions of the ad hoc S.I. Committee (Chairman B.R. Leaton) and agreed with those resolutions.*

IAGA reorganization, the working group recommended for Division I that:

1. "Secular variation" be deleted (present day secular variation being implicit in the first item)
2. That items "Palaeomagnetism" and "Rock Magnetism and Archaeomagnetism" be deleted and that in their places "Palaeomagnetism, Archaeomagnetism, and Ancient Variations", and "Rock Magnetism" be substituted. It was agreed that the separate nature of "Rock Magnetism" be reviewed in two years time at Grenoble by the appropriate working groups. With respect to joint working groups in the

*Editor's Note: These resolutions finally were consolidated into IAGA Resolution No. 3.

new proposed organization Working Group III-6 recommended "the formation of a joint group on Tectonophysics, involving collaboration between IAGA, IASPEI, and IAPSO". The need for such a combination seemed obvious and pressing to all present.

The working group suggested the following topics for symposia at the Grenoble Assembly in 1975:

1. Fine structure of geomagnetic reversal history.
2. The identification of ancient place margins (a joint symposium with IASPEI and IAVCEI).

The working group also supported strongly the symposia "Fluctuations of the geomagnetic field during times of constant polarity" (Working Group III-2) and "Rock magnetic problems in paleointensity methods, and the ancient geomagnetic field strength" (Working Group III-4).

GUIDE TO INTERNATIONAL DATA EXCHANGE*

World Data Centers

- World Data Center A
  Environmental Data Service
  National Oceanic and Atmospheric Administration
  Boulder, Colorado 80302 USA
- World Data Center B
  Molodezhnaya 3
  Moscow 117 296, USSR
- World Data Center C
  (location to be determined according to offer of a National Committee)

INTRODUCTORY STATEMENT – PALEOMAGNETIC COMPILATIONS

Classical studies of paleomagnetism are primarily directed towards the determination of paleopole positions. However, the field of paleomagnetism also includes studies of the geomagnetic paleointensity, geomagnetic polarity transitions, paleo-secular variation and rock magnetism.

It is proposed that under the auspices of the WDC System, the following compilations of paleomagneic data should be officially sponsored. Compilations should be available to all workers on request to the comiler or from the WDCs.

Compilations of paleomagnetic pole positions. These compilations have been undertaken by M.W. McElhinny and are published annually by the Geophysical Journal of the Royal Astronomical Society. The compilations include most data from outside the USSR. Certain regional compilations have been made from time to time by A.N. Khramov (USSR) and H. Kinoshita (Japan). These should be encouraged either as Sub-Compilations (Regional) of a formal (official nature, or

*Editor's Note: This section is a draft of the section on Paleomagnetism and Archeomagnetism of the Guide to International Data Exchange through the World Data Centers. This draft includes the material described in the second and third paragraphs under Business Meeting. The revision given here was dated October 1973 and seems to incorporate the change suggested at the business meeting, but was not yet officially approved by the Committee on World Data Centers and Data Exchange.

for inclusion in the overall world compilation.

Compilations of paleointensity and archeointensity. These compilations have been undertaken by P.J. Smith and are published from time to time by the Geophysical Journal of the Royal Astronomical Society. No regional compilations have yet been undertaken. Continuity of these compilations should be encouraged.

Compilations of geomagnetic polarity transitions. Such compilations are at present not being undertaken. It is proposed that compilations of these sorts of data be sponsored.

3. Official Compilers -- Form of Presentation of Data.

The following have agreed to act as official compilers:

Paleomagnetic pole positions

Dr. M.W. McElhinny
Research School of Earth Sciences
Australian National University
Box 4, P.O.
Canberra, A.C.T. 2600, Australia

Paleointensity and archeointensity

Dr. P.J. Smith
Department of Earth Sciences
The Open University
Walton, Bletchley,
Bucks., England

Geomagnetic polarity transitions

Sub-Department of Geophysics (Dr. P. Bagley)
Oliver Lodge Laboratory
University of Liverpool
P.O. Box 147
Liverpool L69 3BX, England

The compilers (and any sub-compilers) are asked to send to each WDC two (2) copies of each compilation as described above. The form of the compilation should be that which in the opinion of the compiler adequately summarizes the data. All workers in the field of paleomagnetism are urged to send one copy (reprint) of each publication relating to the compilations to the appropriate compiler. It is not intended that the compilers act as data receiving centers for primary data, but workers should be encouraged to include as much primary data as possible in their published work.

As a guide to workers, the following served to identify the types of primary data that should be freely available. Where some of the data are too numerous to include in publications, they should be made available, on request, from the laboratory where the work was undertaken.

Standard paleomagnetic studies (pole position determinations):

- Exact geographic location of sample collection, including Latitude and Longitude (place names cannot always be located).
- Field description of sampling sites and region, including discussion of the gross lithologic aspects of the rock body, its relative freshness and the structural complexities of the

sampling sites and region. The relative stratigraphic position of each sample/rock unit and the basis for this positioning. (For a sequence of lavas or sediments this may be obvious, but it is not for dykes or single intrusions).

- Age of the rock body and basis and accuracy of determination, together with decay constants in the case of radioisotopic ages.
- Sampling procedure, including manner of collection, orientation, marking, and final preparation of samples.
- Directions (D,I) of NRM and those after appropriate cleaning procedures (partial demagnetization) in tabular form, including where pertinent, mean directions of a number of observations. Mean values of N and R samples. If a mean direction is given, a statement of the method by which it was obtained should be added. Directions after each demagnetization step are generally too numerous to include in publications, but should be available upon request.
- Intensities of NRM, together with the demagnetizing field or temperature required to reduce the NRM to one-half. Intensities after each demagnetization are generally too numerous to include in publications but should be available upon request to the laboratory concerned.
- Virtual geomagnetic poles calculated from the cleaned results for each unit and overall mean.
- Statistical parameters (in tabular form) including mean directions, number of samples, length of the resultant vector, 95% cone of confidence of direction and virtual paleomagnetic poles.
- Petrographic description when available of samples in thin section and of opaque minerals in polished section. Pictures should be available upon request where too numerous to include in publications.
- Description of measuring instruments including their accuracy, and conditions during experiments.
- Values of bulk susceptibility and Koenigsberger ratio (Q) in tabular form.

Paleointensity (see also Archeomagnetism). Data from these studies will include much of that already presented under , . In addition the data should specifically include the following:

- The number and polarities (and, wherever possible, the complete paleomagnetic directions) both of independent samples and of specimens. Samples and specimens should be clearly differentiated.
- A Thorough description of the paleointensity technique(s), with

particular emphasis placed on points of originality.

- Microscopic or other observation of the opaque minerals before and after the application of the techniques.
- Evidence of the reliability of the data should be recorded. Examples are i) comparisons of petrology, susceptibility, saturation magnetization, shapes of NRM and TRM curves, etc., before and after the main paleointensity determination, and (ii) the steps taken to remove the effects of secondary components of magnetization.
- The paleointensity for each sample and/or specimen, together with mean values where appropriate. Where mean values are calculated, errors should be stated and its form given (e.g., standard deviation, standard error of the mean). Loose terms such as "probable error" should be avoided.
- Virtual dipole moments (VDMs) (and mean VDMs with errors stated) should be calculated from the basic paleointensity data and associated paleomagnetic directions for material known to have been magnetized in fully normal or reversed fields.

Polarity transitions. Polarity inversions are defined as the sudden change from N→R or R→N. The transition interval may be defined for convenience as follows:

Normal Poles - $0° < 0 < 40°$ colatitude (+90°N to +50°N lat.).

Intermediate Poles - The transition interval proper $40° < 0 < 140°$ colatitude (+50°N to -50°S lat.).

Reversed Poles - $140° < 0 < 180°$ colatitude (-50°S to -90°S lat.).

In addition to the procedures already outlined, the following information needs to be given.

- It is important to state clearly whether any observed intermediate poles are from units known to be stratigraphically between N and R, and to indicate whether the transition is N→R or R→N.
- Data should be more numerous and include virtual pole determinations at intervals through the transition. The need for much finer sampling during transitions is emphasized.
- Paleointensity determinations at intervals through the transition, including especially procedures under 3.2. Intensities for N and R samples for the same time and region are also useful for comparison.
- Estimate of the length of time of the polarity transition.
- Where possible the secular variation during the transition compared with that outside the transition should be estimated.

Other Studies Not Involving Compilations.

- Paleosecular variation. For studies of paleosecular variation the information above should be provided, but special emphasis needs to be given to the estimates both of within-site and between-site precision parameters, to estimates of the confidence limits of the between-site precision parameter, and to estimates of the time spanned by the set of measurements.
- Rock magnetism. Studies of this kind commonly involve a special magnetic property or characteristic of rocks; directional data are generally important. Results of these studies should include:
    - Exact description of samples including age and location and, where possible, chemical composition, mineralogic composition, texture and state of alteration of opagues.
    - Experiments performed, conditions pertaining during experiments and results. Results can usually be reported in tabular form as changes in some measured property such as saturation magnetization, coercive force, Curie Temperature, magnetic viscosity, etc.

      (Note: At the moment there is no compilation of these kinds of data. The Geophysical Institute of the University of Tokyo has specialized in rock magnetic studies and may be a source institution.)
- Archeomagnetism. Archeomagnetic studies primarily involve the application of paleomagnetic procedures to certain archeologic artifacts. the data normally reported are essentially the same as under Paleomagnetism. Archeomagnetic intensity data may differ in detail from paleointensity data, for example.
    - If the basic intensity data are presented as ratios of ancient intensity to present field (in the laboratory or at the site), the present field should always be stated.
    - If archeomagnetic directions are not available, reduced dipole moments (RDMs) should be calculated using the present geomagnetic latitude (at the site or in the laboratory, as appropriate).

      (Note: Currently, enters for collection of archeomagnetic date include:

      1. University of Tokyo and University of Kyoto in Japan
      2. Laboratorie de Geomagnetisme du Parc St. Maur, Paris - Prof. E. Thellier
      3. Research Laboratory for Archeology, Oxford - Dr. M.J. Aitken
      4. School of Earth Sciences, Norman, Oklahoma - Dr. R.L. duBois
      5. Research School of Earth Sciences, Australian National University, Canberra - Dr. M.W. McElhinny
      6. Institute of Physics of the Earth, Moscow - Dr. S.P. Burlatskaya)

Working Group III-7, Geomagnetic Anomalies

A. Hahn - Reporter

A meeting was held at 18:00h, on Thursday, 13 September 1973.

A questionnaire on the use of interpretation methods and on the frequency of different types of geological objects to be investigated was circulated earlier. But the questionnaire was not adequate to the complexity of the situation in this field, so it was decided not to distribute the results.

A symposium on "Geomagnetic Anomalies, Rock Magnetism and Petrography" was prepared together with Working Group III-4, Rock Magnetism. The general problem of the symposium was: What can be said in petrographic terms about geological bodies with produce geomagnetic anomalies? Attention should be paid particularly to completely buried bodies. Out of 27 scheduled papers, 20 were presented, including 3 invited papers. A special report on the symposium is submitted separately.

On request of Commission II, Working Group 4, which had to prepare a symposium on "Secular Variations with Particular Reference to the IGRF" - Convener A.J. Zmuda, a contribution "Practical Experience with IGRF" was presented. The material for this contribution was collected by means of a questionnaire on which replies from 10 institutes had been received. Some considerations on the optimal expansion describing a general reference field were added.

During the last few years the use of the Fourier transformation and Fourier spectrum analysis has clearly increased in the study of anomalous fields. A new method for the direct solution of the inverse problem was developed and presented in the symposium S-5. It can be seen that the interpretation of anomalies by calculating the fields of model bodies can be accomplished by any geophysicist who wants and no longer by specialists alone. This is a result of the easy availability of digital computers.

We are still far from being able to simply convert geomagnetic anomalies into a description of the composition of the crust out of geological bodies of different rock types. However, along with the quick growth of experience during the last years the main lines of the translation task became clearer.

Commission IV

Magnetic Variations And Disturbances

M. Siguira - Cochairman

General Report

Participation of Commission IV in the Kyoto Assembly was so extensive that only highlights and brief summaries of various activities can be reported here. Commission IV sponsored and in some cases cosponsored with Commission V a symposium on Micropulsations, a symposium on Magnetospheric Substorms, a symposium on Magnetospheric Configuration, and a Workshop on Geophysical Indices and held eight Scientific Sessions. The Scientific Sessions included two sessions entitled Worldwide Distribution of Geomagnetic Disturbances conducted by Drs. Campbell and Matsushita (see report on this under Scientific Sessions), and one devoted to the problems of Sq variations; other subjects such as plasma waves and energetic particles were also treated in the scientific sessions. Highlights of the symposium on Micropulsations and the symposium on Magnetospheric Substorms are given elsewhere. In the symposium on Magnetospheric Configuration (1) new results from the HEOS-2 and IMP-2 were discussed, (2) several quantitative models of the magnetospheric field that incorporate recent observations were presented, (3) present understanding of the ionosphere-magnetosphere couplings and of long term effects of various instabilities were summarized and discussed, and (4) the results of several recent conjugate point experiments were presented. As a result of this symposium it is clear that the problem of the ionosphere-magnetosphere coupling is one of the major subjects that will be studied intensively in the future, and that continued efforts should be made to improve magnetospheric field models.

Usefulness of geophysical indices such as Kp, AE, and Dst was demonstrated throughout the symposia and scientific sessions. IAGA has provided the main driving force for the continued derivation, publication, and improvements of these indices. In the Workshop on Geophysical Indices, physical interpretations of the indices were presented in terms of present understanding of solar wind-magnetospheric interactions and magnetospheric processes. Much discussion was made on the relation between the interplanetary field and magnetic activity, and it is now well accepted that the solar magnetospheric Z component of the interplanetary field is a key parameter in the injection of solar wind energy into the magnetosphere. As another new aspect, Dr. Wilcox reviewed the relationship between solar and interplanetary activity and meteorological processes. For instance, he showed that when an interplanetary magnetic sector boundary passes

the earth, there is a decrease in a vorticity area index at the 300 mb height. According to Dr. Wilcox, low pressure troughs formed in the Gulf of Alaska a few days after geomagnetic activity appear to be more prominent than other such troughs. The general problem of the relationships between interplanetary activity and upper atmospheric processes is likely to become one of the important areas of research in the future.

The Working Groups of Commission IV have made siginificant contributions to the recent progress in the field covered by the Commission. Many individuals of Commission IV actively participated in the discussions of the IAGA reorganization, and their views have been reflected in the new structure.

For more information on the Working Groups, see Joint Reports of Commissions IV and V later in this publication.

Scientific Sessions

W. H. Campbell, chairman of the Thursday afternoon, 20 September, Scientific Session, "Worldwide Distribution of Geomagnetic Disturbances" reported the following.

Unfortunately the USSR delegates had left the IAGA Assembly by noon of this day. This resulted in the cancellation of papers 71, 74, 75, and 77 of this afternoon's program. The session opened with paper 69 of Dr. Friis Christensen who showed samples of his cataloging of polar cap geomagnetic field changes. These demonstrated the relationship of the interplanetary by field changes with the polar field measurements. Next, Dr. S. Matsushita, in paper 70, showed the polar cap equivalent current system associated with solar sector changes. Dr. V. L. Patel, in paper 72, reported on the behavior of the interplanetary field at the times of geomagnetic stroms. Dr. W. P. Olsen, paper 73, described the contribution of magnetospheric current systems to the surface field measurements; he introduced an interesting and new magnetospheric cusp region current. N. Fukushima, in paper 76, brought to the attention of the audience the curious increase in DS(H) unrelated to high latitude geomagnetic activity; he proposed that these changes be ascribed to decreases in the dawn-to-dusk field aligned currents. The session closed with the presentation of K. R. Ramanujachary, paper 78, who showed the rather interesting spectral composition of geomagnetic pc 3,4 pulsations from an observatory near Hyderabad.

S. Matsushita, chairman of the Friday morning, 21 September, session on this same topic reported the following.

All scheduled papers (IV-79 through IV-88), except IV-82 By Bossolasoco et al., were presented. I find that the first three papers were interesting, and am pleased to see a large audience even at the end of the session.

A correction to the program (IAGA Bulletin No. 34) is that "Chung-Li" for IV-88 on page 82, is not the author but the town where Dr. Horng works.

Joint Report Of
Commission IV
Magnetic Variations And Disturbances

M. Sugiura - Cochairman

And
Commission V
Solar-Magnetosphere Relations

J. G. Roederer - Chairman

Since the subjects covered by Commission IV and V overlap, the two Comissions held their business meeting jointly from 0900h on 14 September. The main agenda included the following items.

- Brief reports of the Commission IV Working Group Reporters.
- Proposals of symposia for the IUGG Assembly at Grenoble.
- Resolutions.
- IAGA reorganization.

Working Group Reports

Dr. D. van Sabben reported on Working Group IV-1 on Morphology and Indices. He reported that recently a special IAGA Bulletin No. 33 has appeared, containing a hundred years series of geomagnetic indices aa and a list of sudden storm commencements for the period 1868-1967, prepared by P. N. Mayaud. This work was undertaken in order to provide a long series of magnetic indices for correlation studies with other phenomena. The series of Ci-indices, which goes back to 1889, is too inhomogeneous for this purpose as has been shown by Mayaud and by Vatajo, at least for the years before 1910. It has been suggested at the Kyoto Assembly to discontinue the regular determination of Ci in favor of the new index aa, which is based on the K-indices of two antipodal stations.

The working group also discussed the desirability of continued publications of the Threemonthly Bulletin on pulsations, as these data seem to be of little use and their reporting is difficult and unsatisfactory, especially for pc and pg. The same is valid for the reporting of exact times of ssc's. Comments are invited on the usefulness of these data: pc, pg, and Ci.

In the absence of Dr. D. J. Stone, reporter of Working Group IV-2 on Daily

Variations and of Dr. C. A. Onwumechili, reporter of Working Group IV-3, on Equatorial Electrojet, Dr. P. N. Mayaud reported on the joint meeting of these two Working Groups. He conveyed the general feeling of unhappiness of the members of the Working Groups and reported on Dr. Matsushita's plan to hold a symposium on Equatorial Aeronomy, in Hong Kong, in 1975.

Dr. S.-I. Akasofu, reporter for Working Group IV-4 on Special Disturbance Events, was absent, and his report was summerized by the Commission IV Chairman. The main activity has been the publication of reproduced magnetograms from the Geophysical Institute, University of Alaska.

Dr. R. Gendrin, reporter for Working Group IV-5, on Micropulsations, suggested standardization of micropulsation recordings, and recommended: (1) publication of Dr. Campbell's report on Micropulsation Instrumentation. (This document is reproduced at the end of this report), (2) modification of the classification to include Pi3 with period greater than 150 seconds and Pc6 with period greater than 600 seconds, (3) change of the term "micropulsation" to "magnetic pulsation", and (4) discontinuation of special micropulsation days in the International Geophysical Calendar. He proposed a symposium on new techniques of data analysis for ULF and VLF at the next IAGA Assembly (see below).

M. Sugiura, reporter of Working Group IV-6, on Magnetospheric Field Variations, reported that his Working Group sponsored two sessions in this Assembly, namely, The Workshop on Geophysical Indices and a session on Magnetospheric Models in the Symposium on Magnetospheric Configuration. He also reported that provisional Dst indices are published monthly within three to four weeks of the end of each observing month and that the final Dst is published at the end of each year. Thus, the Dst index is now available from 1957 to July 1973.

Dr. O.N. Raspopov, reporter for Working Group IV-7, on Conjugate Points, reported on the Soviet-French joint experiments on ULF and VLF along with the Finnish balloon experiments. The results from this project were discussed at a Soviet-French symposium in March 1973. Dr. Raspopov also submitted a report on the Geomagnetic Meridian Project, a summary of which will be published in an IAGA Bulletin later. Dr. Raspopov reported that his Working Group discussed the question of reorganization and that the Working Group recommended a working group on conjugate point experiments in Division II in the new structure. There was a discussion of the desirability of regarding conjugate point work as "science" rather than a "technique".

Dr. J.G. Roederer reported that individual Working Groups in Commission V did not meet separately.

Proposals For Grenoble Assembly

The following symposia were proposed and extensive discussions were made on them. Drs. W.H. Campbell and S. Matsushita proposed a symposium on Global Effects of Sector Structure. Dr. Campbell indicated that the symposium could be held jointly with IAMAP. Dr. A. Eviator proposed a symposium on Dynamic Effects at Distances Greater than 1 AU because the Pioneer satellite will have encountered

Jupiter by that time. Dr. A.J. Zmuda suggested a symposium on "Magnetospheric, Ionospheric, and Atmospheric Coupling Focussing on the Auroral Oval Region." On this proposal Dr. J.G. Roederer commented that this is the main theme of the Boulder, 1976 Symposium. Dr. H. Trefell proposed a symposium on "Morphology of Auroral Zone Phenomena," as a preparation for the IMS in terms of ground-based networks. Dr. J.G. Roederer then mentioned that the IMS Steering Committee is proposing a symposium on the IMS. Dr. D.J. Williams, who had proposed a symposium on "The Physics of the Plasmapause" himself, suggested to consolidate several of the proposed symposia under on title of the IMS Symposium. Dr. J.G. Roederer commented that for several years there has been no major meeting discussing the radiation belt, and that this could be a topic for the IUGG meeting. However, he thought that this topic can probably be contained within a symposium such as one on "The Physics of the Plasmapause." He suggested that perhaps a symposium on some solar wind topics would be worthwhile considering. Dr. M. Dryer then mentioned that he had been asked to form a Study Group on Travelling Interplanetary Phenomena for SCOSTEP.

It was then suggested that the symposia proposed so far be grouped into four symposia and that priorities be determined by voting. This procedure was adopted and as a result of a voting, the following four symposia were proposed in the order of priority:

1. Symposium on the IMS
2. Symposium on Global Effects of Interplanetary Fields.
3. Symposium on Analysis Techniques of Non-Stationary Signals.
4. Symposium on Dynamic Effects beyond 1AU and Interaction of Solar Wind with Planets.

Resolutions

Five resolutions were proposed, discussed, and approved to be sent to the Resolutions Committee. They are: (1) a resolution concerning the AE index, proposed by Working Group IV-1; (2) a resolution proposed by Working Group IV-5 to recommend discontinuation of the "micropulsation interval days" in the International Geophysical Calendar; (3) a resolution urging IAGA to print Dr. W.H. Campbell's recommendation on "Instrumentation for Rapid Geomagnetic Field Variations" in the IAGA Bulletin, and to recommend that Dr. W.H. Campbell continue to act as a coordinating member for all the questions relevant to the recording of micropulsations; (4) a resolution to recommend use of the term "magnetic pulsations" rather than "micropulsations" and to recommend the establishment of a subgroup to reconsider the classification of magnetic pulsations, and (5) a proposal concerning the Geomagnetic Meridian Project.

Editor's Note: Many of these proposed resolutions survived the required reviews and finally showed up as formal IAGA Resolutions, see main heading of RESOLUTIONS in this publication. The suggestion in (3) above to publish W.H. Campbell's instrumentation document was accomplished by including it in this report (see following pages).

Reorganization

After extensive discussions on the title of the proposed Division III and on its structure, it was decided that Commissions IV and V would at this time propose the major topics to be covered by Division III. The title for the Division and the topics adopted are as follows:

Division III. Magnetospheric Phenomena

Topics : Magnetic fields, electric fields, and current systems
Cosmic ray entry and propagation
Magnetospheric boundary and plasma penetration
Energetic particle populations
Magnetic oscillations, wave-particle interactions
Magnetic storms and substorms
Magnetospheres of other planets
Laboratory experiments

Though the fields of research under the proposed Division IV were not adequately represented at the Business Meeting, it was agreed to recommend that Division IV - Solar Wind and Interplanetary Fields be formed and that a group of organizers be appointed. The topics covered are to be decided by the organizers of the Division.

The Business Meeting adjourned about 1200h.

IAGA Recommended Instrumentation For Rapid Geomagnetic Field Variations

Prepared by W. H. Campbell

QUALITY OF INSTRUMENTATION

1. Three qualities of instrumentation are listed below (A,B,C) in order of decreasing cost and capability. All further use of letters A,B,C refer to these definitions.

A. Present Recommendation. This is considered to be a quality research instrument for use in rigorous analysis of geomagnetic micropulsation phenomena.

B. General Study System. This is considered to be an instrument for low budget operation. The data from this system are of limited quality but are good for many interdisciplinary analyses.

C. Simple System. This is considered to be rudimentary equipment for preliminary investigations which provide information on only the time occurrence, type of pulsations and general level of magnet activity.

Note: A proposed system should assume the recommended features of the next higher level whenever it is possible to appropriately adjust the design.

DETECTORS

Signal Sensors.

(Note: The magnetic field response of the system should be adjusted to the natural relationship of amplitude and pulsation period T by introducing a 1/T dependence of the recorded amplitudes for A and B below. This is done naturally by the induction antenna pickup as dH/dt but should be introduced as a linear

signal level modification on all other A and B systems.

A. Air center induction loop antennas; directional magnetic resonance magnetometers, or directional fluxgate magnetometers.

B. Induction antennas with either air center or high permeability core material, magnetic resonance, or fluxgate magnetometers

C. Earth Current probes

Field Components Measured

A. 3 orthogonal components; geographic directions; positive directions N, E, down (accurate to 1°)

(Note that problems of secular change, local magnetic anomalies, and polar cap region irregularities argue against using magnetic directions for A quality, permanent, geomagnetic stations).

B. 3 orthogonal components; geographic or geomagnetic directions; positive N,E, down; or single total field measurement. (accurateto 5° in direction)

RESPONSE

1. Period (recall that for average signals A/T ~ const.)

A. 600 sec (0.0016 hz) to 0.2 sec (5 hz)

Note: Low limit indicated assumed to slightly overlap standard magnetic observatory capability. For isolated rapid variation stations it would be advisable to extend as far as T = 2 hrs.

B. 100 sec (0.01 hz) to 0.33 sec (3.0 hz)

C. 100 sec (0.01 hz) to 0.5 sec (2.0 hz)

2. Amplitude of minimum detected signal of 1 sec period at a signal to noise ratio of 5.0. (Recall that a 1/T response has been given to the recorded signals on A and B systems.)

A. 0.005 gamma*

B. 0.01 gamma

C. 0.5 gamma (or 0.3 mv/km)

3. Linearity

A. 2% in amplitude; phase shift 3°

B. 10% in amplitude; phase shift 10°

C. Calibration curves for amplitude and phase response provided

4. Amplitude of maximum detected signal of 1 sec period at a signal to noise ratio > 5.0 for a) polar cap and auroral, b) sub-auroral, high mid-latitude, c) middle, low, and equatorial stations.

A. a) 5.0 gamma
   b) 3.0 gamma
   c) 2.0 gamma

B. a) 5.0 gamma
   b) 3.0 gamma
   c) 1.0 gamma

* one gamma is equal to one nanotesla

C. a) 3.0 gamma (or 1.0 V/km)
b) 1.0 gamma (or 0.3 V/km)
c) 1.0 gamma (or o.3 V/km)

5. Temperature Drift
A. Less than 0.5 gamma/°C
B. Less than 1.0 gamma/°C
C. Less than 5.0 gamma/°C

RECORDING

1. General Comments
a) If recording necessarily done in separate amplitude ranges, 40 db per range with overlap of 10 db is recommended for all systems.
b) Paper punch recording methods are not recommended.
c) If magnetic tape recordings available supplementing chart record need only be made on one component of field. This should be preferable the N-S one, except at mid- and low-latitude coastal stations where Z is more advisable.

2. Magnetic tape recording type
A. Analog, frequency modulated (center frequency 20-25 c/s, transport 2-3 cm/min and/or digital (9-track 800 bpi)
B. Optional: analog, frequency modulated or amplitude modulated.
C. Optional: analog amplitude modulated.

3. Chart recording type and speed.
A. Supplementary to magnetic tape apx 7.5 cm/hr for N-S component only.
B. Principal recording method $\geq$ 15 cm/hr.

4. Time accuracy and resolution for events read from records.
A. 0.1 sec
B. $\geq$ 5.0 sec
C. $\geq$ 10.0 sec

5. Recording sessions
A. Continuous throughout year
B. Continuous throughout year
C. Specially defined intervals esp. on world days

CALIBRATIONS

1. Occurrence
A. One calibration daily at fixed, convenient local time.
B. One calibration daily at fixed, convenient local time.
C. One calibration daily

2. Frequency
A. 0.01, 0.1 and 1.0 c/s
B. 0.1 and 1.0 c/s

C. At frequency of maximum response of system

3. Amplitude

A. 1.0 gamma and 0.1 gamma

B. 1.0 gamma and 0.1 gamma

C. About 2/3 of recorder maximum

4. Full frequency, phase and amplitude response check

A. Annually

B. Annually

C. Once for experimental period

5. Calibration information provided with records

A. a) mm/gamma sec for 1% of amplitude range accuracy
b) 1% and 10% flat amplitude range
c) 1° and 10° phase shift values

B. a) mm/gamma sec for 1% amplitude range accuracy
b) 1% and 10% flat amplitude range
c) 1° and 10° phase shift range

C. a) mm/gamma sec or mm/(mV/km)
b) some appropriate frequency and phase information

RECORD NOTES BY OBSERVERS

1. At least once each week for A, B, and C indicate UT date, Time, Station, and field component on charts.

2. Time marks available from chart or tape records

A. 1 min, 1 hr, 1 day marks

B. 1 hr, 1 day marks

C. 1 hr marks

3. Clock accuracy at any moment with respect to international standard

A. 0.05 to 0.1 sec

B. 0.5 to 1.0 sec

C. 5 to 10 sec

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Commission VI
Aurora

G. G. Shepherd - Chairman

Business Meeting

The Business Meeting of Commission VI was held Thursday morning, 13 September, in room C1, Kyoto Conference Hall. Those in attendance were: Gregori (Italy), McNamara (Canada), Wrenn (U.K.), Vallance Jones (Canada), Sivjee (USA), Mende (USA), Romick (USA), Eather (USA), Hultqvist (Sweden), Rees (USA), Arnoldy (USA), Lassen (Denmark), Egeland (Norway), Kuhn (South Africa), Hanson (USA) and Nagy (USA).

IMS PLANS FOR AURORAL OBSERVATIONS

The European scientists appear to be well organized and Stoffregen is the chairman of a coordinating committee. Their program has a focal point in the form of a geostationary satellite, to be launched in 1976, but the experiments were not yet fully defined nor were the associated ground stations decided upon. Egeland agreed to act as information point for those who wanted information about the European program.

The U.K. scientists had submitted a package proposal for IMS studies, and the U.S. and Canada had plans underway but with nothing definite as yet. South Africa also planned to participate.

The role of auroral studies in magnetospheric physics was considered to be the inferring of magnetospheric boundaries with the continuous temporal coverage available by optical means. To this end it was agreed that increased density of ground-based coverage was required in order to provide continuity of coverage along the oval. Certainly there should be an all-sky camera wherever there is a magnetometer. The problems of data reduction were discussed. Following along these lines a resolution was developed which terminated as Resolution 12. (See Resolutions elsewhere in this publication.)

IAGA REORGANIZATION

The working group structure within the new proposed Divisions was discussed and it was agreed that in Division II auroral processes and auroral structures should appear as distinct topics, while in Division III auroral-magnetospehre relationships should appear as a distinct topic (or working group). The meeting recognized the difficulties in dividing the activities of a compatible group of scientists between two divisions, but considered that it was necessary to be consistent with the new structure and in understanding the physical bases of the phenomena.

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Three symposia topics were suggested: (a) "Auroral-Magnetosphere Relationships," (b) "Dynamical Processes in Airglow and Aurora" and (c) "Optical Calibration Standards."

RESOLUTIONS

In addition to the resolution already mentioned, a resolution from Working Group VI-2 was accepted for transmittal. It terminated as IAGA Resolution No. 4. (See Resolutions elsewhere in this publication.)

Working Group VI-1, Auroral Morphology

A. Egeland - Reporter

The Working Group held a meeting Thursday afternoon, 13 September, at the Kyoto Conference Hall. Those in attendance were: C.H. Anger (Canada), G.G. Shepherd (Canada), A. Vallance Jones (Canada), E. Kaneda (Japan), E. Katajo (Finland), C. Sucksdorff (Finland), W. Riedler (Austria), B. Hultqvist (Sweden), G. L. Wrenn (U.K.), G.P. Gregori (Italy) B. Eather (USA), F. Rees (USA), K. Larsen (Denmark), Kukor (South Africa), H. Trefall (Norway and A. Egeland (Norway).

The main topic during this meeting was: IMS plans for auroral observations. Participants from different countries reviewed their different ideas and plans. It turned out that scientists from Japan and Europe had already fairly detailed programs for IMS, while the plans in other countries were more preliminary. The focal point for the European IMS committee, CCOG, is ESRO's geostationary satellite, GEOS, which will be launched in the autumn of 1976.

It was concluded that IMS may be an excellent opportunity for auroral studies. However, it is of great importance that coordination and cooperation between different groups be planned well before the start of IMS. Information should be distributed to all interested. Coordinated ground, balloon, and rocket observations from both hemispheres, along GEOS magnetic field lines will be extremely important.

Working Group VI-2, Spectroscopy And Excitation

A. Vallance Jones - Reporter

The Working Group held a meeting on Tuesday, 11 September, in Room 678, of the Kyoto Conference Hall. Those in attendance were: A. Vallance Jones (chairman), R.H. Eather, J.-C Gerard, O.E. Harang, R. Pastiels, G.G. Sivjee, G.M. Weill, M. Rees, G.G. Shepherd, Z. Kaneda, J. Oksman, T. Tohmatsu, S.B. Mende, G.J. Romick, A.F. Nagy, B.A. Tinsley and A. Egeland.

The Chairman suggested that there may be a problem in the traditional practice of referring auroral intensities to the 5577 A OI emission in view of the fact that the theorectical basis for relating the intensity of this line to energy input in aurora is not fully understood. Since the International Brightness Coefficients(IBC) are defined in terms of this emission there was some discussion as to whether there would be any advantage in changing the basis of the IBC definition. It was felt that the direct measurement of 4278 $\mathring{A}$-N_2^+ emmission at least and preferably other emissions is a more desirable way of reporting auroral intensities. It was moved by Dr. G.G. Shepherd seconded by Dr. Nagy that the Chairman be instructed to draw up a resolution to this effect. This ultimately became IAGA Resolution No. 4 which was passed at the Plenary Session.

The problem of calibration procedures and the special difficulties of extending these calibrations into the ultraviolet region was discussed. It was agreed that it would be valuable if laboratories engaged in auroral spectroscopy and photometry could exchange information as to the exact procedures currently employed in such calibrations. It was thought that a review paper on the topic at the next assembly would be valuable. In the interim it was agreed that the Chairman would write to institutes involved in this work asking for a description of their current calibration procedures and standards. (The reorganization of IAGA and the disappearance of this Working Group has left the status of this project in doubt.)

Dr. Weill raised the question of the increasing levels of stray light from artificial light sources in the neighborhood of observatories. It was decided that this might be a suitable topic for discussion at a Symposium at Grenoble in 1975 since it is of interest in many disciplines. (It was subsequently proposed as part of the proposed Interdisciplinary Symposium No. 8 in IAGA News No. 12.)

Commission VII
Airglow

M. Gadsden - Chairman

The main work of the business meeting which was held at 6:00 p.m., on Thursday, 13 September, related to the impending IAGA reorganization and a discussion of symposia suggested for 1975 Grenoble Assembly. The results of the reorganization discussion are attributed to Commission VII in the minutes of the special organization meeting, and the symposia suggestions are evident in Appendix A of the minutes of the Executive Committee.

A review paper on "Tropical Airglow" which was produced by reporter at large, P.V. Kulkarni, has been sent to the Annales de Geophysique for publication and is not reporduced here.

Dr. Harold I. Schiff, reporter of Working Group VII-4, convened the very important Sympsoium S-16 on "Aeronomic Processes in the Stratosphere and Mesosphere."

The Chairman played an important part in organizing and conducting Symposium S-14 on Aurora and Airglow.

Commission VIII
Upper Atmospheres

L. Block - Reporting in the absence of Chairman

The following agenda lists the items discussed at the Review and Business meetin of Commission VIII which was held Friday morning, 14 September:

1. Statement by Dr. F.S. Johnson on proposed SCOSTEP atmospheric project.

Editor's Note: At the start of the assembly as soon as it was clear that neither Dr. T.M. Donahue, chairman of Commission VIII, or Dr. Y.M. Marov, cochairman would be in attandance, the Executive Committee formally asked Dr. L. Block to act as chairman for the Kyoto Assembly which he graciously agreed to do. During the Commission VIII meetings a great deal of time was spent on reorganization items which turned out to be very useful. Most of these items related to the proposed Divisions II and III. Most of them appear under the main heading "Association General Meeting on Reorganization" where they are attributed to Commission VIII and are not repeated here.

2. Questions and discussion on Dr. Johnson's statement.
3. Discussion of proposed IAGA reorganization, in particular structure of the new Division II.
4. Proposals for statements or recommendations from the Commission to the Open Meeting on IAGA reorganization concerning:
   (a) Objectives of Divisions, Working Groups and Joint Working Groups
   (b) Appointment mechanisms and tasks of membership, leaders of Divisions and Working Groups.
   (c) Interaction with other Associations and Unions.
5. Topics for symposia at Grenoble in 1975.
6. Statements by Working Group reporters.
7. Other matters that may arise.

The Acting Chairman tentatively proposed that reporters be nominated for the following topics, to be covered by the new Division II, provided qualified individuals willing to serve as such can be found:

- Solar emissions of relevance for the photochemistry of the upper atmosphere, including the ionosphere.
- Structure, composition and dynamical processes. The structure and composition is so strongly dependent on dynamical processes that it is felt these should not be separated between different reporters.
- Photochemistry of ionized and neutral constituents, including excited species.
- Atmospheric quantal emissions, including auroral processes and airglow. These emissions result from photochemical reactions and particle precipitation due to interaction with the magnetosphere.
- Interaction with the magnetosphere. This could be joint with the Joint Working Group on Stratospheric and Mesospheric Processes.
- Other planetary atmospheres.
- Laboratory experiments.

The Acting Chairman suggested that should the need arise for a working group on any of these topics, or on some other topic within the scientific field covered by the Division, the appropriate reporter, or the chairman, should nominate members to the working group.

The above suggestions were discussed at length and what emerged finally showed up in the reorganization meeting as Commission VIII input.

In discussing the proposed ICSU Special Committee on Solar-Terrestrial Physics (SCOSTEP) atmospheric project a resolution was proposed as follows:

> Considering the future role of IAGA as outlined in the President's address, Commission VIII of IAGA recommends that IAGA (1) express its willingness to take responsibilities in planned programs for coordinated research in atmospheric physics proposed by SCOSTEP; (2) define the responsibility of its bodies in these programs; (3) nominate three representatives to the Steering Committee for Atmospheric Physics of

SCOSTEP, one for each of its three major programs or studies: (a) Energetics, Dynamics and Structure of the Thermosphere, (b) Neutral and Ion Chemistry, and (c) The Structure and Energetics of the Stratosphere and Mesosphere (SESAME) and (4) assign responsibility for IAGA's participation in the SESAME program to the proposed Joint IAGA-IAMAP Working Group on Stratospheric and Mesospheric Processes.*

Commission VIII, passed the following resolution:

IAGA accepts the proposal of IAU, Commission 22, to participate in a design study for a simple and inexpensive meteor radar system and nominates T.R. Kaiser, R.G. Roper and M. Glass as members of the Ad Hoc Committee on "Radar Observations of Meteor Flux and Radiants and Anomalies at the Base of the Thermosphere."

Commission VIII also passed the following resolution:

Following the initiative of URSI Commission III, IAGA will jointly sponsor an international cooperative experiment using the existing networks of meteor wing radars and incoherent scatter radars and launch programs during the period of the Persid Meteor Shower, August 1974. The simultaneous use of the three techniques will provide complementary measurements of winds and/or temperatures in the lower thermosphere, essential for the detailed study of the effects of disturbances propagating from the strato-mesosphere.

Commission VIII proposed the following symposia be held during the Grenoble Assembly in 1975.

1. "The Second Special Symposium on Dynamics and Structure of the Thermosphere" to be held in conjunction with URSI and COSPAR.
2. "Stratospheric and Mesospheric Relations" to be held in conjunction with a joint program committee.

It was proposed that the Working Group on Meteors be reconstituted as follows to function until the new reorganization takes effect (1 January 1974).

Reporter: T. R. Kaiser (U.K.)

Members: P.B. Babadjanov (USSR), J. Baggaley (New Zealand), Z. Ceplecha (Czech.), W.A. Elford (Australia), V.V. Fedynsky (USSR), D.A. Frost (USA), M. Glass (France), V.M. Lebedinets (USSR), P.M. Millman (Canada), J. Salah (USA) and F. Verniani (Italy).

Commission IX
History

E. J. Chernosky - Chairman

Business Meeting

The business meeting of Commission IX on History was opened by Chairman E.J. Chernosky at 1400h on Thursday, 13 September. D.G. Knapp reported on the work

* Editor's Note: This resolution started an action which terminated in IAGA Resolution No. 20. (See Resolutions section of this publication.)

of the American working group and expressed his view on the importance of historical studies. N. Fukushima, reporter for the Asian-Pacific sector, commented that the response to the invitations to participate in the Hisotry of the Pacific area had been good. G. Porstendorfer, in the absence of G. Fanselau, reporter of the Euro-African sector, noted that papers for the 1975 Paris--Grenoble meeting were being solicited and responses were obtained. Cochairman N. Pushkov could not attend because of illness.

Two resolutions were accepted. One for IAGA recommended that countries take care to preserve and to disseminate their geophysical data of historical importance. This resolution was to be submitted to the Executive Committee for adoption in the final plenary session of IAGA Kyoto Assembly. A second (Commission) resolution expressed sympathy to Father Cardus on his accident here; he had planned to read a paper in this session.

A proposal to encourage an interassociation symposia at the Grenoble meeting was considered favorably. Also the name of one of the working groups was to be altered to indicate its real extent as a European-African working group. Since all of the interests of the History Commission could not properly be defined by geographical boundaries it was decided to plan a fourth working group on historical development of research. (At a later meeting of the chairman and the reporters it was felt that C.S. Gillmor would best fill the requirements for reporter for this working group.)

The proposed reorganization of IAGA was not considered detrimental to the interest of Commission IX on History. Increasing interest and accompanying expected publication of historical studies in journals received by IAGA members was encouraged by the efforts of reporter Fukushima with good results. The approach used by C.S. Gillmor in his historical studies, evoked much interest among the delegates to this IAGA assembly. Persons interested in the activity of this Commission are invited to submit their names for consideration.

Scientific Session

The scientific session, held from 1530h to 1710h was chaired by N. Fukushima who had organized this symposium on the History of Geomagnetism and Aeronomy in the Pacific Area. The Chairman called attention to the publication he prepared for distribution to this assembly. This publication included more information on the papers to be presented at the session, some of which were not included in the assembly. See IAGA Bulletin No. 34. Copies of this History session publication are available by request to N. Fukushima, Geophysical Research Laboratory, University of Tokyo, Tokyo 113, Japan.

The papers presented at the symposium were:

- Gillmor, C.S., Aspects of the history of ionospheric physics in the Asian-Pacific area.

- Neighbour, H., D.G. Rivers and G.O. Walker, A summary of geomagnetic field measurements taken at Hong Kong (Long 114.3°E, Lat. 22.2°N, dip 30°N) from 1884-1973.
- Knapp, D.G., Some aspects of the history of geomagnetism
- Susanto, Report cn the geomagnetic activities in Indonesia.
- Bhargava, B.N. and A. Yacob, Historical and present observations in India.
- Fukushima, N., Archeo-aurora and geomagnetic secular variation.
- D.E. Winch contributed additional information on the Australian stations in Antarctic. A paper read by title: Romaña, A., Contribution of the Jesuit Missionaries to the knowledge of earth magnetism in the Pacific Area.

This meeting of Commission IX provided a very useful opportunity to review the historical and recent observational work in geomagnetism and aeronomy in the Pacific Area. Professor Fukushima kindly offered to arrange for the dissemination of such information in the Pacific area that is brought to his attention. His offer would include the contributions: (1) Santos, C.M., History of Magnetic Observations in the Philippines and (2) Annual Review of the Korean National Committee for IUGG.

The report by Gillmor on the development of ionospheric research in the Pacific area provided new and interesting views on historical aspects that had not received much attention previously. D.G. Knapp's paper included a discussion of his index biographic sources in geomagnetism.

Editor's Note: Note should be made here of the fact that in the reorganization discussions it was concluded that the history work in IAGA would be continued under an Inter-Divisional Commission on History under the chairmanship of E.J. Chernosky. At the end of the Kyoto Assembly, Mr. Chernosky proposed the following organization and leaders: Chairman: E.J. Chernosky, Cochairman: N.V. Pushkov. Working Group 1 - American Area, Reporter: D.G. Knapp. Working Group 2 - Pacific-Asian Area, Reporter: N. Fukushima. Working Group 3 - European-African Area, Reporter: G. Fanselau. Working Group 4 - Development of Research, Reporter: C.S. Gillmor. (Co-reporters had not been decided upon at this date.)

Committee On Lunar Variations

S. R. Malin - Cochairman

Dr. O. Schneider, chairman of this committee, had sent word earlier that for personal reasons he could not attend the Kyoto assembly.

Chairman's Review Of Lunar Studies

S. R. Malin - Cochairman (parts by O. Schneider - Chairman)

The review covers work reported in papers (either published, in the press, or communicated at this meeting) that have come to our attention since the previous assembly held in Moscow, in August 1971. A reference list of papers is appended at the end of the Working Group Reports which supplements similar lists published with previous reports of IAGA assemblies. Papers that were published subsequent to their appearance in the previous list are repeated here with their final references. This reference list should be used in reading all the reports related to the Lunar Committee.

A high level of interest in lunar tidal phenomena, indicated by the number of papers produced, has been maintained and covers a wide range of subjects. It is encouraging to note that an increasing number of papers contain both observational material and interpretation, and many discuss the interrelations of lunar variations in different geophysical phenomena. This trend makes it difficult to classify the papers into rigid compartments; however, we may consider the following broad categories: Reviews, Theory and Methods, the Neutral Atmosphere, Magnetic Field, Equatorial Effects, the Ionosphere and Other Phenomena.

The reviews include those by Schneider [1971a,b] prepared for the Moscow assembly, one covering lunar studies for the two years proceeding the meeting and the other summarizing the contributions of S. Chapman to the subject. Other reviews have been written by Matsushita [1971, 1973a], the latter as a contribution to the Fourth International Symposium on Equatorial Aeronomy.

Theoretical work has looked both outward, at the thermosphere [Kato, 1971] and magnetosphere [Matsushita & Tarpley 1973], and inward, at the currents induced by the ionospheric dynamo in the earth and oceans [Hewson-Browne, 1973b; Hewson et al., 1973]; Hobbs, 1971; Hutson et al., 1972,1973a,b], as well as at the dynamo region itself [Jackson, 1971; Anderson et al, 1973; Kato, 1973]. Of particular importance in relation to neutral atmospheric studies is the work of Hollingsworth [1971] on the effect of ocean and earth tides on the air tide.

A significant new method of lunar analysis have been developed by Schlapp & Weekes [1973], who also critically examine the Chapman-Miller method. Other new methods have been presented by Matsushita & Campbell [1972], together with applications to observed data. The application on spectral analysis techniques to tidal determination is considered by Gupta [1972], Zadro & Poretti [1972] and Currie [1973].

Studies of the tides in the neutral atmosphere have been relatively few; however, in addition to the paper by Hollingsworth mentioned earlier, and a spherical harmonic analysis of the barometric pressure tide [Malin, 1973a, Appendix B], there are several papers to be presented at this meeting which are either wholly or in part concerned with atmospheric tides. These include a study of the lunar diurnal tide [Geller & Schoeberf, 1973], two studies of pressure tides also included non-l_2 terms for Naples [Palumbo, 1973], and Addis Ababa [Gouin & Malin, 1973], and an investigation of l_2 in surface winds, including new determinations for four Indian stations [Reddy, 1973].

The majority of papers are concerned with various aspects of lunar variations in the magnetic field, including spherical harmonic analyses of the main terms associated with the M_2 tide, for sunspot maximum [Malin, 1973a] and minimum [Winch, 1973]; determinations of partial tides [Tarpley, 1971; Winch, 1971; Malin 1972; Rao & Sastri, 1972, Winch & Cunningham, 1972; Gouin & Malin, 1973; Malin, 1973b]; investigations of the magnetic effect of the ocean dynamo both from theoretical and observational points of view [Sastri & Rao, 1971; Windle et al., 1971; Cardus, 1973; Donato, 1973; Malin, 1973a], as well as the more traditional analyses for Trelew [Affolter & Schneider, 1972], Trivandrum [Chapman & Gupta, 1971], Potsdam, Seddin and Niemegk [Fanselau, 1972], Addis Ababa [Gouin & Malin, 1973], Toolangi [Green, 1972], Sodankyla [Gupta, 1973a], Helwan [Hanafy, 1973], Istanbul [Isikara, 1973a], Visokaya Dubrava [Ivanov & Panov, 1973], Alibag, [Raja Rao, et al., 1973[and other Indian stations [Rao, 1972a]. In addition, there are a number of studies of the dependence of magnetic lunar variations on various parameters, such as season [Gupta & Malin, 1972; Winch & Cunningham, 1973], sunspot cycle [Isikara, 1973b; Rao, 1972b], and magnetic activity [Rao & Arora, 1973]. Palumbo [1973] has investigated the latitude of the L current focus, and Matsushita [1973b] is to present a paper on geomagnetic and ionospheric variations in the equatorial region and the polar cap.

Other studies of Equatorial phenomena have been made by [Gupta, 1973b], Tarpley & Balsley [1972] (discussed by Geller, 1972) and Rastogi [1973] for lunar variations in the electrojet and counter-electrojet, and by Misva [1973] concerning horizontal ionospheric drift.

In addition to the studies of ionospheric lunar variations already mentioned, Noonkester [1972] and Ali [1973] have successfully detected D-region tides from phase measurements at 10.6 and 16 b,H_z, respectfully, and Tarpley & Matsushita [1972] have investigated lunar effects in sporadic E. Rao & Rao [1971] have studied the dependence of ionospheric absorption on lunar phase, and Sharma & Rastogi [1971] have investigated electron density tides at fixed heights.

There have been several attempts to detect lunar influences in other phenomena, such as rainfall [Reddy, 1973b], atmospheric ozone [Shah, 1972], Nightglow [Forbes & Geller, 1972] and the geomagnetic activity index, Ap [Frazer-Smith, 1972]. The possibility of lunar effects on atmospheric electricity and thunderstorms is considered by Markson [1971], and the correlation between tides and earthquakes

is discussed by Shlien [1972]. Also of importance for lunar studies are the papers of Cartwright & Taylor [1971] and Vorobyev [1971], concerning the tide-generating potential, and that of Hendershott [1972] concerning the influence of solid earth deformation on the ocean tides.

Internal Coordination In Research On Tides And Related Phenomena**

O. Schneider - Chairman

Recent development as reflected by important published research work, as well as national and international symposia* has shown that tidal phenomena observed in the diverse fields of Geodesy and Geophysics have more common ground than was generally realized. However, it is also true that the tidal manifestations and tide-like phenomena in the earth's body, fluid spheres, ionosphere, and magnetic and gravitational field are modulated in a characteristic fashion, in accordance with the configuration and physical constitution of each of these spheres and their mutual and cosmical relationships, giving rise to several kinds of dynamic, thermal, electric and electromagnetic interactions that have been the subject of an increasing number of special studies in the last years. Interaction and cooscillation phenomena can probably account for some of the anomalies observed in the distribution and composition of tides in the different spheres.

On the other hand, whereas specific methods and criteria of analysis, data grouping and error determination are required in these different domains much can be learned by comparing such methods and evaluating their merits.

Although tides and tidal effects can be observed or supposed to exist in practically all branches of Geodesy and Geophsics, affecting our planet on a global scale and thus clearly coming under the responsibility of IUGG, it is unfortunate that only some Associations of the Union have commissions for promoting and coordinating tidal research in their respective domains, while others do not consider this subject at all, and the Union as a whole lacks an appropriate commission that would offer a home for tide studies at large. In fact, only IAG, IAPSO and IAGA are caring for tidal or lunar effects at the present time, while other important tidal processes are not adequately covered, nor is there an appropriate structure for coordinating the interdisciplinary aspects of tidal theory, observation and analysis.

It is the purpose of this memorandum to stimulate a discussion on the best way of overcoming the present isolationist state of affairs. Several criteria may be conceived of, as regards the name, scope, internal structure and organizational level of the commission here envisaged. Tentatively, subjects that

* Cf.: Symposium on Inner Variations in Geophysical Phenomena; organized by IAGA, with participation of IAG, IAMAP and IAPSO, XVth General Assembly of IUGG, Moscow, 1971. Also: First GEOP (Geodesy/Solid Earth and Ocean Physics) Research Conference, Ohio State University, 1972.

**Editor's Note: This is a report dated 16 August 1973, listed as the Chairman's Address. Since the Chairman was not present, it was read by the Cochairman.

could be covered, and might become the responsibility of Working Groups or Subcommittees, would comprise: (1) Tidal potential; (2) Tidal effects on the solid earth; (3) Ocean tides; (4) Tides and thermo-tides of the neutral atmosphere; (5) Tides of the upper atmosphere and exosphere; (6) Geomagnetic tides; (7) Interaction effects and tidal friction; (8) Lunar effects of nontidal origin; (9) Methods of computation and representation.

A partial solution could be sought by constituting an Inter-Association Commission on (just) Lunar Effects in Geophysical Phenomena; a more ambitious project would go beyond the scope of IUGG and consider the participation of IAU and URSI. As an example of an existing Intra-Association Group, the IAGA Committee on Lunar Variations, including the neutral atmosphere, (LC) can be mentioned, the present writer being more familiar with this attempt than the similar efforts, certainly most important and successful, in solid earth and ocean tides. The LC was founded by the initiative of the late Prof. S. Chapman and was originally a Joint Committee of IATME with Internaional Association of Meteorology (the forerunners of IAGA and IAMAP). A description of its origin, purpose and history is given in IAGA Bulletin No. 25 (Transactions of the St. Gall Meeting, 1967, p. 135.) Bibliographic lists of papers relevant to the subject covered by the Committee and to studies on lunar effects in the lower and upper atmosphere, Geomagnetism and Aeronomy have been published in: Meteorological and Geoastrophysical Abstracts (American Meteorological Society), 14 (12), 1963, p. 3958-4019; IAGA Bulletin 25 (St. Gall Assembly), 1967, p. 135; IAGA Bulletin 27 (Madrid Assembly), 1969, p. 111; IAGA Bulletin 31 (Moscow Assembly), 1971, p. 119. In the same Bulletins, reports on the activities of the LC, as well as worldwide progress reviews on lunar work at large can be found. The LC has Working Groups on: Theoretical problems of atmospheric oscillations; Internal (lithospheric and hydrospheric) aspects of geomagnetic and aeronomical lunar variations; Solar and interplanetary effects in lunar variations; Procedures for analysis of lunar variations; Hydromagnetic aspects of ionospheric lunar variations; and Global planning.

Working Group No. 2, Internal Aspects Of Geomagnetic And Aeronomical Lunar Variations

J. C. Larsen - Reporter

Prof. Mario Bossolascio is involved with electric field measurements at coast and near coastal sites with a view toward the detection of lunar variations in the ocean.

Dr. Antonio Palumbo's work is concerned with the oceanic tidal contribution to atmospheric pressure.

Mr. Geoffrey M. Brown is concerned with lunar variations in earth currents at coastal and near coastal stations.

Dr. R.C. Hewson-Browne is theoretically oriented toward developing models that can explain the observed lunar variations in the magnetic field caused by oceanic tides [Hewson-Brown, 1973].

Dr. Stuart Malin's research centers mainly on improving the detailed understanding and description of the lunar geomagnetic field [Malin, 1973].

Mr. D.J. Stone replies that he is not active and would be happy to step down if this seems necessary.

Prof. Price has never corresponded, but I believe he has retired.

My work is continuing with the observations of very low frequency electric fields (frequencies down to one cycle per month) with the view toward improving the understanding of the mantle conductivity and the observation of low frequency oceanic motion including oceanic tides. Work is progressing here with a graduate student studying the electromagnetic signals produced by barotropic and baroclinic tidal motion using a simple plane wave model. I am also continuing my interest in the hydrodynamic effects of a long ridge, such as the Hawaiian chain of islands, on the global oceanic tides.

My view of the important developments in the literature towards our understanding of lunar variations from the oceans are based on the following works:

1. The theoretical work on electromagnetic induction problems with applications to the oceans (see, for example, Hutson, Kendall, & Malin, 1972). I've written a review article (Larsen, 1973) which deals with the marine induction problem as related to deep ocean sites far from continents.

2. The theoretical work in the numerical solution of Laplace's tidal equation (Hendershott, 1973). This work includes the effect of the nonrigid earth, i.e., the solid earth tides. Important work has been done by Farrell (1972) to compute the loading effect of the tides which is successfully being used to correct the solid earth tides.

3. The theoretical work of Hollingsworth (1971). This work shows that the atmospheric tides have a significant contribution due to the vertical motion of the ocean tides. It might be interesting to study the lunar variations in the ionosphere with a view of determining the extent of the excitation being caused there by oceanic tides. Perhaps a site on the earth where the atmospheric tide is expected to have a node would reveal oceanic influences.

Working Group No. 3, Solar And Interplanetary Effects In Lunar Variations

M. Maeda - Reporter

I feel that the solar ultraviolet and corpuscular radiations and associated interplanetary plasma and fields may have some important effects in observed lunar variations. I am planning to discuss this problem at the Working Group No. 3 meeting in Kyoto.

Brown and Woods (1971) found an abnormally large lunar semi-diurnal component in earth potential gradient at Aberystwyth, and they attributed it to the e effect of a tidal dynamo generating mechanism. Winch (1971) analysed the M_2 and O_1 geomagnetic lunar tides for reactions to adjust the results obtained for a typical seasonal subdivision. Forbes and Geller (1972) studied the effect of lunar tidal dynamics on the OI (5577A) airglow, and it is found that the dynamics

of the lunar tide are sufficient to produce a lunar variation in green-line airglow that is similar to the observed variations. Gupta (1972) carried out a high-resolution cross spectrum analysis between the hourly values of the theoretically generated equilibrium gravitational tide and the hourly values of the geomagnetic H-component. Where as in the tidal spectrum peaks near 27 and 14 days period are seen, in the magnetic spectrum the first three peaks with period nearly 27 14, and 10 days appeared. The frequencies of the 27 and 14 day peaks in magnetograms are closely related to those predicted by the tidal theory, but the frequency of 10 day peak seems to be attributed to the effect of M-region disturbances. Gupta and Malin (1972) analysed the S and L geomagnetic variations based om hourly mean values from 100 observatories for the interval 1957.5 to 1960.5. They found that the least values of the ratio (of seasonal range to annual mean range) occurred at high latitudes for both S. and L. Gupta (1973a) computed the solar and lunar geomagnetic variations at Sodankyla 1914-1966, and found that the magnetic activity peaks delayed several months from the sunspot number peaks. This result was interpreted in terms of the deflection hypothesis and the M-region migration. Gupta (1973b) obtained the solar and lunar daily variations of the lunar ionospheric and oceanic dynamo parts from the lunar harmonic coefficients to geomagnetic data.

Working Group No. 4, Procedures For Analysis Of Lunar Variations

B. Haurwitz - Reporter

This report reviews the main conclusions reached by the Working Group since the St. Gall Assembly in 1967, through extensive discussions by all its members, and with the benefit of an active participation of the late Professor S. Chapman.

Two circumstances concur in suggesting that recommendations on the standardization of procedures for the analysis of lunar variations must have a certain degree of flexibility, viz. the smallness of such variations, affected by a strong variability, on one hand, and the still prevailing lack of adequate global coverage on the other hand. It was felt that too restrictive rules, e.g. on the grouping of data, might discourage investigators from lunar studies in cases where data series of only medium length are available, whose analysis could, nevertheless, contribute to a better global representation of the average behaviour.

Nor is it possible to unify the procedures in the diverse domains of the geophysical sciences here concerned (mainly the neutral atmosphere, ionospheric parameters, other aeronomical properties, and the geomagnetic field, according to the present terms of reference of the Lunar Committee), since the raw data generally are of dissimilar kind and time resolution. The following statements should therefore be interpreted as broad suggestions, to be adapted to the particular requirements and possibilities of each project. A number of papers on procedures and technical hints for the analysis are included in the bibliographic lists appended to the Reports of the Lunar Committee in the IAGA Transactions of the St. Gall (1967), Madrid (1969) and Moscow (1971) Assemblies.

Harmonic analysis of either individual days or appropriate groups of days will be the preferred procedure; spectral analysis can give additional information on particular features of the mean behaviour of lunar variations, especially as regards the presence and significance of partial tides.

Both fixed hour and fixed epoch methods are available for the harmonic analysis, and although the Chapman-Miller method has been widely accepted during the recent years, the working group does not wish to discourage the use of other appropriate procedures. In particular, reference should be made to a study by D.M. Schlapp and K. Weekes "The determination of lunar tides: I. Methods of analysis, Journ. Atmosph. and Terr. Phys., 35, (1973)," who draw attention to the consequences of neglecting the terms corresponding to $p = 0$ as is customary in the standrad application of the Chapman-Miller method.

Raw data are generally given in the form of equidistant values either instantaneous or means-over-unit intervals. The use of mean values will eliminate some of the higher frequency noise, but a slight correction, varying with the order of harmonic under consideration, must then be applied to the computed harmonic coefficients. Provided the series are long enough, satisfactory results can be obtained with bi-hourly or even three-hourly equidistant data; however, in certain cases, the use of hourly values will add some accuracy. Other types of time-spacing, such as 2 1/2 minute intervals, as occurring in some formats of geomagnetic data processing, have also been used with success, as well as a wider spacing with only three observations per day. Non-quidistant or even sporadic data (e.g. from rockets or satellites; whistler; disturbance events) call for special methods of analysis.

Solar, rather than lunar, time will be the standard arrangement of the raw data, and the subsequent lunar analysis should then be based on the mean, rather than the apparent, Moon.

A very important part of the work is the checking of the data to be used, both for 1) errors due to faulty punching or copying and 2) errors in the original data. Errors arising out of 1) should be checked by a verifying punch or by carefuly comparison of the copy with the original. Errors arising out of 2) can be spotted by looking for values which are very different from the neighboring ones. This can be done by using a machine program. In addition, some observatories which publish the data in yearbooks include corrections in subsequent years.

Time grouping of data has many facets discussed below:

- Seasons. Lloyd's grouping has been widely used so far: December solstitial group, d: November, December, January, February; June solstitial group, j: May, June, July, August; Equinoctial group, e: March, April, September, October. (To avoid confusion between northern and southern seasons, the d, e, j, notation is preferable to others implying the words summer and winter). The working group recommends the following alternative possibilities for future work: (a) Analyse the seasonal variations in terms

of pure harmonics whose frequencies differ from that of the fundamental tidal harmonics by small integral multiples of one cycle per year, (b) use of Bartel's season numbers, (c) if the abundance of data permits, split the e (or E) group in two bi-monthly (or roughly equivalent) groups March-April and September-October, to allow for seasonal asymmetry in the shape of the annual modulation, and (d) also if the abundance of data warrants it and a division in 12 monthly (or equivalent) groups is possible, make an annual harmonic analysis of the resulting monthly Fourier coefficients.

• Disturbance. (a) In the lunar analysis of meteorological elements the degree of interference by aperiodic variations is a function of latitude. For instance at higher latitudes the passage of a low pressure area over the station may result in barometric pressure changes 1000 times larger than the lunar barometric tide. Since such large changes could seriously obscure the highly disturbed days, in such cases it will be best to subdivide the days into groups according to the magnitude of the disturbance and compute the lunar effects separately for each group to determine the influence of the selection of data (for instance Bartels' curvature effect). (b) For studying lunar variations in aeronomic elements, ionospheric parameters, or the geomagnetic field, geomagnetic activity is conveniently used as a criterion for subdividing the data. However, no definite recommendation can be made at this time for any one particular scheme of division. One possibility would be the grouping into three sets as follows: The five international quiet days of each month; the fifteen most disturbed days of the month according to Cp, Ci, Ap or C9; the remaining days of the month. Other possibilities would be based on a grouping into classes of approximately equal population, according to one of the activity measures just mentioned.

• Solar activity. According to the present state of knowledge the slowly varying component of solar activity, as expressed, for instance, by the annual mean Relative Sunspot Number, seems to be the appropriate parameter that determines the dependence of lunar variations in geomagnetism (and possibly aeronomic phenomena) on solar activity. It is therefore recommended that the annual mean of the Zurich sunspot number be used as the basis for subdivision. If the abundance of the data is sufficient, three or even four groups can be adopted, with approximately equal population in each of them. The working group encourages the search for other solar parameters, or different combinations of the Wolf-Wolfer number as possible indicators of solar influences on lunar variations.

• Lunar distance and declination. If it is desired to investigate the influence of these elements, this can be done by studying the different rates of change of the diverse lunar tidal terms.

• Basic daily interval. In meteorological work and some of the geomagnetic and aeronomical studies, the solar day from local (or Meridian Zonal Time) midnight to midnight is the appropriate basic time interval. However, in those cases where international indices of magnetic activity, valid for Greenwhich days, must be used for the grouping of the days, the Greenwich day may be a better choice. On the other hand, this becomes a disadvantage whenever the difference

between local and Universal time is greater than a few hours (four, say), since this will introduce increasing difficulties in the correction for non-cyclic change, as a consequence of the statistical day-to-day variability of geomagnetic and aeronomical solar daily variations. In these cases it is recommended to discard the standard international UT daily indices as a measure of geomagnetic, and replace these by daily ad hoc numbers adapted to local time, such as combinations of ap numbers or of weighted successive values Cp or similar.

• Height profiles. Whenever the abundance of available data justified it, the study of lunar variations in the neutral atmosphere or in aeronomic parameters should be made along vertical profiles, by comparing tidal results for different levels.

The presentation of results can also be broken down into several headings:

1. Geographic coordinates of the stations should always be given at an early stage of the papers or reports. In addition, lunar studies on ionospheric, or aeronomic parameter should show the geomagnetic coordinates, and also the dip latitude.

2. It is imperative that all results be presented with a measure of their statistical significance. Since results are in the form of harmonic waves, the vector probable error (radius of the probable error circle) is a convenient measure of significance. This can be found as indicated in the Chapman-Miller method, or by examining the scatter, about the mean, of partical vectors, determined in yearly groups, or day by day.

3. The units adopted should be in reasonable agreement with the level of accuracy attained. This means that, e.g., for atmospheric pressure, the microbat will be an appropriate unit, for wind tides the velocity in cm/sec (clearly specifying N = southward; W = eastward component). Whereas for the geomagnetic field, the centigamma (cγ), equivalent to 10 picotesla seems adequate.

4. To ensure easy comparability of results, the computed oscillations should be presented in the form l_n Sin $(n\tau + \lambda n) \pm \tau_n$. Here n denotes the nth fraction of the local mean lunar day, reckoned from the lower transit of the mean moon, and τ lunar time. The phase constant λ_n should be expressed in degrees (and fractions if warranted); in addition, the mean lunar time in hours, when the maximum occurs, can be specified. In geomagnetic studies, the first four lunisolar harmonics, at least, should be given.

5. In the search for lunar geomagnetic tides, variations of both D and H should, if at all possible, be presented together so that the variations of the horizontal components X and Y can also be obtained.

Working Group No. 5, Hydromagnetic Aspects Of Ionospheric Lunar Variations

S. Matushita - Reporter

The essential points of kind responses to my inquiry letter mailed to the scientists who are members of the working group in early May concerning the acitivity of our working group members and their colleagues are below:

Prof. G. Fanselau ..."In a paper which I am preparing just now is treated a quarter daily variation in Sq. I think that such a quarter daily variation may be connected with oscillations of similar frequency in the tail of the magnetosphere. A pupil of mine has made an investigation on this subject and has found some recent publications of USSR scientists who have given the theretical basis of such oscillations. I intend to investigate how far such magnetospheric oscillations may influence the L. I hope to give you more details at the end of this year, unfortunately not in time for the Kyoto IAGA Assebmly. Sorry I am not able to participate in this very interesting Assembly." [See Franselau 1972.]

Prof. Kato ..."We should study the combined effects of electro-magnetic force and dynamics. We must investigate which tidal mode contributes to electric field propagation and which mode is effective for vertical propagation of dynamical motions, together with the interactions between those two modes." [See Kato and Matsushita 1969, Kato 1971 and Kato 1973.]

Prof. Kendall ..."R.A. Heelis (in collaboration with P.C. Kendall, R.J. Moffett, H. Rishbeth, (R.S.R.S., Slough) and D.W. Windle) has developed a program that examines E-F region coupling. Field-aligned currents from the F region affect the electric fields in the dynamo region below. As yet, only solar-dirven tidal winds in the dynamo region have been included. The calculations show that, for example, the sunset effects in vertical ion drift observed by R.F. Woodman at Jicamarca may be due to the field-aligned currents and the change of E region conductivity at sunset. Clearly the result of lunar perturbations of the E region may depend on conditions in the F region. Rod Heelis is to work with W.B. Hanson (Texas) next year."

Dr. Tarpley [1971] investigated the C_1 component of the geomagnetic daily variation. Tarpley and Balsley [1972] studied the lunar variations in the Peruvian electrojet. Tarpley also investigated the lunar influence on ionospheric Es in collaboration with Matsushita [Tarpley and Matsushita 1971 and 1972].

Dr. Campbell together with Matsushita presented a technique to determine lunar semidiurnal variations from magnetic tapes containing 2.5-minute geomagnetic data digitatization [Matsushita and Campbell 1972].

Semidiurnal lunar-time variations of the ionospheric F2 electron density show unique behavior in low latitudes. Namely, the maxima occur about 4 hours after lunar transit in the magnetic equatorial zone but 10 hours after transit outside this zone. Although this behavior had been explained qualitatively by

an electromagnetic drift model, a detail quantitative explanation has finally been given [Anderson, et al. 1973]. The electron density continuity equation has been numerically solved taking into account production, loss, and transport due to neutral-atmospheric winds, diffusion, and electric fields. The applied electric field has been estimated from geomagnetic data and Jicamarca-radar ionospheric drift measurements. The phase shift in low latitudes is a consequence of the fountain effect which produces the F2 equatorial anomaly. This investigation is one of the highlights in the present working group activity.

Matsushita [1971a, 1971b, 1971c] investigated interactions between the ionosphere and the magnetosphere for the solar and lunar variations and ionospheric F2 motions interacting with the geomagnetic lunar field [Matsushita, 1972]. He also reviewed lunar tidal effects on the low-latitude ionosphere [Matsushita, 1973a]. He is currently examining lunar effects on geomagnetic and ionospheric variations at high latitudes, taking into consideration the interplanetary magnetic field and magnetospheric influences.

Unfortunately, no reply had yet been received from Drs. Benkova, Rastogi and Rawer at the time this report was prepared.

Working Group No. 6, Global Planning

S.R.C. Malin - Reporter

This working group was formed in September 1971. The membership comprises: B. Haurwitz, S.R.C. Malin (reporter), S. Matsushita, M. Siebert, A.M. van Wijk, D.E. Winch and V.A. Zagulyaeva.

Before considering future requirements, it is necessary to establish the present position, and, to this end, charts have been prepared for barometric pressure, magnetic field, and ionospheric height. The stations for which lunar analyses have been made are indicated on world charts by circles, the areas of which are proportional to the number of years of data analysed. For full analyses (e.g. year and seasons, all elements) the circles are filled; for incomplete analyses they are open (see p. 110).

BAROMETRIC PRESSURE

There is a good global coverage between 40°S and 50°N (up to 60°N over Europe), but there are some notable gaps particularly in central Asia, Canada, Brazil, and the South Pacific. Certainly for Asia and Canada, and probably for Brazil, suitable data are available, and it is desirable that these should be analysed. It is also possible that suitable data are available for some of the Pacific Islands. For Brazil and the Pacific, 5 to 10 years of data would probably be sufficient for an adequate determination, but about twice this quantity or more, would be required for Asia and Canada. Useful contributions could also be made by the South Africans, by analysing data from Gough Island and Marion Island. Extension of the coverage to higher latitudes is, in general, impractical because of the excessive quantity of data required to reveal the tidal term above the noise level, but it might be possible by selecting particularly calm days from a suitable site (e.g. Fairbanks, Alaska).

Besides completing the global coverage, it is desirable that the earlier phase of the lunar barometric tide during the j and d seasons in the southern then in the northern hemisphere (Haurwitz & Cowley, PAGEOPH 77, 122 [1969]) should be studied in more detail by having two chains of stations, one in the northern, the other in the southern hemisphere. This would require filling gaps over Asia and the Pacific Ocean. Such a study may also show if the tide progresses at different speeds over land and over water.

SURFACE WIND

No chart of wind tide analyses has been made, as very few are available. Any further determinations from long series of data would be welcome, especially in view of the unexpected direction of rotation of the lunar wind vector (see Harwitz & Cowley, Quart. J. R. Met. Soc. 95, 766 [1969]). Again selection of particularly quiet days might well reduce the noise level without significantly affecting the tidal determination, and this point could readily be investigated using existing series of machine-readable data.

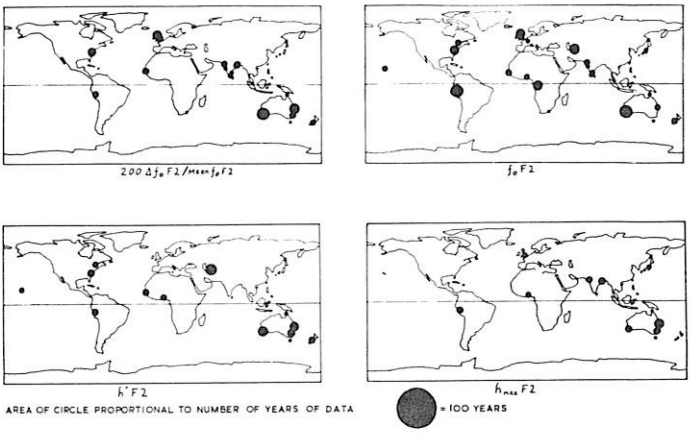
MAGNETIC FIELD

The distribution of analyses of magnetic data is extremely satisfactory, including nearly all the sites for which suitable data are available. However, many of these analyses are for short series of data (four years or less) which are inadequate for significant determinations of L at high magnetic latitudes (although, of course, sub-significant determinations provide vaulable constraints for global models). The main requirement is for more analyses of long time series of data, of which many are available, to reveal more detailed features of the variations, such as sunsport-cycle variation, additional tidal terms and investigation of the ocean effect. For this latter purpose it would be desirable to analyse data from stations at the same latitude, but at differing distances from the ocean. There is also plenty of scope for further analysis and interpretation of the many results of analyses that have recently become available.

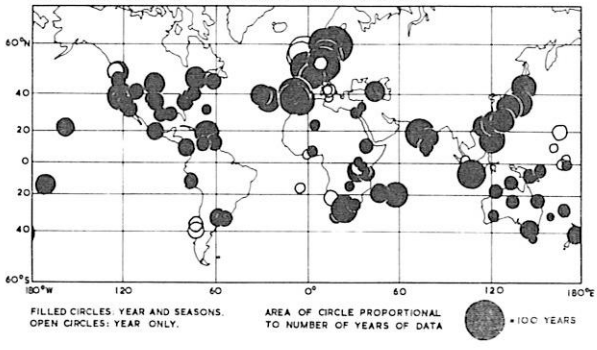
IONOSPHERIC PARAMETERS

In the past, attention has been mainly concentrated on the F2 layer, and analyses have been made for a number of sites of lunar variations in the maximum electron density (200 Δf_0/Mean f_0) and its height (h_{max}) as well as the critical frequency (f_0) and virtual height (h'). These have been plotted from Table 1 of Matsushita (Handbuck der Physik 49/2, p 550, 1967). It is interesting to note that the total quantity of F_2 data so far analysed is less than that used in the single magnetic analysis for Sitka, so there is clearly plenty of scope for further work; however, the number of sites for which suitable data are available is restricted. Inevitably, the southern hemisphere is poorly covered (with the exception of Australia) and analyses form Southern Africa and South America would be desirable. Also, there is a serious gap over Asia. More surprising is the paucity of results from North America and Europe.

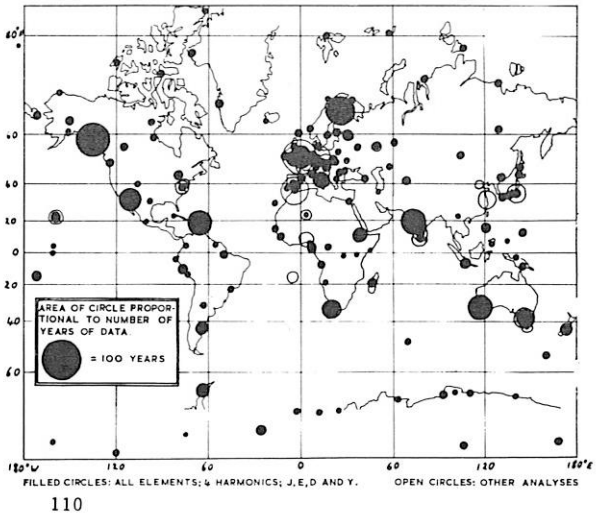
SEMIDIURNAL LUNAR VARIATIONS OF THE F2 LAYER



LUNAR ANALYSES OF THE ATMOSPHERIC PRESSURE



LUNAR ANALYSES OF THE GEOMAGNETIC FIELD



Recently, attention has been concentrated on the E and E_s layers, and this work is to be encouraged.

INTERDISCIPLINARY STUDIES

One of the main objectives of lunar tidal studies is the elucidation of the ionospheric dynamo, and the main problems are lack of knowledge of tidal winds at ionospheric level, the polarisation field and the field-aligned currents through the magnetosphere. Surface pressure and winds give little information of relevance to the ionosphere, but the increasing number of direct measures of ionospheric drift (e.g. from meteors or barium releases) might soon yield tidal information. Lunar variations in electron density are relevant to the polarisation field, but the distribution is not yet adequate for satisfactory global model.

Barometric pressure tides are potentially a valuable source of information on the dynamics of the atmosphere, but their interpretation is complicated by the presence of contributions due to tides in the earth and oceans. Although valuable work has been one on this problem, there is a need for more detailed studies to deduce the contribution of the observed earth and ocean tides to the barometric tide at individual stations.

Similarly, a study of the oceanic dynamo contribution to geomagnetic lunar variations deduced from existing models of the tides might lead to improvements to our knowledge of both the deep-sea tides and the ionospheric dynamo component of magnetic tides.

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Committee On Antarctic Research

T. Nagata - Chairman

Membership

The committee reported a membership as follows:

Chairman: Nagata, T.

Secretary: Oguti, T.

WG-1 Geomagnetic Variations and ULF

Reporter: Lanzerotti, L. J.

Members: Campbell, W. H.
Perraut, S.
Raspopov, O. M.
Troitskaya, V. A.

WG-2 Radar and Optical Aurora

Reporter: Davis, T. N.

Members: Eather, R. H.
Unwin, R. S.

WG-3 VLF and Whistler

Reporter: Carpenter, D. L.

Members: Helliwell, R. A.
Kaiser, T. R.
Morgan, M. G.

WG-4 Ionosphere and CNA

Reporter: King, J. W.

Members: Gledhill, J.
Matuura, N.
Piggott, W. R.

WG-5 Rockets and Sattelites

Reporter: Oguti, T.

Member : Perraut, S.

WG-6 Balloons

Reporter: Rosenbers, T. J.

Members: Keys, J. G.
Oguti, T.

Working Group 1, Geomagnetic Variations And ULF

L. J. Lanzerotti - Reporter

Two items of current, important interest concerning the use of magnetic pulsations requested in the Antarctic are the following:

1. Data from Antarctic stations separated in longitude (but at approximately the same magnetic latitudes) should be examined for the same individual pulsation events. In particular, data should be obtained from stations spaced in longitude about local noon. The orientation of pc-3 and pc-4 ellipses should be studied to confirm, on an individual event basis, the statistical result of pulsation orientation about local noon; i.e., statistically it has been observed that the ellipses for conjugate events have their major axis in the northwest direction before local noon and in the northeast direction after local noon.

2. Data should be obtained from a dual pair of conjugate stations spaced in latitude about the nominal plasmapause location in order to investigate, simultaneously,

the character of pc3 and pc4 pulsations, particularly if one of the frequencies typically appear outside the plasmapause and the other inside. Studies should be made of amplitude, spectral characteristics, and sense of polarisation of both frequency bands. It is highly likely that one frequency may predominate outside the plasmapause.

Working Group 2, Radar And Optical Aurora

T. N. Davis - Reporter

The working group made the following recommendations for the IMS:

- All-Sky Cameras - as many stations as is feasible should be operated during all dark hours with image rate at least 1/min and preferably 2/min. Essentially each manned station on the continent should operate a camera.
- All-Sky (or Large Field) TV - should be operated at Syowa during rocket launches, balloon flights and satellite passes.
- Among specific studies to be emphasized utilizing various instruments (i.e. radar, photometric, etc.) are:
  - (a) Statistical conjugacy-especially between Syowa and Iceland.
  - (b) Coordinated conjugate aircraft flights.
  - (c) Observation and location of cusp phenomena.
  - (d) Participation in active experiments.

Working Group 3, VLF And Whistler

R. A. Helliwell - Reporter

The United States can make a unique contribution to the IMS by monitoring the density and drift of magnetospheric plasma using whistlers detected in the Antarctic. These measurements will play a major role in inferring the large scale convection patterns in the magnetosphere. A network of 6 stations, clustered around Siple Station, is recommended in order to take advantage of the high rate of occurrence of nose whistlers in that area. The basic VLF data needed for such studies are the dispersion of whistlers and the angle-or-arrival of the whistlers.

The VLF stations should be spaced no more than 1000 km apart. For proper longitude coverage a chain of 5 stations along L=4 is recommended. Possible locations for the instruments are Sanae (S.A.), Halley Bay (U.K.), General Bolgrano (Arg.), Siple (U.S.) and a new automatic station (U.S.) to the west of Siple. For latitude coverage, one additional station at Palmer is needed.

Each of the 6 stations would include a VLF goniometer and VLF spectrum recorder. Stations other than Siple or Palmer would be either manned or unmanned, depending on relative costs.

Supporting instruments at the stations would include photometers, a riometer, a magnetic pulsation system and a magnetometer. Manned ionosondes are required at Siple and Palmer in order to monitor wave-induced precipitation and effects and changes in the F-region associated with $\overline{E}x\overline{B}$ drift. An important experiment related to these measurements is the wave-particle work centered around the Siple VLF wave-injection transmitter and the associated balloon and (planned) rocket-borne particle detectors.

The following resolution was proposed:

> IAGA notes that the coming IMS requires a network of whistler ground stations in Antarctica near L=4 for the purpose of monitoring the density and drift of magnetospheric plasma. Therefore, IAGA recommends to SCAR that its member nations undertake to establish new stations and upgrade existing stations so as to provide the required coverage. For proper

longitude coverage a chain of 5 stations along L=4 is suggested. The present stations at Sanae, Halley Bay, General Belgrano and Siple are suitable for this purpose. To complete this chain, along L-4, a new station to the west of Siple on the Antarctic coast should be established. For latitude coverage the present stations at Siple and Argentine Island are sufficient.

Working Group 4, Ionosphere And CNA

J. W. King - Reporter

THE EFFECTS OF DIRECTLY INJECTED OR PRECIPITATED ENERGETIC PARTICLES ON THE ATMOSPHERE AND THE IONOSPHERE

It is already known that energetic particles penetrating through the magnetospheric cleft region produce large effects in the ionosphere at times around local magnetic noon and that particles precipitated from the radiation belts are associated with various ionospheric phenomena. The details of the ionosphere-magnetosphere interaction processes are not yet known, however. Also, the manner in which, or the extent to which, energetic particles affect the lower (meteorological) atmosphere is at present unknown; evidence is now becoming available, however, which suggests strong coupling between the solar wind and the weather. It is known that geomagnetic activity is associated with changes in the troposphere, the stratosphere, the mesosphere and the thermosphere, and it has been suggested that the composition of the upper atmosphere, and hence the amount of ionization present, is dependent on the flux of energetic particles.

Since the phenomena of particle penetration involves the geomagnetic field (which guides the particles to the near-earth environment) it can be studied with particular effort in Antarctica where the geographic and geomagnetic poles are widely separated.

In order to study the problems referred to above, measurements of particle fluxes and atmospheric composition must be made at the same time as a range of ground-based ionospheric, optical and meteorological experiments are carried out.

THE HEAT INPUT TO THE AURORAL ZONES

Although it is known that the energy input to the upper atmosphere at high latitudes is enhanced during magnetically disturbed conditions, the cause of these enhancements is not known. The relative importance of atmospheric waves, electric currents, energetic particles and other forms of heating is not clear.

The heat input to the upper atmosphere at high latitudes is an important problem (partly because the effects of auroral zone heating spread to the atmosphere and the ionosphere at lower latitudes and lower altitudes) which requires investigation. The Arctic and Antarctic regions are the only ones where the relevant measurements can be made.
Antarctica will be particularly interesting.

The following types of experiment need to be carried out simultaneously:

- Satellite measurements of particle fluxes and also (to study Joule heating) of electric fields.
- Temperature changes measured from ground by, for example, Doppler broadening of the 6300A° line or by laser techniques.
- The ionospheric structure prevailing during heating events; data from Antarctic ionosonde network and from topside sounder satellites

operating over Antarctica will be particularly valuable.

DYNAMICAL PHENOMENA

The morphology of the thermospheric winds which blow over Antarctica, and which lead to the well-known ionospheric "Universal Time effect", have not yet been established. The relative importance of the different possible causes (e.g., thermospheric pressure gradients or electrodynamical effects) of these winds is not known. Atmospheric winds from, and waves generated in, high latitude regions affect the global energy and momentum balance. Winds are accompanied by (a) vertical motions (required for continuity) and (b) return flows at lower heights. These result in major effects on, respectively, the thermal balance of atmosphere and the atmospheric composition. It is important, therefore, to gain some understanding of the dynamical processes prevailing at high latitudes.

The experiments which need to be carried out include observations of winds and waves by all possible techniques. Winds can be measured by observing the Doppler shift of the 5577 A° or the 6300 A° emissions and waves can be studied using the H.F. Doppler, total electron content, ionosonde or meteor drift techniques.

COORDINATION WITH ATMOSPHERIC EXPLORER (AE) SATELLITES

The United States AE-D satellite will be launched into a 98°-inclination orbit during 1975 and, since it will carry a comprehensive payload designed to investigate a very wide range of aeronomical problems (including the composition, structure and dynamics of the region above 120 km), attempts should be made urgently by Antarctic ground-based experimenters to coordinate their observations with those made by the satellite. The Atmospheric Explorer Project Scientist (Mr. N.W. Spencer, Code 620, Goddard Space Flight Center, NASA, Greenbelt, Maryland 20771, USA) would welcome enquiries from interested ground-based experimenters.

OTHER MAGNETOSPHERE - IONOSPHERE INTERACTIONS

During the International Magnetosphere Study (1976-78), major investigations of an all aspects of magnetosphere - ionosphere coupling will be made on a coordinated global scale; some of the problems referred to above will naturally constitute part of the IMS. In addition, however, other investigations (see STP Notes) will be carried out and certain ionospheric experiments (such as riometers) operating in Antarctica will provide date which constitute a particularly valuable part of the IMS effort.

Working Group 5, Rockets And Satellites

T. Oguti - Reporter

At first, we must prepare the coordination between ground measurements in Antarctica and observations on board satellites during the IMS, especially in order to be able to do good simultaneous measurements of waves and particle on ground and in space.

- We must establish a list of the observations made in the different stations in Antarctic and which will be running during IMS. We have also to prepare a list of the scientists who are responsible for these experiments.

- A more important task of this working group is to send to the scientists defined above a brief description of the equipment and the experiments settled on board the main geophysical satellites. After that the scientists responsible for ground-satellite experiments and interested by some spatial

experiments must make contact with the working group. The working group should also take initiatives for trying to coordinate the specific projects which will be proposed by the scientists.

- Calculations predicting the satellite crossings above ground stations are expected to be available during the IMS through the Satellite Situation Center, lead by Dr. Sugiura. We think, in agreement with Dr. Sugiura, that it will be better that all the requests of satellite predictions be collected by this working group and then be distributed to the interested observers.

- The coordination between both ground experiment and ground-satellite experiment will surely need an improvement of the present telecommunication system in Antarctica. In particular, some experiments could need rapid exchange of information between the observatories and launching bases in Antarctic, and the Telecommand Centers of the satellites. In order to help this improvement, our working group will have to collect the experimenters need in this respect, and discuss this point with the telecommunication section of SCAR.

- Inside the whole Antarctic Research Committee some cooperative arrangements can be made between satellite observers and balloons or rockets experimenters as well.

- A specific cooperative program has been started between some experimenters of the European Geostationary satellite GEOS and the Japanese scientists working at Syowa Base.

Considering the importance of the research on the auroral particles, in conjunc- with their origin and/or the mechanism of their production, the importance of the research on electric field and the electric current in the auroral ionosphere in connection with the mechanism of the storage of the solar wind energy in the magnetosphere and its release into the auroral ionosphere, the importance of the research on the chemical problems in connection with the energy flow in aurora and the consequent importance of the well organized experiments for the direct measurement of physical quantities in aurora, it is highly desirable that the Committee on Antarctic Research, IAGA, recommends to each participating government that a strong support be given to the well organized rocket experiments in the Antarctic region during the IMS.

Working group 5 considering that the rocket experiments should be carried out in a close cooperation with the ground based observation nets, balloon experiment, and satellite experiments with a special emphasis on the conjugate experiments during IMS, takes note that a geostationary satellite, GEOS of ESRO, will be in operation during IMS, just on and near the conjugate magnetic field line of Syowa-Reykjavik pair stations.

Working Group 6, Balloons

T. J. Rosenberg - Reporter

Two programs should be considered for the IMS period.

1. Recognizing the favorable situation of stations near the plasmapause in the southern hemisphere (e.g., Siple, Campbell, Sanae, Kerguelen, Halley Bay and others that may be operated during IMS), it is suggested that balloon programs be coordinated from several sites to study electron precipitation as measured by bremsstrahlung X-rays. Simultaneous measurements from several locations can examine the extent in longitude of wave-particle interactions associated with the plasmapause. Electric field and VLF measure-

ments from balloons should also be considered. It will be vital to the interpretation of data to have simultaneous VLF emission and micropulsation recordings available at the balloon launch sites and, where possible, at the conjugate points. If feasible, balloon launches from conjugate L=4 stations should be attempted.

It is recommended that initiatives be undertaken immediately to contact the appropriate individuals or organizations concerned with antarctic research at the above-named sites in order to (a) determine interest, (b) define a workable program (probably limited to austral summer), and (c) outline potential logistical difficulties.

2. The use of superpressure balloons to obtain extremely long-duration flights at 10mb and above from South Pole station should be considered to study transient hard electron precipitation events possibly associated with the dayside polar cusp. The occurrence of such events has been suggested by riometer data, but energy spectra and the presence of rapid time structure can be obtained from balloon X-ray measurements. A single flight, powered by solar panels, should last for several weeks and remain essentially over South Pole in the austral summer.

A third program that also deserves serious attention in connection with the IMS, is a conjugate program of X-ray measurements from the Japanese auroral-zone base at Syowa and several balloons operating simultaneously in the vicinity of the projected conjugate point near Reykjavik. H. Trefall has outlined some possible plans for multiple balloon launchings from Scandinavia coordinated with the GEOS satellite. If efforts are successful in having the satellite placed for some time in the vicinity of the Syowa-Reykjavik field line, conjugate X-ray measurements could provide detailed coverage at the ionospheric projections of the satellite field line, to facilitate comparison of fast time variations in electron precipitation with particle flux variations and plasma phenomena at the geomagnetic equator.

IUGG Inter-Association Committee On Mathematical Geophysics

J. C. Cain - IAGA Representative

There has been a good response to the 1st Circular asking for symposia suggestions for the 1974 Conference.

These include:

- Inversion problems in geophysics
  - electromagnetic variations and conductivity structure
  - gravity data and mass distributions
- Solutions to infinite systems of linear equations and to linear difference equations.
- Reductions and processing of large volumes of global geophysical data.
  - Data organization with different computer systems
  - Removal of known effects
  - Three dimensional interpolations
- Time and spatial analyses.
  Spatial spectral and filtering.
  Maximum Entropy Method.

Further suggestions or comments on these would be helpful. Also, since the symposia of this type were previouusly under the auspices of the Upper Mantle Committee, the lists of addresses are limited. We would thus appreciate also suggestions of names of reviewers and addresses of potentially interested participants.

First Meeting Of New Divisions

The Executive Committee at one of its sessions agreed (see Executive Committee minutes) that a meeting would be conducted for each Division during the evening of 19 September at which time a member of the Executive Committee would introduce the new leadership and then turn the meeting over to them to discuss problems internal to the Division. Each Division was encouraged to cover the following items in their discussions:

1. Presentation of Division leadership.
2. Task and duties of Division leaders.
3. Discuss tasks and duties of reporters.
4. List of names proposed for reporters.
5. List terms of reference and staff of working groups.
6. Procedure for establishing and updating Division membership.
7. Symposia for Grenoble Division meetings.

Ideas for item 2 above were written by the Executive Committee (see Appendix C of Executive Committee minutes) and distributed to Division leaders. Descriptions of the Division meetings are given below (some of these are very sketchy since in some cases notes were not taken).

Division I - Internal Magnetic Fields

A member of the Executive Committee reported that on the basis of the balloting the Executive Committee had appointed the following as officers of Division I:

J.C. Cain, chairman (USA)
*K.M. Creer, cochairman (U.K.)
W.D. Parkinson, cochairman (Australia)
T. Yukutake, cochairman (Japan)

The statement on the tasks and duties of Division leaders, prepared by the Executive Committee (see Appendix C of minutes of Executive Committee) was read to those assembled. At this point the meeting was turned over to the new leaders.

Chairman Cain lead a discussion on the future internal structure and organization of the Division. The structure of working groups proposed by the Executive Committee was accepted as a starting reference and a few names of possible chairmen for these working groups were discussed in this context. Some of the tentative suggestions included:

1. Analysis of the main field and SV - Leaton/Pushkov
2. Theory of main field and SV - Winch/Braginski
3. Electromagnetic induction and electrical conductivity of the earth and moon - Gough/Schmucker
4. Magnetic anomalies - Hahn
5. Paleo- and archeo-magnetism - Buch/Cox
6. Rock Magnetism - Carmicheal/Banerjee

It was realized that the structure and names could not be formalized at this meeting. The chairman promised to work closely with his cochairmen and scientists interested in the Division in preparing the final organization.

(* Not yet contacted to determine his willingness to serve.)

Division II - Aeronomic Phenomena

Professor Nicolet reported that on the basis of the balloting the Executive Committee had appointed the following as leaders of the Division:

B.A. Tinsley, chairman (USA)
*M. Ackerman, cochairman, (Belgium)
*H. Rishbeth, cochairman, (U.K.)
A. Vallance Jones, Cochairman, (Canada)

The statement on the tasks and duties of Division leaders, prepared by the Executive Committee at the request of Commission VIII, was read.

Dr. Mayaud recommended that the title of the Division be changed to Aeronomic Phenomena. This was accepted.

The question of an inter-divisional body on solar-quiet variations was also raised by Dr. Mayaud. After some expression of opinion, the matter was left to be resolved at a later meeting. The tasks and duties of reporters were discussed, and a document will be prepared for distribution to proposed reporters.

The list of topics of the Division was discussed, and it was agreed to amend the third topic to read: "Atmospheric quantal emissions, including auroral processes and airglow".

Dr. J.W. King described the SCOSTEP Atmospheric Physics program and its three major programs or studies (a) Energetics, Dynamics and Structure of the Thermosphere, (b) Neutral and Ion chemistry and (c) The structure and energetics of the stratosphere and mesosphere (SESAME).

The meeting endorsed a resolution to the effect that IAGA take responsiblibity of the planned programs for coordinated research and nominated three representatives to the Steering Committee for atmospheric physics to SCOSTEP. These were J.W. King, T. Tohmatsu and J.B. Gregory (subject to acceptance).

Dr. T. Kaiser proposed two motions related to meteor effects. The first proposed that IAGA (Division II) accept the invitation to the IAU Commission 22) to participate in a design study for a simple and inexpensive meteor radar system and nominated T.R. Kaiser, R.G. Roper and M. Glass as members of an ad hoc committee to put this into effect.

The motion was accepted, together with a second motion to the effect that IAGA (Division II) agrees to sponsor jointly with URSI (Commission III) an international cooperative experiment using the existing networks of meteor wind radars and incoherent scatter during the period of the Peosid Meteor Shower, August 1974. Data would be obtained on winds and temperature and propogating disturbances over a large height range.

There was some discussion about whether these activities should best be carried out through a working group on meteor radar observatories in Division V, and it was agreed to propose this at the Division V meeting. R.G. Roper and T.R. Kaiser were proposed as reporters for the Division V working group.

The meeting concluded with a short discussion on procedures for establishing and updating Division membership, and on symposia proposed for the forthcoming Grenoble meeting.

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* Not yet contacted to determine their willingness to serve

Division III - Magnetospheric Phenomena

Dr. J.G. Roederer announced the names of the chairman and cochairman appointed by the Executive Committee in the light of the vote on 17 September, namely:

C-G. Falthammar, chairman, (Sweden)
T. Obayashi, cochairman, (Japan)
D.J. Williams, cochairman, (USA)
R. Gendrin, cochairman, (France)

All of them agreed to serve, although Dr. Gendrin delayed his acceptance until after he counsulted with colleagues in URSI where he also serves as Commission Cochairman. The appointments made by the Executive Committee were approved by a vote among those present. After extensive discussion, the following decisions were made.

Membership

It was decided to recommend to the Executive Committee that membership-at-large should be open to all active scientists interested in the areas of research covered by Division III and desiring to become members. On the basis of appropriate mailing lists, announcements would be distributed describing the new organizational structure of IAGA and inviting membership in Division III. Additional suggestions for potential members should be solicited from individual scientists and national representatives. Response to the questionnaires or independent written requests to the Chairman would be required to obtain membership. A membership list should be prepared and regularly updated.

Subject Matter And Subdivision

The following list of subject matter to be covered by Division III was accepted. Each of the sub-division is intended to be covered by one or two reporters.

1. Magnetic fields, electric fields, and current systems, including ground observations.
2. Magnetosheath, magnetospheric boundary and plasma penetration.
3. Distribution and properties of magnetospheric plasmas.
4. Energetic particle population including cosmic ray entry.
5. Magnetic oscillations, waves and wave particle interaction.
6. Magnetic storms and substorms, including aurora-magnetospheric relations.
7. Magnetosphere-ionosphere interactions.
8. Magnetospheres of other planets.
9. Laboratory experiments of magnetospheric interest.

Tasks Of Reporters

It was agreed that the reporters would be required to (a) act as links with active researchers in their field of responsiblity in an attempt to find areas which Division III may be of service to the scientific community and (b) prepare, and present at IAGA meetings, progress reports high-lighting the scientific developments in their fields of responsibility since the last IAGA meeting.

Working Groups

Working groups should be established as the need arises and should have well-defined tasks, which should be completed in a prescribed interval of time. It was decided not to institute any working groups at the present time. Members should be prepared at any time to suggest to the leadership of the Division the establishment of working groups.

Remaining Matters

For lack of time the matters of nominating reporters and of discussing the proposed symposia for Grenoble were not dealt with at this meeting. However many present expressed the view that IAGA should sponsor several scientific symposia concerned with magnetospheric physics at the Grenoble Assembly. It was thought that by only holding an IMS symposium a distorted view would be presented of IAGA's interests in the magnetosphere. In several individual discussions after the meeting, the concept of holding a minimum of three specific scientific symposia which would contribute to a general IMS theme was found acceptable.

As the time limitation did not allow the meeting of Division III to finish all matters of the agenda, the chairman and cochairmen of the Division met on 20 September to discuss remaining matters in the light of the discussion at the Division meeting and consultations with individual scientists. The conclusions regarding the nomination of reporters and the Grenoble Assembly symposia topics given below were reached.

Nomination Of Reporters

Questionnaires will be distributed by mail asking for suggestions for people to be nominated as reporters and for comments on the symposia proposals given below. On the basis of this response the Commission Chairmen will make selections. This procedure is a compromise adopted for practical reasons, to ensure that the new organization will be operative without undue delay.

Grenoble Assembly

The Grenoble Assembly will be the first scientific assembly of the new IAGA organization and will occur shortly before the beginning of the IMS. Therefore, it was felt very important to hold several strong scientific symposia. The following three symposia with recommended conveners were agreed on by the chairman and the three cochairmen as been appropriate:

1. High-latitude phenomena (including a session on Birkeland currents). Convener should be proposed by Joint Working Group on the Auroral Oval and its Extension into Space.
2. Physics of the plasmapause. (Proposed convener T. Kaiser)
3. Global effects of the magnetosphere-interplanetary medium interaction. (Proposed convener W.H. Campbell)

Division IV - Solar Wind And Interplanetary Magnetic Fields

Dr. A.J. Dessler, of the Executive Committee, announced that solar wind scientists were not adequately represented in Kyoto, because there were no symposia scheduled on this specific topic. Because of this inadequate representation it was decided by the Executive Committee to delay the decision on leadership until further consultation could be held with specialists in the field.

It was decided that the interests of Division IV could be divided into three principal areas with suggested reporters as follows:

1. Solar Wind and the Interplanetary Magnetic Field. Lief Svalgaard, John Wilcox, Leverett Davis and Art Hundhausen
2. Interplanetary Plasma Physics. Fred Scarf, Helmut Rosenbauer and Karl Schindler
3. Interaction of the Solar Wind with Unmagnetized Bodies (Division III would be responsible for the Earth and Jupiter). S. Sonett, N. Ness, J. Freeman,

Hannes Alfven and S. Dolginov.

IUPAP covers cosmic ray modulation, and care must be taken to avoid overlap with Division III.

It was decided that any working groups that are set up will automatically expire at the end of each Assembly, unless they are specifically renewed by action of the Division.

The following Division resolution was moved, seconded and passed without opposition:

"At IAGA Assemblies, only an author of a paper is allowed to present it".

Two symposia were suggested for the Grenoble Assembly with recommended conveners. These were passed on to the General Secretary for consideration by the symposium committee of the Executive Committee.

As a final point, it was suggested that great care should be taken to ensure good geographic representation of leaders of the Division.

Division V - Observatories, Indices, And Data

Meetings of Division V were held on 19 and 20 September. A Division structure exactly like that finally adopted (see Appendix D of Executive Committee minutes) was recommended.

The Chairman and Cochairmen of Division V recommended consideration of the following as reporters or working group leaders: (Where two names are underlined we recommend that both be appointed with equal status.)

1. Magnetic observatories: C. Sucksdorff (Finland)
   K.L. Svendsen (USA)

2. Meteor radar observatories: R.G. Roper (USA)
   Alternate: T.R. Kaiser (U.K.)

3. Geomagnetic Instruments and Standards:
   A.P. De Vuyst (Belgium)
   W.F. Stuart (U.K.)

4. Optical calibration standards:
   R. Pastiels (Belgium)
   J. Noxon (USA)

5. Magnetic surveys and charts:
   E. B. Fabiano (USA)
   A. N. Pushkov (USSR)

6. Geophysical indices: J. V. Lincoln (USA)

7. Collection and dissemination of data: V. P. Golovkov (USSR)

8. Geophysical alerts and forecasts: (Reporter only)
   D. J. Williams (USA)

9. Ad hoc advisory group on coordination of IMS, ground-based balloon and rocket experiments: M. Sugiura (USA)

10. International geomagnetic survey by satellite.

J. C. Cain (USA)
S. Dolginov (USSR)

11. Ad hoc committee on radar observations of meteor flux, radiants and anomalies at the base of the thermosphere: (Joint with IAU.)

B. G. Roper (USA)
T. R. Kaiser (U.K.) } IAGA Members

Division V recommends for Grenoble, 1975, a symposium on "Atmospheric Scattering of Artificial Light".

Drs. G. M. Weill and R. Pastiels are suggested as members of the Program Committee.

The Chairman and Cochairmen of Division V follow:

P. H. Serson, Chairman (Canada)
P. N. Mayaud, Cochairman (France)
R. Pastiels, Cochairman (Belgium)
M. Sugiura, Cochairman (USA)

Closing Plenary Session

The closing plenary session was held 21 September at 1400h. President V.A. Troitskaya conducted the meeting.

Report Of Resolutions Committee

A.J. Dessler, chairman of the resolutions committee, explained that since all surviving resolutions had been distributed in writing to all delegates several days before the final plenary session, it would not be necessary to read each resolution. Chairman Dessler moved in turn that each resolution be accepted. The proceedings were carried out in a very proper parlimentary method during which each resolution was seconded, discussed and then voted upon. In several instances minor ammendments were offered. All of the proposed resolutions (21 scientific and one of thanks) were finally passed in the form shown elsewhere in these transactions.

Report Of Ad Hoc Committee On Symposia For The Grenoble Assembly In 1975

Vice President G.M. Weill, chairman of the ad hoc committee on symposia for the Grenoble Assembly, indicated that all symposia proposed for the Grenoble Assembly, and the delegates priority listing for these symposia had been carefully considered by the ad hoc committee. (Results shown in Appendix A of the minutes of the Executive Committee meeting, p. 24.)

One delegate asked why the committee had modified certain proposals that had been made. It was explained by Dr. Weill and President Troitskaya that many proposals had overlapped so that a reworking was necessary to obtain a consistent list.

It was further pointed out that those symposia, which were considered interdisciplinary in character, would be presented at the IUGG Executive Committee meeting to be held 3 and 4 October, in London. It is expected that they may be modified there. The reader is referred to the minutes of the Executive Committee meeting in this publication for a further discussion of the Grenoble Assembly.

IAGA Third General Scientific Assembly

It was agreed to accept the invitation made by the United States National Academy of Sciences for IAGA to hold its Third General Scientific Assembly in the United States in conjunction with IAMAP, in the summer of 1977.

In discussing this invitation, delegate T.R. Kaiser, from the United Kingdom, proposed that acceptance of the invitation be made contingent upon the United States guaranteeing entrance into the assembly for all delegates from member countries. In the ensuing discussion it was agreed that absolute assurance of this desire is very difficult to determine years in advance, but that every effort would be made to see that it occurred.

Reorganization

President Troitskaya asked Vice President Roederer to discuss the reorganization effort.

Dr. Roederer explained the history of this topic for the past two years, tracing the development up to the present time.*

At this plenary session some minor discussions continued on the reorganization. Some changes in names of Divisions were agreed upon and part of the interdivisional structure was formulated. Finally the new organization was ratified, as shown in Appendix D "New IAGA Structure," in the minutes of the Executive Committee meeting.

Report Of Highlights Of Commissions

The Commission summary highlight reports were given as recorded below:

Commission I

Paul H. Serson - Reporter and Commission Cochairman

The Chairman of Commission I, A.P. DeVuyst, regrets that he is unable to attend this Assembly.

Most of the highlits of Commission I are shown under reports for symposia S1 and S2.

Commission II

B. R. Leaton - Reporter and Commission Chairman

All working groups met either separately or in combination. The commission had two business meetings and one scientific session of topics not covered elsewhere. The commission sponsored two symposia and cosponsored a third. Details of the symposia are given in their separate reports.

Reports of several of the twenty or so regional land surveys of the past two years were presented. In the absence at the present time of a purpose-designed vector sea survey, active steps are being taken to ensure that the mass of total field oceanographic observations are included in the data set available for global modelling. The importance of low-level satellite surveys as an aid to worldwide representation of the field and its secular change was noted. No such satellite is operational. Periodic resurveys are essential. With the time-scale of preparation of such a survey, a vigorous effort is being made to initiate one. Implications of results and analysis regarding the IGRF reported in the IGRF symposium and elsewhere led to more discussion than any other scientific subject. Discrepancies of the IGRF in level fit, space

*Editor's Note: The reader is referred to the "Reorganization" subtitle in the minutes of the Executive Committee meeting and to the general heading "Association General Meeting on Reorganization" in this issue for a full account of this topic.

and time gradients differ from region to region. As a result of a user questionnaire and reports given at this assembly, it was agreed that the advantages of continuity outweigh the disadvantages of IGRF 1965.0 static fit, but that a new set of secular coefficients are essential. The proposed date for such a change is 1975.0. A majority was in favor of a "realistic" secular change model rather than one incorporating any "corrective" element. As an aid in evaluating recent secular change, IZMIRAN was praised for its good work in accordance with IAGA Resolution 1 of the XV IUGG General Assembly and the hope expressed of their publication soon of similar data for repeat stations. The third part of that resolution was interpreted in terms of worldwide freedom to investigate secular change. To obtain international agreement on a good IGRF secular change model of 1975, all investigators are urged to furnish all appropriate observational data to Data Centres by 1 January 1975. To put its several recommendations into effect, the Commission has put forward seven resolutions for consideration at this Assembly, and a symposium was suggested for the Grenoble Assembly in 1975 on the subject of the "Physical and Morphological Aspects of Recent Secular Change".

Forty-four papers directly bearing on the work of Commission II were presented at the Assembly and others with a less direct bearing were given. Many of these reported on good solid work, but of particular mention are those of provocative geophysical significance, for example: a well-defined peak at around 60 years in the geomagnetic spectrum, apparently of internal origin a hint that long wavelength anomalies detected in satellite and near-surface data may be crustal in origin, and a clear indication that the axis of rotation of the core has moved in a systematic way relative to that of the mantle over the last 30 years.

Commission VI

G. G. Shepherd - Reporter and Commission Chairman

The principal activity of Commission VI has been in the organization of scientific sessions for the Kyoto meeting. An Aurora and Airglow symposium was held jointly with Commission VII. Nineteen invited papers were read during the sessions of which 7 were concerned principally with the aurora. Of the 23 contributed papers approximately 15 were concerned mainly with aurora. In addition to the sympsoium, three scientific sessions were held on Auroral Currents, Coordinated Measurements, and the Auroral Event of December 16-21, 1971. Ten invited papers and 12 contributed papers were given in these sessions. This scientific program clearly brought out recent developments in the field. Coordinated measurements have greatly improved, and the relationship between currents and auroral forms is better observed and better understood; so also is the relation between auroral and optical emmissions. Optical imaging of aurora has also dramatically changed. Global

auroral patterns from satellites are being obtained at high spatial resolution in integrated light and at somewhat lower resolution as monochromatic images in N_2^+ and OI. Ground based television imaging systems now provide real time imaging at high spatial resolution in three colors. All of this makes the study of the detailed relationship of aurora to other magnetospheric observables much more precise than in the past.

The present concerns of Commission VI are those of IAGA reorganization and the IMS. The basic physics underlying reorganization demands that some auroral aspects be in Division II and others in Division III. Although one regrets this dividing of a closely compatible group, in the long run it will be much better for the understanding of the physical processes surrounding the aurora. The reorganization is looked to with enthusiasm and we hope all former members of Commission VI will find a suitable home in the new structure.

Regarding the IMS, the imaging systems referred to above will supplement existing all-sky cameras and photometers in providing basic data during the IMS. Those concerned with optical aurora are eager to meet the responsibility of making the data available and expect to cooperate closely among themselves in this task.

A more immediate task is the planning for the forthcoming assembly in Grenoble. The auroral sessions at this scientific assembly were very good, but there was heavy competition with sessions on Mircopulsations, Magnetospheric Substorms, Magnetospheric Configuration, Ionosphere and Thermosphere, Planetary Atmospheres, Geophysical Indices and Controlled Magnetospheric Experiments. A more highly coordinated and limited program would be preferable for Grenoble. The new structure should help to make this possible.

Commission VII

M. Gadsden - Reporter and Commission Chairman

The commission has held one business meeting, one scientific session, and was involved in the symposium on Aurora and Airglow and took part in the initiating stage of the symposium on Aeronomic Processes in the Stratosphere and Mesosphere.

There is considerable interest at present in the optical effects produced by photoelectrons in the high atmosphere and we have heard comprehensive review papers from Nagy, Wrenn, and Carlson. One of the many exciting reports was that presented by Megill, who dealt with the complex phenomena that show up in 6300Å airglow produced by the highpower H.F. radiation from the Platteville, Colorado, transmitter. The details are not yet clear but there are surprising differences between the effects with O-wave and with X-wave transmissions. As Megill said, "For a long time we have wanted to make controlled experiments directly with the ionosphere and these are now demonstrably feasible.

In the scientific session, the paper by Gerard and Monfils dealing with the observations of resonant scattering from magnesium ions participating in the fountain of the Appleton anomaly introduced, among others, papers dealing with sodium and lithium in the mesosphere and bottom of the thermosphere - an old topic which still has interest. The properties of the mesosphere, notoriously inaccessible to direct observation (being too high for balloons, too low for sattelites), were discussed in papers dealing also with recent optical observations of hydroxyl and carbon dioxide emissions.

The administrative business of the Commission was overshadowed by the impending disappearance of the separate existence of what is admittedly a small group of people with identity of interest. There seemed little point in these circumstance in discussing the streamlining of the Commission structure or of continuing a list of effective reporters.

Commission VIII

L. Block - Reporter

At the business and review meeting of the commission a very fruitful discussion focused on the structure of the proposed Division II of the reorganized IAGA. Significant contributions to this discussion were made by several members. The structure proposed by the commission was adopted by the Executive Committee and by the Division with only minor changes.

Three working groups with specified responsibilities and two symposia for Grenoble 1975 were proposed.

At a small scientific session six papers were read. A paper by Dr. Essex dealt with the connection between pre-midnight increases in the total summer electron content of the ionosphere at low and high latitudes. A new model of the concentration of metallic ions in the upper atmosphere was proposed by Drs. Makino, Fujiwara, and Hirono. In addition to previously considered effects, this model also accounted for zonal winds, ion drifts in the dynamo field, and global circulation.

An interesting theory of the VLF probe impedence on space vehicles was presented by Drs. Aso and Oya.

A new relatively simple mathematical approach for calculating the propagation of LF and VLF waves from a source on the ground through an anisotropic stratified ionosphere was presented by Drs. Daniele, Perona, and Zich.

Committee On Lunar Variations

S.R. Malin - Reporter and Committee Cochairman

At the general Assembly of IUGG held in Moscow 1971, the (then) Joint IAGA-IAMAP Committee on Lunar Effects decided that, because of the essentially interdisciplinary nature of their work, they should hold no meeting (either business or symposium) until the next General Assembly of IUGG unless there was a joint IAGA-IAMAP scientific assembly in the meantime. However, the joint committee was subsequently made the sole responsibility of IAGA so it was decided (by correspondence) that a meeting should be held in Kyoto despite the inevitable absence of most of the meteorologists.

Two scientific sessions were held, at which 13 papers were presented (details in IAGA Bulletin No. 34), concerning meteorological, ionospheric, oceanic, and geomagnetic tidal effects, and ranging from theoretical interpretation to observational data and methods of analysis. It is gratifying to note that, as recommended by IAGA resolution 5 of the previous assembly, particular attention was paid to global and regional studies and to theoretical interpretation. Considerable progress has been made in the investigation of tides other than M_2, and in extending the studies to the polar regions, where a new set of ionospheric, lunar induced currents are found to be important. The role of the ocean tidal contribution to both atmospheric and magnetic tides is becoming clearer.

All of the working groups, except that on theoretical problems of atmospheric oscillations, met and presented reports. The business meeting opened with the Chairman's review.* This was followed by discussion of the resolution proposed by W.G. X-3

* See report of Committee on Lunar Variations under Reports of Organizational Units.

reporter, H. Maeda, concerning the need for an improved distribution of data from the southern hemisphere. This, and a proposal by O. Schneider for a symposium on "Interaction Effects in Tidal Phenomena" was approved for transmission to the Executive Committee. The remainder of the discussion concerned the place of tidal studies in the proposed new structure. Dr. Schneider's initiative in exploring the possibilities of forming a new Inter-Association body on tidal phenomena was noted, but it was felt that, whatever the outcome of this, there was need for a permanent place for geomagnetic L studies within IAGA and that until a suitable alternative was found IAGA should honor their agreement (made in Moscow) to take responsibility for tidal variations of the neutral atmosphere. There appeared to be no place for L (in common with, in particular, Sq, SD, Dst, solar flare effects and eclipse phenomena), so it was suggested that such geomagnetic variations of intermediate frequency between micropulsations and secular change should constitute a permanent Inter-Divisional commission. A proposal to this effect was submitted to the Executive Committee.

Committee On Antarctic Research

T. Nagata - Reporter and Chairman of Committee

This committee had two scientific sessions and two business meetings in Kyoto. In the scientific sessions nine invited papers on auroras, VLF and ULF emmissions and the auroral electrojet were presented. A specific emphasis was put on the conjugate relationship of these phenomena between Antarctica and Arctica. It can be said now that Antarctica also has been scientifically well civilized.

Because this committee has been asked by SCAR to initiate the plannings of ground-based, balloon and rocket programs in Antarctica for IMS, six working groups of this committee worked out on geomagnetic, auroral, VLF's, ionospheric, rocket-borne, and balloon-borne programs for IMS. Particularly, possible coordinations between IMS satellites and Antarctic ground stations are encouraged.

This committee strongly requests that we remain an Inter-Division commission in the new reorganized structure of IAGA, because we will have a number of tasks to plan and must implement various observations and data analyses in the Antarctic, at least, until the end of IMS.

Report Of Highlights Of Symposia

Convenors of the special symposia held in Kyoto were invited to briefly report the scientific highlights of their sessions with the following results.

S-1 Symposium On Modern Observatory Techniques

Paul H. Serson - Reporter

Dr. A. P. DeVuyst was the convenor of this symposium but at the last minute was not able to attend the Assembly. He asked Mr. Kendall L. Svendson to conduct the symposium.

This symposium brought out the fact that the instrumentation gap between have and have-not observatories is increasing. Absolute accuracy could be improved significantly by the adoption of proton vector magnetometers which are not expensive and can be constructed locally. Classical methods of photographic recording could be improved by attention to the optics. About ten percent of the magnetic observatories are now recording in digital form and conversion of others is under consideration. This is expensive. A basic digital system can be assembled for 10,000 U.S. dollars but more elaborate systems giving greater reliability can cost several times more.

S-2 Symposium On Magnetic Measurements And Anomalies At Sea

Paul H. Serson - Reporter and Convenor

The first session of this symposium sponsored by Commissions I, II and III concentrated in general on techniques of measurement and analysis, while the second session was devoted to results of ocean magnetic surveys in specific regions.

Project Magnet's new aircraft and survey system provides increased range (9,000 km) and an accuracy of 10 nT in the vector data. Especially noteworthy is the increased accuracy of navigation (0.5km) made possible by satellite navigation with an integrated computer system. Fourier and spectral analyses of magnetic profiles have revealed strong contrasts in the structure of the ocean floor in different regions. Powerful Fourier transform methods facilitate the comparison of profiles at different latitudes and permit the combination of many profiles into a composite reducing the effect of random noise and making possible the clear identification of short polarity events (60,000 years).

Six papers on anomalies over the Pacific Ocean brought out the great complexity of the structure of the Pacific floor near Japan, New Caledonia, and Alaska. New results were presented from magnetic "quiet zones" in the Atlantic and Pacific but no agreement could be reached on their probable origin. Strong evidence of discontinuous spreading in the Red Sea region was presented. Apparently spreading stopped 35 to 40 My ago and started again 6 My ago.

S-3 Symposium On Low Level Satellite Surveys

J. C. Cain - Reporter and Convenor

Reports by Zmuda and Armstrong from the TRIAD satellite and Theile from the AZUR satellite agree that field aligned currents exist in polar regions at almost all times. Although the majority of cases show less than 40 nT in the transverse components, values up to about 1000 nT are reported indicating current densities above 10^{-5} amp/m^2.

Analysis of the POGO total field data by Langel shows that a polar ionospheric current system exists in the sunlit evening quadrant with a pattern similar to that previously given as S_q^p, DPC and DP2 for this quadrant. This HLS (High Latitude Sunlit) system has an intensity which is dependent on magnetic activity and season. A new positive total field variation was discovered on the dawn quadrant also dependent on magnetic activity but of non-ionospheric origin.

A low latitude analysis of the POGO data by Cain and Davis has shown the systematic distortion of the field on the nightside in a direction agreeing with that of the tail field. A similar shift is observed on the dayside intermixed with the effects of the ionospheric Sq system.

Marriott et al. have analyzed the evidence for the equatorial counter-electrojet from satellite and surface results and constructed a theoretical model using solar diurnal and semidiurnal and lunar tides to reproduce the observed ground magnetic variations. The model shows that the counter-electrojet is associated with unusual S_q patterns.

The comparison of the equatorial electrojet effects observed at POGO satellite level and at the ground were reviewed by Mayaud. He pointed out the importance of the close agreement between the latitudes of the electrojet signature and the magnetic dip-equator at 100km height, and, on the other hand, difficulties encountered in comparing amplitudes of the electrojet effects at satellite level with those at the ground.

Benkova and Cherevko, in analyzing the residual field of the COSMOS-49 data, have concluded that internal harmonics to degree 12 are required to approximate their data.

In analyzing the residual field of the POGO data, Regan has produced a world map of crustal anomalies in the wavelengths 800-3000km. The average amplitudes at satellite altitude (500-700km) range from 2 to 12 nT. The largest is found in central Africa, but other anomalies were found elsewhere, many correlating well with known geological structures.

S-4 Symposium On Secular Variations With Particular Reference To The IGRF

A. J. Zmuda - Reporter and Convenor

Assessment of studies following the adoption of the International Geomagnetic Reference Field 1965.0 (IGRF) leads to the following general conclusions: (a) the existing reference field satisfies the needs of some users, (b) improvements could be made but advantages of incorporating these improvements do not outweigh the disadvantages of changing the reference field, and (c) for some types of investigations using satellite observations in the inner magnetosphere, a need exists for a highly precise harmonic description of the internal field. This description will, however, have to be frequently updated, probably on a yearly basis.

The existing reference field, sometimes even restricted to the terms of lower degree and order, is still satisfactory for studies related to (a) the magnetospheric configuration, (b) geomagnetically trapped particles, and (c) the motion of energetic particles such as galactic and solar cosmic rays. In each of these cases and depending on the aspect being considered, errors in the main field coefficients and their secular variations are greatly overshadowed by the effects of magnetopause, neutral-sheet, and ring currents and by the effects of electromagnetic and hydromagnetic temporal variations.

The existing reference field could still be used as a first step in calculating the regional field in studies directed toward isolating and then modeling crustal anomalies, whose fields are generally too complex for description by spherical harmonics with any reasonable number of coefficients.

There is no doubt that the existing reference field can be improved. Investigations with surface as well as near-earth satellite data show that terms beyond $n = m = 8$ are required to describe the field of origin in the core, since global anomalies have wavelengths smaller than those included in the IGRF. The extension to higher degree harmonics has not been delineated, but main field coefficients up to degree-n-equals-about-13 are needed. The main field has wavelength less than 5000km, the minimum wavelength contained in the IGRF. Crustal anomalies have much shorter wavelengths and give field values of 200 gammas and more.

Differences between computed and observed values of the total intensity over ocean areas show no systematic regional discrepancies. Between 40° and 60° S latitude, large errors arise in the total and vertical intensity isopors of the IGRF. Improvements in the IGRF are also needed to satisfy the requirements of ionospheric physicists. For example, noted earlier, a difference of about 1° exists between the equatorial field direction computed by reference fields and observed by radio techniques.

The secular change coefficients are inextricably connected to the main field coefficients. While several characteristics of the secular variation have been established, the remaining features are highly irregular, nonlinear, and unpredictable. In addition, satellite and surface results exhibit major differences

even for similar epochs. If a new reference field is to be chosen, how should it be connected temporally to the existing one? Should the transition be continuous or discontiuous? The IGRF tends to overestimate the secular change in field components at observatories and does not fit the observations to better than 10 gammas per year. Regional trends differ significantly from the IGRF values; particularly in Japan.

For satellite surveys applicable to descriptions of the internal field, the scalar intensity is and will probably be the only magnetic element measured. Additional work is needed to improve the description of the vector field by using a spherical harmonic series derived with scalar intensity values. A need also exists for a satellite survey of the vector magnetic field.

A reference field for the field of origin in the core should probably fit surface observations to an rms of about $\pm$ 200 to $\pm$ 300 gammas (the contribution of crustal anomalies) and satellite observations to an rms of about $\pm$ 30 to $\pm$ 50 gammas (the contribution of the external magnetospheric currents).

S-5 Symposium On Geomagnetic Anomalies, Rock Magnetism, And Petrography

A. Hahn - Reporter and Convenor

The general problem of the symposium was: What can be said in petrographic terms about geological bodies which produce geomagnetic anomalies? Attention should be paid particularly to completely buried bodies.

The first group of papers was devoted to the interpretation of aeromagnetic surveys of large areas situated in North American and Northeast Asia. The bodies responsible for the anomalies can be classified into several groups:

(a) Bodies of magmatic origin, partly extrusive, partly intrusive

(b) Sequences of metamorphic rocks

(c) Ore deposits

These groups contain a great variety of petrological character, the respective bodies show in many cases strong relations to tectonic features. An ancient continental margin could be traced along the Atlantic coast. The existence of inversely magnetized large units could be proved in different parts of the North American continent. In a particular area of Northeastern Asia a high pyrrhotite concentration instead of the usual magnetite content caused an anomaly chain of considerable length. A combined magnetic and seismic study was concerned with the structure of the lower crust in particular with the thickness of the layer between the Riel- and the Moho-discontinuity (15-30km), (Zietz, Ismailov, Hall).

A second group of papers was concerned with the aspect of rock magnetism of our problem.

Under natural conditions in the earth's crust magnetic minerals are subject to alterations of chemical composition and crystal structure dependent on temperature, pressure, oxygen fugacity and cation concentration which yield alterations of their magnetic properties. A thorough general consideration of these relations (Haggerty) as well as several special examples of different sites and geological situations were presented, one group dealing with samples of only one

level (Koshkina et al., Kobayashi & Nomura, Lowrie, Vlasov et al., (Lecaille et al.) another group dealing with samples of different levels (Dunlop, Radhakrishnamurty, Banerjee & Butler, Bagin et al., Deutsch). On the basis of these relations and considering the conditons within the earth's crust some predictions concerning the likely depth distribution of magnetic properties in connection with the petrographic character of the respective rocks were suggested, guided by some practical examples (Lidiak).

Supplementary to these papers lying on the general line of the symposium the following contributions were presented:

(1) Local anomalies of the secular variation of considerable amplitude were observed in the Ural region. At the present stage the most probable interpretation seemsto be variations of the stress distribution in the crust (Shapiro & Ivanov).

(2) A phenomenon related to the stress effects in the reaction of magnetic minerals to mechanical shocks was discussed. Some experiments on igneous rocks and a mathematical description of the results were reported. (Nagata).

(3) Two papers were concerned with the relations of rock magnetism and paleomagnetism. One of them studied the stability of the remanent magnetization of magnetic minerals in the ocean floor near ridges (Joshima & Ozima) the other one was dealing with the suitability of lavas for paleointensity measurements using Thellier's method. The suitability was checked by investigating lavas originated during the last few years. (Carmichael).

The symposium has shown that we still are far from being able to simply convert geomagnetic anomalies into a description of the composition of the crust in terms of geological bodies of different rock types. However, along with the quick growth of experience during the last years the main lines of this translation task became clearer.

S-6 Symposium On Polarity Transitions

A. V. Cox - Reporter and Convenor

Emphasis was placed at this meeting on the characteristics of the geomagnetic field during transitions of the field. There is general agreement that the time interval during which the field reverses its direction has a length of 3000 to 5000 years. The change in direction is preceded and followed by a time during which the field intensity decreases by a factor of from 3 to 8. Estimates of the total length of this period ofdecreased field range from 10^4 to 10^5 years. The evidence from deep sea cores concerning the length of this interval is at this time not entirely consistent, possibly because of local differences in the processes by which deep sea cores become magnetized. Considerable interest was also directed to new evidence for excursions of the field, which are swings in field direction of 90° or more in which the field does not

lock into the 180° reversed direction but rather returns to its previous polarity. These excursions appear to constitute a distinct class of phenomena separate from both ordinary secular variation and from geomagnetic reversals. They have typical durations of a few thousand years. New data were presented for an excursion recorded in sediments of Lake Biwa 18,000 years ago and one recorded in ancient fireplaces of Australia 31,000 years ago. During the latter the intensity of the field increased by a factor of two. As yet these excursions have not been well correlated between different continents, so it is not clear whether they represent unusually large nondipole foci or unusually large dipole wobble.

New evidence was presented concerning the changes in the direction of the field during reversals. Two kinds of changes are observed. In one, virtual geomagnetic poles move from one geographic pole to the other along a meridional great circle path. In the other the pole path is more complex and changes greatly in longitude, especially when near the equator. Quite clearly the pole paths for different polarity tansitions as seen from different continents do not all cross the equator at the same longitude, as had previously been supposed. However, there still seems to be a weak tendency for the magentic field vector at one locality to move along the same path in different polarity transitions.

An intensive search is underway for evidence of long period magnetic variations in the paleomagnetic record contained in sediments. Evidence was presented suggesting the presence of geomagnetic field fluctuations with periods of the order of 10^5 years. There was considerable discussion of the question of whether these represented true fluctuations of the geomagnetic field or whether they were due to a biasing of the paleomagnetic record by climatic processes.

S-7 Symposium On Paleomagnetic Intensity Variations And The Carbon-14 Balance

V. Bucha - Reporter and Convenor

The symposium was attended by about 50 scientists from all over the world and a total of 13 papers were read in two sessions. A number of very interesting papers were given on the subject of Radiocarbon Production and Geomagnetic as well as Heliomagnetic Changes by Berger, Bucha, Damon and Hasegawa.

The discussion of archeomagnetic determination of the intensity and direction of the field was contained in papers presented by Barbetti, Bolshakova, Burlatskaya, Bucha, Hirooka, Kawai, Kitasawe and Tanguy. Following each paper there was time for comprehensive discussion of the ramifications into the various scientific aspects; most of the time many questions and comments were fully discussed to mutual satisfaction. Most participants were very satisfied with the overall value of the meetings.

The symposium showed that many more investigations into magnetic changes and isotopic concentration need to be carried out before a fully comprehensive picture of the history of the geomagnetic field and its effects emerges. While many data so far give a good qualitative impression, a greater number of quantitative data are necessary. In fact, over the next two years sufficient new information should become available that will merit discussion.

The sessions showed that the main direction of investigation in the future should cover the following problems: (1) Determination of the earth's magnetic field changes (intensity and direction) during the past 60,000 years in conjunction with radiocarbon measurements, (2) the study of magnetic properties of archeological materials from the point of view of their suitability, (3) relationship between magnetic changes, radiocarbon and independent chronologies, and (4) the relationship between the geomagnetic and heliomagnetic effects.

The importance of the problems discussed and promise of forthcoming results makes it imperative that the discussions continue at Grenoble perhaps as items on the agenda of Symposia 4 or 8 of Division I. (Fluctuations of the Field during Times of Constant Polarity or Fine Structure of Geomagnetic Reversal History) or a separate symposium as at the Kyoto meeting.

S-8 Symposium On Steady And Induced Magnetic Fields On The Moon And Planets

T. Nagata - Reporter and Co-convenor

P. Dyal the other co-covenor of this symposium was unable to attend the Kyoto Assembly.

This symposium had two sessions where 12 papers were presented. The first session dealt mostly with the magnetic and electrical properties of lunar materials. This was practically the first meeting of active workers in this field since the time when the lunar samples were returned to the earth, so that the most up-to-date and the most reliable data of the magnetic and electrical properties of lunar materials were summarized and reviewed in this session.

The second session discussed first the lunar magnetic field and its variation observed on the lunar surface and on the lunar sub-satellites and then the magnetic field of Mars and the planned magnetic measurement programs on Jupiter. Analyses of the transient magnetic field variations on the lunar surface have led to the electrical conductivity profile within the moon, and the laboratory data of the temperature dependence of the conductivity have given information about the lunar temperature profile.

S-9 Symposium On Electromagnetic Induction Studies Of Tectonic Regions: Deep Conductive Structures And Physical Processes In The Earth

T. Rikitake - Reporter and Convenor

It was most appropriate to have this symposium here in Japan because Japan is one of the tectonically active countries and systematic studies of geomagnetic variation anomalies were started in this country around 1950.

As a result of extensive array observations of geomagnetic variations, unusually high electrical conductivity under western North America was brought to light. Similar studies have also been conducted in Australia. Many conductivity anomalies have recently been found in the USSR.

It becomes certain that some of the Japanese conductivity anomalies must be caused by lateral non-uniformity in the mantle. It is most interesting to hear that the conductivity anomaly at Alert in the Canadian arctic is stretching into

the sea as have been made clear by the observations on floating ice. We have to admit an electric current concentration beneath the sea floor.

Arrangement has been made to publish the papers presented at the symposium in a special issue of the Journal of Geomagnetism and Geoelectricity.

S-10 Symposium On Micropulsations : Theory And New Experimental Results

A. Hasegawa - Reporter and Convenor

Significant progress in the theoretical interpretation of micropulsations and several interesting new experimental observations were reported during this symposium.

Unlike the classical idea of a magnetospheric cavity resonance, it was made clear that the Pc3 to Pc5 magnetic pulsations are a consequence of either an excitation of a local field line oscillation by a monochromatic wave excited at, or outside, the magnetopause, or an excitation of a localized surface eigen mode due to a sharp density gradient (Chen, Hasegawa, Southwood). This interpretation is supported by new observations of pulsations in correlation with the position of the plasmapause (Fukunishi, Lanzerotti, Orr).

Concerning nonlinear effects of pulsations, new theories in the wave-particle interactions of whistler packets (Karpman) and the particle diffusion associated with various plasma instabilities (Thorne) were presented. It was pointed out both theoretically (Gendrin, Gul'elmi, Nambu) and experimentally (Perrant, Roux) that the proton cyclotron instability is less sensitive to the cold electron concentration than in the case of the whistler instability.

Various new satellite observations, some correlated with ground observations, were presented (McPherron, Cahill, Parady, Lin). A datum that showed a simultaneous observation of a Pc5 pulsation in the solar wind and on the ground was shown (Watanabe). This observation supports new and independent experimental findings that the pulsation frequency (Pc3 to Pc5) is linearly proportional to the intensity of the interplanetary magnetic field (Troitskaya).

A new, damped-type long period pulsation was observed during substorms and is named Pi3 (Saito).

S-13 Symposium On Dynamics, Chemistry, And Thermal Processes In The Ionosphere And Thermosphere

T. R. Kaiser - Reporter and Convenor

This symposium was organized by IAGA in consultation with URSI and COSPAR.

Although the symposium papers were arranged loosely under the separate headings of Energy Input, Chemistry and Transport Phenomena a recurring theme was the exphasis on the complex chain of interactions between these processes. Energy input in one location may cause effects which can be transported elsewhere and released in another form. New aspects of solar activity on the whole atmosphere are revealed, especially from satellite evidence, for instance, the report of the effects of soft magnetosheath particle fluxes in modifying the chemistry in the cusp regions.

Another highlight has been the successful progress in understanding dynamical

features (waves, eddy turbulence, etc.) throughout the thermosphere and clear directions for future work are indicated. In this respect the increasing activity on the interactions between different atmospheric levels is to be welcomed. The evidence reported for the transfer of planetary wave energy from the troposphere to the mesosphere should stimulate new work to understand the mechanism by which it is transmitted.

The limitations of any single technique for resolving the broad problems of atmospheric physics has become apparent and is providing incentive for better planning, for instance, of ground-based, rocket and satellite studies. A healthy sign here is the extension of classical ionospheric work into this broader context. New laboratory studies of processes of aeronomic interest were reported.

A word now to our collegues from the Soviet Union: We welcome the important and interesting contributions from Soviet scientists but regret that so many could not be delivered personally by the authors. The resulting limitations in communication represent a loss to all of us and not least to Soviet science itself. Please take this message back to the Academy.

We now have a reorganized IAGA and I believe that this symposium has had an important role in indicating tasks ahead for Division II.

The Journal of Atmospheric and Terrestrial Physics has offered publication facilities for the symposium papers. Each paper must, of course, meet the review requirements of the Journal.

S-14 Symposium On Aurora And Airglow

(See Plenary Reports of Commissions VI and VII)

Dr. G.G. Shepherd, convenor of this symposium, has indicated that they plan to publish the invited papers for this symposium (about 20 papers) in Annales de Geophysique. He feels this can be done without assistance from IAGA. Dr. G.M. Weill has agreed to approach the editor of the Journal to make the arrangements.

W-2 Workshop On Controlled Magnetosphereic Experiments

J. G. Roederer - Reporter

Papers from the Workshop will be included in a special issue of Space Science Reviews.

President Troitskaya closed the Assembly by thanking all those who took part in helping arrange the scientific program and especially the Japanese hosts who provided an ideal setting for the meeting, wonderful secretarial service, and a delightful ladies program for guests at the Assembly.

The President also especially thanked the Executive Committee members who attended lengthy sessions almost every day of the Assembly.

Resolutions

Resolution Of Thanks

The International Association of Geomagnetism and Aeronomy (IAGA) wishes to express its warmest thanks to the Science Council of Japan for their invitation to hold the Second General Scientific Assembly in Kyoto. In particular, IAGA wishes to thank Honorary Chairman T. Nagata, Chairman T. Rikitake, Executive Secretaries N. Fukushima, T. Obayashi and H. Maeda and the many able members of the Japanese Organizing Committee for the excellent preparations and arrangements they made for our meeting.

IAGA also wishes to especially thank Professor and Mrs. S. Kato, who led in the planning and organization of a most pleasant and informative Ladies Program, and all the participants are grateful to the people of the beautiful city of Kyoto for their gracious hospitality.

L'Association Internationale de Géomagnétisme et d'Aéronomie désire exprimer ses remerciements les plus chaleureux au Conseil des Sciences du Japon pour son invitation à tenir la Seconde Assemblée Scientifique Générale à Kyoto. L'AIGA tient à remercier particulièrement le Président Honoraire T. Nagata, le Président T. Rikitake, les Secrétaires Exécutifs N. Fukushima, T. Obayashi et H. Maeda, et tous les membres du Comité Japonais d'organisation pour l'excellente préparation de cette Assemblée.

L'AIGA tient aussi à remercier spécialement le Professeur et Madame S. Kato qui ont eu la responsabilité de préparer et d'organiser un Programme des Dames très agréable et instructif, et tous les participants exprement leur reconnaissance aux habitants de la si belle cité de Kyoto pour leur gracieuse hospitalité.

Scientific Resolutions

Resolution 1

IAGA, considering the importance of the systematic and orderly development of the sciences of Geomagnetism and Aeronomy, and the cost and manpower spent in organizing related activities, calls to the attention of adhering bodies in participating countries the necessity of having elected and appointed IAGA officers and speakers attend the Assemblies in order to fulfill their responsibilities in the interest of efficiency and economy for all concerned. Therefore, IAGA recommends that if the adhering body finds that, for any reason, such an official of IAGA or invited speaker can not attend an Assembly, the adhering body should notify the General Secretary at least six months before the Assembly so that others can be invited or appointed to serve in order to avoid gaps in the programs and other work of the Association.

L'AIGI, considérant, d'une part l'importance du développement systématique et ordonné des connaissances en Géomagnétisme et Aéronomie, d'autre part l'argent et l'énergie humaine dépensés pour organiser les activités correspondantes, rappelle aux organismes affiliés des pays membres qu'il est nécessaire que les membres officiels et conférenciers élus ou désignés assistent aux Assemblées afin de remplir leurs obligations dans un souci d'efficacité et d'économie qui concerne tous les membres de l'Association. En conséquence, l'AIGA recommande que, si un organisme affilié d'un pays membre juge que, pour quelque raison que ce soit, un membre officiel de l'AIGA ou

un conférencier invité ne peut participer à une Assemblée, cet organisme en informe le Secrétaire Général au moins six mois avant l'Assemblée; ainsi d'autres personnes pourront être invitées ou désignees à sa place, afin d'éviter toute lacune dans le déroulement des sessions et autres travaux de l'Assemblée.

Resolution 2

IAGA, recognizing the importance of the continued study of natural electromagnetic phenomena and the fact that man-made sources of electromagnetic energy continue to increase in a way that tends to obscure these natural phenomena, recommends that adhering countries make an effort to set aside reservations in which man-made sources of electromagnetic energy in the frequency range of interest to IAGA are excluded so as to preserve such areas in which natural electromagnetic phenomena can be studies in years to come.

L'AIGA, reconnaissant, d'une part, l'importance de l'étude continue des phénomènes électromagnétiques naturels et, d'autre part, le fait que les sources artificielles d'énergie électromagnétique continuent de s'accroître et tendent à masquer ces phénomènes naturels, recommande que les pays membres s'efforcent de constituer des réserves géographiques d'où soit exclue toute source d'énergie électromagnétique dans la bande de fréquence qui intéresse l'Association, afin de prëserve des régions ou l'étude des phénomènes électromagnétiques naturels puisse être poursuivie dans les années à venir.

Resolution 3

IAGA, considering that SI Units are achieving international recognition as a single standard for worldwide use, recommends adoption of SI Units in the field of geomagnetism. Specifically IAGA recommends that:

1. (a) Values of the geomagnetic "field" be expressed in terms of the magnetic induction B (SI Unit tesla = weber/metre^2).
   (b) If it is desired to express values in gamma, a note should be added stating that "one gamma is equal to one nanotesla".
2. (a) Values of "intensity of magnetization" to be expressed in terms of magnetization M (SI Unit ampere/metre).
   (b) If it is desired to express values in e.m.u., a note should be added stating that "one e.m.u. is equal to 10^3 ampere/metre".
3. (a) Values of susceptibility be expressed as the ratio between magnetization M and the magnetic field H.
   (b) If, during the transitional period, it is desired to use values of susceptibility in e.m.u., a note should be added stating that "χ_{SI} is equal to $4\pi\chi_{e.m.u.}$".

(See further explanation of this resolution on page 146.)

L'AIGA, considérant que les Unités SI sont actuellement universellement reconnues comme base normalisée à usage mondial, recommande l'adoption des Unités SI dans le domaine du Géomagnétisme. Plus précisément, l'AIGA recommande:

1. (a) que les valeurs du champ magnétique terrestre soient exprimées en terms d'induction magnétique B (l'Unite SI, le tesla, est égale à un weber par mètre carré).
   (b) que, si l'on désire exprimer les valeurs de ce champ en gamma, une note soit ajoutée indiquant que "un gamma est égal à un nanotesla".
2. (a) que les valeurs de l'"intensité d'aimantation" soient exprimées en termes d'aimantation M (Unité SI ampere par mètre).
   (b) que, si l'on désire exprimer ces valeurs en u.e.m., une note soit ajoutée indiquant qu'"une u.e.m. est équivalente à 10^3 ampére par mètre".

3. (a) que les valeurs de susceptibilite soient exprimees comme etant le rapport entre l'aimantation M et le champ magnetique H.

(b) que, si on désire utiliser des valeurs de susceptibilité en u.e.m. durant la période de transition, une note soit ajoutée indiquant que "χ_{SI} est égal à $4\pi\chi_{u.e.m.}$".

Resolution 4

IAGA, considering the progress in absolute auroral photometry and the theoretical understanding of the connection between N_2^+ 1N band intensity and particle-energy input, recommends that in the future the brightness of auroras be reported whenever possible in terms of the intensity of the 4278 Å N_2^+ band (preferably in conjunction with those of 5577 Å and 6300 Å [OI], 4861 Å H-beta, and other features where appropriate). The use of International Brightness Coefficients should be strictly confined to the reporting of visual estimates.

L'AIGA, considérant les progrès des mesures absolues en photométrie aurorale et la relation théorique établie entre l'intensité des bandes N_2^+ IN et l'apport d'énergie par les particles, recommande que, dorénavant, la luminence des aurores soit caractérisée autant que possible par l'intensité de la bande 4238 A° (en y ajoutant, d'ailleurs, celle des raies 5577 A° et 6300 A° (OI), 4861 A° H_β et, éventuellement, celle d'autres raies) et que l'usage des Coefficients Internationaux de Luminence (ICB) soit strictement réservé aux estimations visuelles.

Resolution 5

IAGA, noting the existence of the sub-commission on magnetic stratigraphy within the International Union of Geological Sciences (IUGS) requests that the IUGS establish a joint working group with IAGA on this topic.

L'AIGA, prenant note de l'existence d'une sous-commission de stratigraphie magnétique dans l'Union Internationale des Sciences Géologiques (UISG) propose que l'"USIG forme un Groupe de Travail commun avec l'"AIGA sur ce sujet.

Resolution 6

IAGA recommends that records and data from temporary magnetic observatories or variation stations established for special problem-solving be offered to the WDC's when the records are considered to be of possible value to other scientists.

L'AIGA recommande que les enregistrements et données en provenance d'observatories stations magnétiques temporaires, installés pour résoudre des problèmes spéciaux, soient envoyés aux Centres Mondiaux de Données quand ces documents peuvent être considérés comme intéressants pour d'autres chercheurs.

Resolution 7

IAGA, recommends that all observatories ensure that the microfilms sent to World Data Centers (WDC's) contain at least the information contained in a list to be provided by WDC's.

L'AIGA, recommande que les microfilms envoyés aux Centres Mondiaux de Données (WDC's) par les observatoires contiennent au moins les informations énumerées dans la liste qui sera fournie par les Centres Modiaux.

Resolution 8

IAGA, notes with satisfaction the recent derivation and publications of AE- indices from eleven stations, AE(11), for 1970 by World Data Center A, and urges that the rapid flow of magnetograms from these stations continue in order to permit the routine derivation of AE- indices in time for publication in the IAGA Bulletin No. 32-series. IAGA encourages the establishment of new magnetic observatories to improve the AE- index by filling

longitudinal gaps in the distribution of the present AE(11) stations.

L'AIGA prenant note avec satisfaction des calculs et publications des indices AE faits récemment pour 1970 par le Centre Mondial de Données A à partir de onze stations (AE 11), insiste pour que ces stations continuent d'envoyer rapidement leurs magnétogrammes afin de permettre le calcul régulier des indices et leur publication dans la série des Bulletins 32, encourage l'installation de nouveaux observatories magnétiques afin d'améliorer ces mêmes indices par une meilleure distribution en longitude des stations AE actuelles.

Resolution 9

IAGA recommends that the "micropulsation interval days" be suppressed from the International Geophysical Calendar because these days are not specifically used by the major part of the scientific community.

L'AIGA, recommande que les "séries de jours d'observation de micropulsations" soient supprimées du Calendrier Geophysique International parce que ces jours ne font pas l'objet d'une attention spéciale de la part de la majeure partie de la communauté scientifique.

Resolution 10

IAGA recommends the use of the term "magnetic pulsation" or simply "pulsation" instead of "micropulsation: for the following reasons:

(a) The amplitude of pulsations is often large with respect to the main field in the outer magnetosphere.

(b) The wavelength of pulsations may be large with respect to the size of the earth.

L'AIGA recommande que le terme "pulsation magnetique" ou simplement "pulsation" soit utilisé au lieu de "micropulsation" pour les raisons suivantes:

(a) l'amplitude des pulsations est souvent grande par rapport à la valeur du champ principal dans la magnétopshère externe

(b) la longueur d'onde des pulsations peut être grande par rapport à la dimension de la Terre.

Resolution 11

IAGA recommends the addition of two classes of pulsations to the existing classification: Pc6 for continuous pulsations with periods longer than 600 seconds and Pi3 for irregular pulsations with periods longer than 150 seconds.

L'AIGA recommande l'addition de deux classes de pulsations à la classification existante: les Pc6 pour les pulsations continues dont la période est supérieure à 600 secondes, et les Pi3 pour les pulsations irrégulières dont la période est supérieure a 150 secondes.

Resolution 12

IAGA, considering the great value of knowing the instantaneous global pattern of auroral precipitation in order to relate it to localized measurements in the magnetosphere, recommends that all countries having territories lying within auroral latitudes should, during the IMS, cooperate in operating enough all-sky cameras, and photometers where possible, to provide adequate coverage across all longitudes. It is specifically recommended that all-sky cameras be operated at all auroral magnetometer stations. IAGA further recommends that all countries having satellites in orbit with auroral detection capabilities at the time of the IMS, should endeavor to continue these measurements during the IMS.

L'AIGA considérant le grand intérêt qu'il y a à relier la connaissance de la configuration globale instantanée des précipitations aurorales à des mesures faites dans des régions limitées de la magnétosphère, recommande que tous les pays ayant des territoires situés aux latitudes aurorales participent, durant l'Etude Magnétosphérique Internationale (IMS), à

une couverture adéquate à toute longitude en mettant en oeuvre suffisamment de caméras plein ciel et, là où c'est possible, des photomètres. Il est en particulier recommandé que des cameras plein ciel soient installees a toutes les stations aurorales ayant des magnetometres. De plus, l'AIGA recommande que, au moment de l'"IMS, tous les pays ayant en robite des satellites capables de détecter les aurores soient encouragés à continuer ces mesures pendant la durée de l'IMS.

Resolution 13

IAGA notes that the coming International Magnetospheric Study requires extensive chains of ground (magnetic) stations for use in conjunction with satellite measurements. The IAGA strongly recommends that its member nations fill gaps in the existing networks where these fall within their territories. Where feasible, IAGA urges data be gathered and distributed with minimum delay to aid in the coordination of ground, balloon, and rocket experiments.

L'AIGA prenant note que la prochaine "Etude Magnétosphérique Internationale" (IMS) requiert une chaîne étendue de stations (magnétiques) au sol en vue d'une utilisation conjointe avec les observations par satellite, recommande fortement que les pays membres comblent les vides que présentent les réseaux existants lorsque ceux-ci se trouvent sur leurs territoires, et insiste pour que, là où cela est réalisable, les données soient réunies et communiquées avec le minimum de retard afin de faciliter la coordination des expériences au sol, par balloons et par fusées.

Resolution 14

IAGA notes with satisfaction that, in accordance with IAGA Resolution 2 at the Moscow Assembly, an ad hoc working group for coordination of the Geomagnetic Meridian Project (GMP) program has been established and considerable progress has been made in setting up observing stations along the 105° and 145° geomagnetic meridians. In relation to the GMP program, IAGA stresses the need for conjugate point studies and for measurements by polar-orbiting satellites of magnetic and electric fields.

L'AIGA note avec satisfaction que, selon la Résolution 2 do l'Assemblée de Moscou, un Groupe de Travail "ad hoc" a été formé pour coordonner les opérations du programme "Projet de Méridien Géomagnétique" (GMP) et qu'un progrès considérable a été fait en installant des stations d'observation le long des méridiens géomagnétiques 105° et 145°. En liaison avec ce programme, l'AIGA souligne le besoin de réaliser des études entre points conjugués et des mesures de champs magnétiques et électriques à bord de satellites d'orbite polaire.

Resolution 15

IAGA, considering the need for better models of variations of the geomagnetic field (in particular, secular changes, disturbances, and longitudinal changes in Sq and L) and recognizing the dependence of such models on a suitable geographical distribution of the data, urges that every effort be made to improve the distribution and density of observatories in the southern hemisphere.

L'IAGA, considérant que de meilleurs modèles des variations de champ magnétique terrestre (en particulier en ce qui concerne les variations séculaires, les perturbations et la répartition en longitude des variations Sq et L) sont requis et reconnaissant que de tels modéles dépendent d'une répartition géographique convenable des données, insiste pour que tout effort soit fait en vue d'améliorer la répartition et la densité des observatoires dans l'hémisphère Sud.

Resolution 16

IAGA, considering the great need for improvement of knowledge of recent secular change,

recommends a renewed effort to re-occupy repeat stations, particularly in remote regions and islands.

L'AIGA, considérant que la connaissance de la variation séculaire actuelle requiert d'être grandement améliorée, recommande que soient renouvelés les efforts faits pour réoccuper les stations de répétition, spécialement dans les régions éloignees et les îles.

Resolution 17

IAGA, recognizing that a global model of the geomagnetic field can be maintained accurately by periodic surveys that should include low-altitude satellite measurements of the vector components, and noting that the last survey (total field only) ended in 1971, recommends the establishment of an "International Project for a Satellite Magnetic Survey" with a steering committee to solicit support from appropriate National Committees.

L'AIGA, reconnaissant qu'un modèle global du champ magnétique terrestre ne peut être maintenu avec précision que par des levés périodiques qui devranient comprendre des mesures des composantes vectorielles à bord d'un satellite de basse altitude, et prenant note que le dernier levé (enregistrement du seul module) s'est achevé en 1971, recommande que soit établi un "Projet International pour un levé magnétique par satellite" avec un comité de direction dont le but serait d'obtenir une aide des Comités Nationaux appropriés.

Resolution 18

IAGA, considering that a need exists for a geomagnetic reference field satisfying at least some of several diverse requirements, recommends that the International Geomagnetic Reference field 1965.0 (IGRF 1965.0) be retained as a standard until 1975.0, after which time it will be replaced by IGRF 1975.0. It is requested that all pertinent observational data be deposited in World Data Centers by 1 January 1975.

L'AIGA, considérant qu'il est nécessaire de disposer d'un champ magnétique terrestre de référence, tel qu'il satisfasse au moins partiellement divers besoins, recommande que le Champ Géomangétique International de Référence pour 1965.0 (CGIR 1965.0) soit maintenu comme standard jusqu'en 1975.0, date à laquelle il sera remplacé par le CGIR 1975.0. Il est demandé que toutes les données d'observation utiles soient envoyées aux Centres Mondiaux de Données avant le 1er janvier 1975.

Resolution 19

IAGA recommends a recording speed for normal magnetographs of 20 mm/hour to provide uniformity of record format. New observatories are urged to obtain equipment for this recoring speed and existing stations are urged to consider modification of present equipment.

L'AIGA, recommande pour les magnétographes normaux une vitesse d'enregistrement de 20 mm/heure afin d'assurer une meilleure homogénéité du format d'enregistrement, et insiste pour que les nouveaux observatoires choisissent un équipment ayant cette vitesse d'enregistrement et pour que les stations existantes envisagent de modifier leur équipment actuel.

Resolution 20

IAGA, having accepted responsibilities for some topics in the Atmospheric Physics Programs proposed by SCOSTEP, agrees to name three representatives to the Steering Committee for Atmospheric Physics Programs, and agrees to assign responsibility for IAGA's interests in the SESAME (Structure and Energetics of the Stratosphere and Mesosphere) program to the proposed joint IAGA-IAMAP Working Group on Stratospheric and Mesospheric Processes.

L'AIGA, ayant accepté des responsabilités pour divers sujets dans les Programmes de Physique Atmosphérique proposés par le Comité Spécial de Physique Solaire et Terrestre (SC (SCOSTEP), accepte de désigner trois représentants au Comité de Direction pour les Programmes de Physique Atmosphérique, et de confier la responsabilité des intérêts de l'Association

dans le Programme SESAME (Structure et Energétique de la Stratosphère et de la Memosphère) au Groupe de Travail commun AIGA-AIMPA sur les Processus stratosphériques et mesosphériques qui a été proposé.

Resolution 21

IAGA, recognizing that data and records of observations made in previous epochs will be of great importance in the study of the long-term variation of the aeronomic and geomagnetic aspects of the earth and its environment, recommends that each country take appropriate action to catalogue and to preserve such historically important data and to advise the scientific community of their availability.

L'AIGA, reconnaissant que les données et les enregistrements acquis aux époques antérieures seront d'une grande importance pour l'étude des variations à long terme des phenomenes aeronomiques et magnetiques de la Terra et de son environnement, recommande que chaque pays prenne des dispositions appropriées pour cataloguer et conserver ces données historiques et pour informer la communaute scientifique de leur disponsibilité.

Adoption Of SI Units In Geomagnetism

SI is the accepted symbol for Système International d'Unités (International System of Units), the modern form of the metric system finally agreed at the Eleventh General Conference of Weights and Measures (CGPM) in 1960.* SI has been adopted throughout most of the world and is likely to remain for a very long time as the primary world system of units of measurement. Since the CGPM 1960 meeting, details have been decided by Technical Committee No. 12 of the International Organisation for Standardization (ISO/TC 12) in consultation with:

The International Union of Pure and Applied Physics
The International Union of Pure and Applied Chemistry
The International Electrotechnical Commission

The ratified agreements are issued as ISO Recommendation R 31 in thirteen parts. Part V referring to Electricity and Magnetism was issued in 1965.

A definitive version of SI has been published by the Bureau International des Poids et Measures (BIPM) (Terrien and de Boer, 1970). English language translations, approved by BIPM, have been published by the U.S.A. National Bureau of Standards (1971) and by the U.K. National Physical Laboratory (1970)

SI rationalizes the main metric units of measurement and standardizes their names and symbolic representation, but, in doing so, renders obsolete many of the old metric units and symbols used in geomagnetism. This is true not only of the CGS system (Maurain, 1931) but also of some of the more recent varieties of the MKSA system. The need to change to SI becomes steadily more insistent. However, it is not enough merely to opt for the use of SI as a whole. Within the system, several options are open. There is, therefore, a need for some guidance in the use of SI in magnetostatics within IAGA.

At the Madrid Assembly in 1969, an ad hoc Committee reflecting the interests of IAGA Commissions I, II, III and IX was constituted to explore this matter. At the 1971 Moscow Assembly, the Committee proposed certain resolutions, but these were referred back for consideration of wider interests within IAGA. The Committee was accordingly expanded and reconstituted to include representatives from IAGA Commissions I, II, III, IV, V and IX. In consequence of further extensive correspondence and consultation, this body proposed in Kyoto a slightly modified version of the Moscow recommendation. After some discussion at the

* Editor's Note: The following report was written subsequent to the Kyoto Assembly by the Ad Hoc Committee on SI Units. It is included here as a very desirable backup explanation of IAGA resolution no. 3.

final plenary session of 21 September 1973, the new version was formally adopted as IAGA Resolution No. 3. A brief explanation follows of the rationale and the implications of this action.

SI is based on the fundamental units-metre, kilogram, second, and ampere —and indeed is similar in most respects to the MKSA rationalized system. Many of its units differ only by powers of 10 from those of the familiar CGS e.m. system (hereafter referred to as e.m.u.). However, magnetostatics entails a further distinction in that μ_0; the so-called "permeability of free space" has the value of $4\pi \times 10^{-7}$ in SI, rather than unity as it was in e.m.u. Also, while μ_0 was often treated as dimensionless in e.m.u., it is normally considered to have dimensions in SI. So the two vector fields B and H have different numerical measures and different dimensions. In a vacuum $B = \mu_0 H$, but, in general, B and $\mu_0 H$ are unequal (see below). The two fields have different properties, and in order to state rigorously which is relevant and should be specified we must consider the particular circumstances.

In almost all situations involving the ambient geomagnetic field in air, the relation $B = \mu_0 H$, is valid to the normal accuracy of measurement and it does not matter which entity we specify; if we use only one of them our results will be easier to compare and understand. The SI unit of B is the tesla, which is equal to 10^4 gauss, whereas the SI unit of H is the ampere/metre, which is equal to $4\pi \times 10^{-3}$ oersted. The use of B rather than H, as called for in Part 1a of the resolution, should serve to bring geomagnetic practice into conformity with SI with the least possible disruption of existing numerical usage. There is no basis in rigorous theory for supposing that conventional measurements of particular kinds give H rather than B. The fact is that practically all geomagnetic intensity measurements strictly give neither H or B but rather a hybrid depending on the geometrical shape of the magnet or other sensing element and on the permeability of the ambient medium (Knapp 1953, Lowes 1974a).

Note that the resolution expresses no opinion as to whether B or H is the more fundamental, a point which physicists continue to debate actively. Meanwhile, there is an urgent need for practical guidance in the workaday world of geophysics. The Kyoto recommendation to use B for expressing geomagnetic field values rests largely on numerical convenience.

Inside a magnetic material, the (macroscopically averaged) vector fields B and $\mu_0 H$ are no longer even roughly equal. They differ by a third vector field which represents the (macroscopically averaged) magnetization or magnetic moment per unit volume. This third vector field can be written <u>either</u> as J or as $\mu_0 M$. The term "magnetization", formerly applied to J or M indiscriminately, is nowadays reserved for M; the traditional magnetization J is now distinguished as "magnetic polarization". Since the SI unit of J equals $10^4/4\pi$ e.m.u. while the SI unit of M equals 10^{-3} e.m.u., the resolution recommends expressing numerical values in terms of M unit ampere/metre. The corresponding magnetic moment then has units of ampere-metre^2 and one such unit equals 10^3 e.m.u. The resolution deals explicitly with volume magnetization, but obviously the analogous treatment of mass magnetization is implied. The choice of magnetization in the newer sense rather than magnetic polarization is again simply a matter of preferring a factor of 1000 rather than $4\pi/10^4$ for converting measures in e.m.u. to SI, without implying that magnetization is a more valid concept than magnetic polarization.

If one works in SI, permeability is conveniently divided by μ_0 reducing the values to dimensionless or relative permeability, so numerically matching the e.m.u. values. Similarly, the traditional susceptibility based on polarization may be divided by μ_0 to get a dimensionless index. Exactly the same parameter is obtained by redefining susceptibility in terms of "magnetization M". Part 3 of the resolution merely affirms existing SI usage. The inclusion of Part 3 serves to remind us that there the 4π conversion factor is needed when translating susceptibility from e.m.u. to SI.

In SI, we have

$$B = \mu_0 H + J$$

$$= \mu_0 H + \mu_0 M$$

$$\mu = B/H$$

$$\mu_r = \mu/\mu_0$$

$$\chi = \kappa/\mu_0 = M/H \ , \qquad (1)$$

whereas in e.m.u. we had

$$B = H + 4\pi$$

$$\mu = B/H$$

$$\chi = J/H \ . \qquad (2)$$

Parts 1b, 2b and 3b of the resolution indicate a procedure for facilitating the transition to SI, particularly by enabling a reader to relate the data to his own customary usage. The Committee's correspondence with interested investigators, as well as an independent survey by W. H. Campbell of the opinions of all those on the IAGA Mailing List, disclosed that many individuals in IAGA, while generally favouring SI, wished to retain use of the gamma. Part 1b of the resolution recognizes this sentiment, but it is anticipated that use of the nanotesla (abbreviation nT) will become steadily more general.

Views of the concept of magnetic polarization are widely divergent. Some people consider that this concept and relationships invoking it have no place in magnetostatic theory; others still regard polarization as a valid concept alongside the newer one of magnetization. Part 2a of the resolution is consistent with either viewpoint; moreover, for numerical convenience, it is expedient to follow the recommended practice.

Some of the more useful and familiar formulae will now be presented in the form which they assume in SI. Most of these relations would need to be modified to make them applicable in a medium with relative permeability different from unity. The presence of such a medium cannot be taken into account by simply inserting the permeability (see Knapp 1953, Brown 1951, Primdahl 1971 and Lowes 1974b).

Field (induction due to a point pole of strength p at a distance r:

$$B = \frac{\mu_0 p}{4\pi r^2} \qquad (3)$$

Force between two point poles at separation r:

$$F = \frac{\mu_0 p p'}{4\pi r^2} \qquad (4)$$

[Note: p is not an agreed symbol for magnetic pole strength. Magnetic poles are fictitious quantities, but they are a useful simple concept.]

Components of the field of a dipole of moment m; in spherical coordinates:

$$B_r = \frac{\mu_0 2m}{4\pi r^3} \cos\theta \qquad (5)$$

$$B_\theta = \frac{\mu_0 m}{4\pi r^3} \sin\theta \qquad (6)$$

$$B_\varphi = 0 \qquad (7)$$

Field of a current element Ids at vector distance $\mathbf{r}$:

$$dB = \frac{\mu_o}{4\pi} \frac{Ids \times \hat{r}}{r^2} \qquad (8)$$

where $\hat{r}$ is the unit vector in the direction of $\mathbf{r}$.

Circular field at radius r due to current I in an infinitely long straight wire

$$B = \frac{\mu_o I}{2\pi r} \qquad (9)$$

Axial field at distance z from a circular current I of radius a:

$$B = \frac{\mu_o I}{2} \frac{a^2}{(z^2 + a^2)^{3/2}} \qquad (10)$$

Magnetic moment of current loop of area A:

$$m = A \cdot I \qquad (11)$$

The demagnetizing factor D (Stoner 1945) is unchanged by the transition to SI. The factor is used to compute the internal field $\mathbf{B}_i$ (induction) in an ellipsoid of relative permeability μ_r place with one of the axes parallel to an external field $\mathbf{B}_e$:

$$\mathbf{B}_i = \frac{\mu_r \mathbf{B}_e}{1 + D(\mu_r - 1)} \qquad (12)$$

D is related to the older demagnetizing factor N introduced by Maxwell by

$$D = \frac{N}{4\pi} . \qquad (13)$$

The ad hoc Committee on SI Units consisted most recently of B.R. Leaton (chairman), D.G. Kanpp, F.J. Lowes, F. Primdahl, J.G. Roederer and M. Sugiura. The original chairman was D.W. Nichol.

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